



Red Hat Enterprise Linux 7 Linux Domain Identity, Authentication, and Policy Guide

Managing Identity and Authorization Policies for Linux-Based
Infrastructures
Edition 3.3.0

Ella Deon Ballard

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Abstract

Identity and policy management — for both users and machines — is a core function for almost any enterprise environment. Identity Management provides a way to create an identity domain that allows machines to enroll to a domain and immediately access identity information required for single sign-on and authentication services, as well as policy settings that govern authorization and access. This manual covers all aspects of installing, configuring, and managing Identity Management domains, including both servers and clients. This guide is intended for IT and systems administrators.

Table of Contents

Preface	5
1. Information for Managing Identity and Authentication Policies in Linux	5
2. Audience and Purpose	5
3. Giving Feedback	6
4. Document Change History	6
Chapter 1. Introduction to Identity Management	8
1.1. IdM v. LDAP: A More Focused Type of Service	8
1.2. Bringing Linux Services Together	10
1.3. Relationships Between Servers and Clients	13
Part I. Installing Identity Management Servers and Services	18
Chapter 2. Prerequisites for Installation	19
2.1. Supported Server Platforms	19
2.2. Hardware Recommendations	19
2.3. Software Requirements	19
2.4. System Prerequisites	19
Chapter 3. Installing an IdM Server	24
3.1. Installing the IdM Server Packages	24
3.2. About ipa-server-install	24
3.3. Example: Running the Script Interactively and Silently	26
3.4. Examples: Installing with Different CA Configurations	29
3.5. Example: Configuring DNS Services within the IdM Domain	33
Chapter 4. Setting up IdM Replicas	37
4.1. Planning the Server/Replica Topologies	37
4.2. Prerequisites for Installing a Replica Server	40
4.3. Installing the Replica Packages	40
4.4. Creating the Replica	41
4.5. Alternate Options for Creating a Replica	44
Chapter 5. Setting up Systems as IdM Clients	46
5.1. What Happens in Client Setup	46
5.2. System Ports	47
5.3. Configuring a Linux System as an IdM Client	47
5.4. Manually Configuring a Linux Client	52
5.5. Setting up a Linux Client Through Kickstart	60
5.6. Re-enrolling a Host	61
5.7. Renaming Machines and Reconfiguring IdM Client Configuration	61
5.8. Performing a Two-Administrator Enrollment	63
5.9. Removing Clients from the Domain	63
5.10. Manually Unconfiguring Client Machines	64
Chapter 6. Upgrading Identity Management	66
6.1. Migration Notes	66
6.2. Migrating the IdM Server to Red Hat Enterprise Linux 7	66
6.3. Updating DNS Configuration for BIND 9.9.x	73
Chapter 7. Uninstalling IdM Servers and Replicas	74
Chapter 8. The Basics of Managing the IdM Server and Services	75
8.1. Starting and Stopping the IdM Domain	75
8.2. About the IdM Client Tools	75
8.3. Logging into IdM	80
8.4. Using the IdM Web UI	82

Part II. Managing User Identities in a Linux Domain	89
Chapter 9. Managing Users and User Groups	90
9.1. Setting up User Home Directories	90
9.2. Managing User Entries	92
9.3. Managing Public SSH Keys for Users	99
9.4. Changing Passwords	105
9.5. Enabling and Disabling User Accounts	107
9.6. Unlocking User Accounts After Password Failures	109
9.7. Managing User Private Groups	109
9.8. Managing Unique UID and GID Number Assignments	111
9.9. Managing User and Group Schema	113
9.10. Managing User Groups	122
Part III. Managing System Identities in a Linux Domain	141
Chapter 10. Managing Hosts	142
10.1. About Hosts, Services, and Machine Identity and Authentication	142
10.2. About Host Entry Configuration Properties	143
10.3. Disabling and Re-enabling Host Entries	144
10.4. Creating Certificates for Hosts	145
10.5. Managing Public SSH Keys for Hosts	154
10.6. Setting Ethers Information for a Host	162
10.7. Managing Host Groups	163
Chapter 11. Managing Services	168
11.1. Adding and Editing Service Entries and Keytabs	168
11.2. Creating Certificates for Services	171
11.3. Storing Certificates in NSS Databases	181
11.4. Configuring Clustered Services	181
11.5. Using the Same Service Principal for Multiple Services	182
11.6. Disabling and Re-enabling Service Entries	182
Chapter 12. Delegating User Access to Hosts and Services	184
12.1. Delegating Service Management	184
12.2. Delegating Host Management	185
12.3. Delegating Host or Service Management in the Web UI	185
12.4. Accessing Delegated Services	186
Chapter 13. Integrating with NIS Domains and Netgroups	188
13.1. About NIS and Identity Management	188
13.2. Setting the NIS Port for Identity Management	189
13.3. Creating Netgroups	190
13.4. Exposing Automount Maps to NIS Clients	194
13.5. Migrating from NIS to IdM	195
Chapter 14. Managing DNS	202
14.1. About DNS in IdM	202
14.2. Using IdM and DNS Service Discovery with an Existing DNS Configuration	202
14.3. DNS Notes	203
14.4. Adding or Updating DNS Services After Installation	203
14.5. Setting up the rndc Service	204
14.6. Updating the DNS Configuration After Migrating from Red Hat Enterprise Linux 6	204
14.7. Managing DNS Zone Entries	205
14.8. Managing DNS Record Entries	225
14.9. Configuring the bind-dyndb-ldap Plug-in	233
14.10. Changing Recursive Queries Against Forwarders	235
14.11. Resolving Hostnames in the IdM Domain	236
Part IV. Defining Domain-wide System Policies	227

Part IV. Defining Domainwide System Policies	237
Chapter 15. Using Automount	238
15.1. About Automount and IdM	238
15.2. Configuring Automount	238
15.3. Setting up a Kerberized NFS Server	243
15.4. Configuring Locations	246
15.5. Configuring Maps	248
Chapter 16. Defining Password Policies	255
16.1. About Password Policies and Policy Attributes	255
16.2. Viewing Password Policies	257
16.3. Creating and Editing Password Policies	262
16.4. Managing Password Expiration Limits	265
16.5. Changing the Priority of Group Password Policies	265
16.6. Setting Account Lockout Policies	266
16.7. Enabling a Password Change Dialog	268
Chapter 17. Managing the Kerberos Domain	269
17.1. About Kerberos	269
17.2. Setting Kerberos Ticket Policies	270
17.3. Refreshing Kerberos Tickets	272
17.4. Caching Kerberos Passwords	273
17.5. Removing Keytabs	274
Chapter 18. Using sudo	275
18.1. About sudo and IPA	275
18.2. Setting up sudo Commands and Command Groups	276
18.3. Defining sudo Rules	280
18.4. Configuring Hosts to Use IdM sudo Policies	291
Chapter 19. Configuring Host-Based Access Control	295
19.1. About Host-Based Access Control	295
19.2. Creating Host-Based Access Control Entries for Services and Service Groups	296
19.3. Defining Host-Based Access Control Rules	300
19.4. Testing Host-Based Access Control Rules	308
Chapter 20. Defining SELinux User Maps	313
20.1. About Identity Management, SELinux, and Mapping Users	313
20.2. Configuring SELinux User Map Order and Defaults	315
20.3. Mapping SELinux Users and IdM Users	318
Chapter 21. Defining Automatic Group Membership for Users and Hosts	324
21.1. About Automembership	324
21.2. Defining Automembership Rules (Basic Procedure)	325
21.3. Examples of Using Automember Groups	328
Part V. Configuring the Identity Management Server	331
Chapter 22. Defining Access Control for IdM Users	332
22.1. About Access Controls for IdM Entries	332
22.2. Defining Self-Service Settings	333
22.3. Delegating Permissions over Users	335
22.4. Defining Role-Based Access Controls	337
Chapter 23. Configuring IdM Servers	349
23.1. Identity Management Files and Logs	349
23.2. Managing Certificates and Certificate Authorities	357
23.3. Disabling Anonymous Binds	367
23.4. Changing Domain DNS Configuration	368
Chapter 24. Managing the Server Replica Relationship	370

Chapter 24. Managing the Server-Replica Relationships	370
24.1. Managing Replication Agreements Between IdM Servers	370
24.2. Removing a Replica	377
24.3. Renaming a Server or Replica Host System	377
Chapter 25. Migrating from an LDAP Directory to IdM	379
25.1. An Overview of LDAP to IdM Migration	379
25.2. Examples for Using migrate-ds	386
25.3. Scenario 1: Using SSSD as Part of Migration	388
25.4. Scenario 2: Migrating an LDAP Server Directly to Identity Management	390
25.5. Scenario 3: Migrating over SSL	391
Troubleshooting Identity Management	394
A.1. Installation Issues	394
A.2. UI Connection Problems	397
A.3. IdM Server Problems	398
A.4. Host Problems	399
A.5. Kerberos Errors	400
A.6. SELinux Login Problems	401
Glossary	401
Index	419

Preface

Identity Management is a Red Hat Enterprise Linux-based way to create a security, identity, and authentication domain. The different security and authentication protocols available to Linux and Unix systems (like Kerberos, NIS, DNS, PAM, and sudo) are complex, unrelated, and difficult to manage coherently, especially when combined with different identity stores.

Identity Management provides a layer that unifies all of these disparate services and simplifies the administrative tasks for managing users, systems, and security. IdM breaks management down into two categories: *identity* and *policy*. It centralizes the functions of managing the users and entities within your IT environment (identity) and then provides a framework to define authentication and authorization for a global security framework and user-friendly tools like single sign-on (policy).

1. Information for Managing Identity and Authentication Policies in Linux

Managing user and system identities, authentication settings, and application policies is one of the central responsibilities of system administration. It is critical that systems administrators be able to consistently define authentication and authorization policies, particularly in secure environments.

Identity Management in Red Hat Enterprise Linux is a server which combines and controls many security and identity applications — such as LDAP, Kerberos, and DNS — that normally have dispersed management servers and only system-level configuration. Identity Management allows Linux servers to be truly united into a Linux domain.

Domain management is a higher-level of Linux system administration. This guide deals explicitly with setting up Identity Management services and configuring users, systems, and services that function within the Linux domain.

There are two related guides for Red Hat Enterprise Linux 7 which deal with different scenarios related to identity, authentication, and policy management:

- ▶ For managing identity and authentication services at the system-level, see the *System-Level Authentication Guide*.
- ▶ For integrating Linux servers into an Active Directory environment, see the *Windows Integration Guide*.

2. Audience and Purpose

With Identity Management, a Red Hat Enterprise Linux system can easily become the center of an identity/authentication domain and even provide access to the domain for clients of other operating systems. IdM is an integrated system, that builds on existing and reliable technologies like LDAP and certificate protocols, with a robust yet straightforward set of tools (including a web-based UI). The key to identity/policy management with IdM is simplicity and flexibility:

- ▶ Centralized identity stores for authentication and single sign-on using both integrated LDAP services (with 389 Directory Server) and, optionally, NIS services
- ▶ Clear and manageable administrative control over system services like PAM, NTP, and sudo
- ▶ Simplified DNS domains and maintenance
- ▶ Scalable Kerberos realms and cross-realms which clients can easily join

This guide is written for systems administrators and IT staff who will manage IdM domains, user systems, and servers. This assumes a moderate knowledge of Linux-based systems administration and familiarity with important concepts like access control, LDAP, and Kerberos.

This guide covers every aspect of using IdM, including preparation and installation processes, administrative tasks, and the IdM tools. This guide also explains the major concepts behind both identity and policy management, generally, and IdM features specifically. Administrative tasks in this guide are categorized as either *Identity* or *Policy* in the chapter title to help characterize the administrative functions.

3. Giving Feedback

If there is any error in this book or there is any way to improve the documentation, please let us know. Bugs can be filed against the documentation for IdM through Bugzilla, <http://bugzilla.redhat.com/bugzilla>. Make the bug report as specific as possible, so we can be more effective in correcting any issues:

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2. Set the component to **doc-Enterprise_Identity_Management_Guide**.
3. For errors, give the page number (for the PDF) or URL (for the HTML), and give a succinct description of the problem, such as incorrect procedure or typo.

For enhancements, put in what information needs to be added and why.

4. Give a clear title for the bug. For example, "**Incorrect command example for setup script options**" is better than "**Bad example**".

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4. Document Change History

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Chapter 1. Introduction to Identity Management

Red Hat Enterprise Linux IdM is a way to create identity stores, centralized authentication, domain control for Kerberos and DNS services, and authorization policies — all on Linux systems, using native Linux tools. While centralized identity/policy/authorization software is hardly new, Identity Management is one of the only options that supports Linux/Unix domains.

Identity Management provides a unifying skin for standards-defined, common network services, including PAM, LDAP, Kerberos, DNS, NTP, and certificate services, and it allows Red Hat Enterprise Linux systems to serve as the domain controllers.

Identity Management defines a domain, with servers and clients that share centrally-managed services, like Kerberos and DNS. This chapter first explains what Identity Management is. This chapter also covers how all of these services work together within the domain and how servers and clients interact with each other.

1.1. IdM v. LDAP: A More Focused Type of Service

At the most basic level, Red Hat Identity Management is a domain controller for Linux and Unix machines. Identity Management defines the domain, using controlling servers and enrolled client machines. This provides centralized structure that has previously been unavailable to Linux/Unix environments, and it does it using native Linux applications and protocols.

1.1.1. Defining a True Linux Domain

Security information frequently relates to *identities* of users, machines, and services. Once the identity is verified, then access to services and resources can be controlled.

For efficiency, risk management, and ease of administration, IT administrators try to manage identities as centrally as possible and to unite identity management with authentication and authorization policies. Historically, Linux environments have had a very difficult time establishing this centralized management. There are a number of different protocols (such as NIS and Kerberos) which define domains, while other applications store data (such as LDAP) and still others manage access (such as sudo). None of these applications talk to each other or use the same management tools. Every application had to be administered separately and it had to be managed locally. The only way to get a consistent identity policy was to copy configuration files around manually or to try to develop a proprietary application to manage identities and policies.

The goal of Identity Management is to simplify that administrative overhead. Users, machines, services, and polices are all configured in one place, using the same tools. Because IdM creates a domain, multiple machines can all use the same configuration and the same resources simply by joining the domain. Users only have to sign into services once, and administrators only have to manage a single user account.

IdM does three things:

- ▶ Create a Linux-based and Linux-controlled domain. Both IdM servers and IdM clients are Linux or Unix machines. While IdM can synchronize data with an Active Directory domain to allow integration with Windows servers, it is not an administrative tool for Windows machines and it does not support Windows clients. Identity Management is a management tool for Linux domains.
- ▶ Centralize identity management and identity policies.
- ▶ Build on existing, native Linux applications and protocols. While IdM has its own processes and configuration, its underlying technologies are familiar and trusted by Linux administrators and are well established on Linux systems.

In a sense, Identity Management isn't making administrators do something new; it is helping them do it better. There are a few ways to illustrate that.

On one extreme is the *low control* environment. Little Example Corp. has several Linux and Unix servers, but each one is administered separately. All passwords are kept on the local machine, so there is no central identity or authentication process. Tim the IT Guy just has to manage users on every machine, set authentication and authorization policies separately, and maintain local passwords. With IdM, things come to order. There is a simple way to have central user, password, and policy stores, so Tim the IT Guy only has to maintain the identities on one machine (the IdM server) and users and policies are uniformly applied to all machines. Using host-based access control, delegation, and other rules, he can even set different access levels for laptops and remote users.

In the middle is the *medium control* environment. Mid-Example Corp. has several Linux and Unix servers, but Bill the IT Guy has tried to maintain a greater degree of control by creating a NIS domain for machines, an LDAP directory for users, and Kerberos for authentication. While his environment is well under control, every application has to be maintained separately, using different tools. He also has to update all of the services manually whenever a new machine is added to his infrastructure or when one is taken offline. In this situation, IdM greatly reduces his administrative overhead because it integrates all of the different applications together seamlessly, using a single and simplified tool set. It also makes it possible for him to implement single sign-on services for all of the machines in his domain.

On the other extreme is the *absent control* environment. At Big Example Corp., most of the systems are Windows based and are managed in a tightly-knit Active Directory forest. However, development, production, and other teams have many Linux and Unix systems — which are basically excluded from the Windows controlled environment. IdM brings native control to the Linux/Unix servers, using their native tools and applications — something that is not possible in an Active Directory forest. Additionally, because IdM is Windows-aware, data can be synchronized between Active Directory and IdM, preserving a centralized user store.

IdM provides a very simple solution to a very common, very specific problem: identity management.

1.1.2. Contrasting Identity Management with a Standard LDAP Directory

The closest relative to Identity Management is a standard LDAP directory like 389 Directory Server, but there are some intrinsic differences between what they do and what they're *intended* to do.

First, it helps to understand what a directory service is. A directory service is a collection of software, hardware, and processes that stores information. While directory services can be highly specific (for example, DNS is a directory service because it stores information on hostnames), a generic directory service can store and retrieve any kind of information. LDAP directories like 389 Directory Server are generic directories. They have a flexible schema that supports entries for users, machines, network entities, physical equipment, and buildings, and that schema can be customized to define entries of almost anything. Because of its extensibility, LDAP servers like 389 Directory Server are frequently used as backends that store data for other applications. 389 Directory Server not only contains information, it organizes information. LDAP directories use a hierarchical structure, a *directory tree*, that organize entries into root entries (suffixes), intermediate or container entries (subtrees or branches), and leaf entries (the actual data). Directory trees can be very complex, with a lot of branch points, or very simple (flat) with few branch points.

The primary feature of an LDAP directory is its generality. It can be made to fit into a variety of applications.

Identity Management, on the other hand, has a very specific purpose and fits a very specific application. It is not a general LDAP directory, it is not a backend, and it is not a general policy server. It is not generic.

Identity Management focuses on identities (user and machine) and policies that relate to those identities and their interactions. While it uses an LDAP backend to store its data, IdM has a highly-customized and specific set of schema that defines a particular set of identity-related entries and defines them in detail. It has a relatively flat and simple directory tree because it has only a handful of entry types and relationships

that are relevant to its purpose. It has rules and limitations on how the IdM server can be deployed because it can only be deployed for a specific purpose: managing identities.

The restrictions on IdM also give it a great deal of administrative simplicity. It has a simple installation process, a unified set of commands, and a clearly defined role in the overall IT infrastructure. An IdM domain is easy to configure, easy to join, and easy to manage, and the functions that it serves — particularly identity/authentication tasks like enterprise-wide single sign-on — are also easier to do with IdM than with a more general-purpose directory service.

Table 1.1. Identity Management Compared to 389 Directory Server

	389 Directory Server	Identity Management
Use	General purpose	Single domain, focused on identity management
Flexibility	Highly-customizable	Limitations to focus on identity and authentication
Schema	Default LDAP schema	Optimized, special schema for identity management
Directory Tree	Standard and flexible hierarchy	Flat tree with a fixed hierarchy
Authentication	LDAP	Kerberos or Kerberos and LDAP
Active Directory Synchronization	Bi-directional	Unidirectional, Active Directory to Identity Management
Password Policies	LDAP-based	Kerberos-based
User Tools	Java Console and standard LDAP utilities	Web-based UI and special Python command-line tools

LDAP directories like 389 Directory Server have flexibility and adaptability which makes them a perfect backend to any number of applications. Its primary purpose is to store and retrieve data efficiently.

IdM fills a very different niche. It is optimized to perform a single task very effectively. It stores user information and authentication and authorization policies, as well as other information related to access, like host information. Its single purpose is to manage identities.

1.2. Bringing Linux Services Together

Identity Management unifies disparate yet related Linux services into a single management environment. From there, it establishes a simple, easy way to bring host machines into the domain of those services.

An IdM server is, at its core, an identity and authentication server. The primary IdM server, essentially a domain controller, uses a Kerberos server and KDC for authentication. An LDAP backend contains all of the domain information, including users, client machines, and domain configuration.

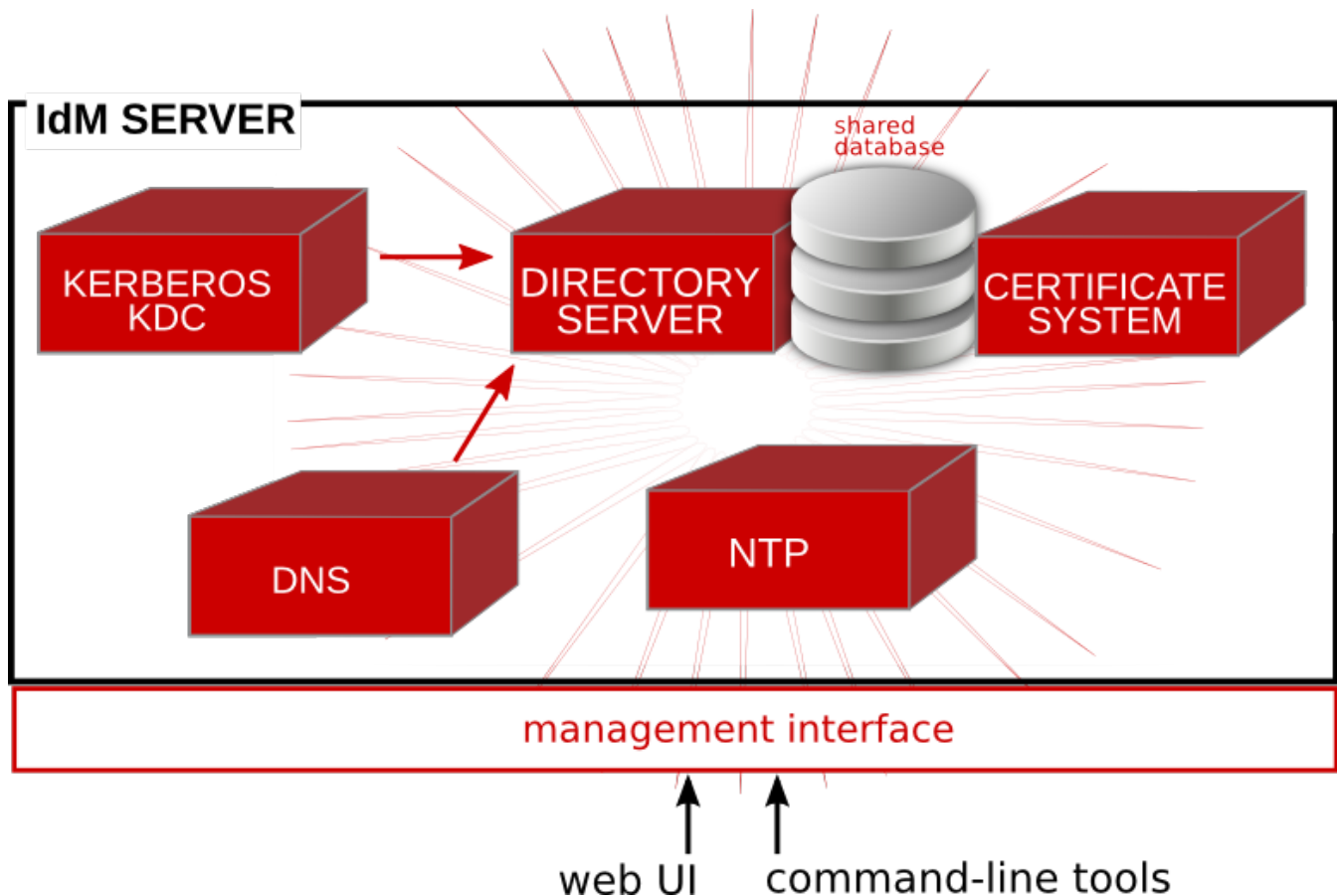


Figure 1.1. The IdM Server: Unifying Services

Other services are included to provide support for the core identity/authentication functions. DNS is used for machine discovery and for connecting to other clients in the domain. NTP is used to synchronize all domain clocks so that logging, certificates, and operations can occur as expected. A certificate service provides certificates for Kerberos-aware services. All of these additional services work together under the control of the IdM server.

The IdM server also has a set of tools which are used to manage all of the IdM-associated services. Rather than managing the LDAP server, KDC, or DNS settings individually, using different tools on local machines, IdM has a single management toolset (CLI and web UI) that allows centralized and cohesive administration of the domain.

1.2.1. Authentication: Kerberos KDC

Kerberos is an authentication protocol. Kerberos uses symmetric key cryptography to generate *tickets* to users. Kerberos-aware services check the ticket cache (a *keytab*) and authenticate users with valid tickets.

Kerberos authentication is significantly safer than normal password-based authentication because passwords are never sent over the network — even when services are accessed on other machines.

In Identity Management, the Kerberos administration server is set up on the IdM domain controller, and all of the Kerberos data are stored in IdM's backend Directory Server. The Directory Server instance defines and enforces access controls for the Kerberos data.

**NOTE**

The IdM Kerberos server is managed through IdM tools instead of Kerberos tools because all of its data are stored in the Directory Server instance. The KDC is unaware of the Directory Server, so managing the KDC with Kerberos tools does not affect the IdM configuration.

1.2.2. Data Storage: 389 Directory Server

Identity Management contains an internal 389 Directory Server instance. All of the Kerberos information, user accounts, groups, services, policy information, DNS zone and host entries, and all other information in IdM is stored in this 389 Directory Server instance.

When multiple servers are configured, they can talk to each other because 389 Directory Server supports *multi-master replication*. Agreements are automatically configured between the initial server and any additional *replicas* which are added to the domain.

1.2.3. Authentication: Dogtag Certificate System

Kerberos can use certificates along with keytabs for authentication, and some services require certificates for secure communication. Identity Management includes a certificate authority, through Dogtag Certificate System, with the server. This CA issues certificates to the server, replicas, and hosts and services within the IdM domain.

The CA can be a root CA or it can have its policies defined by another, external CA (so that it is *subordinate* to that CA). Whether the CA is a root or subordinate CA is determined when the IdM server is set up.

1.2.4. Server/Client Discovery: DNS

Identity Management defines a domain — multiple machines with different users and services, each accessing shared resources and using shared identity, authentication, and policy configuration. The clients need to be able to contact each other, as IdM servers. Additionally, services like Kerberos depend on hostnames to identify their principal identities.

Hostnames are associated with IP addresses using the *Domain Name Service* (DNS). DNS maps hostnames to IP addresses and IP addresses to hostnames, providing a resource that clients can use when they need to look up a host. From the time a client is enrolled in the IdM domain, it uses DNS service discovery to locate IdM servers within the domain and then all of the services and clients within the domain.

The client installation tool automatically configures the local System Security Services Daemon (SSSD) to use the IdM domain for service discovery. SSSD uses DNS already to look for LDAP/TCP and Kerberos / UDP services; the client installation only needs to supply the domain name. SSSD service discovery is covered in the [SSSD chapter in the Red Hat Enterprise Linux Deployment Guide](#).

On the server, the installation script configures the DNS file to set which services the DNS service discovery queries. By default, DNS discovery queries the LDAP service on TCP and different Kerberos services on both UDP and TCP. The DNS file which is created is described in [Section 14.2, “Using IdM and DNS Service Discovery with an Existing DNS Configuration”](#).

**NOTE**

While it is technically possible to configure the IdM domain to use DNS service discovery *without* having an IdM server host the DNS services, this is not recommended.

Multiple DNS servers are usually configured, each one working as an authoritative resource for machines within a specific domain. Having the IdM server also be a DNS server is optional, but it is strongly recommended. When the IdM server also manages DNS, there is tight integration between the DNS zones and the IdM clients and the DNS configuration can be managed using native IdM tools. Even if an IdM server is a DNS server, other external DNS servers can still be used.

1.2.5. Management: SSSD

The System Security Services Daemon (SSSD) is a platform application which caches credentials. Most system authentication is configured locally, which means that services must check with a local user store to determine users and credentials. What SSSD does is allow a local service to check with a local cache in SSSD, but that cache may be taken from any variety of remote identity providers — including Identity Management.

SSSD can cache usernames and passwords, Kerberos principals and keytabs, automount maps, and SSH keys which are used by Identity Management domain users and systems. This allows two significant benefits to administrators: all identity configuration can be centralized in a single application (the IdM server) and it allows that external information to be cached on a local system to continue normal authentication operations, in case the system or the IdM server is ever offline.

SSSD is automatically configured by IdM client installation and management scripts, so the system configuration never needs to be manually updated, even as domain configuration changes.

1.2.6. Management: NTP

Many services require that servers and clients have the same system time, within a certain variance. For example, Kerberos tickets use time stamps to determine their validity. If the times between the server and client skew outside the allowed range, then any Kerberos tickets are invalidated.

Clocks are synchronized over a network using *Network Time Protocol* (NTP). A central server acts as an authoritative clock and all of the clients which reference that NTP server sync their times to match.

When the IdM server is the NTP server for the domain, all times and dates are synchronized before any other operations are performed. This allows all of the date-related services — including password expirations, ticket and certificate expirations, account lockout settings, and entry creation dates — to function as expected.

The IdM server, by default, works as the NTP server for the domain. Other NTP servers can also be used for the hosts.

1.3. Relationships Between Servers and Clients

Identity Management itself defines a *domain*, a group of machines that have shared configuration, policies, and identity stores. This shared configuration allows the machines (and users) within the domain to be aware of each other and operate together. This awareness can be used to enable cross-platform compatibility, like unifying Windows and Linux systems, or to enable infrastructure-wide single sign-on.

1.3.1. About IdM Servers and Replicas

Identity Management works by having identified servers which are the master stores of information for user and machine identities and domain-wide policies. These servers host domain-related services such as certificate authorities, NTP, Kerberos, SSH, and DNS. The server also acts as a central repository of identity and policy information.

Clients interact indirectly with IdM servers when they attempt to access domain resources, such as fileshares, services, remote machines, or authentication (through SSSD and Kerberos).

As said, an IdM server is a controller for a lot of associated services. While a number of those services are *supported*, most of them are not *required*. For example, a server may have a CA, a DNS server, or an NTP server — or it can be installed without those services.

Once an IdM server is set up, its configuration can be copied and used as the basis for another IdM server. When an IdM server is copied, that copy is called a *replica*.



NOTE

The only real difference between an IdM server and an IdM replica is that a server is a new installation — so that it defines the domain configuration — and a replica is based on an existing server and existing domain configuration.

Once an instance is configured, servers and replicas are basically identical in functionality and behavior within the IdM domain.

There is a good deal of flexibility in the IdM server (and replica) topology. For example, Server A can be installed with a CA and DNS services, while Replica A can be based on Server A's configuration but not host either DNS or CA services. Replica B can be added to the domain, also without CA or DNS services. At any time in the future, a CA or DNS service can be created and configured on Replica A or Replica B.

Servers and replicas both use underlying LDAP directories to store user and host entries, configuration data, policy configuration, and keytabs, certificates, and keys. Servers and replicas propagate data among each other through *multi-master replication agreements*. Replication agreements are configured for all LDAP backends as well as the LDAP subtrees used by Dogtag Certificate System. Both servers and replicas are masters (peers) in the replication topology.

Because the servers within the IdM domain are all LDAP peer servers, the replication topology must conform to the topology limits of a 389 Directory Server domain. This means that there can be no more than 20 peer servers in the IdM domain. Planning the server/replica topology is described more in [Section 4.1, “Planning the Server/Replica Topologies”](#).

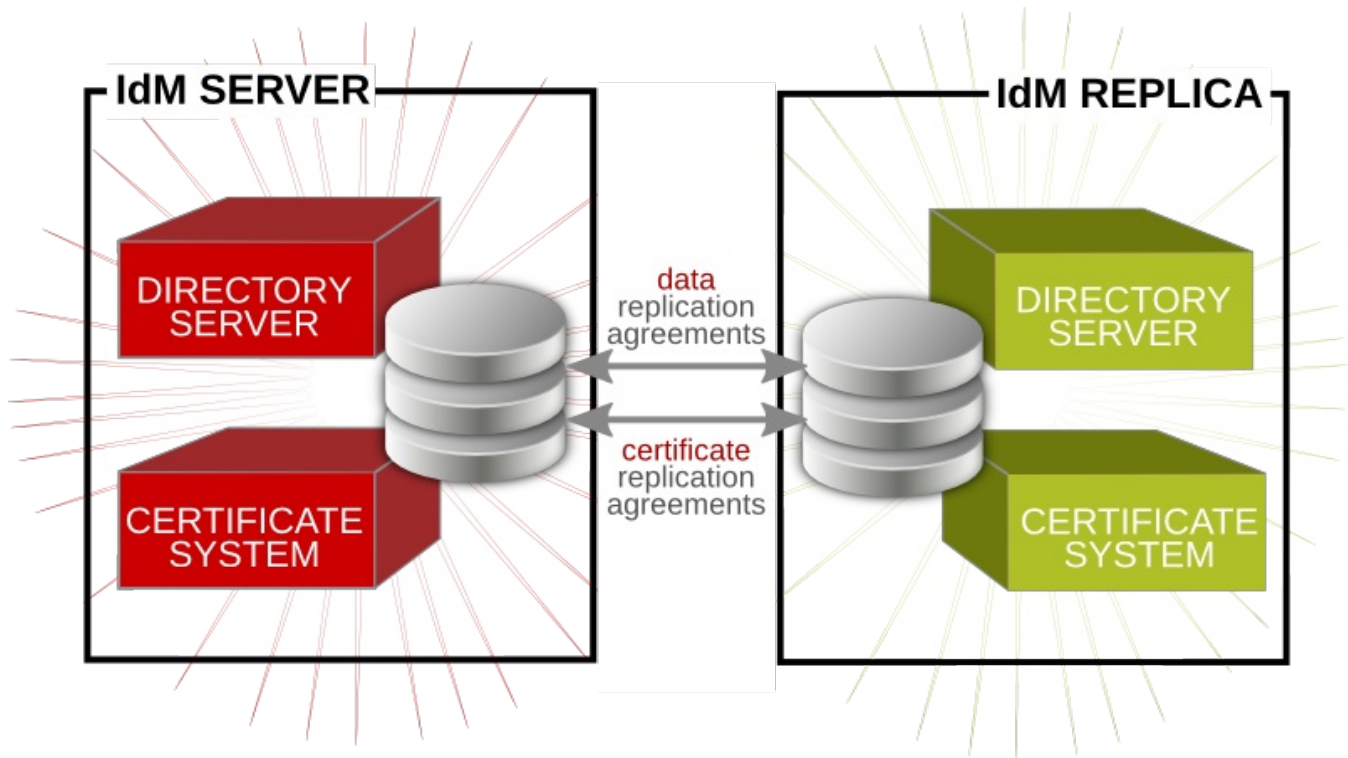


Figure 1.2. Server and Replica Interactions



TIP

The replication topology essentially creates a cloud of IdM servers. One benefit of a server domain is automatic load balancing, using the SRV records in DNS. The SRV record sets the priority order that servers and replicas are contacted, while weight distributes the load between servers/replicas with the same priority. The server and replica DNS entries can be edited to change the load balancing, which is covered in [Example 14.9, “SRV Record”](#) and [Section 23.4.3, “Changing Load Balancing for IdM Servers and Replicas”](#).

1.3.2. About IdM Clients

A client is simply any machine which is configured to operate within the IdM domain, using its Kerberos and DNS services, NTP settings, and certificate services. That's an important distinction: a client does not require a daemon or (necessarily) an installed product. It requires only system configurations which direct it to use IdM services.

For Red Hat Enterprise Linux systems, a certain number of platform tools are available for IdM to use, such as the System Security Services Daemon (SSSD). IdM-enabled platform applications are aspects of the underlying platform that work with IdM services. Other tools, like certain PAM and NSS modules and IdM command-line utilities, are provided by Identity Management itself as IdM-specific packages that must be installed on the machine. These are IdM components, rather than platform components used by Identity Management.

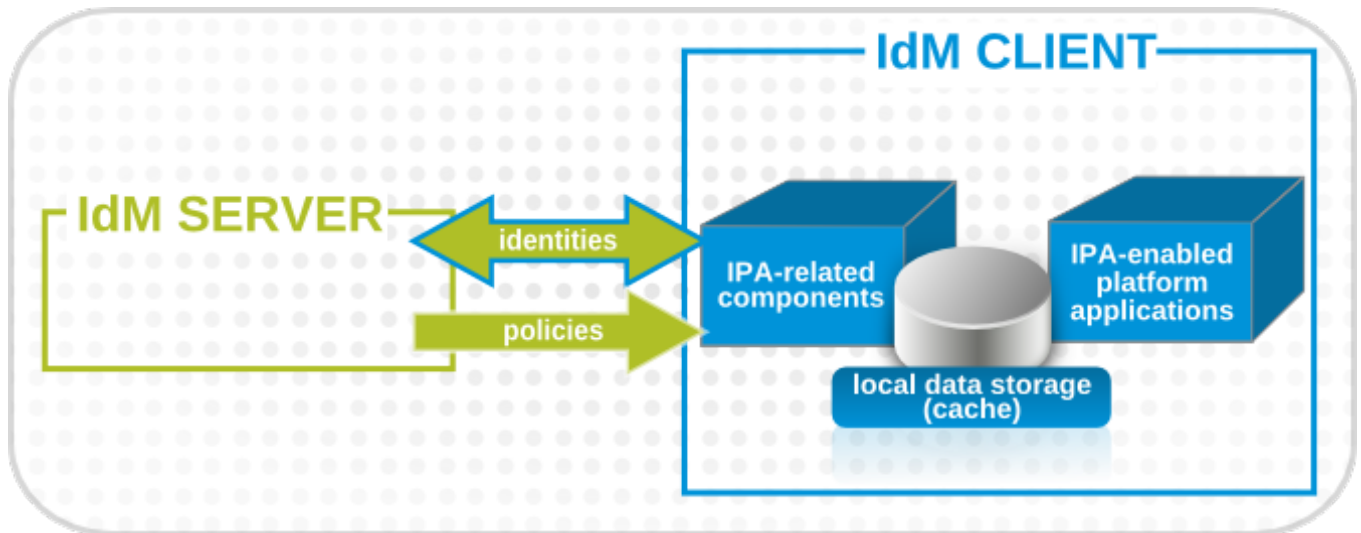


Figure 1.3. Server and Client Interactions

IdM uses the local storage (cache) on a client to improve performance in a few ways:

- ▶ Store IdM information when the machine is offline.
- ▶ Keep information active beyond its normal timeout period if the client cannot access the central server. The cache is persistent even after rebooting the machine.
- ▶ Reduce the round-trip time of requests by checking information locally before looking at the server.

Information is stored either in an LDB database (similar to LDAP) or the local filesystem (as XML files), depending on the *type* of information.

- ▶ Identity information (about users, machines, and groups) is stored in the LDB database, which uses the same syntax as an LDAP directory. This identity information is originally stored in the IdM server's 389 Directory Server instance. Because this information changes frequently and is referenced frequently, it is important to be able to call the more current information quickly, which is possible using an LDB database on the client and the Directory Server on the server.
- ▶ Policy information is more static than identity information, and it can include configuration for SELinux or sudo. These policies are set globally on the server and then are propagated to the clients. On the client, the policy information is stored in the filesystem in XML files which can be downloaded and converted into a native file for whatever service is being managed.

A specific set of services on the IdM server interact with a subset of services and modules on the IdM client. A client is any machine (a *host*) which can retrieve a keytab or certificates from the IdM domain.

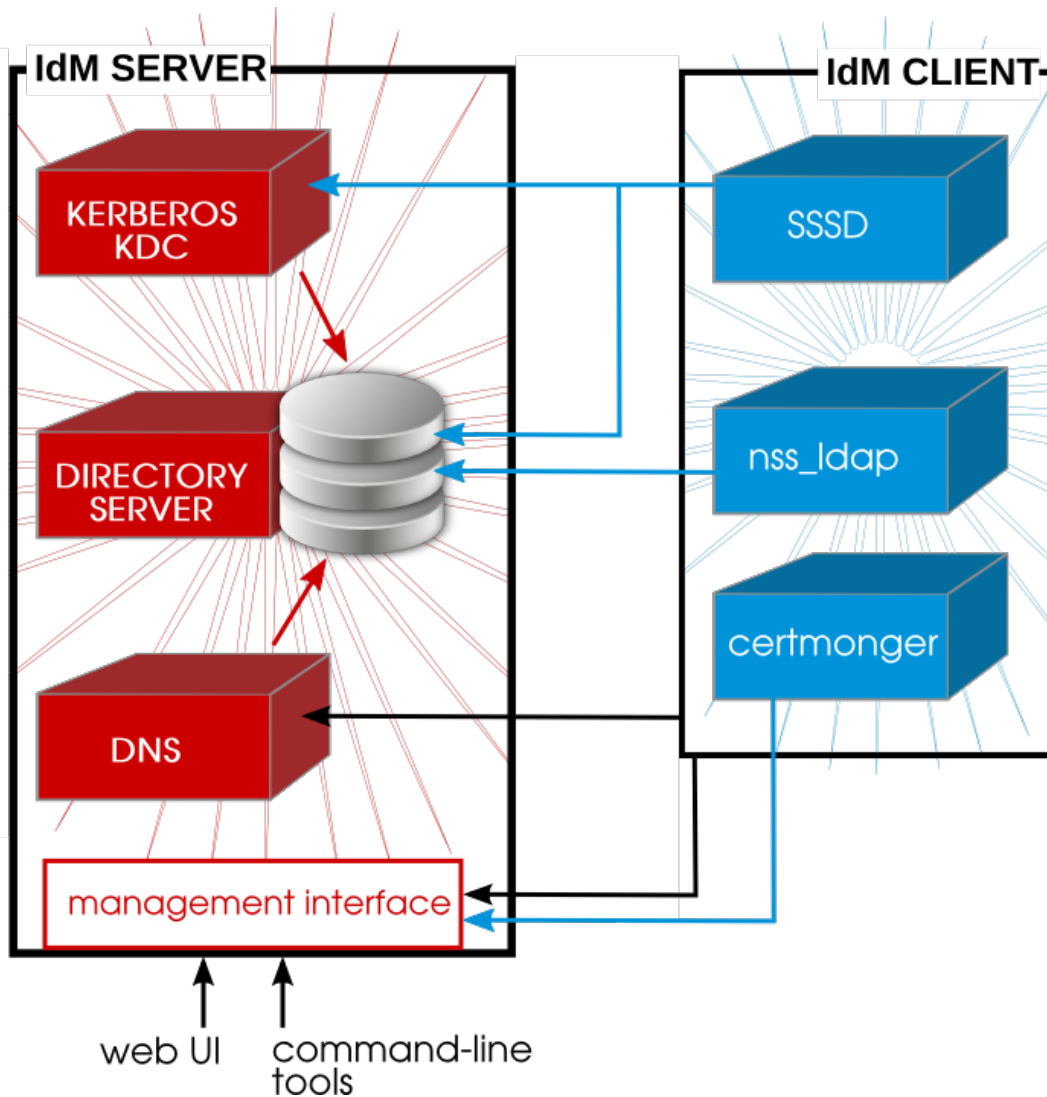


Figure 1.4. Interactions Between IdM Services

Figure 1.4, “Interactions Between IdM Services” shows that Red Hat Enterprise Linux uses two native daemons to interact with the IdM server:

- ▶ SSSD provides the user authentication for the machine and enforces host-based access control rules.
- ▶ **certmonger** monitors and renews the certificates on the client. It can request new certificates for the services on the system, including virtual machines.

When a Red Hat Enterprise Linux client is added to the domain (*enrolled*), its SSSD and **certmonger** are configured to connect to the IdM server and the required Kerberos keytab and host certificates are created. (The host certificate is not used directly by IdM; it may be used by other services, such as a web server.)

Part I. Installing Identity Management Servers and Services

Chapter 2. Prerequisites for Installation

Before you install IdM, ensure that the installation environment is suitably configured. You also need to provide certain information during the installation and configuration procedures, including realm names and certain usernames and passwords. This section describes the information that you need to provide.

2.1. Supported Server Platforms

IdM 3.2 is supported on these platforms:

- ▶ Red Hat Enterprise Linux 7 i386
- ▶ Red Hat Enterprise Linux 7 x86_64

2.2. Hardware Recommendations

A basic user entry is about 1 KB in size, as is a simple host entry with a certificate. The most important hardware feature to size properly is RAM. While all deployments are different, depending on the number of users and groups and the type of data stored, there is a rule of thumb to use to help determine how much RAM to use:

- ▶ For 10,000 users and 100 groups, have at least 2GB of RAM and 1GB swap space.
- ▶ For 100,000 users and 50,000 groups, have at least 16GB of RAM and 4GB of swap space.



TIP

For larger deployments, it is more effective to increase the RAM than to increase disk space because much of the data are stored in cache.

The underlying Directory Server instance used by the IdM server can be tuned to increase performance. For tuning information, see the Directory Server documentation at http://docs.redhat.com/docs/en-US/Red_Hat_Directory_Server/8.2/html/Performance_Tuning_Guide/system-tuning.html.

2.3. Software Requirements

Most of the packages that an IdM server depends on are installed as dependencies when the IdM packages are installed. There are some packages, however, which are required before installing the IdM packages:

- ▶ Kerberos 1.10. This is installed as a dependency if it is not already installed.
- ▶ The *named* and *bind-dyndb-ldap* packages for DNS. The *named* is installed as a dependency if it is not already available; however, the *bind-dyndb-ldap* package must be explicitly installed first or attempting to configure an IdM server with DNS support will fail.

2.4. System Prerequisites

The IdM server is set up using a configuration script, and this script makes certain assumption about the host system. If the system does not meet these prerequisites, then server configuration may fail.

2.4.1. DNS Records

Proper forward and reverse DNS settings are critical for both IdM servers and replicas (copies of servers) to be configured. DNS is used for replicating data between servers, for identifying servers in SSL certificates, and in Kerberos tickets, among other places. Therefore, servers must be resolvable in both forward and reverse DNS configuration.

The DNS settings for a host can be determined easily used **ifconfig** and **dig**.

1. Obtain the hostname.

```
[root@server ~]# hostname
server.example.com
```

2. Get the IP address. In this example, the returned IP address is **196.2.3.4**.

```
[root@server !]# ifconfig eth0
eth0      Link encap:Ethernet  HWaddr 52:54:01:4C:E1:2C
          inet  addr:196.2.3.4  Bcast:196.9.8.7  Mask:255.255.255.255
          inet6 addr: 2620:52:0:102f:5054:1ff:fe4c:e12c/64 Scope:Global
          inet6 addr: fe80::5054:1ff:fe4c:e12c/64 Scope:Link
          ...
```

3. Verify that forward DNS is properly configured by using **dig** to query the hostname and check what IP address is returned. In this example, the expected IP address is **196.2.3.4**.

```
[root@server ~]# dig server.example.com
; <<>> DiG 9.8.2rc1-RedHat-9.8.2-0.17.rc1.el6 <<>> server.example.com
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 56680

;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 7, ADDITIONAL: 12

;; QUESTION SECTION:
;server.example.com. IN A

;; ANSWER SECTION:
server.example.com. 2946 IN A 196.2.3.4
```

4. Verify the reverse DNS configuration using **dig** with the **-t ptr** to query the PTR records (reverse records) for the address. This is the IP address in reverse order, with **.in-addr.arpa**. appended to the address. This should resolve to the hostname, **server.example.com**. in this example.

```
[root@server ~]# dig -t ptr 4.3.2.196.in-addr.arpa.
; <<>> DiG 9.8.2rc1-RedHat-9.8.2-0.17.rc1.el6 <<>> -t ptr 241.40.16.10.in-addr.arpa
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 57899

;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 7, ADDITIONAL: 10

;; QUESTION SECTION:
```

```

;4.3.2.196.in-addr.arpa. IN PTR
;; ANSWER SECTION:
4.3.2.196.in-addr.arpa. 21600 IN PTR server.example.com.

```

The DNS records should resolve to whatever hostname is used in the IdM certificates.



NOTE

If the IdM server is configured to host its own DNS server, the IdM DNS service processes all DNS queries. The IdM DNS records take precedence, and any previous existing DNS configuration is ignored.

All systems within the domain must be configured to use the IdM-managed DNS server.

2.4.2. Hostname and IP Address Requirements

Regardless of whether the DNS is within the IdM server or external, the server host must have DNS properly configured:

- ▶ The hostname must be a fully-qualified domain name. For example, **ipaserver.example.com**.



IMPORTANT

This must be a valid DNS name, which means only numbers, alphabetic characters, underscores (`_`), and hyphens (`-`) are allowed. Other characters in the hostname will cause DNS failures.

- ▶ The hostname must be all lower-case.
- ▶ The server's A record must be set and resolve to its public IP address.

The fully-qualified domain name cannot resolve to the loopback address. It must resolve to the machine's public IP address, not to **127.0.0.1**. The output of the **hostname** command cannot be **localhost** or **localhost6**.

The A and PTR records do not need to match for the server.

- ▶ The server's hostname and IP address must be in its own **/etc/hosts** file. The fully-qualified domain name for the IdM server must be listed in the **hosts** file *before* any aliases.



NOTE

A misconfigured file can prevent the IdM command-line tools from functioning correctly and can prevent the IdM web interface from connecting to the IdM server.

Additionally, the hostname cannot be part of the localhost entry.

For example, this lists the IPv4 and IPv6 localhost entries for the host (properly), then the IdM server IP address and hostname as the first entry.

```
127.0.0.1 localhost.localdomain localhost
::1 localhost6.localdomain6 localhost6
192.168.1.1 ipaserver.example.com ipaserver
```

- It is recommended that a separate DNS domain be allocated for the IdM server to manage. While not required (clients from other domains can still be enrolled in the IdM domain), this is a convenience for overall DNS management.

2.4.3. Directory Server

There must not be any instances of 389 Directory Server installed on the host machine.

2.4.4. System Files

The server script overwrites system files to set up the IdM domain. The system should be clean, without custom configuration for services like DNS and Kerberos, before configuring the IdM server.

2.4.5. System Ports

IdM uses a number of ports to communicate with its services. These ports, listed in [Table 2.1, “IdM Ports”](#), must be open and available for IdM to work. They cannot be in use by another service or blocked by a firewall. To make sure that these ports are available, try **nc**, **telnet**, or **nmap** to connect to a port or run a port scan.

To open a port:

```
[root@server ~]# firewallld -A INPUT -p tcp --dport 389 -j ACCEPT
```

The **firewalld** manpage has more information on opening and closing ports on a system.

Table 2.1. IdM Ports

Service	Ports	Type
HTTP/HTTPS	80	TCP
	443	
LDAP/LDAPS	389	TCP
	636	
Kerberos	88	TCP and UDP
	464	
DNS	53	TCP and UDP
NTP	123	UDP
Dogtag Certificate System - LDAP	7389	TCP

2.4.6. NTP

Network time protocol (NTP) synchronizes time between systems on a network. An NTP server centralizes and manages that clock synchronization. By default, Identity Management installs and configures an NTP server which is used by the domain to synchronize clocks for other Identity Management servers, replicas, and systems and services within the IdM domain.

Some sort of NTP server must be running for some domain tasks — such as Kerberos ticket maintenance and data replication between servers and replicas in the topology — to function properly. **It is not required that an IdM server host the NTP server, but it is strongly recommended. This is the default configuration.**

If a server is being installed on a virtual machine, that server *should not* run an NTP server. To disable NTP for IdM, use the `--no-ntp` option when the IdM server is configured to prevent an NTP server from being installed.

2.4.7. NSCD

It is strongly recommended that you avoid or restrict the use of `nscd` in an IdM deployment. The `nscd` service is extremely useful for reducing the load on the server, and for making clients more responsive, but there can be problems when a system is also using SSSD, which performs its own caching.

`nscd` caches authentication and identity information for all services that perform queries through `nsswitch`, including `getent`. Because `nscd` performs both positive and negative caching, if a request determines that a specific IdM user does not exist, it caches this as a negative response. Values stored in the cache remain until the cache expires, regardless of any changes that may occur on the server. The results of such caching is that new users and memberships may not be visible, and users and memberships that have been removed may still be visible.

To avoid clashes with SSSD caches and to prevent locking out users, avoid using `nscd` altogether. Alternatively, use a shorter cache time by resetting the time-to-live caching values in the `/etc/nscd.conf` file:

```
positive-time-to-live    group    3600
negative-time-to-live    group    60
positive-time-to-live    hosts    3600
negative-time-to-live    hosts    20
```

Chapter 3. Installing an IdM Server

The IdM domain is defined and managed by an IdM *server* which is essentially a domain controller. There can be multiple domain controllers within a domain for load-balancing and failover tolerance. These additional servers are called *replicas* of the master IdM server.

Both IdM servers and replicas only run on Red Hat Enterprise Linux systems. For both servers and replicas, the necessary packages must be installed and then the IdM server or replica itself is configured through setup scripts, which configure all of the requisite services.

3.1. Installing the IdM Server Packages

Installing only the IdM server requires a single package, **ipa-server**. If the IdM server will also manage a DNS server, then it requires two additional packages to set up the DNS.

All of these packages can be installed using the **yum** command:

```
[root@server ~]# yum install ipa-server bind bind-dyndb-ldap
```

Installing the **ipa-server** also installs a large number of dependencies, such as *389-ds-base* for the LDAP service and *krb5-server* for the Kerberos service, along with IdM tools.

After the packages are installed, the server instance must be created using the **ipa-server-install** command. The options for configuring the new server instance are described in [Section 3.2, “About ipa-server-install”](#).

3.2. About ipa-server-install

An IdM server instance is created by running the **ipa-server-install** script. This script can accept user-defined settings for services, like DNS and Kerberos, that are used by the IdM instance, or it can supply predefined values for minimal input from the administrator.

The IdM setup script creates a server instance, which includes configuring all of the required services for the IdM domain:

- ▶ The network time daemon (ntpd)
- ▶ A 389 Directory Server instance
- ▶ A Kerberos key distribution center (KDC)
- ▶ Apache (httpd)
- ▶ An updated SELinux targeted policy
- ▶ The Active Directory WinSync plug-in
- ▶ A certificate authority
- ▶ *Optional.* A domain name service (DNS) server

The IdM setup process can be minimal, where the administrator only supplies some required information, or it can be very specific, with user-defined settings for many parts of the IdM services. The configuration is passed using arguments with the **ipa-server-install** script.


**NOTE**

The port numbers and directory locations used by IdM are all defined automatically, as defined in [Section 2.4.5, “System Ports”](#) and [Section 23.1, “Identity Management Files and Logs”](#). These ports and directories *cannot* be changed or customized.

While **ipa-server-install** can be run without any options, so that it prompts for the required information, it has numerous arguments which allow the configuration process to be easily scripted or to supply additional information which is not requested during an interactive installation.

[Table 3.1, “ipa-server-install Options”](#) lists some common arguments used with **ipa-server-install**. The full list of options are in the **ipa-server-install** manpage. The **ipa-server-install** options are versatile enough to be customized to the specific deployment environment to install and configure different services as needed.

Table 3.1. ipa-server-install Options

Argument	Description
<code>-a ipa_admin_password</code>	The password for the IdM administrator. This is used for the admin user to authenticate to the Kerberos realm.
<code>--hostname=hostname</code>	The fully-qualified domain name of the IdM server machine.
	 IMPORTANT This must be a valid DNS name, which means only numbers, alphabetic characters, and hyphens (-) are allowed. Other characters, like underscores, in the hostname will cause DNS failures. Additionally, the hostname must be all lower-case. No capital letters are allowed.
<code>-n domain_name</code>	The name of the LDAP server domain to use for the IdM domain. This is usually based on the IdM server's hostname.
<code>-p directory_manager_password</code>	The password for the superuser, cn=Directory Manager , for the LDAP service.
<code>-P kerberos_master_password</code>	The password for the KDC administrator. This is randomly generated if no value is given.
<code>-r realm_name</code>	The name of the Kerberos realm to create for the IdM domain.
<code>--subject=subject_DN</code>	Sets the base element for the subject DN of the issued certificates. This defaults to o=realm .
<code>--forwarder=forwarder</code>	Gives a DNS forwarder to use with the DNS service. To specify more than one forwarder, use this option multiple times.

Argument	Description
<code>--no-forwarders</code>	Uses root servers with the DNS service instead of forwarders.
<code>--no-reverse</code>	Does <i>not</i> create a reverse DNS zone when the DNS domain is set up. (If a reverse DNS zone is already configured, then that existing reverse DNS zone is used.) If this option is not used, then the default value is true, which assumes that reverse DNS should be configured by the installation script.
<code>--setup-dns</code>	Tells the installation script to set up a DNS service within the IdM domain. Using an integrated DNS service is optional, so if this option is not passed with the installation script, then no DNS is configured.
<code>--idmax=<i>number</i></code>	Sets the upper bound for IDs which can be assigned by the IdM server. The default value is the ID start value plus 199999.
<code>--idstart=<i>number</i></code>	Sets the lower bound (starting value) for IDs which can be assigned by the IdM server. The default value is randomly selected.

The way that an IdM server is installed can be different depending on the network environment, security requirements within the organization, and the desired topology. These examples illustrate some common options when installing the server. These examples are not mutually exclusive; it is entirely possible to use CA options, DNS options, and IdM configuration options in the same server invocation. These are called out separately simply to make it more clear what each configuration area requires.

3.3. Example: Running the Script Interactively and Silently

3.3.1. Basic Interactive Installation

All that is required to set up an IdM server is to run the `ipa-server-install` script. This launches the script interactively, which prompts for the required information to set up a server, but without more advanced configuration like DNS and CA options.

1. Run the `ipa-server-install` script.

```
[root@server ~]# ipa-server-install
```

2. If DNS configuration is not specified, then the script prompts to configure integrated DNS services. This example goes with the default of no; installing DNS services is described in [Section 3.5, “Example: Configuring DNS Services within the IdM Domain”](#).

```
Do you want to configure integrated DNS (BIND)? [no]:
```

3. Enter the hostname. This is determined automatically using reverse DNS.

```
Server host name [ipaserver.example.com]:
```

4. Enter the domain name. This is determined automatically based on the hostname.

```
Please confirm the domain name [example.com]:
```

5. Enter the new Kerberos realm name. This is usually based on the domain name.

```
Please provide a realm name [EXAMPLE.COM]:
```

6. Enter the password for the Directory Server superuser, **cn=Directory Manager**. There are password strength requirements for this password, including a minimum password length (eight characters).

```
Directory Manager password:
Password (confirm):
```

7. Enter the password for the IdM system user account, **admin**. This user is created on the machine.

```
IPA admin password:
Password (confirm):
```

8. The script then reprints the hostname, IP address, and domain name. Confirm that the information is correct.

```
The IPA Master Server will be configured with
Hostname:   ipaserver.example.com
IP address: 192.168.1.1
Domain name: example.com
Realm name: EXAMPLE.COM
Continue to configure the system with these values? [no]: yes
```

9. After that, the script configures all of the associated services for IdM, with task counts and progress bars.

```
Configuring NTP daemon (ntpd)
[1/4]: stopping ntpd
...
Done configuring NTP daemon (ntpd).
Configuring directory server (dirsrv): Estimated time 1 minute
[1/38]: creating directory server user
....
Configuring certificate server (pki-tomcatd): Estimated time 3 minutes 30
seconds
[1/20]: creating certificate server user
...
Done configuring certificate server (pki-tomcatd).
Configuring Kerberos KDC (krb5kdc): Estimated time 30 seconds
[1/10]: adding sasl mappings to the directory
...
Done configuring Kerberos KDC (krb5kdc).
Configuring kadmind
[1/2]: starting kadmind
[2/2]: configuring kadmind to start on boot
Done configuring kadmind.
Configuring ipa_memcached
[1/2]: starting ipa_memcached
[2/2]: configuring ipa_memcached to start on boot
Done configuring ipa_memcached.
Configuring ipa_otpd
[1/2]: starting ipa_otpd
[2/2]: configuring ipa_otpd to start on boot
Done configuring ipa_otpd.
Configuring the web interface (httpd): Estimated time 1 minute
[1/15]: disabling mod_ssl in httpd
```

```

...
Done configuring the web interface (httpd).
Applying LDAP updates
Restarting the directory server
Restarting the KDC
Sample zone file for bind has been created in /tmp/sample.zone.pUfcGp.db
Restarting the web server

Setup complete

```

10. Restart the **SSH** service to retrieve the Kerberos principal and to refresh the name server switch (NSS) configuration file:

```
[root@server ~]# systemctl start sshd.service
```

11. Authenticate to the Kerberos realm using the admin user's credentials to ensure that the user is properly configured and the Kerberos realm is accessible.

```
[root@server ~]# kinit admin
Password for admin@EXAMPLE.COM:
```

12. Test the IdM configuration by running a command like **ipa user-find**. For example:

```
[root@server ~]# ipa user-find admin
-----
1 user matched
-----
User login: admin
Last name: Administrator
Home directory: /home/admin
Login shell: /bin/bash
UID: 939000000
GID: 939000000
Account disabled: False
Password: True
Kerberos keys available: True
-----
Number of entries returned 1
-----
```

3.3.2. Silent (Non-Interactive) Installation

As shown in [Section 3.3.1, “Basic Interactive Installation”](#), only a few pieces of information are required to configure an IdM server. While the setup script can prompt for this information in interactive mode, this information can also be passed with the setup command to allow automated and unattended configuration:

- ▶ Passwords for the IdM administrative user and the Directory Server super user (Directory Manager)
- ▶ The server hostname
- ▶ The Kerberos realm name
- ▶ The DNS domain name

This information can be passed with the **ipa-server-install**, along with the **-U** to force it to run without requiring user interaction.

Example 3.1. Basic Installation without Interaction

```
[root@server ~]# ipa-server-install -a secret12 --hostname=ipaserver.example.com
-r EXAMPLE.COM -p secret12 -n example.com -U
```

The script then prints the submitted values:

To accept the default shown in brackets, press the Enter key.

```
The IPA Master Server will be configured with
Hostname:      ipaserver.example.com
IP address:    192.168.1.1
Domain name:   example.com
```

The server name must be a valid DNS name, which means only numbers, alphabetic characters, and hyphens (-) are allowed. Other characters, like underscores, in the hostname will cause DNS failures. Additionally, the hostname must be all lower-case. No capital letters are allowed.

Then the script runs through the configuration progress for each IdM service, as in [Section 3.3.1, “Basic Interactive Installation”](#).

3.4. Examples: Installing with Different CA Configurations

Identity Management uses an integrated certificate authority (CA) to create the certificates and keytabs used by users and hosts within the domain. Even internal domain services, such as the LDAP server and the Apache server for the Identity Management web UI, require server certificates to establish secure connections with each other.

A Dogtag Certificate System CA is almost always installed with the IdM server. That CA uses a *CA signing certificate* to create and sign all of the server and user certificates created within the IdM domain. That CA certificate itself has to be signed by the CA which issued it, and there are two different ways that a CA can sign the Dogtag Certificate System CA signing certificate:

- ▶ The Dogtag Certificate System can sign *its own* certificate. This means that the Dogtag Certificate System instance is a *root CA*. There are no higher CAs, and the root CA can set its own certificate policies.

This is the default configuration.

- ▶ The Dogtag Certificate System CA can be signed by an externally-hosted CA (such as Verisign). In that case, the external CA is the root CA, and the configured Dogtag Certificate System CA is *subordinate* to that root. This means that the certificates issued within the IdM domain are potentially subject to restrictions set by the root CA for attributes like the validity period.

Referencing an external CA still uses a Dogtag Certificate System instance to issue all of the IdM domain certificates; the only difference is that the initial domain CA certificate is issued by a different CA.

There is one other option: installing without a CA at all. This requires that all certificates used within the IdM domain be created, uploaded, and renewed manually. There may be some environments where the additional maintenance burden is sustainable because of other restrictions within the infrastructure, but, in general, most deployments will use an integrated Dogtag Certificate System instance (and **certmonger**) to manage IdM domain certificates.

**IMPORTANT**

It is not possible to change the CA configuration after the domain is created and it is not possible to migrate from one configuration to another. It is crucial that the CA requirements be considered before beginning the installation process.

3.4.1. Installing with an Internal Root CA

The default configuration is to install a Dogtag Certificate System which signs its own root CA certificate. There are no additional parameters or configuration steps required when the **ipa-server-install** command is run.

```
[root@server ~]# ipa-server-install
... &< ...

The IPA Master Server will be configured with:
Hostname:      server.example.com
IP address:    10.1.1.1
Domain name:   example.com
Realm name:    EXAMPLE.COM

Continue to configure the system with these values? [no]: yes

The following operations may take some minutes to complete.
Please wait until the prompt is returned.

... &< ...

Configuring directory server for the CA (pkids): Estimated time 30 seconds
[1/3]: creating directory server user
[2/3]: creating directory server instance
[3/3]: restarting directory server
Done configuring directory server for the CA (pkids).
Configuring certificate server (pki-cad): Estimated time 3 minutes 30 seconds
[1/21]: creating certificate server user
...
Done configuring certificate server (pki-cad).

... &< ...
```

3.4.2. Installing Using an External CA

The IdM server can use a certificate issued by an external CA. This can be a corporate CA or a third-party CA like Verisign or Thawte. As with a normal setup process, using an external CA still uses a Dogtag Certificate System instance for the IdM server for issuing all of its client and replica certificates; the initial CA certificate is simply issued by a different CA.

When using an external CA, there are two additional steps that must be performed: submit the generated certificate request to the external CA and then load the CA certificate and issued server certificate to complete the setup.

**IMPORTANT**

The CA signing certificate generated for the Identity Management server must be a valid CA certificate. **This requires either that the Basic Constraint be set to `CA=true` or that the Key Usage Extension be set on the signing certificate to allow it to sign certificates.**

**IMPORTANT**

It is not possible to change the CA configuration after the domain is created and it is not possible to migrate from one configuration to another. It is crucial that the CA requirements be considered before beginning the installation process.

Example 3.2. Using an External CA

1. Run the `ipa-server-install` script, using the `--external-ca` option.

```
[root@server ~]# ipa-server-install -a secret12 -r EXAMPLE.COM -P password -
p secret12 -n ipaserver.example.com --external-ca
```

2. The script sets up the NTP and Directory Server services as normal.
3. The script completes the CA setup and returns information about where the certificate signing request (CSR) is located, `/root/ipa.csr`. This request must be submitted to the external CA.

```
Configuring certificate server: Estimated time 6 minutes
[1/4]: creating certificate server user
[2/4]: creating pki-ca instance
[3/4]: restarting certificate server
[4/4]: configuring certificate server instance
The next step is to get /root/ipa.csr signed by your CA and re-run ipa-
server-install.
```

4. Submit the request to the CA. The process differs for every service.

It may be necessary to request the appropriate extensions for the certificate. The CA signing certificate generated for the Identity Management server must be a valid CA certificate. This requires either that the Basic Constraint be set to `CA=true` or that the Key Usage Extension be set on the signing certificate to allow it to sign certificates.

5. Retrieve the issued certificate and the CA certificate chain for the issuing CA. Again, the process differs for every certificate service, but there is usually a download link on a web page or in the notification email that allows administrators to download all the required certificates. Be sure to get the full certificate chain for the CA, not just the CA certificate.
6. Rerun `ipa-server-install`, specifying the locations and names of the certificate and CA chain files. For example:

```
[root@server ~]# ipa-server-install --
external_cert_file=/tmp/servercert20110601.p12 --
external_ca_file=/tmp/cacert.p12
```

7. Complete the setup process and verify that everything is working as expected, as in [Section 3.3.1, “Basic Interactive Installation”](#).

3.4.3. Installing without a CA

In very rare cases, it may not be possible to install certificate services with the Identity Management server. In that case, it is possible to install Identity Management without an integrated Certificate System instance, **as long as all required certificates are created and installed independently.**

For installation, three certificates are required:

- ▶ An LDAP server certificate
- ▶ An Apache server certificate
- ▶ An LDAP server certificate

This certificates must be requested from a third-party authority *before* beginning the installation process.

There are some important limitations with how certificates can be managed when there is no integrated Dogtag Certificate System instance:

- ▶ **certmonger** is not used to track certificates, so there is no expiration warning.
- ▶ There is no way to renew certificates through Identity Management.
- ▶ The certificate management tools (**ipa cert-***) cannot be used to view or manage certificates.
- ▶ All host certificates and any service certificates must be requested, generated, and uploaded manually. This also affects how host management tools like **ipa host-add** function.
- ▶ If a certificate is removed from an entry, it is not automatically revoked.



IMPORTANT

It is not possible to change the CA configuration after the domain is created and it is not possible to migrate from one configuration to another. It is crucial that the CA requirements be considered before beginning the installation process.

Example 3.3. Installing Identity Management Without a CA

There are five options required when installing without a CA, to pass the required certificates directly to the setup process:

- ▶ **LDAP server certificate**
 - `--dirsrv_pkcs12`, with the PKCS#12 certificate file for the LDAP server certificate
 - `--dirsrv_pin`, with the password to access the PKCS#12 file
- ▶ **Apache server certificate**
 - `--http_pkcs12`, with the PKCS#12 certificate file for the Apache server certificate
 - `--http_pin`, with the password to access the PKCS#12 file
- ▶ **Root CA certificate** (to allow the Apache and LDAP server certificates to be trusted across the domain)
 - `--root-ca`, with the PEM file of *only* the CA certificate, not the certificate chain

```
[root@server ~]# ipa-server-install --http_pkcs12 /tmp/http-server.p12 --http_pin
secret1 --dirsrv_pkcs12 /tmp/ldap-server.p12 --dirsrv_pin secret2 --root-ca-file
/tmp/root.pem ...
```

3.5. Example: Configuring DNS Services within the IdM Domain

IdM can be configured to manage its own DNS or use an existing DNS (which is the default). Running the setup script alone does not configure DNS; this requires the `--setup-dns` option.

**WARNING**

DNS records are vital for nearly all IdM domain functions, including running LDAP directory services, Kerberos, and Active Directory integration.

Be extremely cautious and ensure that you have a tested and functional DNS service available if the IdM domain will not use an IdM-hosted DNS server. It is critical that you have properly configured A and PTR records.

As with a basic setup, the DNS setup can either prompt for the required information or the DNS information can be passed with the script to allow an automatic or unattended setup process.

3.5.1. DNS Notes

- ▶ Wildcards cannot be used when configuring DNS names. Only explicit DNS domain names are supported.
- ▶ The **rndc** service is not configured by the **--setup-dns** option. This service must be configured manually after the IdM server is configured.

3.5.2. Installing with an Integrated DNS

Example 3.4. Interactive DNS Setup

1. Run the `ipa-server-install` script, using the `--setup-dns` option.

```
[root@server ~]# ipa-server-install -a secret12 -r EXAMPLE.COM -P password -
p secret12 -n ipaserver.example.com --setup-dns
```

2. The script prompts to overwrite the existing BIND configuration. This must be allowed for the installation to proceed.

```
Existing BIND configuration detected, overwrite? [no]: yes
```

3. The script configures the hostname and domain name as normal.

4. The script prompts for a realm name for the DNS realm.

```
Please provide a realm name [EXAMPLE.COM]:
```

5. The script sets up the Directory Server and IdM administrative users.
6. The script sets up the NTP, Directory Server, Certificate System, Kerberos, and Apache services.
7. The script then prompts for DNS forwarders. If forwarders will be used, enter yes, and then supply the list of DNS servers. If IdM will manage its own DNS service, then enter no.

```
Do you want to configure DNS forwarders? [yes]: no
No DNS forwarders configured
```

8. The script then configures the reverse zone.

```
Do you want to configure the reverse zone? [yes]:
Please specify the reverse zone name [0.1.2.in-addr.arpa.]:
Using reverse zone 0.1.2.in-addr.arpa.
```

9. The `ipa-dns-install` command (which is run with the install script when the `--setup-dns` option is used) does not automatically configure the system's `rndc` service. This must be configured manually, after DNS is configured for IdM.

- a. Create the `rndc` configuration file and key.

```
[root@server ~]# /usr/sbin/rndc-confgen -a
[root@server ~]# /sbin/restorecon /etc/rndc.key
```

This may require some user input to create entropy while the key is being created.

- b. Change the owner and permissions of the `rndc` key file.

```
[root@server ~]# chown root:named /etc/rndc.key
[root@server ~]# chmod 0640 /etc/rndc.key
```

10. Verify that everything is working as expected, as in [Section 3.3.1, "Basic Interactive Installation"](#).

If DNS is used with IdM, then two pieces of information are required: any DNS forwarders that will be used and whether to use reverse DNS. To perform a non-interactive setup, this information can be passed using the **--forwarder** or **--no-forwarders** option and **--no-reverse** option.

Example 3.5. Setting up DNS Non-Interactively

To set up a DNS server and domain for the IdM server, use the **--setup-dns** option. To configure additional forwarders, use the **--forwarder** option; for multiple forwarders, use multiple invocations of **--forwarder**.

```
[root@server ~]# ipa-server-install ... --setup-dns --forwarder=1.2.3.0 --  
forwarder=1.2.255.0
```

Some kind of forwarder information is required. If no external forwarders will be used with the IdM DNS service, then use the **--no-forwarders** option to indicate that only root servers will be used.

The script always assumes that reverse DNS is configured along with DNS, so it is not necessary to use any options to *enable* reverse DNS. To disable reverse DNS, use the **--no-reverse** option; if a reverse DNS zone is already configured, then using the **--no-reverse** option means that existing reverse DNS zone is used.

```
[root@server ~]# ipa-server-install ... --setup-dns --no-reverse
```

The **ipa-dns-install** command (which is run with the install script when the **--setup-dns** option is used) does not automatically configure the system's **rndc** service. This must be configured manually, after DNS is configured for IdM.

1. Create the **rndc** configuration file and key.

```
[root@server ~]# /usr/sbin/rndc-confgen -a  
[root@server ~]# /sbin/restorecon /etc/rndc.key
```

This may require some user input to create entropy while the key is being created.

2. Change the owner and permissions of the **rndc** key file.

```
[root@server ~]# chown root:named /etc/rndc.key  
[root@server ~]# chmod 0640 /etc/rndc.key
```

Chapter 4. Setting up IdM Replicas

Replicas are essentially clones of existing Identity Management servers, and they share identical core configuration. The replica installation process, then, has two major parts: copying the existing, required server configuration and then installing the replica based on that information.

4.1. Planning the Server/Replica Topologies

In the IdM domain, there are three types of machines:

- ▶ Servers, which manage all of the services used by domain members
- ▶ Replicas, which are essentially copies of servers (and, once copied, are identical to servers)
- ▶ Clients, which belong to the Kerberos domains, receive certificates and tickets issued by the servers, and use other centralized services for authentication and authorization

A replica is a clone of a specific IdM server. The server and replica share the same internal information about users, machines, certificates, and configured policies. These data are copied from the server to the replica in a process called *replication*. The two Directory Server instances used by an IdM server — the Directory Server instance used by the IdM server as a data store and the Directory Server instance used by the Dogtag Certificate System to store certificate information — are replicated over to corresponding consumer Directory Server instances used by the IdM replica. The different Directory Server instances recognize each other through *replication agreements*. An initial replication agreement is created between a master server and replica when the replica is created; additional agreements can be added to other servers or replicas using the `ipa-replica-manage` command.

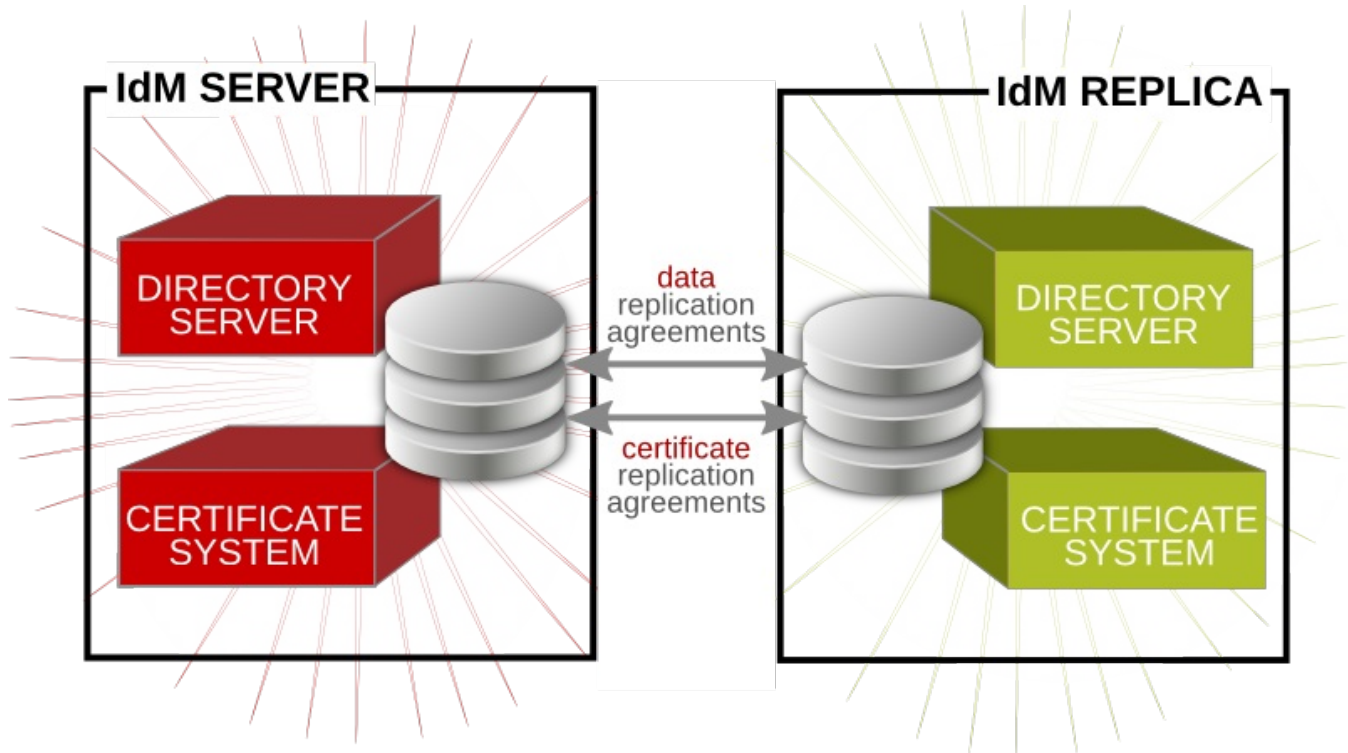


Figure 4.1. Server and Replica Agreements

Once they are installed, replicas are functionally identical to servers.

There are some guidelines with multi-master replication which place restrictions on the overall server/replica topology.

- ▶ No more than four replication agreements can be configured on a single server/replica.
- ▶ No more than 20 servers and replicas should be involved in a single Identity Management domain.
- ▶ Every server/replica should have a minimum of two replication agreements to ensure that there are no orphan servers or replicas cut out of the IdM domain if another server fails.

One of the most resilient topologies is to create a cell configuration for the servers/replicas, where there are a small number of servers in a cell which all have replication agreements with each other (a tight cell), and then each server has one replication agreement with another server *outside* the cell, loosely coupling that cell to every other cell in the overall domain.

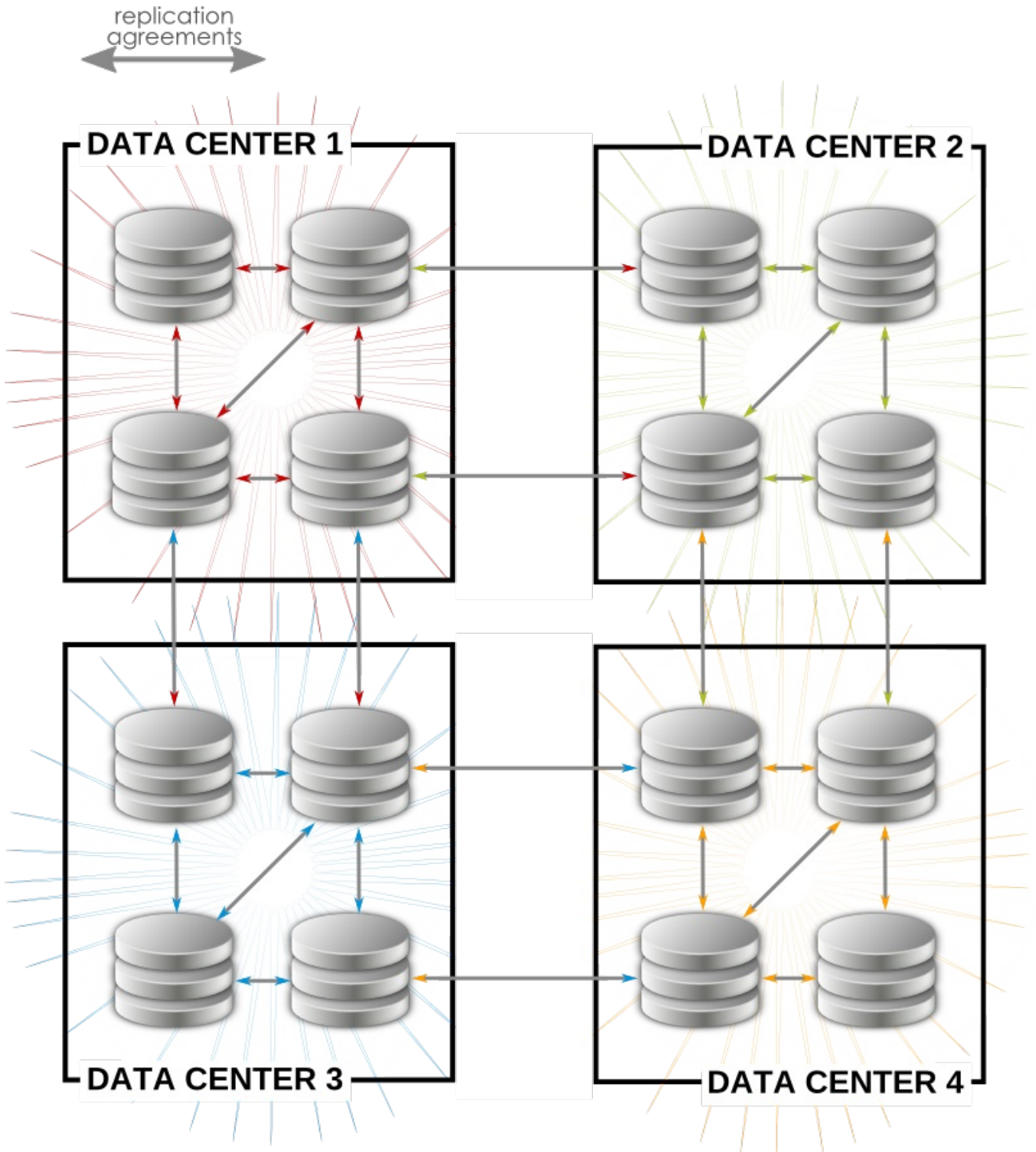


Figure 4.2. Example Topology

There are some recommendations on how to accomplish this easily:

- ▶ Have at least one IdM server in each main office, data center, or locality. Preferably, have two IdM servers.
- ▶ Do not have more than four servers per data center.
- ▶ Rather than using a server or replica, small offices can use SSSD to cache credentials and use an off-site IdM server as its data backend.

4.2. Prerequisites for Installing a Replica Server

Replicas are functionally the same as IdM servers, so they have the same installation requirements and packages. However, replicas are also *copies* of existing servers, so they must also mirror the originating server configuration.

- ▶ Make sure that the machine meets all of the prerequisites listed in [Chapter 2, Prerequisites for Installation](#).
- ▶ **The replica and the master server must be running the same version of IdM.**

The replica essentially is a copy of a server, based off the existing server configuration. Therefore, the server and the replica (its copy) must be running the same version of Identity Management so that the configuration can be properly copied from the server to the replica.

If the master server is running on Red Hat Enterprise Linux 7, IdM version 3.2, then the replica must also run on Red Hat Enterprise Linux 7 and use the IdM 3.2 packages.



IMPORTANT

Creating a replica of a different version than the master **is not supported**. Attempting to create a replica using a different version fails when attempting to configure the 389 Directory Server instance.

- ▶ If there is an existing Dogtag Certificate System or Red Hat Certificate System instance on the replica machine, make sure that port **7389** is free. This port is used by the master IdM server to communicate with the replica.
- ▶ Make sure the appropriate ports are open on both the server and the replica machine during and after the replica configuration. Servers and replicas connect to each other over ports 9443, 9444, 9445, and 7389 during the replica configuration. Once the replica is set up, the server and replica communicate over port 7389.
- ▶ The replica must use the same CA configuration as the server and must have the same root CA. For example, if the server is its own root CA (using Dogtag Certificate System), then that must be the root CA for the replica. If the server used an external CA to issue its certificates, then the replica must use that same external CA.

4.3. Installing the Replica Packages

Since the replica is an IdM server (based on the configuration of an existing server), it is installed from the IdM server packages, **ipa-server**. If the replica will also host DNS services, then include the **bind** and

bind-dyndb-ldap packages.

```
[root@server ~]# yum install ipa-server bind bind-dyndb-ldap
```



IMPORTANT

Do not run the **ipa-server-install** script.

4.4. Creating the Replica

1. On the master server, create a *replica information file*. This contains realm and configuration information taken from the master server which will be used to configure the replica server.

Run the **ipa-replica-prepare** command *on the master IdM server*. The command requires the fully-qualified domain name of the *replica* machine. Using the **--ip-address** option automatically creates DNS entries for the replica, including the A and PTR records for the replica to the DNS.



NOTE

Only pass the **--ip-address** option if the IdM server was configured with integrated DNS. Otherwise, there is no DNS record to update, and the attempt to create the replica fails when the DNS record operation fails.

```
[root@server ~]# ipa-replica-prepare ipareplica.example.com --ip-address 192.168.1.2
```

```
Directory Manager (existing master) password:
Preparing replica for ipareplica.example.com from ipaserver.example.com
Creating SSL certificate for the Directory Server
Creating SSL certificate for the dogtag Directory Server
Saving dogtag Directory Server port
Creating SSL certificate for the Web Server
Exporting RA certificate
Copying additional files
Finalizing configuration
Packaging replica information into /var/lib/ipa/replica-info-
ipareplica.example.com.gpg
Adding DNS records for ipareplica.example.com
Using reverse zone 1.168.192.in-addr.arpa.
The ipa-replica-prepare command was successful
```

This must be a valid DNS name, which means only numbers, alphabetic characters, underscores (`_`), and hyphens (`-`) are allowed. Other characters in the hostname will cause DNS failures. Additionally, the hostname must be all lower-case. No capital letters are allowed.

For more options with **ipa-replica-prepare**, see the **ipa-replica-prepare** manpage.

Each replica information file is created in the `/var/lib/ipa/` directory as a GPG-encrypted file. Each file is named specifically for the replica server for which it is intended, such as **replica-info-ipareplica.example.com.gpg**.

**NOTE**

A replica information file cannot be used to create multiple replicas. It can only be used for the specific replica and machine for which it was created.

**WARNING**

Replica information files contain sensitive information. Take appropriate steps to ensure that they are properly protected.

- Copy the replica information file to the replica server:

```
[root@server ~]# scp /var/lib/ipa/replica-info-ipareplica.example.com.gpg
root@ipaserver:/var/lib/ipa/
```

- On the replica server, run the replica installation script, referencing the replication information file. There are other options for setting up DNS, much like the server installation script. Additionally, there is an option to configure a CA for the replica; while CA's are installed by default for servers, they are optional for replicas.

Some information about DNS forwarders is required. A list can be given of configured DNS forwarders using a **--forwarder** option for each one, or forwarder configuration can be skipped by specifying the **--no-forwarders** option.

For example:

```
[root@ipareplica ~]# ipa-replica-install --setup-ca --setup-dns --no-
forwarders /var/lib/ipa/replica-info-ipareplica.example.com.gpg

Directory Manager (existing master) password:

Warning: Hostname (ipareplica.example.com) not found in DNS
Run connection check to master
Check connection from replica to remote master 'ipareplica. example.com':
  Directory Service: Unsecure port (389): OK
  Directory Service: Secure port (636): OK
  Kerberos KDC: TCP (88): OK
  Kerberos Kpasswd: TCP (464): OK
  HTTP Server: Unsecure port (80): OK
  HTTP Server: Secure port (443): OK

The following list of ports use UDP protocol and would need to be
checked manually:
  Kerberos KDC: UDP (88): SKIPPED
  Kerberos Kpasswd: UDP (464): SKIPPED

Connection from replica to master is OK.
Start listening on required ports for remote master check
Get credentials to log in to remote master
admin@EXAMPLE.COM password:

Execute check on remote master
admin@example.com's password:
Check connection from master to remote replica 'ipareplica. example.com':
  Directory Service: Unsecure port (389): OK
  Directory Service: Secure port (636): OK
```

```

Kerberos KDC: TCP (88): OK
Kerberos KDC: UDP (88): OK
Kerberos Kpasswd: TCP (464): OK
Kerberos Kpasswd: UDP (464): OK
HTTP Server: Unsecure port (80): OK
HTTP Server: Secure port (443): OK

```

```
Connection from master to replica is OK.
```

```
Connection check OK
```

Additional options for the replica installation script are listed in the **ipa-replica-install** manpage.

The replica installation script runs a test to ensure that the replica file being installed matches the current hostname. If they do not match, the script returns a warning message and asks for confirmation. This could occur on a multi-homed machine, for example, where mismatched hostnames may not be an issue.

4. Enter the Directory Manager password when prompted. The script then configures a Directory Server instance based on information in the replica information file and initiates a replication process to copy over data from the master server to the replica, a process called *initialization*.
5. Verify that the proper DNS entries were created so that IdM clients can discover the new server. DNS entries are required for required domain services:

- ▶ `_ldap._tcp`
- ▶ `_kerberos._tcp`
- ▶ `_kerberos._udp`
- ▶ `_kerberos-master._tcp`
- ▶ `_kerberos-master._udp`
- ▶ `_ntp._udp`

If the initial IdM server was created with DNS enabled, then the replica is created with the proper DNS entries. For example:

```

[root@ipareplica ~]# DOMAIN=example.com
[root@ipareplica ~]# NAMESERVER=ipareplica
[root@ipareplica ~]# for i in _ldap._tcp _kerberos._tcp _kerberos._udp
_kerberos-master._tcp _kerberos-master._udp _ntp._udp; do echo ""; dig
@${NAMESERVER} ${i}.${DOMAIN} srv +nocmd +noquestion +nocomments +nostats +noaa
+noadditional +noauthority; done | egrep -v "^;" | egrep _

_ldap._tcp.example.com. 86400 IN SRV 0 100 389
ipaserver1.example.com.
_ldap._tcp.example.com. 86400 IN SRV 0 100 389
ipaserver2.example.com.
_kerberos._tcp.example.com. 86400 IN SRV 0 100 88
ipaserver1.example.com.
...8<...

```

If the initial IdM server was created without DNS enabled, then each DNS entry, including both TCP and UDP entries for some services, should be added manually. For example:

```
[root@ipareplica ~]# kinit admin
[root@ipareplica ~]# ipa dnsrecord-add example.com _ldap._tcp --srv-rec="0
100 389 ipareplica.example.com."
```

6. *Optional.* Set up DNS services for the replica. These are not configured by the setup script, even if the master server uses DNS.

Use the **ipa-dns-install** command to install the DNS manually, then use the **ipa dnsrecord-add** command to add the required DNS records. For example:

```
[root@ipareplica ~]# ipa-dns-install

[root@ipareplica ~]# ipa dnsrecord-add example.com @ --ns-rec
ipareplica.example.com.
```



IMPORTANT

Use the fully-qualified domain name of the replica, including the final period (.), otherwise BIND will treat the hostname as relative to the domain.

4.5. Alternate Options for Creating a Replica

Much of the core configuration of the replica is identical to that of the server from which it was created, such as the realm name and directory settings. However, while the settings need to match, it is not required that a replica manage the same services as the server. This is true for major services (DNS and CAs) and for minor services (NTP and OpenSSH).

The difference settings can be defined in the **ipa-replica-prepare** command or in the **ipa-replica-install** command.

4.5.1. Different DNS Settings

For DNS, the **ipa-replica-prepare** command can be used to configure DNS settings specific to the replica, meaning its IP address and reverse zone. For example:

```
[root@server ~]# ipa-replica-prepare ipareplica.example.com --ip-address=192.68.0.0
--no-reverse
```

If the server does not host any DNS services, then the replica can be set up to host DNS services for the Identity Management domain. As with installing a server, this is done with the **--setup-dns** option, and then settings for forward and reverse zones. For example, to configure DNS services for the replica with no forwarders and using an existing reverse zone:

```
[root@server ~]# ipa-replica-install ipareplica.example.com --setup-dns --no-
forwarders --no-reverse --no-host-dns ...
```

The DNS options are described in the **ipa-replica-prepare** and **ipa-replica-install** manpages.

4.5.2. Different CA Settings

The CA configuration of the replica must echo the CA configuration of the server. If the server is configured with an integrated Dogtag Certificate System instance (regardless of whether it is a root CA or whether it is subordinate to an external CA), then the replica can either create its own integrated CA which is subordinate to the server CA or it can forgo having a CA at all, and forward all requests to the server's CA.

If the replica will have its own CA, then it uses the `--setup-ca` option. The rest of the configuration is taken from the server's configuration.

```
[root@ipareplica ~]# ipa-replica-install ipareplica.example.com --setup-ca ...
```

However, if the server was installed without any CA at all, then is nowhere to forward certificate operations — including the ability to request certificates for the new replica instance. All of the certificates for the replica, as with the server, must be requested and retrieved before installing the replica and then submitted with the installation command. The only exception is the root CA certificate; this is retrieved from the server as part of the replica setup.

```
[root@ipareplica ~]# ipa-replica-install ipareplica.example.com --  
dirsrv_pkcs12=/tmp/dirsrv-cert.p12 --dirsrv_pin=secret1 --http_pkcs12=/tmp/http-  
cert.p12 --http_pin=secret2 ...
```

4.5.3. Different Services

There are three support services that are installed on both servers and replicas by default: NTP, OpenSSH client, and OpenSSH server. Any or all of this can be disabled on a replica. For example:

```
[root@server ~]# ipa-replica-install ... --no-ntp --no-ssh --no-sshd ...
```

Chapter 5. Setting up Systems as IdM Clients

A *client* is any system which is a member of the Identity Management domain. While this is frequently a Red Hat Enterprise Linux system (and IdM has special tools to make configuring Red Hat Enterprise Linux clients very simple), machines with other operating systems can also be added to the IdM domain.

One important aspect of an IdM client is that *only* the system configuration determines whether the system is part of the domain. (The configuration includes things like belonging to the Kerberos domain, DNS domain, and having the proper authentication and certificate setup.)



NOTE

IdM does not require any sort of agent or daemon running on a client for the client to join the domain. However, for the best management options, security, and performance, clients should run the System Security Services Daemon (SSSD).

For more information on SSSD, see [the SSSD chapter in the Deployment Guide](#) [the SSSD project page](#).

This chapter explains how to configure a system to join an IdM domain.



NOTE

Clients can only be configured after at least one IdM server has been installed.

5.1. What Happens in Client Setup

Whether the client configuration is performed automatically on Red Hat Enterprise Linux systems using the client setup script or manually on other systems, the general process of configuring a machine to serve as an IdM client is mostly the same, with slight variation depending on the platform:

- ▶ Retrieve the CA certificate for the IdM CA.
- ▶ Create a separate Kerberos configuration to test the provided credentials.

This enables a Kerberos connection to the IdM XML-RPC server, necessary to join the IdM client to the IdM domain. This Kerberos configuration is ultimately discarded.

Setting up the Kerberos configuration includes specifying the realm and domain details, and default ticket attributes. Forwardable tickets are configured by default, which facilitates connection to the administration interface from any operating system, and also provides for auditing of administration operations. For example, this is the Kerberos configuration for Red Hat Enterprise Linux systems:

```
[libdefaults]
default_realm = EXAMPLE.COM
dns_lookup_realm = false
dns_lookup_kdc = false
rdns = false
forwardable = yes
ticket_lifetime = 24h

[realms]
EXAMPLE.COM = {
```

```

kdc = ipaserver.example.com:88
admin_server = ipaserver.example.com:749
}
[domain_realm]
.example.com = EXAMPLE.COM
example.com = EXAMPLE.COM

```

- ▶ Run the **ipa-join** command to perform the actual join.
- ▶ Obtain a service principal for the host service and installs it into **/etc/krb5.keytab**. For example, **host/ipa.example.com@EXAMPLE.COM**.
- ▶ Enable **certmonger**, retrieve an SSL server certificate, and install the certificate in **/etc/pki/nssdb**.
- ▶ Disable the **nscd** daemon.
- ▶ Configure **SSSD** or **LDAP/KRB5**, including **NSS** and **PAM** configuration files.
- ▶ Configure an **OpenSSH** server and client, as well as enabling the host to create **DNS SSHFP** records.
- ▶ Configure **NTP**.

5.2. System Ports

IdM uses a number of ports to communicate with its services. These ports, listed in [Table 5.1, “IdM Ports”](#), must be open and available for IdM to work. They cannot be in use by another service or blocked by a firewall. To make sure that these ports are available, try **firewalld** to list the available ports or **nc**, **telnet**, or **nmap** to connect to a port or run a port scan.

To open a port:

```
[root@server ~]# firewalld -A INPUT -p tcp --dport 389 -j ACCEPT
```

The **firewalld** manpage has more information on opening and closing ports on a system.

Table 5.1. IdM Ports

Service	Ports	Type
HTTP/HTTPS	80	TCP
	443	
LDAP/LDAPS	389	TCP
	636	
Kerberos	88	TCP and UDP
	464	
DNS	53	TCP and UDP
NTP	123	UDP

5.3. Configuring a Linux System as an IdM Client

There are two elements to prepare before beginning the client setup process for the Red Hat Enterprise Linux client:

- ▶ There must be a way to connect the client machine to the Kerberos domain, either by having an available Kerberos identity (such as the admin user) or by manually adding the client machine to the KDC on the server with a one-time password before beginning the enrollment process for the client machine.
- ▶ If there is an Active Directory server on the same network that serves DNS records, the Active Directory DNS records could prevent the client from automatically detecting the IdM server address. The **ipa-client-install** script retrieves the Active Directory DNS records instead of any records that were added for IdM.

In this case, it is necessary to pass the IdM server address directly to the **ipa-client-install** script.

5.3.1. Installing the Client (Full Example)

1. Install the client packages. These packages provide a simple way to configure the system as a client; they also install and configure SSSD.

For a regular user system, this requires only the **ipa-client** package:

```
[root@client ~]# yum install ipa-client
```

An administrator machine requires the **ipa-admintools** package, as well:

```
[root@client ~]# yum install ipa-client ipa-admintools
```

2. If the IdM server is configured as the DNS server and is in the same domain as the client, add the server's IP address as the first entry in the list of name servers in the client's **/etc/resolv.conf** file.



TIP

If every machine in the domain will be an IdM client, then add the IdM server address to the DHCP configuration.

3. Run the client setup command.

```
[root@client ~]# ipa-client-install --enable-dns-updates
```

The **--enable-dns-updates** option updates DNS with the client machine's IP address. This option should only be used if the IdM server was installed with integrated DNS or if the DNS server on the network accepts DNS entry updates with the GSS-TSIG protocol.

Options for **ipa-client-install** are listed in the **ipa-client-install** manpage.

4. If prompted, enter the domain name for the IdM DNS domain.

```
DNS discovery failed to determine your DNS domain
Please provide the domain name of your IPA server (ex: example.com):
example.com
```


- If prompted, enter the fully-qualified domain name of the IdM server. Alternatively, use the `--server` option with the client installation script to supply the fully-qualified domain name of the IdM server.

```
DNS discovery failed to find the IPA Server
Please provide your IPA server name (ex: ipa.example.com):
ipaserver.example.com
```



IMPORTANT

This must be a valid DNS name, which means only numbers, alphabetic characters, underscores (`_`), and hyphens (`-`) are allowed. Other characters in the hostname will cause DNS failures.

- The client script then prompts for a Kerberos identity to use to contact and then join the Kerberos realm. When these credentials are supplied, then the client is able to join the IdM Kerberos domain and then complete the configuration:

```
Continue to configure the system with these values? [no]: y
User authorized to enroll computers: admin
Synchronizing time with KDC...
Password for admin@EXAMPLE.COM:
Successfully retrieved CA cert
Subject: CN=Certificate Authority, O=EXAMPLE.COM
Issuer: CN=Certificate Authority, O=EXAMPLE.COM
Valid From: Tue Aug 13 09:29:07 2014 UTC
Valid Until: Sat Aug 13 09:29:07 2033 UTC
Enrolled in IPA realm EXAMPLE.COM
Created /etc/ipa/default.conf
New SSSD config will be created
Configured /etc/sss/sss.conf
Configured /etc/krb5.conf for IPA realm EXAMPLE.COM
Failed to update DNS records.
Adding SSH public key from /etc/ssh/ssh_host_rsa_key.pub
Adding SSH public key from /etc/ssh/ssh_host_dsa_key.pub
Could not update DNS SSHFP records.
SSSD enabled
Configured /etc/openldap/ldap.conf
NTP enabled
Configured /etc/ssh/ssh_config
Configured /etc/ssh/sshd_config
Client configuration complete.
```

- Test that the client can connect successfully to the IdM domain and can perform basic tasks. For example, check that the IdM tools can be used to get user and group information:

```
[jsmith@client ~]$ id
[jsmith@client ~]$ getent passwd admin
[jsmith@client ~]$ getent group admins
```

- If an NFS server is already configured, then set NFS on the client system to work with Kerberos.

An NFS server must already be configured within the domain. This is covered in [Section 15.2, “Configuring Automount”](#).

**TIP**

To help troubleshoot potential NFS setup errors, enable debug information in the `/etc/sysconfig/nfs` file.

```
RPCGSSDARGS="-vvv"
RPCSVCGSSDARGS="-vvv"
```

- a. On an IdM server, add an NFS service principal for the NFS client.

```
[root@client ~]# kinit admin
[root@client ~]# ipa service-add nfs/ipaclient.example.com@EXAMPLE
```

**NOTE**

This must be run from a machine with the `ipa-admintools` package installed so that the `ipa` command is available.

- b. On the IdM server, obtain a keytab for the NFS service principal.

```
[root@client ~]# ipa-getkeytab -s ipaserver.example.com -p
nfs/ipaclient.example.com@EXAMPLE -k /tmp/krb5.keytab
```

- c. Copy the keytab from the IdM server to the IdM client. For example:

```
[root@client ~]# scp /tmp/krb5.keytab
root@client.example.com:/etc/krb5.keytab
```

- d. Configure the `/etc/exports` file on the NFS server.

```
/ipashare      gss/krb5p(rw,no_root_squash,subtree_check,fsid=0)
```

- e. Create the mount point.

```
[root@client ~]# mkdir /mnt/ipashare
```

- f. On the client, mount the NFS share. Use the same `-o sec` setting as is used in the `/etc/exports` file for the NFS server.

```
[root@client ~]# mount -v -t nfs4 -o sec=krb5p nfs.example.com:/
/mnt/ipashare
```

5.3.2. Examples of Other Client Installation Options

There are a number of different configuration options with the `ipa-client-install` command which can be used to configure the client system in different ways, depending on the infrastructure requirements.

Example 5.1. Enabling DNS Updates

Depending on the DHCP configuration, the IP addresses of clients can change with some regularity. If the IP address changes, this can cause discrepancies between the DNS records in the IdM server and the actual IP addresses in use, which could affect policies set within IdM and communications between clients and services.

The **--enable-dns-updates** option sets the System Security Services Daemon to update the DNS entries whenever the IP address for a client changes.

```
[root@client ~]# ipa-client-install --enable-dns-updates
```

Example 5.2. Specifying Domain Information

When just running the client installation command, the script prompts for required IdM domain information, including the name of an IdM server to register with, the DNS domain name, and the Kerberos realm and principal.

All of the basic information can be passed with the installation command (which is useful for automated installations).

- ▶ **--domain** for the DNS domain name (which is only used if the IdM server is configured to host DNS services)
- ▶ **--server** for the IdM server to register with (which can be any server or replica in the topology)

This must be a valid DNS name, which means only numbers, alphabetic characters, underscores (`_`), and hyphens (`-`) are allowed. Other characters in the hostname will cause DNS failures.

- ▶ **--realm** for the Kerberos realm name and, optionally, **-p** for a Kerberos principal name

```
[root@client ~]# ipa-client-install --domain EXAMPLE.COM --server
ipaserver.example.com --realm EXAMPLE -p host/server.example.com
```

Example 5.3. Setting a Specific IdM Server

There can be multiple servers and replicas within the IdM server topology. When a client needs to connect to a server for updates or to retrieve user information, it (by default) uses a service scan to discover available servers and replicas in the domain. This means that the actual server to which the client connects is random, depending on the results of the discovery scan.

It is possible to set a specific server within the IdM domain which is used for client updates; if for some reason, connecting to that server fails, then the client can discover another server within the domain for failover.

The preferred server is set in the **--fixed-primary** option.

```
[root@client ~]# ipa-client-install --fixed-primary ipaserver.example.com
```

Example 5.4. Disabling System Authentication Tools

Red Hat Enterprise Linux uses the **authconfig** tool to set and update authentication clients and settings for a local system. Identity Management uses the System Security Services Daemon (SSSD) to store IdM server configuration and to retrieve policy information, users, passwords, and groups configured within the IdM domain.

It is strongly recommended that you use authconfig and SSSD to manage your user, group, and other IdM client configuration.

There may be some situations where an administrator wants to disable dynamic changes to system authentication configuration. In that case, it is possible to disable IdM from making updates to **authconfig** or SSSD.

The **--noac** option prevents any changes through **authconfig**. The **--no-sssd** option prevents IdM from using SSSD.

```
[root@client ~]# ipa-client-install --noac --no-sssd
```

A related option is **--preserve-sssd**. While this allows the client to change the SSSD configuration file to configure the IdM domain, it saves the old SSSD configuration.

Example 5.5. Disabling Password Caching

One of the primary functions of SSSD is *password caching*. Normally, when a system uses an external password store, authentication fails if that password store is ever inaccessible. However, SSSD can cache passwords after a successful authentication attempt and store those passwords locally. This allows users to log in and access domain services (which they have previously accessed) even if the IdM server is inaccessible.

In highly-secure environments, it may be necessary to prevent password caching to prevent potentially unauthorized access. In that case, the **--no-krb5-offline-passwords** option can be used to prevent passwords from being cached in SSSD.

```
[root@client ~]# ipa-client-install --no-krb5-offline-passwords
```

5.4. Manually Configuring a Linux Client

The **ipa-client-install** command automatically configures services like Kerberos, SSSD, PAM, and NSS. However, if the **ipa-client-install** command cannot be used on a system for some reason, then the IdM client entries and the services can be configured manually.

5.4.1. Setting up an IdM Client (Full Procedure)

1. Install SSSD, if it is not already installed.
2. *Optional.* Install the IdM tools so that administrative tasks can be performed from the host.

```
[root@client ~]# yum install ipa-admintools
```

3. *On an IdM server.* Create a host entry for the client.

```
[jsmith@client ~]$ kinit admin
[jsmith@client ~]$ ipa host-add --force --ip-address=192.168.166.31
ipaclient.example.com
```

Creating hosts manually is covered in [Section 5.4.2, “Other Examples of Adding a Host Entry”](#).

4. *On an IdM server.* Create keytabs for the client.

- a. Log in as IdM administrator.

```
[jsmith@client ~]$ kinit admin
```

- b. Set the client host to be managed by the server.

```
[jsmith@client ~]$ ipa host-add-managedby --hosts=ipaserver.example.com
ipaclient.example.com
```

- c. Generate the keytab for the client.

```
[jsmith@client ~]$ ipa-getkeytab -s ipaserver.example.com -p
host/ipaclient.example.com -k /tmp/ipaclient.keytab
```

5. Copy the keytab to the client machine and rename it **/etc/krb5.keytab**.



TIP

If there is an existing **/etc/krb5.keytab** that should be preserved, the two files can be combined using **ktutil**.

6. Set the correct user permissions for the **/etc/krb5.keytab** file.

```
[root@client ~]# chown root:root /etc/krb5.keytab
[root@client ~]# chmod 0600 /etc/krb5.keytab
```

7. Set the SELinux contexts for the **/etc/krb5.keytab** file.

```
[root@client ~]# chcon system_u:object_r:krb5_keytab_t:s0 /etc/krb5.keytab
```

8. Configure SSSD by editing the **/etc/sss/sss.conf** file to point to the IdM domain.

```
[root@client ~]# touch /etc/sss/sss.conf
[root@client ~]# vim /etc/sss/sss.conf
```

```
[sss]
config_file_version = 2
services = nss, pam
```

```
domains = example.com
```

```
[nss]
```

```
[pam]
```

```
[domain/example.com]
cache_credentials = True
krb5_store_password_if_offline = True
```

```

ipa_domain = example.com
id_provider = ipa
auth_provider = ipa
access_provider = ipa
ipa_hostname = ipaclient.example.com
chpass_provider = ipa
ipa_server = ipaserver.example.com
ldap_tls_cacert = /etc/ipa/ca.crt

```

9. Configure NSS to use SSSD for passwords, groups, users, and netgroups.

```

[root@client ~]# vim /etc/nsswitch.conf

...
passwd:      files sss
shadow:     files sss
group:      files sss
...
netgroup:   files sss
...

```

10. Configure the `/etc/krb5.conf` file to point to the IdM KDC.

```

[logging]
default = FILE:/var/log/krb5libs.log
kdc = FILE:/var/log/krb5kdc.log
admin_server = FILE:/var/log/kadmind.log

[libdefaults]
default_realm = EXAMPLE.COM
dns_lookup_realm = false
dns_lookup_kdc = false
rdns = false
ticket_lifetime = 24h
forwardable = yes
allow_weak_crypto = true

[realms]
EXAMPLE.COM = {
    kdc = ipaserver.example.com:88
    admin_server = ipaserver.example.com:749
    default_domain = example.com
}

[domain_realm]
.example.com = EXAMPLE.COM
example.com = EXAMPLE.COM

```

11. Update the `/etc/pam.d` configuration to use the `pam_sss.so` modules.

- For `/etc/pam.d/fingerprint-auth`:

```

...
account      [default=bad success=ok user_unknown=ignore] pam_sss.so
...
session      optional          pam_sss.so

```

- For `/etc/pam.d/system-auth`:

```

...
auth      sufficient    pam_sss.so use_first_pass
...
account   [default=bad success=ok user_unknown=ignore] pam_sss.so
...
password  sufficient    pam_sss.so use_authtok
...
session   optional      pam_sss.so

```

- For `/etc/pam.d/password-auth`:

```

...
auth      sufficient    pam_sss.so use_first_pass
...
account   [default=bad success=ok user_unknown=ignore] pam_sss.so
...
password  sufficient    pam_sss.so use_authtok
...
session   optional      pam_sss.so

```

- Enrollment_with_Separation_of_DutiesFor `/etc/pam.d/smartcard-auth`:

```

...
account   [default=bad success=ok user_unknown=ignore] pam_sss.so
...
session   optional      pam_sss.so

```

12. Install the IdM server's CA certificate.

- a. Obtain the certificate from the server.

```
[root@ipaclient ~]# wget -O /etc/ipa/ca.crt
http://ipa.example.com/ipa/config/ca.crt
```

- b. Install the certificate in the system's NSS database.

```
[root@ipaclient ~]# certutil -A -d /etc/pki/nssdb -n "IPA CA" -t CT,C,C -
a -i /etc/ipa/ca.crt
```

13. Set up a host certificate for the host in IdM.

- a. Make sure **certmonger** is running.

```
[root@ipaclient ~]# systemctl start certmonger.service
```



TIP

Configure **chkconfig** so that the **certmonger** service starts by default.

```
[root@ipaclient ~]# chkconfig certmonger on
```

- b. Use the **ipa-getcert** command, which creates and manages the certificate through **certmonger**. The options are described more in the **certmonger** manpage.

```
[root@ipaclient ~]# ipa-getcert request -d /etc/pki/nssdb -n Server-Cert
-K HOST/ipaclient.example.com -N 'CN=ipaclient.example.com,O=EXAMPLE.COM'
```

If administrative tools were not installed on the client, then the certificate can be generated on an IdM server, copied over to the host, and installed using **certutil**.

14. Set up NFS to work with Kerberos.



TIP

To help troubleshoot potential NFS setup errors, enable debug information in the **/etc/sysconfig/nfs** file.

```
RPCGSSDARGS="-vvv"
RPCSVCGSSDARGS="-vvv"
```

a. On an IdM server, add an NFS service principal for the NFS client.

```
[root@ipaclient ~]# ipa service-add nfs/ipaclient.example.com@EXAMPLE
```



NOTE

This must be run from a machine with the *ipa-admintools* package installed so that the **ipa** command is available.

b. On the IdM server, obtain a keytab for the NFS service principal.

```
[root@ipaclient ~]# ipa-getkeytab -s ipaserver.example.com -p
nfs/ipaclient.example.com@EXAMPLE -k /tmp/krb5.keytab
```



NOTE

Some versions of the Linux NFS implementation have limited encryption type support. If the NFS server is hosted on a version older than Red Hat Enterprise Linux 7, use the **-e des-cbc-crc** option to the **ipa-getkeytab** command for any `nfs/<FQDN>` service keytabs to set up, both on the server and on all clients. This instructs the KDC to generate only DES keys.

When using DES keys, all clients and servers that rely on this encryption type need to have the **allow_weak_crypto** option enabled in the **[libdefaults]** section of the **/etc/krb5.conf** file. Without these configuration changes, NFS clients and servers are unable to authenticate to each other, and attempts to mount NFS filesystems may fail. The client's **rpc.gssd** and the server's **rpc.svcgssd** daemons may log errors indicating that DES encryption types are not permitted.

c. Copy the keytab from the IdM server to the NFS server. For example, if the IdM and NFS servers are on different machines:


```
[root@ipaclient ~]# scp /tmp/krb5.keytab
root@nfs.example.com:/etc/krb5.keytab
```

- d. Copy the keytab from the IdM server to the IdM client. For example:

```
[root@ipaclient ~]# scp /tmp/krb5.keytab
root@client.example.com:/etc/krb5.keytab
```

- e. Configure the `/etc/exports` file on the NFS server.

```
/ipashare          gss/krb5p(rw,no_root_squash,subtree_check,fsid=0)
```

- f. On the client, mount the NFS share.

- ▶ Always specify the share as `nfs_server:/mountpoint`.
- ▶ Use the same `-o sec` setting as is used in the `/etc/exports` file for the NFS server.

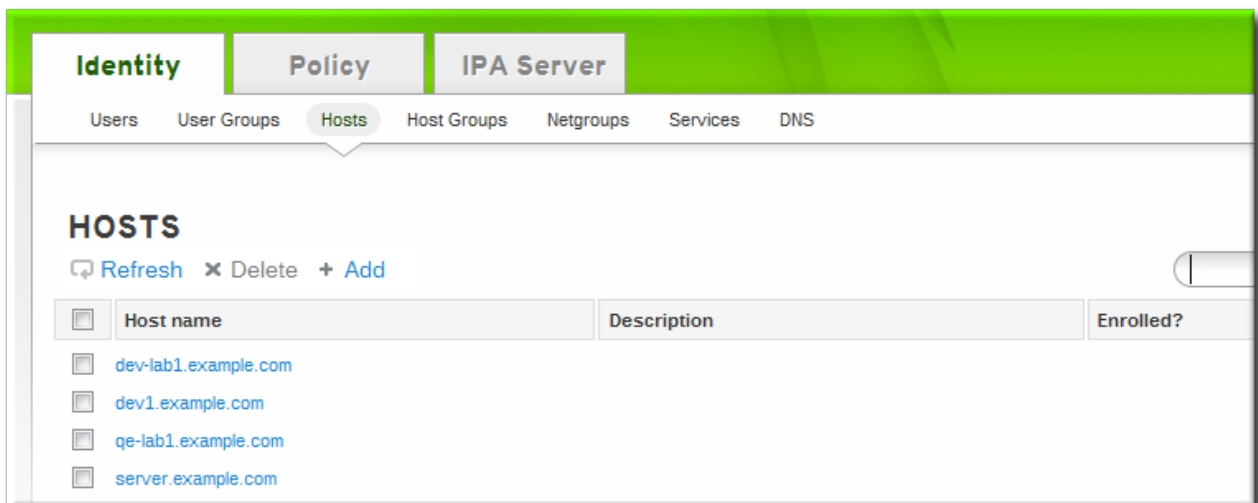
```
[root@client ~]# mount -v -t nfs4 -o sec=krb5p nfs.example.com:/
/mnt/ipashare
```

5.4.2. Other Examples of Adding a Host Entry

[Section 5.4.1, “Setting up an IdM Client \(Full Procedure\)”](#) covers the full procedure for configuring an IdM client manually. One of those steps is creating a host entry, and there are several different ways and options to perform that.

5.4.2.1. Adding Host Entries from the Web UI

1. Open the **Identity** tab, and select the **Hosts** subtab.
2. Click the **Add** link at the top of the hosts list.



3. Fill in the machine name and select the domain from the configured zones in the drop-down list. If the host has already been assigned a static IP address, then include that with the host entry so that the DNS entry is fully created.

DNS zones can be created in IdM, which is described in [Section 14.7.1, “Adding Forward DNS Zones”](#). If the IdM server does not manage the DNS server, the zone can be entered manually in the menu area, like a regular text field.



NOTE

Select the **Force** checkbox to add the host DNS record, even if the hostname cannot be resolved.

This is useful for hosts which use DHCP and do not have a static IP address. This essentially creates a placeholder entry in the IdM DNS service. When the DNS service dynamically updates its records, the host's current IP address is detected and its DNS record is updated.

4. Click the **Add and Edit** button to go directly to the expanded entry page and fill in more attribute information. Information about the host hardware and physical location can be included with the host entry.

Hosts » server.example.com

HOST: server.example.com

server.exempl... is a member of: server.exempl... is managed by:

Settings Host Groups Netgroups Roles HBAC Rules Sudo Rules Hosts (1)

Refresh Reset Update Collapse

Principal name: host/server.example.com@EXAMPLE.COM

Description:

Locality:

Location:

Platform:

Operating system:

SSH public keys: C9:26:8B:F6:32:D2:0D:08:41:5F:4A:27:7F:93:06:8C (ssh-rsa) [Show/Set key](#) [Delete](#)
 DD:0E:B4:8B:0E:E0:D9:A8:FF:49:3A:64:3A:75:30:A7 (ssh-dss) [Show/Set key](#) [Delete](#)
[Add](#)

MAC address: [undo](#)
[Add](#) [undo all](#)

▼ ENROLLMENT

Kerberos Key: ✔ Kerberos Key Present, Host Provisioned

One-Time-Password: ⚠ One-Time-Password Not Present

ACTIONS

[Unprovision](#)
[Set One-Time-Password](#)

5.4.2.2. Adding Host Entries from the Command Line

Host entries are created using the **host-add** command. This command adds the host entry to the IdM Directory Server. The full list of options with **host-add** are listed in the **ipa host** manpage. At its most basic, an add operation only requires the client hostname to add the client to the Kerberos realm and to create an entry in the IdM LDAP server:

```
$ ipa host-add client1.example.com
```

If the IdM server is configured to manage DNS, then the host can also be added to the DNS resource records using the **--ip-address** and **--force** options.

Example 5.6. Creating Host Entries with Static IP Addresses

```
$ ipa host-add --force --ip-address=192.168.166.31 client1.example.com
```

Commonly, hosts may not have a static IP address or the IP address may not be known at the time the client is configured. For example, laptops may be preconfigured as Identity Management clients, but they do not have IP addresses at the time they're configured. Hosts which use DHCP can still be configured with a DNS entry by using **--force**. This essentially creates a placeholder entry in the IdM DNS service. When the DNS service dynamically updates its records, the host's current IP address is detected and its DNS record is updated.

Example 5.7. Creating Host Entries with DHCP

```
$ ipa host-add --force client1.example.com
```

Host records are deleted using the **host-del** command. If the IdM domain uses DNS, then the **--updatedns** option also removes the associated records of any kind for the host from the DNS.

```
$ ipa host-del --updatedns client1.example.com
```

5.5. Setting up a Linux Client Through Kickstart

A kickstart enrollment automatically adds a new system to the IdM domain at the time it is provisioned.

This requires pre-creating the hosts on the IdM server, with a predefined password that can be used to authenticate to complete the enrollment operation.

1. Create the host entry on the IdM server and set a temporary Kerberos password for the entry.

When the **ipa-client-install** script is run normally (interactively), it prompts for authentication credentials to access the IdM domain. However, when the script is run automatically, the system has to have some way to access the IdM domain without using an existing IdM user; this is done by setting the host principal in the script and using a Kerberos password (configured for the host account) to access the IdM domain.

For example:

```
[jsmith@ipaserver ~]$ ipa host-add kickstart-server.example.com --
password=secret
```

The password expires after the first authentication attempt. After enrollment completes, the host is authenticated using its keytab.

2. Include the **ipa-client** package with the other install packages.

```
%packages
@ X Window System
@ Desktop
@ Sound and Video
ipa-client
...
```

3. Create a post-install instruction that runs the **ipa-client-install** script, passes all the required information to access and configure the IdM domain services, and specifies the pre-set password. Use the **--unattended** option to instruct the script to run non-interactively.

```
%post --log=/root/ks-post.log

# Get the hostname to set as the host principal
/bin/hostname > /tmp/hostname.txt

# Run the client install script
/usr/sbin/ipa-client-install --domain=EXAMPLEDOMAIN --enable-dns-updates --
mkhomedir -w secret --realm=EXAMPLEREALM --server=ipaserver.example.com --
unattended
```

4. Run the kickstart script.

5.6. Re-enrolling a Host

There can be instances when host information is corrupt or compromised or when a system is being reprovisioned, and the host needs to be re-enrolled to the IdM domain. Re-enrollment updates identifying information for the host:

- ▶ It revokes the original host certificate.
- ▶ It generates a new host certificate.
- ▶ It creates new SSH keys.
- ▶ It retains the unique identifier for the host within the domain, and any historical configuration.

A host can be re-enrolled as long as its domain entry is active. This means that it cannot have been unenrolled (the `ipa-client-install --uninstall` command has never been run), and the host entry is not disabled (`ipa host-disable`).



NOTE

The host entry must be active for it to be re-enrolled. Disabling a host revokes all associated certificates, Kerberos keys, and services, which prevents that host from participating in the IdM domain.

The `ipa-client-install` command can re-enroll a host. There are two ways to re-enroll:

- ▶ If the enrollment is being done interactively, then it is possible to force a new enrollment operation with the `--force-join` option. This requires the administrator password for the domain.

```
[root@server ~]# ipa-client-install --force-join --password secret
```

- ▶ If the re-enrollment is automated (such as a kickstart enrollment through a provisioning system) or if it is not feasible to use the administrator password, then it is possible to re-enroll using the existing keytab to authenticate. This is passed in the `--keytab` option. By default, the host keytab location is `/etc/krb5.keytab`.

```
[root@server ~]# ipa-client-install --keytab /etc/krb5.keytab
```

The existing keytab is used to authenticate to initiate the enrollment. As part of the re-enrollment process, a new keytab is generated.

5.7. Renaming Machines and Reconfiguring IdM Client Configuration

The hostname of a system is critical for the correct operation of Kerberos and SSL. Both of these security mechanisms rely on the hostname to ensure that communication is occurring between the specified hosts. Infrastructures which use virtual machines or clustered servers will commonly have hosts which are renamed because systems are copied, moved, or renamed.

Red Hat Enterprise Linux does not provide a simple rename command to facilitate the renaming of an IdM host. Renaming a host in an IdM domain involves deleting the entry in IdM, uninstalling the client software, changing the hostname, and re-enrolling using the new name. Additionally, part of renaming hosts requires regenerating service principals.

To reconfigure the client:

1. Identify which services are running on the machine. These need to be re-created when the machine is re-enrolled.

```
# ipa service-find server.example.com
```

Each host has a default service which does not appear in the list of services. This service can be referred to as the "host service". The service principal for the host service is **host/<hostname>**, such as **host/server.example.com**. This principal can also be referred to as the *host principal*.

2. Identify all host groups to which the machine belongs.

```
[root@client ~]# kinit admin
[root@client ~]# ipa hostgroup-find server.example.com
```

3. Identify which of the services have certificates associated with them. This can be done using the **ldapsearch** command to check the entries in the IdM LDAP database directly:

```
[root@client ~]# ldapsearch -x -b "cn=accounts,dc=example,dc=com" "(&
(objectclass=ipaservice)(userCertificate=*))" krbPrincipalName -D "cn=directory
manager" -w secret -h ipaserver.example.com -p 389
```

4. For any service principals (in addition to the host principal), determine the location of the corresponding keytabs on **server.example.com**. The keytab location is different for each service, and IdM does not store this information.

Each service on the client system has a Kerberos principal in the form *service_name/hostname@REALM*, such as **ldap/server.example.com@EXAMPLE.COM**.

5. Unenroll the client machine from the IdM domain:

```
[root@client ~]# ipa-client-install --uninstall
```

6. For each identified keytab other than **/etc/krb5.keytab**, remove the old principals:

```
[root@client ~]# ipa-rmkeytab -k /path/to/keytab -r EXAMPLE.COM
```

7. On an IdM server, as an IdM administrator, remove the host entry. This removes all services and revokes all certificates issued for that host:

```
[root@server ~]# kinit admin
[root@server ~]# ipa host-del server.example.com
```

At this point, the host is completely removed from IdM.

8. Rename the machine.
9. Re-enroll the system with IdM:

```
[root@client ~]# ipa-client-install
```

This generates a host principal for with the new hostname in `/etc/krb5.keytab`.

10. On an IdM server, add a new keytab for every service:

```
[root@server ~]# ipa service-add serviceName/new-hostname
```

11. To generate certificates for services, use either **certmonger** or the IdM administration tools.
12. Re-add the host to any applicable host groups.

5.8. Performing a Two-Administrator Enrollment

Enrolling machines as clients in the IdM domain is a two-part process. A host entry is created for the client (and stored in the 389 Directory Server instance), and then a keytab is created to provision the client.

Both parts are performed automatically by the **ipa-client-install** command. It is also possible to perform those steps separately; this allows for administrators to prepare machines and the IdM server configuration in advance of actually configuring the clients. This allows more flexible setup scenarios, including bulk deployments.

When performing a manual enrollment, the host entry is created separately, and then enrollment is completed when the client script is run, which creates the requisite keytab.



NOTE

There are two ways to set the password. You can either supply your own or have IdM generate a random one.

There may be a situation where an administrator in one group is prohibited from *creating* a host entry and, therefore, from simply running the **ipa-client-install** command and allowing it to create the host. However, that administrator may have the right to run the command *after* a host entry exists. In that case, one administrator can create the host entry manually, then the second administrator can complete the enrollment by running the **ipa-client-install** command.

1. An administrator creates the host entry, as described in [Section 5.4.2, “Other Examples of Adding a Host Entry”](#).
2. The second administrator installs the IdM client packages on the machine, as in [Section 5.3, “Configuring a Linux System as an IdM Client”](#).
3. When the second administrator runs the setup script, he must pass his Kerberos password and username (principal) with the **ipa-client-install** command. For example:

```
$ ipa-client-install -w secret -p admin2
```

4. The keytab is generated on the server and provisioned to the client machine, so that the client machine is not able to connect to the IdM domain. The keytab is saved with **root:root** ownership and 0600 permissions.

5.9. Removing Clients from the Domain

There are a number of different situations where an IdM client needs to be removed or reconfigured. For example, a client system could be moved from one IdM domain to another or a virtual system could be cloned or moved between systems.

Unenrolling a client (either permanently or as part of reconfiguring the client) is done using the **ipa-client-install** command with the **--uninstall** option. This automatically removes all of the IdM-specific configuration for system services like SSSD and restores its previous configuration.

```
[root@server ~]# ipa-client-install --uninstall --updatedns
```

Use the **--updatedns** option, as when installing a client, to update the domain DNS configuration automatically.



WARNING

When a machine is unenrolled, the procedure cannot be undone. The machine can only be enrolled again.

5.10. Manually Unconfiguring Client Machines

There are a number of different situations where an IdM client needs to be reconfigured. If it is not possible to uninstall the client directly, then the IdM configuration can be manually removed from the client system.



WARNING

When a machine is unenrolled, the procedure cannot be undone. The machine can only be enrolled again.

1. On the client, remove the old hostname from the main keytab. This can be done by removing every principal in the realm or by removing specific principals. For example, to remove all principals:

```
[jsmith@client ~]$ ipa-rmkeytab -k /etc/krb5.keytab -r EXAMPLE.COM
```

To remove specific principals:

```
[jsmith@client ~]$ ipa-rmkeytab -k /etc/krb5.keytab -p  
host/server.example.com@EXAMPLE.COM
```

2. On the client system, disable tracking in **certmonger** for every certificate. Each certificate must be removed from tracking individually.

First, list every certificate being tracked, and extract the database and nickname for each certificate. The number of certificates depends on the configured services for the host.

```
[jsmith@client ~]$ ipa-getcert list
```

Then, disable tracking for each. For example:

```
[jsmith@client ~]$ ipa-getcert stop-tracking -n "Server-Cert" -d  
/etc/httpd/alias
```


3. On the IdM server, remove the old host from the IdM DNS domain. While this is optional, it cleans up the old IdM entries associated with the system and allows it to be re-enrolled cleanly at a later time.

```
[jsmith@server ~]$ kinit admin  
[jsmith@server ~]$ ipa host-del server.example.com
```

4. If the system should be re-added to a new IdM domain — such as a virtual machine which was moved from one location to another — then the system can be rejoined to IdM using the **ipa-join** command on the client system.

```
[jsmith@client ~]$ ipa-join
```

Chapter 6. Upgrading Identity Management

Identity Management can be migrated from a Red Hat Enterprise Linux 6.5 system to a Red Hat Enterprise Linux 7 system. This is similar to creating and promoting a replica to replace a server; this process migrates the data and configuration from one instance to another. The older IdM instance can then be decommissioned and replaced by the new IdM instance.

6.1. Migration Notes

- ▶ When a replica is created, it must be the same version as the master it is based on. This means that **replicas should not be created on an older version of Identity Management while the servers are in the process of being upgraded**. Wait until the upgrade process is completed, and *then* create new replicas.
- ▶ Schema changes are replicated between servers. So once one master server is updated, all servers and replicas will have the updated schema, even if their packages are not yet updated. This ensures that any new entries which use the new schema can still be replicated among all the servers in the IdM domain.
- ▶ Clients do not need to have new packages installed. The client packages used to configure a Red Hat Enterprise Linux system do not impact the enrollment of the client within the domain.
- ▶ Changes to other packages on the operating system can affect services and configuration within IdM. For example, there are changes to the way that BIND handles reverse zones in Red Hat Enterprise Linux 7 to how it did in Red Hat Enterprise Linux 6. This can affect DNS configuration managed by IdM.

6.2. Migrating the IdM Server to Red Hat Enterprise Linux 7

As is covered in [Section 23.2.5, “Changing Which Server Generates CRLs”](#), only one server within the IdM domain generates certificate revocation lists and has the root signing key to generate certificates. This is the master certificate authority (CA), and it is the master server within the IdM environment.

When migrating an IdM server from Red Hat Enterprise Linux 6 to Red Hat Enterprise Linux 7, the process is very similar to promoting a replica to a master. A new server is created on Red Hat Enterprise Linux 7; all data are migrated over; and all services (CRL and certificate creation, DNS management, Kerberos KDC administration) are transitioned over to the new system.

1. Update the Red Hat Enterprise Linux 6 system to Red Hat Enterprise Linux 6.5, and upgrade the **ipa** packages.

```
[root@rhel6 ~]# yum update ipa-*
```

2. Install the IdM packages on the Red Hat Enterprise Linux 7 system.

```
[root@rhel7 ~]# yum install ipa-server bind bind-dyndb-ldap
```

3. There are schema changes between IdM v3.1 and IdM v3.3. Copy a python script from the Red Hat Enterprise Linux 7 system to the Red Hat Enterprise Linux 6 system to update the schema.

```
[root@rhel7 ~]# scp /usr/share/ipa/copy-schema-to-ca.py rhel6:/root/
```

4. Run the schema update script on the Red Hat Enterprise Linux 6.5 system.

```
[root@rhel6 ~]# python copy-schema-to-ca.py
ipa      : INFO      Installed /etc/dirsrv/slapd-PKI-
IPA//schema/60kerberos.ldif
ipa      : INFO      Installed /etc/dirsrv/slapd-PKI-
IPA//schema/60samba.ldif
ipa      : INFO      Installed /etc/dirsrv/slapd-PKI-
IPA//schema/60ipaconfig.ldif
ipa      : INFO      Installed /etc/dirsrv/slapd-PKI-
IPA//schema/60basev2.ldif
ipa      : INFO      Installed /etc/dirsrv/slapd-PKI-
IPA//schema/60basev3.ldif
ipa      : INFO      Installed /etc/dirsrv/slapd-PKI-
IPA//schema/60ipadns.ldif
ipa      : INFO      Installed /etc/dirsrv/slapd-PKI-IPA//schema/61kerberos-
ipav3.ldif
ipa      : INFO      Installed /etc/dirsrv/slapd-PKI-
IPA//schema/65ipasudo.ldif
ipa      : INFO      Installed /etc/dirsrv/slapd-PKI-
IPA//schema/05rfc2247.ldif
ipa      : INFO      Restarting CA DS
ipa      : INFO      Schema updated successfully
```

- On the Red Hat Enterprise Linux 6 system, create the replica file for the Red Hat Enterprise Linux 7 system; in this example, the new server is **rhel7.example.com**.

```
[root@rhel6 ~]# ipa-replica-prepare rhel7.example.com --ip-address 192.168.1.2

Directory Manager (existing master) password:
Preparing replica for rhel7.example.com from rhel6.example.com
Creating SSL certificate for the Directory Server
Creating SSL certificate for the dogtag Directory Server
Saving dogtag Directory Server port
Creating SSL certificate for the Web Server
Exporting RA certificate
Copying additional files
Finalizing configuration
Packaging replica information into /var/lib/ipa/replica-info-
rhel7.example.com.gpg
Adding DNS records for rhel7.example.com
Using reverse zone 1.168.192.in-addr.arpa.
The ipa-replica-prepare command was successful
```

- Install the replica, using the new replica file, on the Red Hat Enterprise Linux 7 system. Use the **- -setup-ca** option to set up a Dogtag Certificate System instance and the **- -setup-dns** option to configure the DNS server.

```
[root@rhel7 ~]# ipa-replica-install --setup-ca --ip-address=192.168.2.129 -p
secret -w secret -N --setup-dns --forwarder=192.168.2.2 -U
/var/lib/ipa/replica-info-rhel7.example.com.gpg
Run connection check to master
Check connection from replica to remote master 'rhel6.example.com':
  Directory Service: Unsecure port (389): OK
  Directory Service: Secure port (636): OK
  Kerberos KDC: TCP (88): OK
  Kerberos Kpasswd: TCP (464): OK
  HTTP Server: Unsecure port (80): OK
  HTTP Server: Secure port (443): OK
  PKI-CA: Directory Service port (7389): OK
...
```

7. Verify the configuration.

- Verify that the IdM services are running:

```
[root@rhel7 ~]# ipactl status
Directory Service: RUNNING
krb5kdc Service: RUNNING
kadmin Service: RUNNING
named Service: RUNNING
ipa_memcached Service: RUNNING
httpd Service: RUNNING
pki-tomcatd Service: RUNNING
ipa-otpd Service: RUNNING
ipa: INFO: The ipactl command was successful
```

- Verify that both IdM CAs are configured as master CAs.

```
[root@rhel7 ~]# kinit admin
[root@rhel7 ~]# ipa-replica-manage list
rhel6.example.com: master
rhel7.example.com: master
[root@rhel7 ~]# ipa-replica-manage list -v rhel7.example.com
rhel6.example.com: replica
  last init status: None
  last init ended: None
  last update status: 0 Replica acquired successfully: Incremental update
started
  last update ended: None
```

8. On the Red Hat Enterprise Linux 6 system. Edit the Red Hat Enterprise Linux 6 IdM server so that it no longer issues CRLs.

- Identify which server instance is the master CA server. Both CRL generation *and* renewal operations are handled by the same CA server. So, the master CA can be identified by having the **renew_ca_cert** certificate being tracked by **certmonger**.

```
[root@server ~]# getcert list -d /var/lib/pki-ca/alias -n "subsystemCert
cert-pki-ca" | grep post-save
post-save command: /usr/lib64/ipa/certmonger/renew_ca_cert
"subsystemCert cert-pki-ca"
```

- On the original master CA**, disable tracking for all of the original CA certificates.

```
[root@server ~]# getcert stop-tracking -d /var/lib/pki-ca/alias -n
"auditSigningCert cert-pki-ca"
Request "20141127184547" removed.
[root@server ~]# getcert stop-tracking -d /var/lib/pki-ca/alias -n
"ocspSigningCert cert-pki-ca"
Request "20141127184548" removed.
[root@server ~]# getcert stop-tracking -d /var/lib/pki-ca/alias -n
"subsystemCert cert-pki-ca"
Request "20141127184549" removed.
[root@server ~]# getcert stop-tracking -d /etc/httpd/alias -n ipaCert
Request "20141127184550" removed.
```

- Reconfigure the original master CA to retrieve renewed certificates from a new master CA.
 - Copy the renewal helper into the **certmonger** directory, and set the appropriate permissions.

```
[root@server ~]# cp /usr/share/ipa/ca_renewal
/var/lib/certmonger/cas/ca_renewal
[root@server ~]# chmod 0600 /var/lib/certmonger/cas/ca_renewal
```

- b. Update the SELinux configuration.

```
[root@server ~]# /sbin/restorecon
/var/lib/certmonger/cas/ca_renewal
```

- c. Restart **certmonger**.

```
[root@server ~]# systemctl restart certmonger.service
```

- d. Check that the CA is listed to *retrieve* certificates. This is printed in the CA configuration.

```
[root@server ~]# getcert list-cas
...
CA 'dogtag-ipa-retrieve-agent-submit':
    is-default: no
    ca-type: EXTERNAL
    helper-location: /usr/libexec/certmonger/dogtag-ipa-retrieve-agent-
submit
```

- e. Get the CA certificate database PIN.

```
[root@server ~]# grep internal= /var/lib/pki-ca/conf/password.conf
```

- f. Configure **certmonger** track the certificates for external renewal. This requires the database PIN.

```
[root@server ~]# getcert start-tracking -c dogtag-ipa-retrieve-
agent-submit -d /var/lib/pki-ca/alias -n "auditSigningCert cert-pki-
ca" -B /usr/lib64/ipa/certmonger/stop_pkicad -C
'/usr/lib64/ipa/certmonger/restart_pkicad "auditSigningCert cert-
pki-ca"' -T "auditSigningCert cert-pki-ca" -P database_pin
New tracking request "20141127184743" added.
[root@server ~]# getcert start-tracking -c dogtag-ipa-retrieve-
agent-submit -d /var/lib/pki-ca/alias -n "ocspSigningCert cert-pki-
ca" -B /usr/lib64/ipa/certmonger/stop_pkicad -C
'/usr/lib64/ipa/certmonger/restart_pkicad "ocspSigningCert cert-pki-
ca"' -T "ocspSigningCert cert-pki-ca" -P database_pin
New tracking request "20141127184744" added.
[root@server ~]# getcert start-tracking -c dogtag-ipa-retrieve-
agent-submit -d /var/lib/pki-ca/alias -n "subsystemCert cert-pki-ca"
-B /usr/lib64/ipa/certmonger/stop_pkicad -C
'/usr/lib64/ipa/certmonger/restart_pkicad "subsystemCert cert-pki-
ca"' -T "subsystemCert cert-pki-ca" -P database_pin
New tracking request "20141127184745" added.
[root@server ~]# getcert start-tracking -c dogtag-ipa-retrieve-
agent-submit -d /etc/httpd/alias -n ipaCert -C
/usr/lib64/ipa/certmonger/restart_httpd -T ipaCert -p
/etc/httpd/alias/pwdfile.txt
New tracking request "20141127184746" added.
```

- d. Stop CRL generation on the original master CA.

- a. Stop CA service:

```
[root@server ~]# systemctl stop pki-tomcatd@pki-tomcat.service
```

- b. Open the CA configuration file.

```
[root@server ~]# vim /var/lib/pki/pki-tomcat/conf/ca/CS.cfg
```

- c. Change the values of the **ca.cr1.MasterCRL.enableCRLCache** and **ca.cr1.MasterCRL.enableCRLUpdates** parameters to **false** to disable CRL generation.

```
ca.cr1.MasterCRL.enableCRLCache=false
ca.cr1.MasterCRL.enableCRLUpdates=false
```

- d. Start the CA service:

```
[root@server ~]# systemctl start pki-tomcatd@pki-tomcat.service
```

- e. Configure Apache to redirect CRL requests to the new master.

- a. Open the CA proxy configuration.

```
[root@server ~]# vim /etc/httpd/conf.d/ipa-pki-proxy.conf
```

- b. Uncomment the **RewriteRule** on the last line:

```
RewriteRule ^/ipa/crl/MasterCRL.bin
https://server.example.com/ca/ee/ca/getCRL?
op=getCRL&crlIssuingPoint=MasterCRL [L,R=301,NC]
```

- c. Restart Apache:

```
[root@server ~]# systemctl restart httpd.service
```

9. *On the Red Hat Enterprise Linux 7 system.* Configure the new Red Hat Enterprise Linux 7 IdM instance as the master:

- a. Stop tracking the CA's certificates to change the renewal settings. As a clone, the CA was configured to retrieve its renewed certificates from the master; as the master CA, it will issue the renewed certificates.

```
[root@server ~]# getcert stop-tracking -d /etc/pki/pki-tomcat/alias -n
"auditSigningCert cert-pki-ca"
Request "20141127163822" removed.
[root@server ~]# getcert stop-tracking -d /etc/pki/pki-tomcat/alias -n
"ocspSigningCert cert-pki-ca"
Request "20141127163823" removed.
[root@server ~]# getcert stop-tracking -d /etc/pki/pki-tomcat/alias -n
"subsystemCert cert-pki-ca"
Request "20141127163824" removed.
[root@server ~]# getcert stop-tracking -d /etc/httpd/alias -n ipaCert
Request "20141127164042" removed.
```

- b. Get the PIN for the CA certificate database.

```
[root@server ~]# grep internal= /var/lib/pki/pki-
tomcat/conf/password.conf
```

- c. Set up the certificates to be tracked in **certmonger** using the renewal agent profile.

```
[root@server ~]# getcert start-tracking -c dogtag-ipa-renew-agent -d
/etc/pki/pki-tomcat/alias -n "auditSigningCert cert-pki-ca" -B
/usr/lib64/ipa/certmonger/stop_pkicad -C
'/usr/lib64/ipa/certmonger/renew_ca_cert "auditSigningCert cert-pki-ca" '
-P database_pin
New tracking request "20141127185430" added.
[root@server ~]# getcert start-tracking -c dogtag-ipa-renew-agent -d
/etc/pki/pki-tomcat/alias -n "ocspSigningCert cert-pki-ca" -B
/usr/lib64/ipa/certmonger/stop_pkicad -C
'/usr/lib64/ipa/certmonger/renew_ca_cert "ocspSigningCert cert-pki-ca" ' -
P database_pin
New tracking request "20141127185431" added.
[root@server ~]# getcert start-tracking -c dogtag-ipa-renew-agent -d
/etc/pki/pki-tomcat/alias -n "subsystemCert cert-pki-ca" -B
/usr/lib64/ipa/certmonger/stop_pkicad -C
'/usr/lib64/ipa/certmonger/renew_ca_cert "subsystemCert cert-pki-ca" ' -P
database_pin
New tracking request "20141127185432" added.
[root@server ~]# getcert start-tracking -c dogtag-ipa-renew-agent -d
/etc/httpd/alias -n ipaCert -C /usr/lib64/ipa/certmonger/renew_ra_cert -p
/etc/httpd/alias/pwdfile.txt
New tracking request "20141127185433" added.
```

- d. Configure the new master CA to generate CRLs.

- a. Stop CA service:

```
[root@server ~]# systemctl stop pki-tomcatd@pki-tomcat.service
```

- b. Open the CA configuration file.

```
[root@server ~]# vim /etc/pki/pki-tomcat/ca/CS.cfg
```

- c. Change the values of the **ca.cr1.MasterCRL.enableCRLCache** and **ca.cr1.MasterCRL.enableCRLUpdates** parameters to **true** to enable CRL generation.

```
ca.cr1.MasterCRL.enableCRLCache=true
ca.cr1.MasterCRL.enableCRLUpdates=true
```

- d. Start CA service:

```
[root@server ~]# systemctl start pki-tomcatd@pki-tomcat.service
```

- e. Configure Apache to disable redirect CRL requests. As a clone, all CRL requests were routed to the original master. As the new master, this instance will respond to CRL requests.

- a. Open the CA proxy configuration.

```
[root@server ~]# vim /etc/httpd/conf.d/ipa-pki-proxy.conf
```

- b. Comment out the **RewriteRule** argument on the last line:

```
#RewriteRule ^/ipa/crl/MasterCRL.bin
https://server.example.com/ca/ee/ca/getCRL?
op=getCRL&crlIssuingPoint=MasterCRL [L,R=301,NC]
```

- c. Restart Apache:

```
[root@server ~]# systemctl start httpd.service
```

10. Stop all services on the Red Hat Enterprise Linux 6 system; this forces domain discovery to the Red Hat Enterprise Linux 7 server.

```
[root@rhel6 ~]# systemctl start named.service
Starting named: [ OK ]
[root@rhel6 ~]# ipactl stop
Stopping CA Service
Stopping pki-ca: [ OK ]
Stopping HTTP Service
Stopping httpd: [ OK ]
Stopping MEMCACHE Service
Stopping ipa_memcached: [ OK ]
Stopping DNS Service
Stopping named: . [ OK ]
Stopping KPASSWD Service
Stopping Kerberos 5 Admin Server: [ OK ]
Stopping KDC Service
Stopping Kerberos 5 KDC: [ OK ]
Stopping Directory Service
Shutting down dirsrv:
  EXAMPLE-COM... [ OK ]
  PKI-IPA... [ OK ]
```

11. For each server in the environment, create a replica file from the Red Hat Enterprise Linux 7 master server, and install it on the new Red Hat Enterprise Linux 7 replica system. Creating replicas is covered in [Chapter 4, Setting up IdM Replicas](#).
12. Decommission the Red Hat Enterprise Linux 6 host.
- a. Remove the local IdM configuration.

```
[root@rhel6 ~]# ipa-server-install -uninstall
```

- b. Remove the Red Hat Enterprise Linux 6 server from the IdM server topology by running the **ipa-replica-manage del** command on the Red Hat Enterprise Linux 7 system.

```
[root@rhel7 ~]# ipa-replica-manage del rhel6.example.com --force
Connection to 'rhel6.example.com' failed:
Forcing removal of rhel6.example.com
Skipping calculation to determine if one or more masters would be
orphaned.
Deleting replication agreements between rhel6.example.com and
rhel7.example.com
Failed to get list of agreements from 'rhel6.example.com':
Forcing removal on 'rhel7.example.com'
Any DNA range on 'rhel6.example.com' will be lost
Deleted replication agreement from 'rhel7.example.com' to
'rhel6.example.com'
Background task created to clean replication data. This may take a while.
This may be safely interrupted with Ctrl+C
```


6.3. Updating DNS Configuration for BIND 9.9.x

BIND 9.9, which is the version supported in Red Hat Enterprise Linux 7, changes the way that it handles queries for reverse zones. This particularly affects queries which use DNS delegation.

[RFC 1918](#) defines how to allocate addresses within a private network. If an environment was using DNS delegation for RFC 1918 addresses, then it was possible for local queries to leak to the public Internet and increase the load on nameservers. A new standard, [RFC 6303](#), defines a different way to handle local or private queries by creating automatic empty zones for RFC 1918 address spaces.

With existing DNS environments, however, this new default configuration can cause queries for PTR records not to be forwarded and to an *NXDomain* (non-existent domain) response.

For example, this zone configuration has a single zone and forwarder (**1.2.3.4**):

```
zone "3.10.in-addr.arpa" {
    type forward;
    forward only;
    forwarders { 1.2.3.4; } ;
};
```

In older versions of BIND, this would query the specified forwarder and return its response. In BIND 9.9, this returns the **NXDomain** error.

BIND 9.9 enables empty zones. For this example, it creates an empty zone for the domain, **10.in-addr.arpa**, but it does not automatically delegate any authority to the **3.10.in-addr.arpa** subdomain. The forward declaration does not do anything because the **named** service does not recurse.

If forward zones are being used in the IdM configuration, then this BIND change can negatively affect DNS queries. There are several ways to address this:

- ▶ Disable all empty zones by changing the **named.conf** file setting:

```
empty-zones-enable no;
```

- ▶ Disable a specific empty zone, such as **10.in-addr.arpa**.

```
disable-empty-zone "10.in-addr.arpa";
```

- ▶ Create a real master zone (for example, for **10.in-addr.arpa**) and then delegate authority to a subdomain (for **3.10.in-addr.arpa**).
- ▶ Configure the original zone as a stub zone or a slave zone to the original forwarder.

```
zone "3.10.in-addr.arpa" {
    type stub;
    masters { 1.2.3.4; } ;
};
```

Chapter 7. Uninstalling IdM Servers and Replicas

To uninstall both an IdM server and an IdM replica, pass the `--uninstall` option to the `ipa-server-install` command:

```
[root@ipareplica ~]# ipa-server-install --uninstall
```

Chapter 8. The Basics of Managing the IdM Server and Services

All of the access to Identity Management, both through the web UI and through the command line, is done by a user authenticating to the IdM domain. This chapter covers the basics of setting up browsers to handle Kerberos authentication, logging into Identity Management, and troubleshooting some common connection issues.

8.1. Starting and Stopping the IdM Domain

When an IdM server is installed, there are a number of different services which can be installed and configured with it in any combination, including (but not limited to) a Directory Server, a certificate authority, a web server, DNS, NTP, certmonger, and Kerberos.

All of these servers work together in concert. Because there are dependencies between the services, the order in which services are started and stopped is critical.

When changes are made to a single service (such as the LDAP directory or the web server), then that individual service can be started and stopped using the **service** command. However, when multiple domain services need to be restarted (or the entire IdM server), then use the **ipactl** command, which always starts and stops services in the appropriate order.

Which services are configured for a specific IdM server are defined in the 389 Directory Server configuration, based on the hostname of the IdM server. ^[1] The 389 Directory Server service is always the first service started and the last service stopped. The rest of the run order depends on the configured services.

The **ipactl** command can start, stop, and restart services.

```
ipactl start | stop | restart
```

The **chkconfig** command sets what services to start automatically when the system restarts. The **ipactl** command can be used to start the domain services in the proper order, without having to configure each one individually in the **chkconfig** run order.

```
[root@server ~]# chkconfig ipactl on
```

8.2. About the IdM Client Tools

IdM creates a domain of recognized services, host machines, and users with universally-applied authentication sources and common policies. From the perspective of a client machine and an IdM user, the domain itself is fairly transparent after the initial configuration. All users need to do is log into the domain using Kerberos, and that's it.

However, an administrator has two ongoing tasks: add principals to the IdM Kerberos domain and set the domain policies and server configuration that govern domain interactions. Identity Management has both command-line and web-based interfaces for administrators to use to manage the domain, services, and IdM entries.

The most common method to maintain the domain is using the command-line tools. Identity Management has an incredibly broad set of scripts and commands that are available to administrators. The entry management functions of the domain are carried out with a single script: **ipa**. This script is a parent or control script for associated subcommands; each subcommand relates to a specific entry type.

The command-line scripts offer a number of benefits:

- ▶ The scripts allow management tasks to be automated and performed repeatedly in a consistent way without manual intervention.
- ▶ Entries can be added with all possible attributes configured (or a desired subset of attributes) in a single step. The web UI frequently requires two steps to fully configure an entry: the first to create the entry and the next to add optional attributes.
- ▶ The command-line scripts support adding additional attributes which may not be available in the UI or even custom attributes to entries, if the schema is configured.

8.2.1. The Structure of the ipa Command

The **ipa** command is essentially a big plug-in container. It supports dozens of subcommands; these subcommands are actually plug-ins which manage specific types of objects in Identity Management.

The first type of a subcommand identifies the object type (such as user, sudo, group, host, or dns), and the second part identifies the operation being performed on that object.

```
ipa objectType-operation objectName --option=value
```

For example, adding a user is done using the **user-add** subcommand:

```
ipa user-add entryName options
```

Related subcommands are grouped together into *plug-in modules*. Commands for managing DNS entries like **dnszone-add** and **dnsrecord-add** all belong to the *dns* module or *topic*. All of the information for managing a specific area, with all of the supported commands and examples for each, are available by viewing the help for that topic:

```
ipa help topic
```



TIP

To get a list of all available topics:

```
ipa help topics
```

All topic or command areas follow a consistent pattern for how entries are managed.

8.2.1.1. Adding, Editing, and Deleting Entries with ipa

New entries are added using an **-add* command. For example:

```
$ ipa user-add jsmith
```

For **add** operations, commands usually prompt for any required configuration attributes, which can be passed as command-line options or using **--set/addattr** options ([Section 8.2.3, “Managing Entry Attributes with --setattr, --addattr, and --delattr”](#)).

```
$ ipa user-add
First name: John
Last name: Smith
User login [jsmith]: jsmith
-----
Added user "jsmith"
-----
...
```

Likewise, entries are usually edited through a *** -mod** commands, and then any new or edited attributes are listed as options after it.

```
$ ipa user-mod jsmith --title="Editor III"
```

Last, entries can be deleted using the *** -del** command and the entry's name.

```
$ ipa user-del jsmith
```

8.2.1.2. Finding and Displaying Entries with ipa

Entries for an entire type are searched for using the *** -find** command and an optional search criterion. The criterion is a string which can either be an exact match or a substring of any of the search attribute values. For example, this searches both for the exact match on the string *smith* (such as an **sn** value of Smith) and a substring search for values such as a username of *jsmith* or a longer surname, such as *Smithson*.

```
ipa user-find smith
```

All searches are automatically substring searches; it is not necessary to specify a wildcard.

With no search criterion, every entry of that type is displayed.

Searches (any *** -find** command) have certain limits imposed as part of the server configuration, specifically how many entries are returned (size limits) and how long a search will run (time limits). This is covered in [Section 9.10.3.1.2, "Setting IdM Search Limits"](#). Part of the server configuration is setting global defaults for size and time limits on searches. While these limits are always enforced in the web UI, they can be overridden with any *** -find** command with the **--sizelimit** and **--timelimit** options. For example, if the default time limit is 60 seconds and a search is going to take longer, the time limit can be increased to 120 seconds:

```
[jsmith@ipaserver ~]$ ipa user-find smith --timelimit=120
```

Not every possible attribute in an entry type can be searched for. A certain subset of attributes are predefined and indexed for searches. (This list is configurable for users and groups, but not for other types of entries.)

When entries are returned, only certain default attributes are displayed with the entry; to return all attributes currently set for entries, use the **--all** option.

To display a specific entry, use the *** -show** command and the entry name. As with searches, only a subset of attributes is displayed with the entry unless the **--all** option is used.

8.2.1.3. Adding Members to Groups and Containers with ipa

Group members are added and removed with separate commands, apart from simply modifying an entry. Member commands essentially create a relationship between different IdM entries. While this is obvious in traditional group-member roles, it is also true for some policy entries (like SELinux and sudo policies) where entries are associated with another entry.

Most commonly, the command format for adding a member entry is *** -add-member**, although the command may specify an entry type, such as *** -add-user**.

Likewise, entries are removed as members (not deleted) using a *** -remove-member** or *** -remove-type** command.

8.2.2. Positional Elements in ipa Commands

Usually, **ipa** subcommands have only two elements: the name of the entry being modified (the *object*) and then any options available for the subcommand:

```
ipa command entryName --options=values
```

With a few types of entries, however, not only the entry name itself needs to be specified; the entry's *parent* must also be specified. This is the case with **automount** commands, for example. With automount, the location must be included whenever a new key or map is created.

The parent entry name is given first, and then the child entry name. For example, for automount, the location is given first, and then the map or key entry name.

```
ipa command parentEntryName childEntryName --childOptions=childValues
```

8.2.3. Managing Entry Attributes with --setattr, --setattr, and --delattr

All identities and configuration in Identity Management are stored as LDAP entries, with standard attribute-value assertions (AVAs). Whether an entry is created through the UI or the CLI, there are certain attributes which are required and others which are available, depending on the default and custom object classes for that entry type.

For the most common attributes, the **ipa** command uses specified command-line arguments to set values. For example, adding a mail attribute to a user can be done with the **--mail** argument; enabling dynamic updates for a DNS zone can be done with the **--allow-dynupdate** option with zone commands; and a map key for an automount map is given in the **--key** option.

However, entries can also allow attributes that may not have command-line (or UI) options for setting them. Partially, this is because the underlying LDAP schema is very rich, particularly for user entries, with many possible allowed attributes. Additionally, Identity Management allows schema extensions for users and groups, and those custom schema elements are not necessarily reflected in the UI or command-line tools.

Any supported attribute can be added or edited to an entry using the **--setattr** and **--addattr** options.



IMPORTANT

The value of the attribute being added is not validated by the modify command or the **--setattr** or **--addattr** options.

Both options have this format:

```
--setattr=attribute=value
```

The **--setattr** option sets one value for the given attribute; any existing values are overwritten, even for multi-valued attributes.

The **--addattr** option adds a new value for an attribute; for a multi-valued attribute, it adds the new value while preserving any existing values.

Both **--setattr** option and **--addattr** can be used multiple times in the same command invocation. For example:

```
$ ipa user-mod jsmith --addattr=mail=johnnys@me.com --
addattr=mail=jsmith@example.com --setattr=description="backup IT manager for the
east coast branch"
```

Likewise, an attribute or specific attribute value can be removed from an entry using the **--delattr** option. For a single-valued attribute, this removes the attribute; for a multi-valued attribute, it removes only the specified value. For example:

```
$ ipa user-mod jsmith --delattr=mail=johnnys@me.com
```



NOTE

Deleting attributes is evaluated last, after adding or editing attributes. If the same attribute is added and deleted in the same modify operation, it is a no-op.

```
$ ipa user-mod jsmith --addattr=mail=johnnys@me.com --
delattr=mail=johnnys@me.com
```

8.2.4. Setting a List of Values

In LDAP, multi-valued attributes have a single attribute-value assertion (*attribute: value*) that can be used multiple times in an entry. For example:

```
mail: admin@example.com
mail: jsmith@example.com
```

There are some attributes, however, where the value itself can contain a list. For example, in IdM, the attributes that are searched when searching for users or groups is defined in a list, not in multiple AVAs:

```
ipaUserSearchFields: uid, givenname, sn, telephonenumber, ou, title
```

This applies to search fields, permissions and other access control settings, and some types of group lists, like for sudo command groups, host-based access control rules, and service groups.

Attempting to add a single item to the list when modifying the entry overwrites all previous settings, because there is only a single AVA. It is possible to create the list value in either of two ways:

- Use the same command-line argument multiple times *within the same command invocation*. For example:

```
--permissions=read --permissions=write --permissions=delete
```

- Enclose the list in curly braces, which allows the shell to do the expansion. For example:

```
--permissions={read,write,delete}
```



IMPORTANT

When adding or updating an attribute with a list as a value, include every item in the list with the update. The list is updated every time, and any previous value is overwritten with the new update.

8.2.5. Using Special Characters with IdM Tools

The IdM command-line tools are run as any other utilities in a shell. If there are special characters in the command — such as angle brackets (> and <), ampersands (&), asterisks (*), and pipes (|) — the characters must be escaped. Otherwise, the command fails because the shell cannot properly parse the unescaped characters.

8.2.6. Logging into the IdM Domain Before Running

Before running any IdM commands (with the exception of the installation scripts, such as **ipa-server-install**), the user must first authenticate to the IdM domain by obtaining a Kerberos ticket. This is done using **kinit**:

```
[jsmith@ipaserver ~]$ kinit admin
```

Different login options are described in [Section 8.3, “Logging into IdM”](#).

8.3. Logging into IdM

Users are authenticated to IdM services, including the command-line tools and the web UI, using Kerberos authentication. This means that logging into Identity Management requires running **kinit**.

Running **kinit** issues the user a Kerberos *ticket*. This ticket is checked by any IdM or Kerberos-aware service, so that a user only needs to log in once to access all domain services. Domain services include the IdM web UI, mounted file shares, wikis, or any other application which uses IdM as its identity/authentication store.

8.3.1. Logging into IdM

Logging into Identity Management requires running **kinit** on a client within the IdM domain.

```
$ kinit
```

The **kinit** command must be run from a machine which has been configured as a client within the IdM domain, so that the client authenticates with the IdM KDC.

Simply running **kinit** logs into IdM as the currently logged-in user account. This user account must also be an IdM user for them to authenticate to the IdM Kerberos domain successfully. For example, if you are logged into the machine as **jsmith**:

```
$ kinit
Password for jsmith@EXAMPLE.COM:
```


 NOTE

If SSSD or **pam_krb5** is configured on the IdM client machine, then when a user logs into the machine, a ticket is created which can be used for machine services which require authentication, such as **sudo**.

8.3.2. Logging in When an IdM User Is Different Than the System User

To specify an IdM username — because a person's system username is different than the IdM username or to switch IdM user accounts — simply rerun the **kinit** command, specifying the new user. For example:

```
$ kinit userName
Password for userName@EXAMPLE.COM:
```

When the server is first set up, an administrative user, **admin**, is created to perform normal administrative activities. To authenticate as the admin user, use the name **admin** when running **kinit**:

```
$ kinit admin
```

 NOTE

Only one set of tickets can be stored per logged-in user. The current stored credentials are the ones that will be used when accessing IdM services.

If you were already connected to the IdM web UI as another user, refresh the browser to display the updated details for the new user.

8.3.3. Checking the Current Logged in User

Use the **klist** command to verify the identity and the ticket granting ticket (TGT) from the server:

```
$ klist
Ticket cache: KEYRING:persistent:0:0
Default principal: ipaUser@EXAMPLE.COM

Valid starting      Expires            Service principal
11/10/08 15:35:45  11/11/08 15:35:45  krbtgt/EXAMPLE.COM@EXAMPLE.COM

Kerberos 4 ticket cache: /tmp/tkt500
klist: You have no tickets cached
```

It's important to know who the authenticated user is because the currently-authenticated user is the only one who can access the IdM services. The Kerberos client libraries for **kinit** have some limitation, one of them being that the current ticket is overwritten with any new invocation of **kinit**. Authenticating as User A and then authenticating as User B overwrites User A's ticket.

To allow there to be multiple authenticated users on a machine, set the **KRB5CCNAME** environment variable. This variable keeps credential caches separate in different shells.

8.3.4. Caching User Kerberos Tickets

Only one set of tickets can be stored per logged-in user. The current stored credentials are the ones that will be used when accessing IdM services.

For example, if you authenticated as **admin**, added a new user, set the password, and then tried to authenticate as that user, the administrator's ticket is lost.

To keep separate credential caches in different shells, a special environment variable, **KRB5CCNAME**, can be used.

8.4. Using the IdM Web UI

In order to use the web UI, the user must be authenticated with the IdM Kerberos domain and have an active Kerberos ticket ([Section 8.3, “Logging into IdM”](#)). Generally, the web UI can only be accessed from an IdM server or client machine and the user must be locally authenticated. There are a couple of ways to work around this, either by configuring Kerberos on a non-domain machine to connect to the Kerberos domain ([Section 8.4.5, “Using a Browser on Another System”](#)) or by password authentication to the UI.

8.4.1. Supported Web Browsers

These browsers are supported for connecting to the web UI:

- ▶ Firefox 17 and higher
- ▶ Internet Explorer 9 (limited to personal account management)

8.4.2. About the Web UI

The web UI has three major functional areas which correspond to each of the major functions of IdM: identity management, policy management, and domain configuration.

Table 8.1. Configuration Areas Per Tab

Main Menu Tab	Configuration Areas
Identity	<ul style="list-style-type: none"> ▶ User entries ▶ User groups entries ▶ Host/client entries ▶ Host group entries ▶ Netgroups entries ▶ Domain services entries ▶ DNS (if configured)
Policy	<ul style="list-style-type: none"> ▶ Host-based access control ▶ Sudo rules ▶ Automount ▶ User password policies ▶ Kerberos ticket policy

Main Menu Tab	Configuration Areas
IdM Server (access controls within Identity Management)	<ul style="list-style-type: none"> ▶ Role-based access control (permissions based on group membership) ▶ Self permissions ▶ Delegations (user access control over other users)

The *main menu* at the top of every page has three tabs which correspond to the functional areas listed in [Table 8.1, “Configuration Areas Per Tab”](#). When a tab is selected, there is a submenu of the different configuration areas. Some configuration areas may have multiple possible entries; for example, role-based access controls define user roles/groups, the areas that access can be granted or denied (privileges), and then the permissions granted to those areas. Each separate configuration entry has its own task area beneath the primary configuration area.

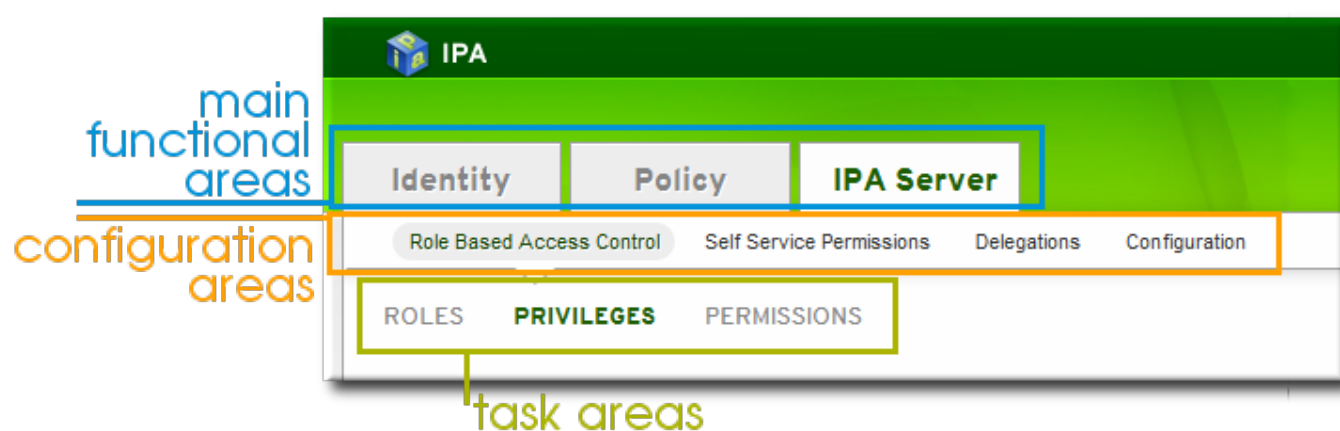


Figure 8.1. The Main Menu

8.4.3. Opening the IdM Web UI

The browser must be properly configured, as described in [Section 8.4.4, “Configuring the Browser”](#), to support Kerberos authentication so that the user can connect to the UI.

To open the web UI:

1. Get a valid Kerberos ticket using `kinit`, as in [Section 8.3, “Logging into IdM”](#).
2. Open the IdM URL. The full URL is `https://IPAserver-FQDN/ipa/ui`, but this service is also accessed simply by opening `https://IPAserver-FQDN`. For example:

```
https://server.example.com
https://server.example.com/ipa/ui
```

8.4.4. Configuring the Browser

Firefox can use Kerberos credentials to authenticate to the IdM UI, but Kerberos negotiation needs to be configured to use the IdM domain. At the first log-in attempt, if Firefox has not been configured to support Kerberos authentication, then an error message appears.

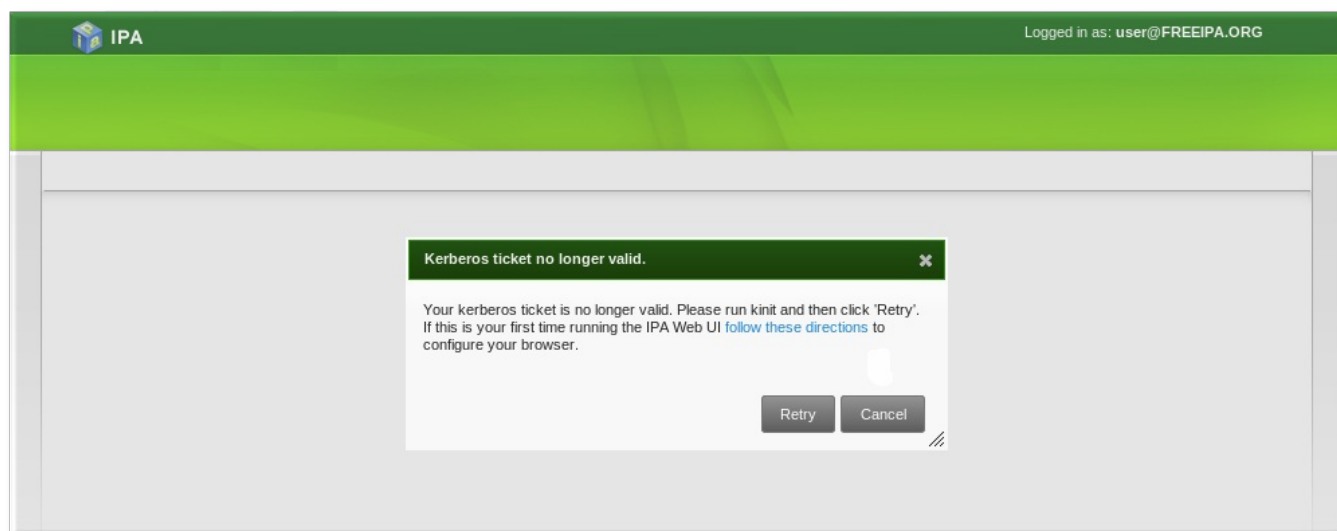
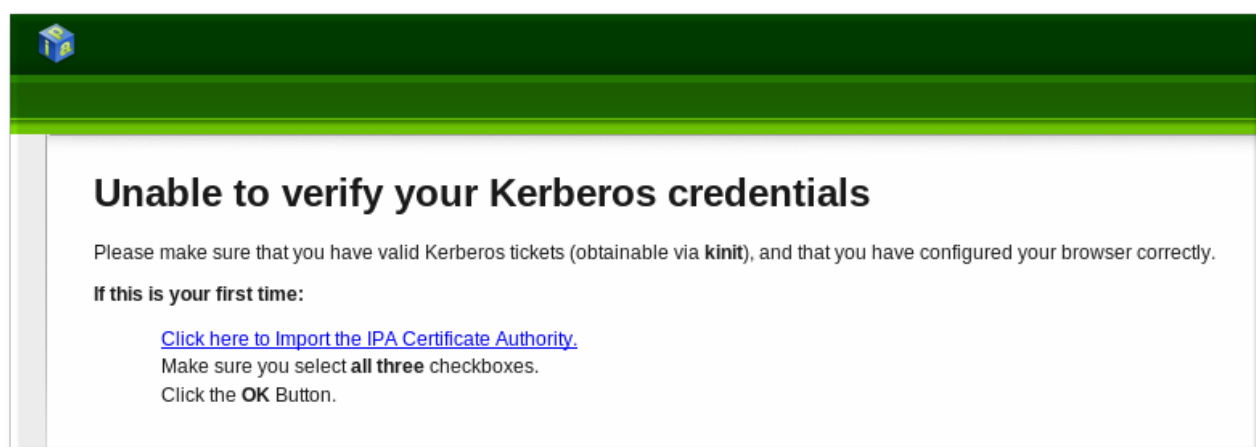


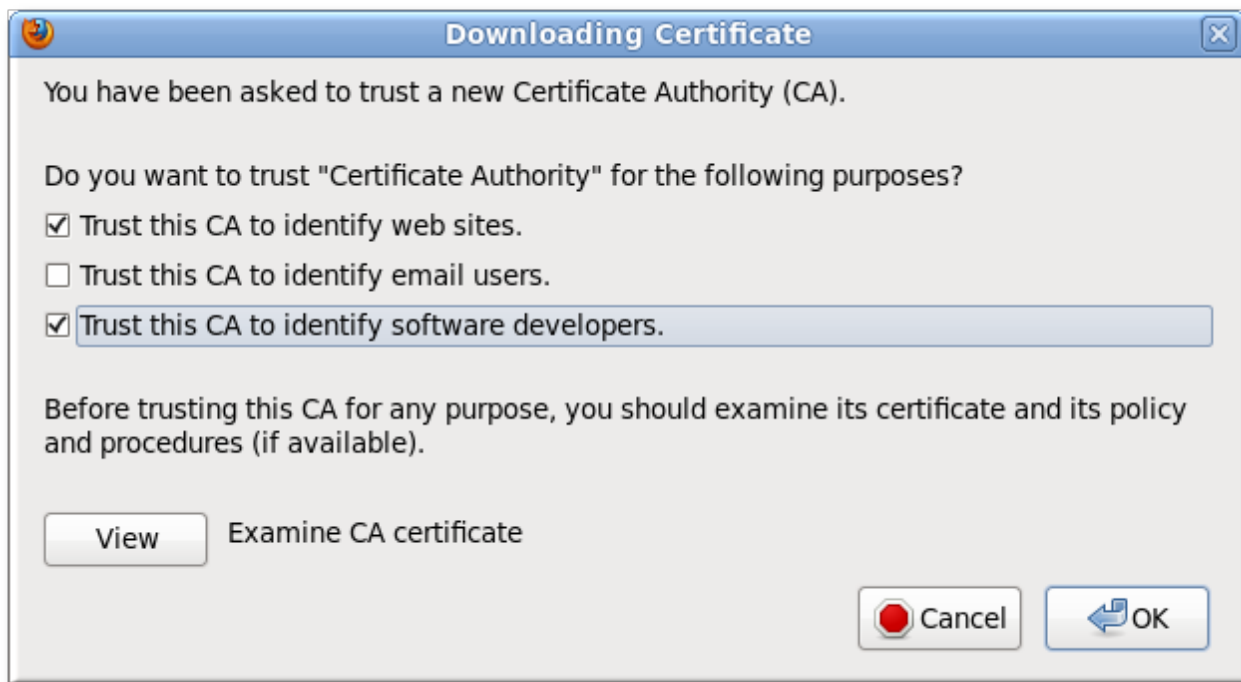
Figure 8.2. Kerberos Authentication Error

If you see that error, then the IdM web UI can perform the required configuration:

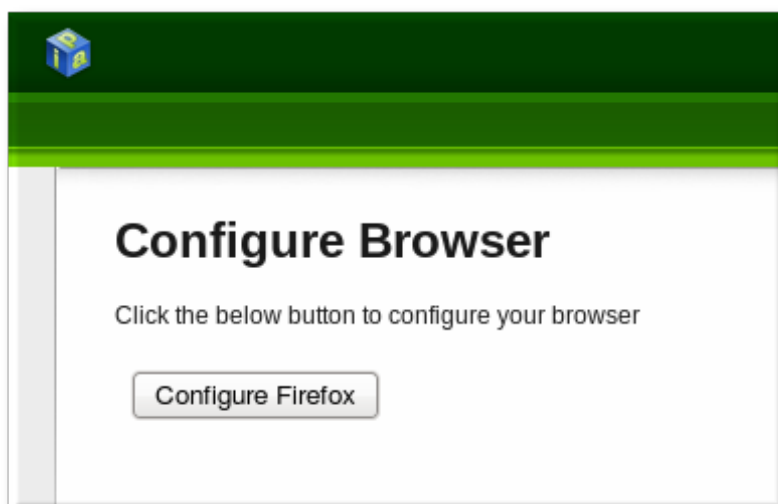
1. Click the **follow these directions** link.
2. Click the link to import the CA certificate for the IdM server.



3. Set the web site and software developer (first and last) trust bits for the CA certificate.



4. Click the **Configure Firefox** button. This automatically fills out all the **negotiate** settings in the Firefox configuration to use the IdM domain settings.



When the process is complete, a success box pops up saying that Firefox has been configured for single sign-on. For there, you are redirected to the IdM web UI.



This can also be done manually:

1. Open Firefox.
2. Type **about:config** in the address bar.

3. In the **Search** field, type **negotiate** to filter out the Kerberos-related parameters.
4. On Red Hat Enterprise Linux, enter the domain name for the URI parameters, including the preceding period (.) and set the **gsslib** parameter to true:

```
network.negotiate-auth.trusted-uris .example.com
network.negotiate-auth.using-native-gsslib true
```

On Windows, set the trusted URIs and library path, and disable the built-in Microsoft Kerberos for authentication:

```
network.negotiate-auth.trusted-uris .example.com
network.auth.use-sspi false
network.negotiate-auth.gsslib: C:\Program Files\MIT\Kerberos\bin\gssapi32.dll
```

On a 64-bit system, the library location is in **C:\Program Files(x86)\MIT\Kerberos\bin\gssapi32.dll**.

5. Open the web UI by going to the fully-qualified domain name of the IdM server such as **http://ipaserver.example.com**. Make sure that you can open the web UI and that there are no Kerberos authentication errors.
6. Next, download the IdM server's CA certificate from **http://ipa.example.com/ipa/config/ca.crt**.
7. Select the first (**Trust this CA to identify web sites**) and third (**Trust this CA to identify software developers**) check boxes.

8.4.5. Using a Browser on Another System

It is possible to connect to the Identity Management web UI from a system which is *not* a member of the IdM domain. In this case, it is possible to specify an IdM-specific Kerberos configuration file on the external (non-IdM) machine before running **kinit**, and then the user can authenticate against the IdM server domain.

This is especially useful there are multiple realms or overlapping domains across your infrastructure.

1. Copy the **/etc/krb5.conf** file from the IdM server.

```
# scp /etc/krb5.conf root@externalmachine.example.com:/etc/krb5_ipa.conf
```



WARNING

Do not overwrite the existing **krb5.conf** file.

2. On the external machine, set the terminal session to use the copied IdM Kerberos configuration file:

```
$ export KRB5_CONFIG=/etc/krb5_ipa.conf
```

3. Configure Firefox on the external machine as in [Section 8.4.4, “Configuring the Browser”](#).

8.4.6. Logging in with Simple Username/Password Credentials

If Kerberos authentication fails, then browser login also fails. That prevents access to the IdM web UI. Simple authentication for the UI allows users to log in even if there are problems with the Kerberos service or if the system is outside the IdM domain.

When the IdM server cannot find a valid Kerberos ticket for the user attempting to log into the web UI, it splashes an error message. Since the preferred method of connecting to IdM domain services (including the UI) is using Kerberos authentication, the error first says to renew the Kerberos credentials or to configure the browser to support Kerberos authentication.

The second part of the message offers the alternative of using simple authentication. The **form-based authentication** link opens a login page.

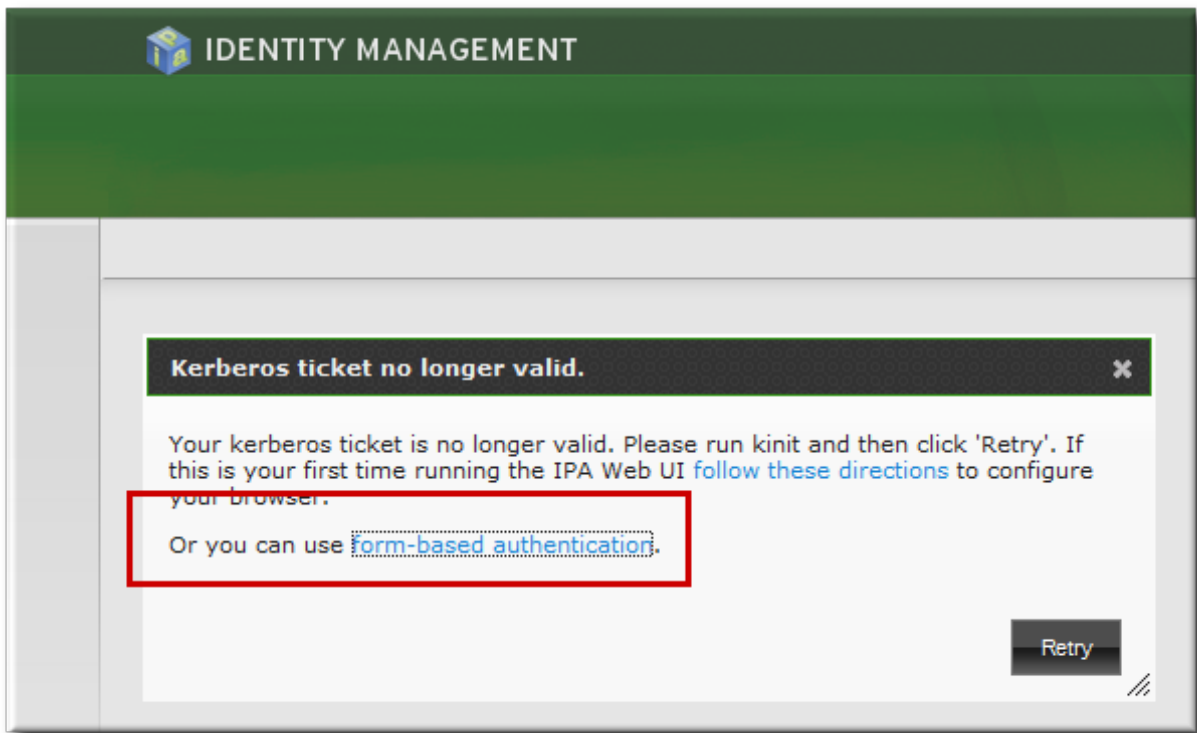


Figure 8.3. IdM Form-Based Login Option

Then simply supply the UID and password for a configured IdM user.

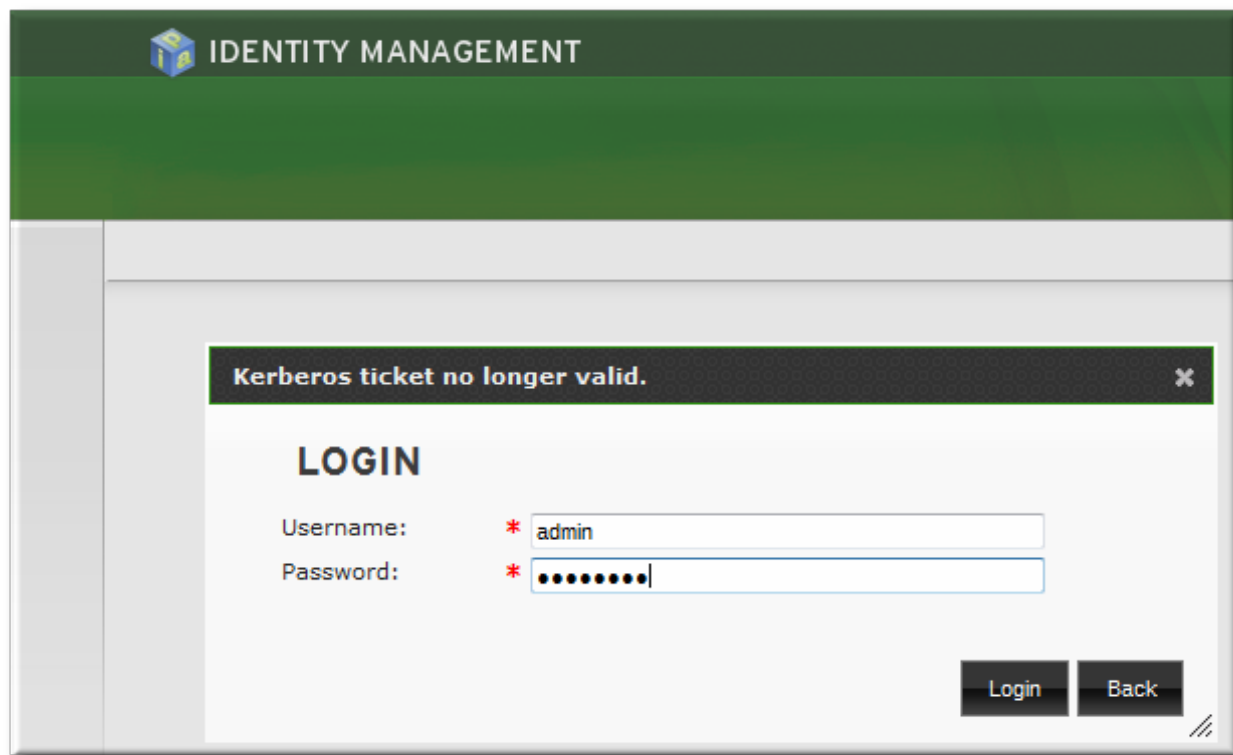


Figure 8.4. IdM Password Prompt

8.4.7. Using the UI with Proxy Servers

Proxy servers can be used to access the web UI without any additional configuration in IdM.

Port forwarding is not supported with the IdM server. However, because it is possible to use proxy servers with IdM, an operation similar to port forwarding can be configured using proxy forwarding with OpenSSH and the SOCKS option. This is described in <http://www.meadowey.org/~gotoh/ssh/openssh-socks.html>.

[1] The hostname used in the directory lookup can be controlled in the `/etc/ipa/default.conf` configuration file.

Part II. Managing User Identities in a Linux Domain

Chapter 9. Managing Users and User Groups

Users in Identity Management are able to access services and servers within the domain through Kerberos authentication. This chapter covers general management tasks for users, groups, password policies, and other configuration for users.

9.1. Setting up User Home Directories

A home directory is required for any IdM user. Without a home directory in the expected location, a user may be unable to log into the domain. While systems administrators can manage home directories outside of IdM, it is also possible to use a PAM module to create home directories automatically on both IdM servers and clients.

9.1.1. About Home Directories

IdM, as part of managing users, can manage user home directories. However, IdM has certain defined parameters for any managed home directories:

- ▶ The default prefix for users' home directories is **/home**.
- ▶ IdM does not automatically create home directories when users log in. Automatically creating home directories requires either the **pam_oddjob_mkhomedir** module or the **pam_mkhomedir** module. This module can be configured as part of client installation or after installation, as described in [Section 9.1.2, “Enabling the PAM Home Directory Module”](#).

The home directory process for IdM first attempts to use the **pam_oddjob_mkhomedir** module because this requires fewer user privileges and access to create the home directories, as well as integrating smoothly with SELinux. If this module is not available, then the process falls back to the **pam_mkhomedir** module.



NOTE

On Red Hat Enterprise Linux 5 clients, the client installation script uses the **pam_mkhomedir** module even if the **pam_oddjob_mkhomedir** module is available. To use the **pam_oddjob_mkhomedir** module on Red Hat Enterprise Linux 5, edit the PAM configuration manually.

- ▶ It is possible to use an NFS file server that provides **/home** that can be made available to all machines in the domain and then automounted on the IdM server.

There are potential issues when using NFS, such as security issues related to granting root access to the NFS user, performance issues with loading the entire **/home** tree, and network performance issues for using remote servers for home directories. There are some general guidelines for using NFS with Identity Management:

- Use automount to mount only the user's home directory and only when the user logs in, rather than loading the entire **/home** tree.
- Use a remote user who has limited permissions to create home directories and mount the share on the IdM server as that user. Since the IdM server runs as an **httpd** process, it is possible to use **sudo** or a similar program to grant limited access to the IdM server to create home directories on the NFS server.

- Use a mechanism, such as the **pam_oddjob_mkhomedir** module, to create the home directory as that user.

Using automounts for home directories is described in [Section 9.1.3, “Manually Mounting Home Directories”](#).

- ▶ If a suitable directory and mechanism are not available to create home directories, users may not be able to log in.

9.1.2. Enabling the PAM Home Directory Module

For a home directory to be created automatically when a user logs in, IdM can use either the **pam_oddjob_mkhomedir** module or the **pam_mkhomedir** module. Because it requires fewer permissions and works well with SELinux, IdM preferentially uses the **pam_oddjob_mkhomedir** module. If that module is not installed, then it falls back to the **pam_mkhomedir** module.



NOTE

IdM does not require the **pam_oddjob_mkhomedir** module or **pam_mkhomedir** module. This is because the ***_mkhomedir** module may try to create home directories even when the shared storage is not available. If the module is unable to create the home directory, then users can be blocked from logging into the IdM domain.

The system administrator must activate this module on each client or server as needed.

There are two ways to enable the **pam_oddjob_mkhomedir** (or **pam_mkhomedir**) module:

- ▶ The **--mkhomedir** option can be used with the **ipa-client-install** command. While this is possible for clients, this option is not available to servers when they are set up.
- ▶ The **pam_oddjob_mkhomedir** module can be enabled using the system's **authconfig** command. For example:

```
authconfig --enablemkhomedir --update
```

This option can be used for both server and client machines post-installation.



NOTE

On Red Hat Enterprise Linux 5 clients, the client installation script uses the **pam_mkhomedir** module even if the **pam_oddjob_mkhomedir** module is available. To use the **pam_oddjob_mkhomedir** module on Red Hat Enterprise Linux 5, edit the PAM configuration manually.

9.1.3. Manually Mounting Home Directories

While PAM modules can be used to create home directories for users automatically, this may not be desirable behavior in every environment. In that case, home directories can be manually added to the IdM server from separate locations using NFS shares and **automount**.

1. Create a new location for the user directory maps:

```
[bjensen@server ~]$ ipa automountlocation-add userdirs
Location: userdirs
```

2. Add a direct map to the new location's **auto.direct** file. In this example, the mount point is **/share**:

```
[bjensen@server ~]$ ipa automountkey-add userdirs auto.direct --key=/share --
info="-ro,soft, ipaserver.example.com:/home/share"
```

```
Key: /share
Mount information: -ro,soft, ipaserver.example.com:/home/share
```

Using automounts with IdM is described in detail in [Chapter 15, Using Automount](#).

9.2. Managing User Entries

9.2.1. About Username Formats

The default length for usernames is 32 characters.

IdM supports a wide range of username formats, based on this regular expression:

```
[a-zA-Z0-9_][a-zA-Z0-9_-.]{0,252}[a-zA-Z0-9_.$-]?
```



TIP

The trailing \$ symbol is permitted for Samba 3.x machine support.

Any system limits — such as starting a username with a number on Unix systems — apply to the usernames in IdM.



NOTE

Usernames are case insensitive when they are created, meaning that any case letter can be entered but case is ignored when the username is saved.

Username are automatically normalized to be all lower case, even if the user is created with mixed case or upper case letters.

9.2.2. Adding Users

9.2.2.1. From the Web UI

1. Open the **Identity** tab, and select the **Users** subtab.
2. Click the **Add** link at the top of the users list.

The screenshot shows the Identity Management web interface. The top navigation bar includes 'Identity', 'Policy', and 'IPA Server'. Below this, there are tabs for 'Users', 'User Groups', 'Hosts', 'Host Groups', 'Netgroups', and 'Services'. The 'Users' tab is active, displaying a table of users. The table has columns for 'User login', 'First name', 'Last name', 'Status', and 'UID'. Two users are listed: 'admin' (Administrator, Enabled, UID 1084600000) and 'jsmith' (john smith, Enabled, UID 1084600001). Above the table are buttons for 'Refresh', 'Delete', 'Add', 'Disable', and 'Enable'.

	User login	First name	Last name	Status	UID
<input type="checkbox"/>	admin		Administrator	✓ Enabled	1084600000
<input checked="" type="checkbox"/>	jsmith	john	smith	✓ Enabled	1084600001

- Fill in the user's first and last names. The user login (UID) is automatically generated based on the user's full name, but this can be set manually by clicking the **Optional field** link.

The screenshot shows the 'Add User' dialog box. It has a title bar with 'Administrator', 'Enabled', and '172200000'. The dialog contains the following fields: 'User login' (jsmith), 'First name' (John), 'Last name' (Smith), 'New Password' (masked with dots), and 'Verify Password' (masked with dots). A legend indicates that fields with a red asterisk are required. At the bottom, there are four buttons: 'Add', 'Add and Add Another', 'Add and Edit', and 'Cancel'.



NOTE

Username are case insensitive when they are created, meaning that case is ignored. Username are automatically normalized to be all lower case, even if the user is created with mixed case or upper case letters.

- Click the **Add and Edit** button to go directly to the expanded entry page and fill in more attribute information, as in [Section 9.2.3.1, "From the Web UI"](#). The user entry is created with some basic information already filled in, based on the given user information and the user entry template.

The screenshot shows the Red Hat Identity Management web interface. At the top, there are tabs for 'Identity', 'Policy', and 'IPA Server'. Under 'Identity', there are sub-tabs for 'Users', 'User Groups', 'Hosts', 'Host Groups', 'Netgroups', 'Services', and 'DNS'. The 'Users' tab is selected, and the breadcrumb 'Users » jsmith' is visible. The main heading is 'USER: jsmith'. Below this, it says 'jsmith is a member of:' followed by a row of tabs: 'Settings', 'User Groups (1)', 'Netgroups', 'Roles', 'HBAC Rules', and 'Sudo Rules'. The 'Settings' tab is active. There are three action buttons: 'Refresh', 'Reset', and 'Update'. The page is divided into two sections: 'IDENTITY SETTINGS' and 'ACCOUNT SETTINGS'. Under 'IDENTITY SETTINGS', there are input fields for 'Job Title', 'First name: * John', 'Last name: * Smith', 'Full name: * John Smith', 'Display name: John Smith', and 'Initials: JS'. Under 'ACCOUNT SETTINGS', there is a 'Status: Enabled: Click to Disable' link, 'User login: jsmith', 'Password: Reset Password' link, and 'UID: * 172200003'.

9.2.2.2. From the Command Line

New user entries are added with the **user-add** command. Attributes (listed in [Table 9.2, “Default Identity Management User Attributes”](#)) can be added to the entry with specific values or the command can be run with no arguments.

```
[bjensen@server ~]$ ipa user-add [username] [attributes]
```

When no arguments are used, the command prompts for the required user account information and uses the defaults for the other attributes, with the defaults printed below. For example:

```
[bjensen@server ~]$ ipa user-add
First name: John
Last name: Smith
User login [jsmith]: jsmith
-----
Added user "jsmith"
-----
User login: jsmith
First name: John
Last name: Smith
Full name: John Smith
Display name: John Smith
Initials: JS
Home directory: /home/jsmith
GECOS: John Smith
Login shell: /bin/sh
Kerberos principal: jsmith@EXAMPLE.COM
Email address: jsmith@example.com
UID: 882600007
GID: 882600007
Password: False
Member of groups: ipausers
Kerberos keys available: False
```

Any of the user attributes can be passed with the command. This will either set values for optional attributes or override the default values for default attributes.

```
[bjensen@server ~]$ ipa user-add jsmith --first=John --last=Smith --manager=bjensen
--email=johnls@example.com --homedir=/home/work/johns --password
```



NOTE

Username are case insensitive when they are created, meaning that case is ignored. Username are automatically normalized to be all lower case, even if the user is created with mixed case or upper case letters.



IMPORTANT

When a user is created without specifying a UID or GID number, then the user account is automatically assigned an ID number that is next available in the server or replica range. (Number ranges are described more in [Section 9.8, "Managing Unique UID and GID Number Assignments"](#).) This means that a user always has a unique number for its UID number and, if configured, for its private group.

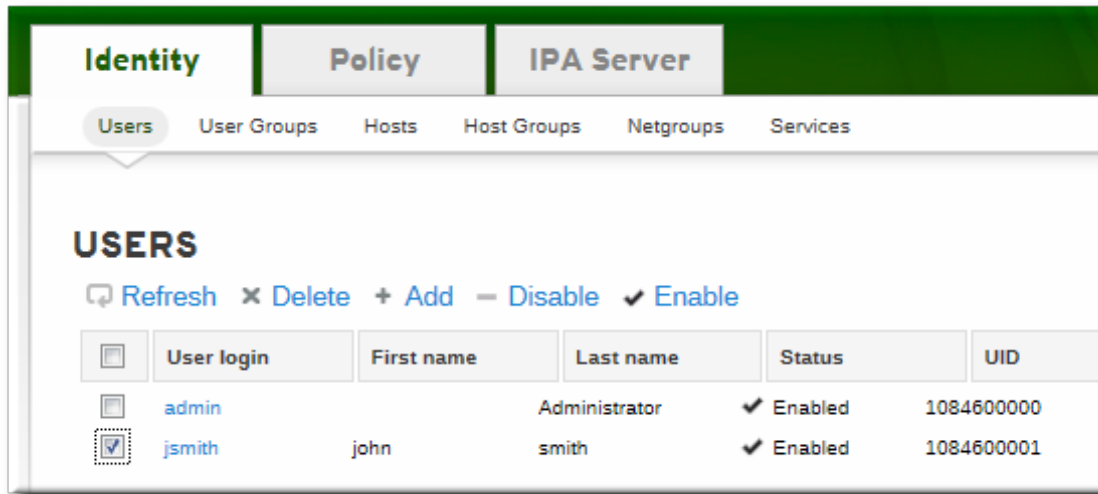
If a number is *manually* assigned to a user entry, the server does not validate that the **uidNumber** is unique. It will allow duplicate IDs; this is expected (though discouraged) behavior for POSIX entries.

If two entries are assigned the same ID number, only the first entry is returned in a search for that ID number. However, both entries will be returned in searches for other attributes or with **ipa user-find --all**.

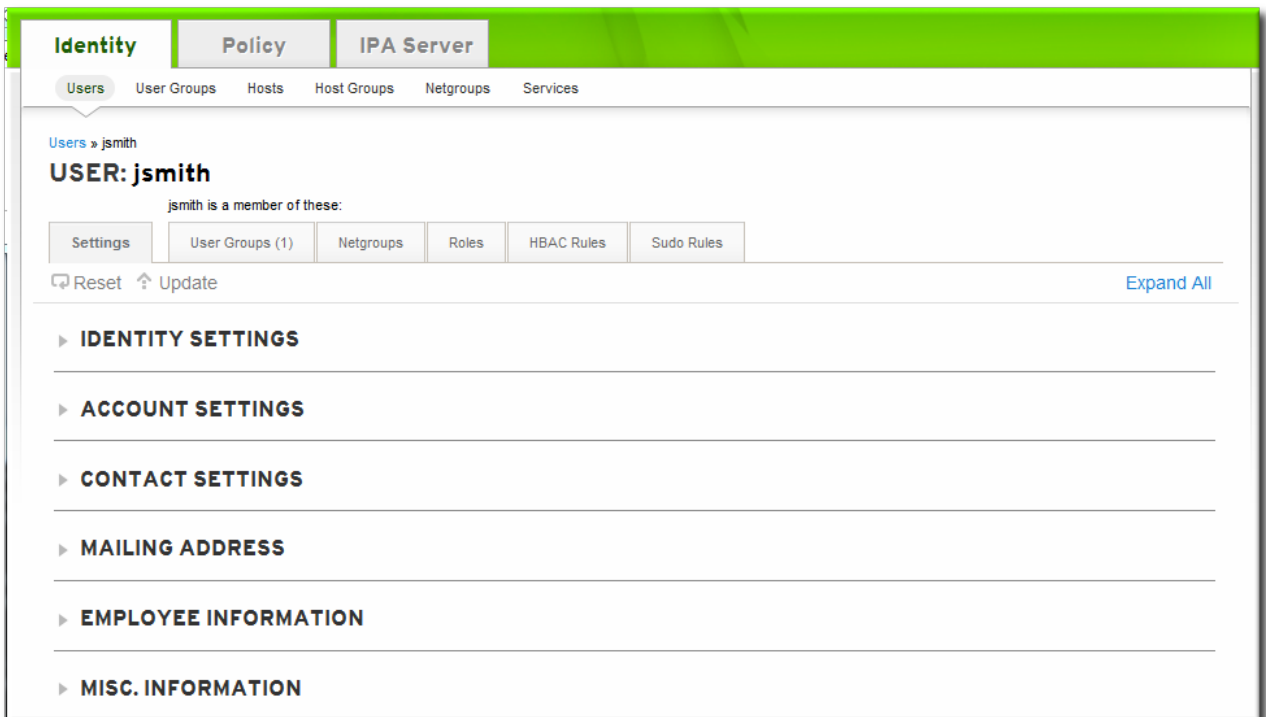
9.2.3. Editing Users

9.2.3.1. From the Web UI

1. Open the **Identity** tab, and select the **Users** subtab.
2. Click the name of the user to edit.



3. There are a number of different types of attributes that can be edited for the user. All of the default attributes are listed in [Table 9.2, “Default Identity Management User Attributes”](#). Most of the attributes in the **Identity Settings** and **Account Settings** areas have default values filled in for them, based on the user information or on the user entry template.



4. Edit the fields or, if necessary, click the **Add** link by an attribute to create the attribute on the entry.

▼ **CONTACT SETTINGS**

Email address: [Add](#)

Telephone Number: [Add](#)

Pager Number: [Add](#)

Mobile Telephone Number: [Add](#)

Fax Number: [Add](#)

5. When the edits are done, click the **Update** link at the top of the page.

9.2.3.2. From the Command Line

The **user-mod** command edits user accounts by adding or changing attributes. At its most basic, the **user-mod** specifies the user account by login ID, the attribute to edit, and the new value:

```
[bjensen@server ~]$ ipa user-mod loginID --attributeName=newValue
```

For example, to change a user's work title from *Editor II* to *Editor III*:

```
[bjensen@server ~]$ ipa user-mod jsmith --title="Editor III"
```

Identity Management allows *multi-valued* attributes, based on attributes in LDAP that are allowed to have multiple values. For example, a person may have two email addresses, one for work and one for personal, that are both stored in the mail attribute. Managing multi-valued attributes can be done using the **--addattr** option.

If an attribute allows multiple values — like mail — simply using the command-line argument will overwrite the value with the new value. This is also true for using **--setattr**. However, using **--addattr** will add a new attribute; for a multi-valued attribute, it adds the new value in addition to any existing values.

Example 9.1. Multiple Mail Attributes

A user is created first using his work email account.

```
[bjensen@server ~]$ ipa user-add jsmith --first=John --last=Smith --
email=johnls@example.com
```

Then, his personal email account is added.

```
[bjensen@server ~]$ ipa user-mod jsmith --addattr=mail=johnnys@me.com
```

Both email addresses are listed for the user.

```
[bjensen@server ~]$ ipa user-find jsmith --all
-----
1 user matched
-----
dn: uid=jsmith,cn=users,cn=accounts,dc=example,dc=com
User login: jsmith
.....
Email address: jsmith@example.com, jsmith@new.com
```

To set two values at the same time, use the `--addattr` option twice:

```
[bjensen@server ~]$ ipa user-add jsmith --first=John --last=Smith --
email=johnls@example.com --addattr=mail=johnnys@me.com --
addattr=mail=admin@example.com
```

9.2.4. Deleting Users

Deleting a user account permanently removes the user entry and all its information from IdM, including group memberships and passwords. External configuration — like a system account and home directory — will still exist on any server or local machine where they were created, but they cannot be accessed through IdM.

Deleting a user account is permanent. The information cannot be recovered; a new account must be created.



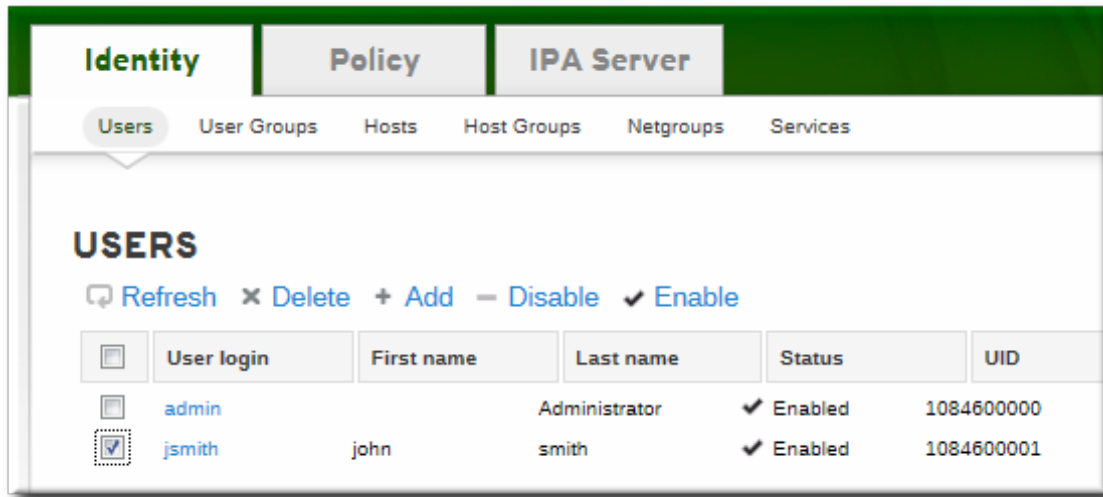
NOTE

If all admin users are deleted, then you must use the Directory Manager account to create a new administrative user.

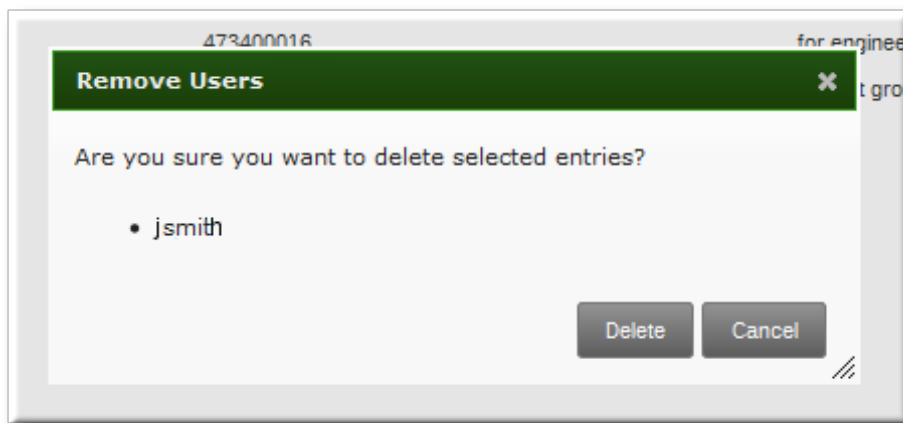
Alternatively, any user who belongs in the group management role can also add a new admin user.

9.2.4.1. With the Web UI

1. Open the **Identity** tab, and select the **Users** subtab.
2. Select the checkboxes by the names of the users to delete.



3. Click the **Delete** link at the top of the task area.
4. When prompted, confirm the delete action.



9.2.4.2. From the Command Line

Users are deleted using the **user-del** command and then the user login. For example, a single user:

```
[bjensen@server ~]$ ipa user-del jsmith
```

To delete multiple users, simply list the users, separated by spaces.

```
[bjensen@server ~]$ ipa user-del jsmith bjensen mreynolds cdickens
```

When deleting multiple users, use the **--continue** option to force the command to continue regardless of errors. A summary of the successful and failed operations is printed to stdout when the command completes. If **--continue** is not used, then the command proceeds with deleting users *until* it encounters an error, and then it exits.

9.3. Managing Public SSH Keys for Users

OpenSSH uses *public-private key pairs* to authenticate users. A user attempts to access some network resource and presents its key pair. The first time the user authenticates, the administrator on the target machine has to approve the request manually. The machine then stores the user's public key in an **authorized_keys** file. Any time that the user attempts to access the resource again, the machine simply

checks its **authorized_keys** file and then grants access automatically to approved users.

There are a couple of problems with this system:

- ▶ SSH keys have to be distributed manually and separately to all machines in an environment.
- ▶ Administrators have to approve user keys to add them to the configuration, but it is difficult to verify either the user or key issuer properly, which can create security problems.

On Red Hat Enterprise Linux, the System Security Services Daemon (SSSD) can be configured to cache and retrieve user SSH keys so that applications and services only have to look in one location for user keys. Because SSSD can use Identity Management as one of its identity information providers, Identity Management provides a universal and centralized repository of keys. Administrators do not need to worry about distributing, updating, or verifying user SSH keys.

9.3.1. About the SSH Key Format

When keys are uploaded to the IdM entry, the key format can be either an [OpenSSH-style key](#) or a raw [RFC 4253-style blob](#). Any RFC 4253-style key is automatically converted into an OpenSSH-style key before it is imported and saved into the IdM LDAP server.

The IdM server can identify the type of key, such as an RSA or DSA key, from the uploaded key blob. However, in a key file such as **id_rsa.pub**, a key entry is identified by its type, then the key itself, and then an additional comment or identifier. For example, for an RSA key associated with a specific hostname:

```
"ssh-rsa ABCD1234...== ipaclient.example.com"
```

All three parts from the key file can be uploaded to and viewed for the user entry, or only the key itself can be uploaded.

9.3.2. Uploading User SSH Keys Through the Web UI

1. Generate a user key. For example, using the OpenSSH tools:

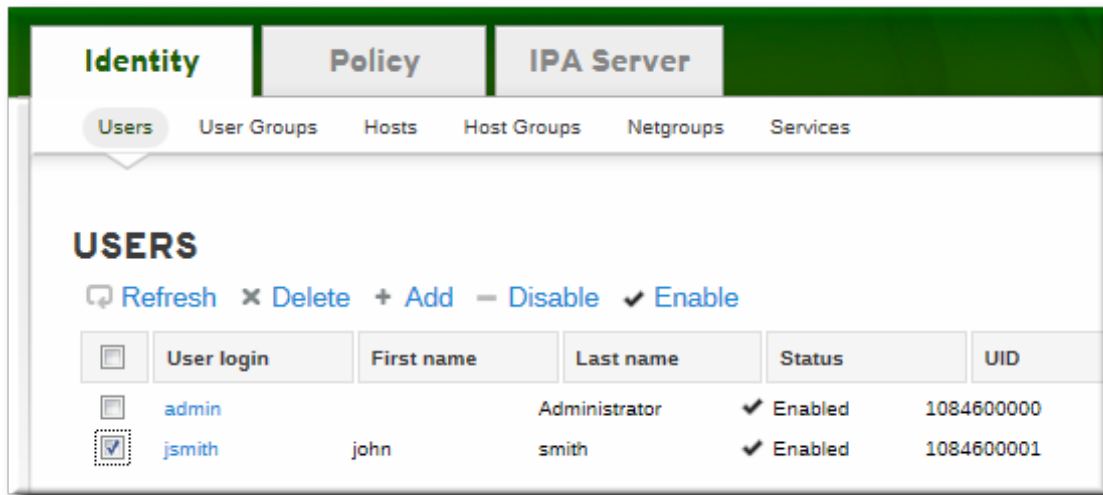
```
[jsmith@server ~]$ ssh-keygen -t rsa -C jsmith@example.com
Generating public/private rsa key pair.
Enter file in which to save the key (/home/jsmith/.ssh/id_rsa):
Created directory '/home/jsmith/.ssh'.
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/jsmith/.ssh/id_rsa.
Your public key has been saved in /home/jsmith/.ssh/id_rsa.pub.
The key fingerprint is:
a5:fd:ac:d3:9b:39:29:d0:ab:0e:9a:44:d1:78:9c:f2 jsmith@example.com
The key's randomart image is:
+--[ RSA 2048 ]-----+
|           + .           |
|        + =   .         |
|         =  +          |
|        . E S..         |
|       . . . .o         |
|      . . . .oo.        |
|     . o . .+.+o       |
|    o  .o..o+o        |
+-----+

```

2. Copy the public key from the key file. The full key entry has the form *type key== comment*. Only the *key==* is required, but the entire entry can be stored.

```
[jsmith@server ~]$ cat /home/jsmith/.ssh/id_rsa.pub  
ssh-rsa AAAAB3NzaC1yc2E...tJG1PK2Mq++wQ== jsmith@example.com
```

3. Open the **Identity** tab, and select the **Users** subtab.
4. Click the name of the user to edit.



5. In the **Account Settings** area of the **Settings** tab, click the **SSH public keys: Add** link.

The screenshot shows the Red Hat Identity Management web console interface. At the top, there are tabs for 'Identity', 'Policy', and 'IPA Server'. Below these, there are sub-tabs for 'Users', 'User Groups', 'Hosts', 'Host Groups', 'Netgroups', and 'Services'. The 'Users' tab is selected, and the user 'jsmith' is selected. The page title is 'Users » jsmith'. Below the title, there is a dropdown menu with '-- select action --' and an 'Apply' button. The text 'jsmith is a member of:' is followed by a row of tabs: 'Settings', 'User Groups (1)', 'Netgroups', 'Roles', 'HBAC Rules', and 'Sudo Rules'. Below these tabs, there are buttons for 'Refresh', 'Reset', and 'Update'. The main content area is divided into sections: 'IDENTITY SETTINGS', 'ACCOUNT SETTINGS', and 'PASSWORD POLICY'. The 'ACCOUNT SETTINGS' section contains the following fields: 'User login: jsmith', 'Password: *****', 'Password expiration: Mon Oct 22 2012 11:14:37 GMT-0500 (Central Daylight Time)', 'UID: * 951400001', 'GID: * 951400001', 'Login shell: /bin/sh', and 'Home directory: /home/jsmith'. The 'SSH public keys: Add' field is highlighted with a red box.

6. Click the **Add** link by the **SSH public keys** field.

▼ **ACCOUNT SETTINGS**

User login: **jsmith**

Password: *********

Password expiration: **Mon Oct 22 2012 11:14:37 GMT-0500 (Central Daylight Time)**

UID: *

GID: *

Login shell:

Home directory:

SSH public keys: **New: key not set** [Show/Set key](#) [undo](#)

[Add](#) [undo all](#)

- Paste in the public key for the user, and click the **Set** button.

Set SSH key [X]

SSH public key:

```
ssh-rsa
AAAAB3NzaC1yc2EAAAABIwAAAQEA6HsLXndrd+P+55SdJIrdMIPe1fKJEzucLNioGsC7
59JVwpuul6sQE1Kuu6Vec4Q5Jh7Ork2ERkxSxwwf+Pka5oN+M3sbaA+PBaQykBn4LAQ2
DvG0BSox8ObU2CydsoZuk+jQ7Ni13Qxka0rAllCgyGJT5T0nmFBHqTWhOKs81RBFbtmj
Ps75+MziNP1Mik8a7TD3s6SubH23VtB9SYd90iKsouuI7+fhbR7+JaFUtT0c8sU9JP4o
o1KHUZeDcP7c666nHPmvmP2ItsqzkcKCiGB1JZPKMiOaX2jFqryU709DBDZMiAiAEVOP
qVJCTg5py0MYHyRZ1HzNqjr6xr7Q4w== jsmith@example.com
```

[Set](#) [Cancel](#)

The **SSH public keys** field now shows **New: key set**. Clicking the **Show/Set key** link opens the submitted key.

- To upload multiple keys, click the **Add** link below the list of public keys, and upload the other keys.
- When all the keys have been submitted, click the **Update** link at the top of the user's page to save the changes.

When the public key is saved, the entry is displayed as the key fingerprint, the comment (if one was included), and the key type [2].

ACCOUNT SETTINGS

User login: **jsmith**

Password: *********

Password expiration: **Mon Oct 22 2012 11:14:37 GMT-0500 (Central Daylight Time)**

UID: *

GID: *

Login shell:

Home directory:

SSH public keys: **19:DD:37:6C:7C:7E:70:6A:E7:53:97:D2:F2:45:D4:D8 jsmith@example.com (ssh-rsa)** [Show/Set key](#) [Delete](#)

[Add](#)

ACTIONS
[Reset Passw](#)

Figure 9.1. Saved Public Key

After uploading the user keys, configure SSSD to use Identity Management as one of its identity domains and set up OpenSSH to use SSSD for managing user keys. This is covered in the [Deployment Guide](#).

9.3.3. Uploading User SSH Keys Through the Command Line

The `--sshpubkey` option uploads the 64 bit-encoded public key to the user entry. For example:

```
[jsmith@server ~]$ ipa user-mod jsmith --sshpubkey="ssh-rsa 12345abcde=ipaclient.example.com"
```

With a real key, the key is longer and usually ends with an equals sign (=).

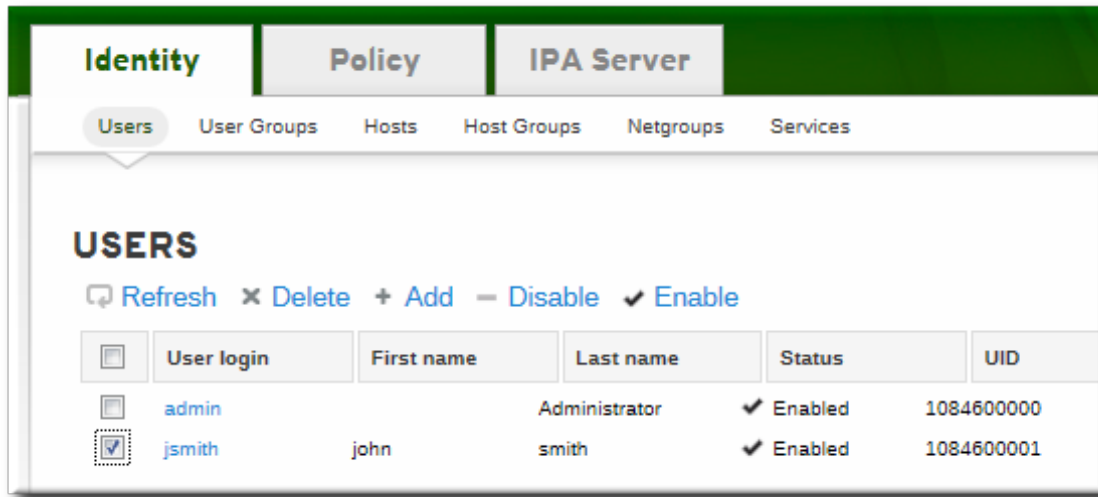
To upload multiple keys, pass a comma-separated list of keys with a single `--sshpubkey` option:

```
--sshpubkey="12345abcde==, key2==, key3=="
```

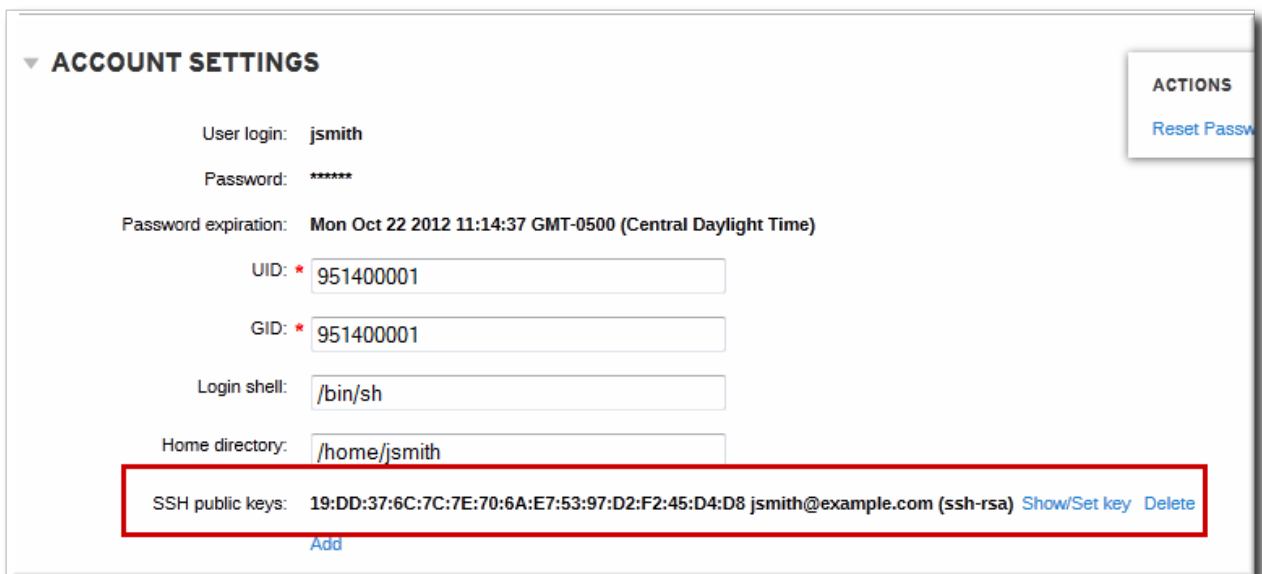
After uploading the user keys, configure SSSD to use Identity Management as one of its identity domains and set up OpenSSH to use SSSD for managing user keys. This is covered in the [Red Hat Enterprise Linux Deployment Guide](#).

9.3.4. Deleting User Keys

1. Open the **Identity** tab, and select the **Users** subtab.
2. Click the name of the user to edit.



3. Open the **Account Settings** area of the **Settings** tab.
4. Click the **Delete** link by the fingerprint of the key to remove.



5. Click the **Update** link at the top of the user's page to save the changes.

The command-line tools can be used to remove all keys. This is done by running `ipa user-mod` with the `--sshpubkey=` set to a blank value; this removes *all* public keys for the user. For example:

```
[jsmith@server ~]$ kinit admin
[jsmith@server ~]$ ipa user-mod --sshpubkey= jsmith
```

9.4. Changing Passwords

Password policies ([Chapter 16, Defining Password Policies](#)) and minimal access restrictions can be applied to a password change operation:

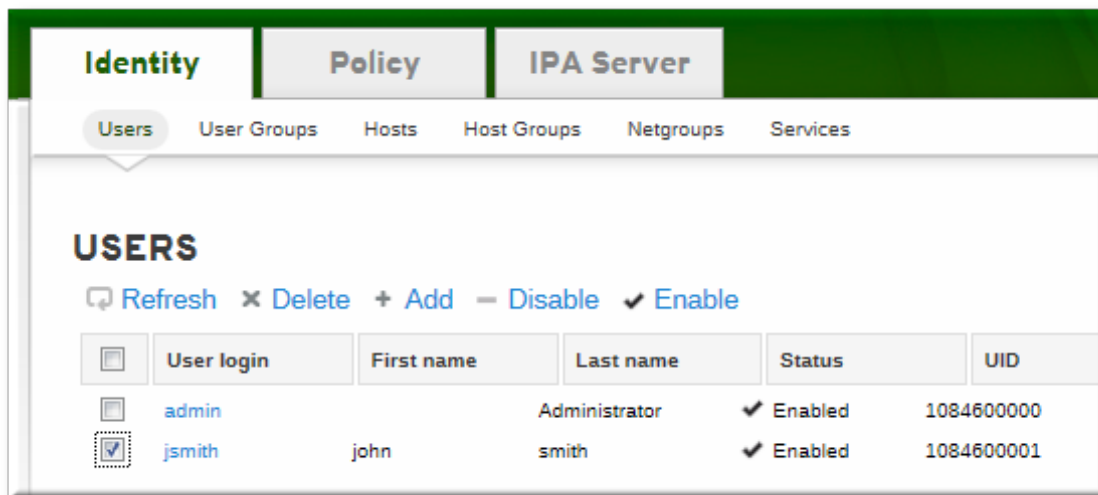
- Regular, non-administrative users can change only their personal passwords, and all passwords are constrained by the IdM password policies.

This allows administrators to create initial passwords or to reset passwords easily, while still keeping the final password confidential. Since any password sent by an administrator to the user is temporary, there is little security risk.

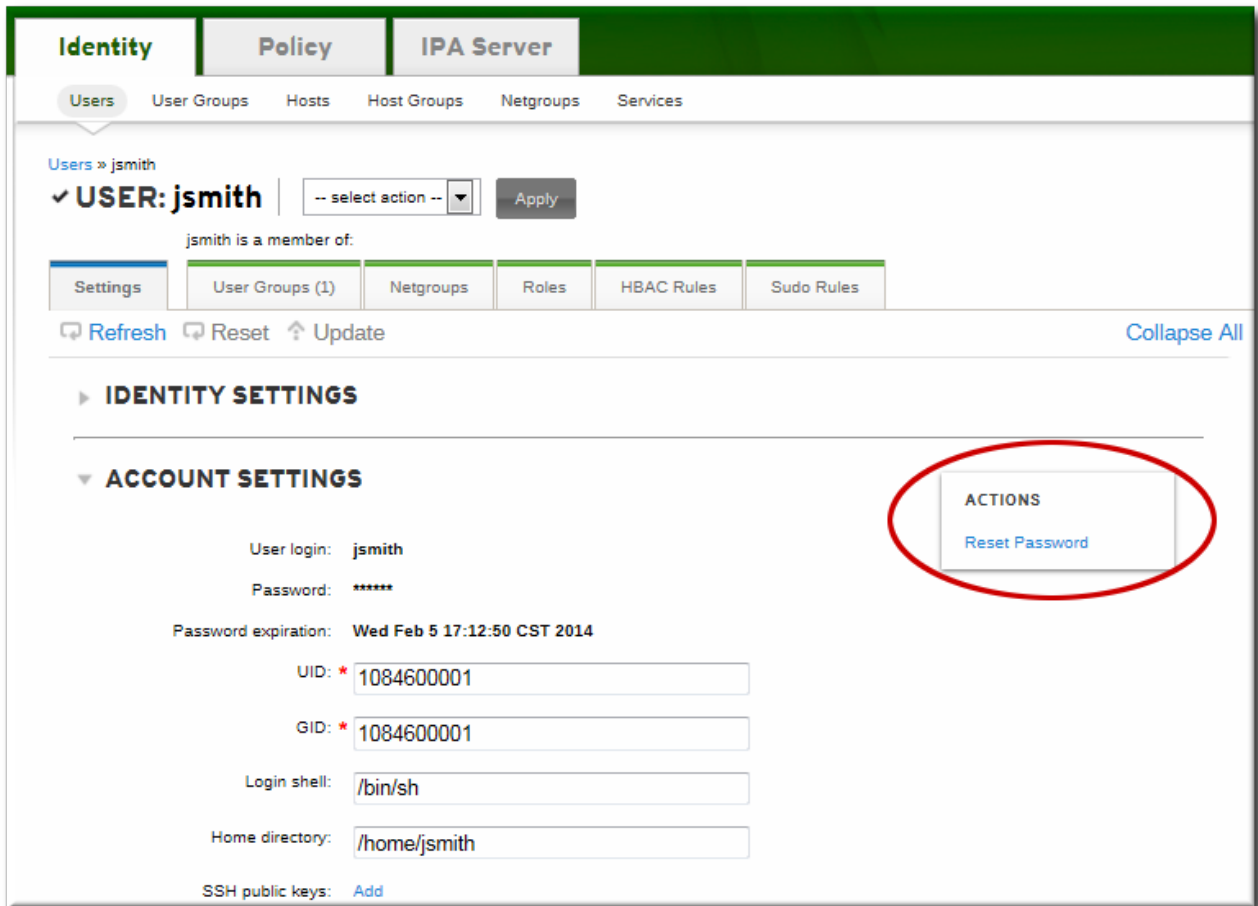
- ▶ Changing a password as the IdM admin user overrides any IdM password policies, but the password expires immediately. This requires the user to change the password at the next login. Similarly, any user who has password change rights can change a password and no password policies are applied, but the other user must reset the password at the next login.
- ▶ Changing a password as the LDAP Directory Manager user, *using LDAP tools*, overrides any IdM password policies.

9.4.1. From the Web UI

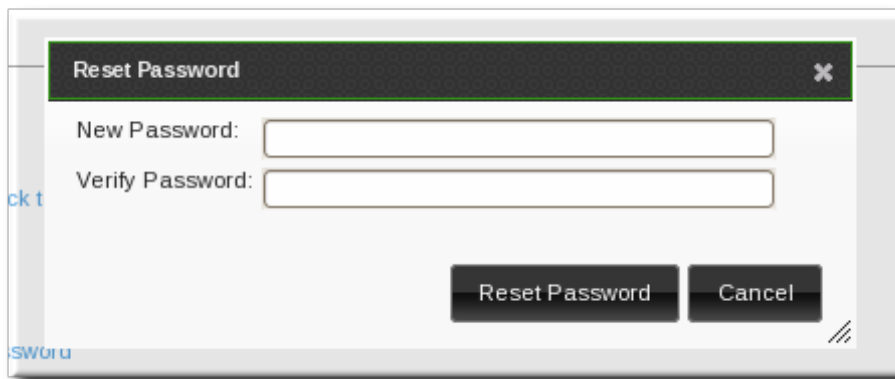
1. Open the **Identity** tab, and select the **Users** subtab.
2. Click the name of the user for whom to reset the password. All users can change their own password; only administrators or users with delegated permissions can change other user's passwords.



3. Scroll to the **Account Settings** area.
4. Click the **Reset Password** link.



5. In the pop-up box, enter and confirm the new password.



9.4.2. From the Command Line

Changing a password — your own or another user's — is done using the **user-mod** command, as with other user account changes.

```
[bjensen@ipaserver ~]$ kinit admin
[bjensen@ipaserver ~]$ ipa user-mod jsmith --password
```

9.5. Enabling and Disabling User Accounts

User accounts can be deactivated or *disabled*. A disabled user cannot log into IdM or its related services (like Kerberos) and he cannot perform any tasks. However, the user account still exists within Identity Management and all of the associated information remains unchanged.

NOTE

Any existing connections remain valid until the Kerberos TGT and other tickets expire. Once the ticket expires, the user cannot renew the ticket.

9.5.1. From the Web UI

Multiple users can be disabled from the full users list by selecting the checkboxes by the desired users and then clicking the **Disable** link at the top of the list.

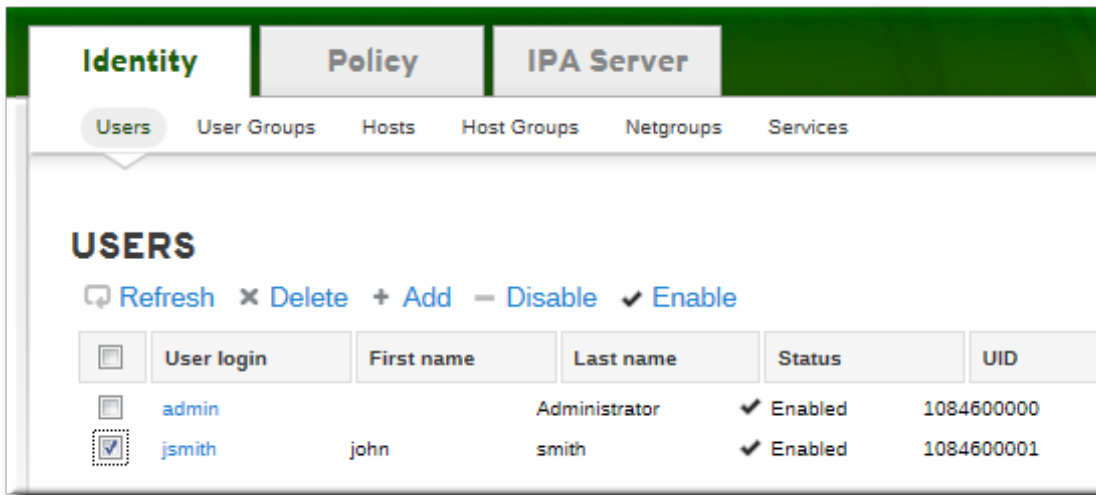
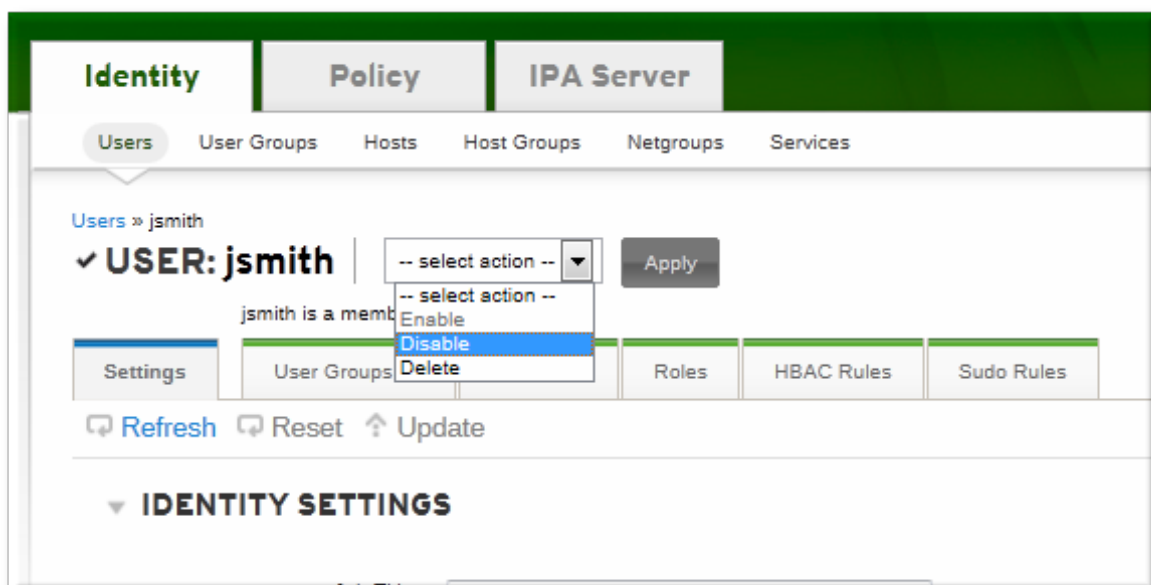


Figure 9.2. Disable/Enable Options at the Top of the Users List

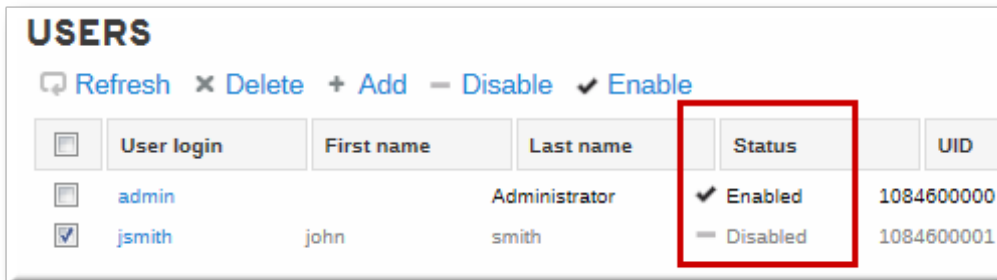
A user account can also be disabled from the user's individual entry page.

1. Open the **Identity** tab, and select the **Users** subtab.
2. Click the name of the user to deactivate or activate.
3. In the actions drop-down menu, select the **Disable** item.



4. Click the **Accept** button.

When a user account is disabled, it is signified by a minus (-) icon for the user status in the user list and by the username on the entry page. Additionally, the text for the user is gray (to show it is inactive) instead of black.



<input type="checkbox"/>	User login	First name	Last name	Status	UID
<input type="checkbox"/>	admin		Administrator	✓ Enabled	1084600000
<input checked="" type="checkbox"/>	jsmith	john	smith	– Disabled	1084600001

Figure 9.3. Disable Icon for User Status

9.5.2. From the Command Line

Users are enabled and disabled using **user-enable** and **user-disable** commands. All that is required is the user login. For example:

```
[bjensen@server ~]$ ipa user-disable jsmith
```

9.6. Unlocking User Accounts After Password Failures

If a user attempts to log in and uses the wrong password a certain number of times, then that user account is locked. The exact number of failed attempts that locks an account and the duration of the lockout is defined as part of the password policy ([Section 16.6, “Setting Account Lockout Policies”](#)).

A password policy can implicitly define a reset period, where the account unlocks naturally after a certain amount of time lapses. However, if the duration is fairly long or if the deployment requires stronger security checks before unlocking an account, then an administrator can unlock an account manually.

An account is unlocked using the **user-unlock** command. For example:

```
[bjensen@ipaserver ~]$ kinit admin
[bjensen@ipaserver ~]$ ipa user-unlock jsmith
```

9.7. Managing User Private Groups

On Red Hat Enterprise Linux systems, every time a user is created, a corresponding, secret user group is automatically created with that new user as its only member. This is a *user private group*. Using user private groups makes it simpler and safer to manage file and directory permissions because **umask** defaults only have to restrict user access, not group access.

When a new user is created in the IdM domain, it is also created with a corresponding private group, following the Red Hat Enterprise Linux convention. For most environments, this is an acceptable default behavior, but there may be certain users or types of users which do not require a private group or the environment may already have those GIDs ^[3] assigned to NIS groups or other system groups.

9.7.1. Listing User Private Groups

User private groups are specific to a single user and are only used by the system. They are private, so they are not viewable in the IdM UI. However, not every user has a private group, depending on the options when a user is created, so it can be useful to get a list of configured private groups within the IdM user domain. Private groups can be searched and listed by using the `--private` option with the `group-find` command. For example:

```
[root@server ~]# ipa group-find --private
-----
1 group matched
-----
Group name: jsmith
Description: User private group for jsmith
GID: 1084600001
-----
Number of entries returned 1
-----
```

9.7.2. Disabling Private Groups for a Specific User

Private group creation can be disabled when a user is created by using the `--noprivate` option.

There is one thing to note when adding a user without a private group: the Linux system still expects a user GID for the new user. However, the one default user group (`ipausers`) is a non-POSIX group and, therefore, does not have an associated GID. So that the add operation does not fail, it is necessary either to set an explicit user GID with the `--gid` option or to create a group with a GID and add the user to that group using an *automembership* rule (covered in [Chapter 21, Defining Automatic Group Membership for Users and Hosts](#)).

```
[jsmith@server ~]$ ipa user-add jsmith --first=John --last=Smith --noprivate --gid
10000
```

9.7.3. Disabling Private Groups Globally

User private groups are managed through the Managed Entries Plug-in in 389 Directory Server. This plug-in can be disabled, which effectively disables private group creation for all new users.

This is done using the `ipa-managed-entries` command.

1. Use the `ipa-managed-entries` command to list possible Managed Entries Plug-in definitions. By default, there are two, one for new users (UPG) and one for netgroups (NGP).

```
[root@ipaserver ~]# ipa-managed-entries --list -p DMpassword
Available Managed Entry Definitions:
UPG Definition
NGP Definition
```

2. Disable the desired Managed Entries Plug-in instance. For example:

```
[root@ipaserver ~]# ipa-managed-entries -e "UPG Definition" -p DMpassword
disable
Disabling Plugin
```

3. Restart the 389 Directory Server to load the new plug-in configuration.

```
[root@ipaserver ~]# service dirsrv restart
```

Managed Entries Plug-in instances can be re-enabled with the **enable** option.

9.8. Managing Unique UID and GID Number Assignments

An IdM server must generate random UID and GID values and simultaneously ensure that replicas never generate the same UID or GID value. The need for unique UID and GID numbers might even cross IdM domains, if a single organization has multiple disparate domains.

9.8.1. About ID Number Ranges

The UID and GID numbers are divided into *ranges*. By keeping separate numeric ranges for individual servers and replicas, the chances are minimal that any numbers issued by one server or replica will duplicate those from another. Ranges are updated and shared intelligently between servers and replicas through the Dynamic Numeric Assignment (DNA) Plug-in, as part of the backend 389 Directory Server instance for the domain. The same range is used for user IDs (*uidNumber*) and group IDs (*gidNumber*). A user and a group may have the same ID, but since the ID is set in different attributes, there is no conflict. Using the same ID number for both a user and a group also allows an administrator to configure user private groups, where a unique system group is created for each user and the ID number is the same for both the user and the group.

When a user is created interactively or without specifying a UID or GID number, then the user account is created with an ID number that is next available in the server or replica range. This means that a user always has a unique number for its UID number and, if configured, for its private group.



IMPORTANT

If a number is *manually* assigned to a user entry, the server does not validate that the *uidNumber* is unique. It will allow duplicate IDs; this is expected (though discouraged) behavior for POSIX entries. The same is true for group entries: a duplicate *gidNumber* can be manually assigned to the entry.

If two entries are assigned the same ID number, only the first entry is returned in a search for that ID number. However, both entries will be returned in searches for other attributes or with **ipa user-find --all**.

9.8.2. About ID Range Assignments During Installation

The IdM administrator can initially define a range during server installation, using the **--idstart** and **--idmax** options with **ipa-server-install**. These options are not required, so the setup script can assign random ranges during installation.

If no range is set manually when the first IdM server is installed, a range of 200,000 IDs is randomly selected. There are 10,000 possible ranges. Selecting a random range from that number provides a high probability of non-conflicting IDs if two separate IdM domains are ever merged in the future.

With a single IdM server, IDs are assigned to entries in order through the range. With replicas, the initial server ID range is split and distributed.

When a replica is installed, it is configured with an invalid range. It also has a directory entry (that is shared among replicas) that instructs the replica where it can request a valid range. When the replica starts, or as its current range is depleted so that less than 100 IDs are available, it can contact one of the available servers for a new range allotment. A special extended operation splits the range in two, so that the original server and the replica each have half of the available range.

9.8.3. A Note on Bad ID Ranges

It is possible for an administrator to define an ID number range — which means that it is possible for an administrator to define a *bad* range.

Red Hat Enterprise Linux reserves all UID/GID numbers below 500 for system use. SSSD treats all UID/GID numbers below 1000 as local system accounts. If an administrator sets the ID range to start at 500 to interact with a legacy application (for example), then user accounts assigned an ID number below 1000 will be unable to log in, because their user account is not recognized by SSSD.

9.8.4. Adding New Ranges

If the range for the entire domain is close to depletion, a new range can be manually selected and assigned to one of the master servers. All replicas then request ID ranges from the master as necessary.

The changes to the range are done by editing the 389 Directory Server configuration to change the DNA Plug-in instance. The range is defined in the ***dnaNextRange*** parameter. For example:

```
ldapmodify -x -D "cn=Directory Manager" -W -h server.example.com -p 389
Enter LDAP Password: *****
dn: cn=POSIX IDs,cn=Distributed Numeric Assignment Plugin,cn=plugins,cn=config
changetype: modify
add: dnaNextRange
dnaNextRange: 123400000-123500000
```



NOTE

This command only adds the specified range of values; it does not check that the values in that range are actually available. This check is performed when an attempt is made to allocate those values. If a range is added that contains mostly values that were already allocated, the system will cycle through the entire range searching for unallocated values, and then the operation ultimately fails if none are available.

9.8.5. Repairing Changed UID and GID Numbers

When a user is created, the user is automatically assigned a user ID number and a group ID number.

When the user logs into an IdM system or service, SSSD on that system caches that username with the associated UID/GID numbers. The UID number is then used as the identifying key for the user. If a user with the same name but a different UID attempts to log into the system, then SSSD treats it as two different users with a name collision.

What this means is that SSSD does not recognize UID number changes. It interprets it as a different and new user, not an existing user with a different UID number. If an existing user changes the UID number, that user is prevented from logging into SSSD and associated services and domains. This also has an impact on any client applications which use SSSD for identity information; the user with the conflict will not be found or accessible to those applications.

**Important**

UID/GID changes are not supported in Identity Management or in SSSD.

If a user for some reason has a changed UID/GID number, then the SSSD cache must be cleared for that user before that user can log in again. For example:

```
[root@server ~]# sss_cache -u jsmith
```

9.9. Managing User and Group Schema

When a user entry is created, it is automatically assigned certain LDAP object classes which, in turn, make available certain attributes. LDAP attributes are the way that information is stored in the directory. (This is discussed in detail in the *Directory Server Deployment Guide* and the *Directory Server Schema Reference*.)

Table 9.1. Default Identity Management User Object Classes

Description	Object Classes
IdM object classes	ipaobject ipasshuser
Person object classes	person organizationalperson inetorgperson inetuser posixAccount
Kerberos object classes	krbprincipalaux krbticketpolicyaux
Managed entries (template) object classes	mepOriginEntry

A number of attributes are available to user entries. Some are set manually and some are set based on defaults if a specific value is not set. There is also an option to add any attributes available in the object classes in [Table 9.1, “Default Identity Management User Object Classes”](#), even if there is not a UI or command-line argument for that attribute. Additionally, the values generated or used by the default attributes can be configured, as in [Section 9.9.4, “Specifying Default User and Group Attributes”](#).

Table 9.2. Default Identity Management User Attributes

UI Field	Command-Line Option	Required, Optional, or Default ^[a]
User login	<i>username</i>	Required
First name	--first	Required
Last name	--last	Required

UI Field	Command-Line Option	Required, Optional, or Default
Full name	--cn	Optional
Display name	--displayname	Optional
Initials	--initials	Default
Home directory	--homedir	Default
GECOS field	--gecos	Default
Shell	--shell	Default
Kerberos principal	--principal	Default
Email address	--email	Optional
Password	--password [b]	Optional
User ID number [c]	--uid	Default
Group ID number[c]	--gidnumber	Default
Street address	--street	Optional
City	--city	Optional
State/Province	--state	Optional
Zip code	--postalcode	Optional
Telephone number	--phone	Optional
Mobile telephone number	--mobile	Optional
Pager number	--pager	Optional
Fax number	--fax	Optional
Organizational unit	--orgunit	Optional
Job title	--title	Optional
Manager	--manager	Optional
Car license	--carlicense	Optional
	--noprivate	Optional
SSH Keys	--sshpubkey	Optional
Additional attributes	--addattr	Optional

[a] Required attributes must be set for every entry. Optional attributes may be set, while default attributes are automatically added with a pre-defined value unless a specific value is given.

[b] The script prompts for the new password, rather than accepting a value with the argument.

[c] When a user is created without specifying a UID number, then the user account is automatically assigned an ID number that is next available in the server or replica range. (Number ranges are described more in [Section 9.8, “Managing Unique UID and GID Number Assignments”](#).) This means that a user always has a unique number for its UID number and, if configured, for its private group.

If a number is *manually* assigned to a user entry, the server does not validate that the *uidNumber* is unique. It will allow duplicate IDs; this is expected (though discouraged) behavior for POSIX entries.

If two entries are assigned the same ID number, only the first entry is returned in a search for that ID number. However, both entries will be returned in searches for other attributes or with `ipa user-find --all`.

9.9.1. About Changing the Default User and Group Schema

It is possible to add or change the object classes and attributes used for user and group entries ([Section 9.9, “Managing User and Group Schema”](#)).

The IdM configuration provides some validation when object classes are changed:

- ▶ All of the object classes and their specified attributes must be known to the LDAP server.
- ▶ All default attributes that are configured for the entry must be supported by the configured object classes.

There are limits to the IdM schema validation, however. Most important, the IdM server does not check that the defined user or group object classes contain all of the required object classes for IdM entries. For example, all IdM entries require the **ipaobject** object class. However, when the user or group schema is changed, the server does not check to make sure that this object class is included; if the object class is accidentally deleted, then future entry add operations will fail.

Also, all object class changes are atomic, not incremental. The entire list of default object classes has to be defined every time there is a change. For example, a company may create a custom object class to store employee information like birthdays and employment start dates. The administrator cannot simply add the custom object class to the list; he must set the entire list of current default object classes *plus* the new object class. The *existing* default object classes must always be included when the configuration is updated. Otherwise, the current settings will be overwritten, which causes serious performance problems.

9.9.2. Applying Custom Object Classes to New User Entries

User and group accounts are created with a pre-defined set of LDAP object classes applied to the entry. Any attributes which belong to the object class can be added to the user entry.

While the standard and IdM-specific LDAP object classes will cover most deployment scenarios, administrators may have custom object classes with custom attributes which should be applied to user entries.

9.9.2.1. From the Web UI

1. Add all of the custom schema elements to the 389 Directory Server instance used by Identity Management. Adding schema elements is described in [the schema chapter of the Directory Server Administrator's Guide](#).
2. Open the **IPA Server** tab.
3. Select the **Configuration** subtab.
4. Scroll to the **User Options** area.

CONFIGURATION

↶ Reset ↗ Update

▼ SEARCH OPTIONS

Search size limit:

Search time limit:

▼ USER OPTIONS

User search fields:

Default e-mail domain for new users:

Default users group:

Home directory base:

Max. username length:

Password Expiration Notification (days):

Enable migration mode:

Default user objectclasses: [Delete](#)

5. At the bottom of the users area, click the **Add** link to add a new field for another object class.



IMPORTANT

Always include the *existing* default object classes when the configuration is updated. Otherwise, the current settings will be overwritten. If any object classes required by Identity Management are not included, then subsequent attempts to add an entry will fail with object class violations.

Default user objectclasses:

top	Delete
person	Delete
organizationalperson	Delete
inetorgperson	Delete
inetuser	Delete
posixaccount	Delete
krbprincipalaux	Delete
krbticketpolicyaux	Delete
ipaobject	Delete

[Add](#)

6. When the changes are complete, click the **Update** link at the top of the **Configuration** page.

9.9.2.2. From the Command Line

1. Add all of the custom schema elements to the 389 Directory Server instance used by Identity Management. Adding schema elements is described in [the schema chapter of the Directory Server Administrator's Guide](#).
2. Add the new object class to the list of object classes added to entries. The option for user object classes is `--userobjectclasses`.



IMPORTANT

Always include the *existing* default object classes when the configuration is updated. Otherwise, the current settings will be overwritten. If any object classes required by Identity Management are not included, then subsequent attempts to add an entry will fail with object class violations.

All object classes must be included in the list of object classes. The information passed with the `config-mod` command overwrites the previous values. This can be done by specifying each object class with a `--userobjectclasses` argument or by listing all of the object classes in a comma-separated list inside curly braces, such as `{attr1,attr2,attr3}`. For long lists, it can be easier to use the curly braces than multiple options. For example:

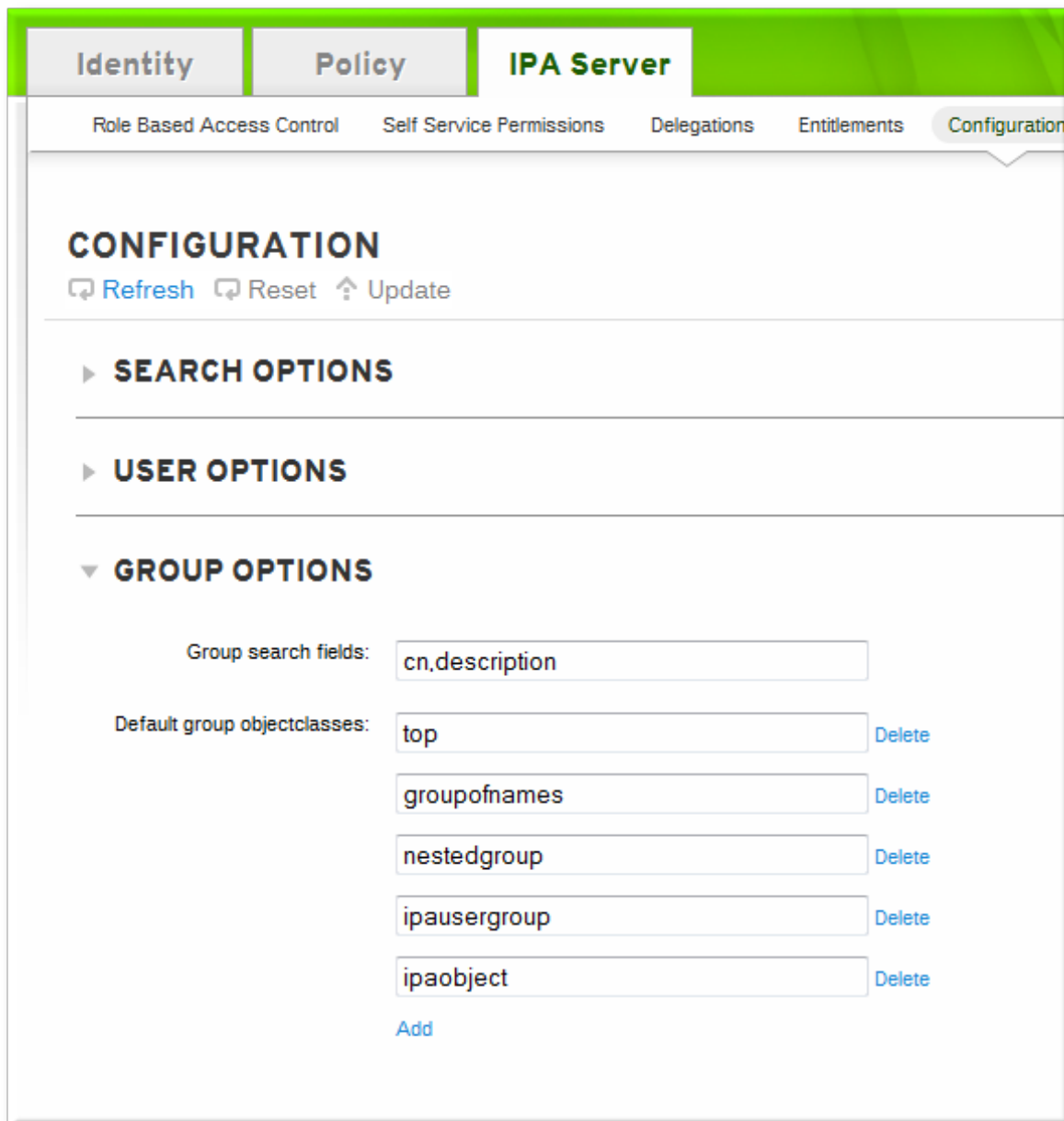
```
[bjensen@server ~]$ ipa config-mod --
userobjectclasses={top,person,organizationalperson,inetorgperson,inetuser,positixaccount,krbprincipalaux,krbticketpolicyaux,ipaobject,ipasshuser,employeeinfo}
```

9.9.3. Applying Custom Object Classes to New Group Entries

As with user entries, administrators may have custom object classes with custom attributes which should be applied to group entries. These can be added automatically by adding the object classes to the IdM server configuration.

9.9.3.1. From the Web UI

1. Add all of the custom schema elements to the 389 Directory Server instance used by Identity Management. Adding schema elements is described in [the schema chapter of the Directory Server Administrator's Guide](#).
2. Open the **IPA Server** tab.
3. Select the **Configuration** subtab.
4. Scroll to the **Group Options** area.



5. Click the **Add** link to add a new field for another object class.

**IMPORTANT**

Always include the *existing* default object classes when the configuration is updated. Otherwise, the current settings will be overwritten. If any object classes required by Identity Management are not included, then subsequent attempts to add an entry will fail with object class violations.

6. When the changes are complete, click the **Update** link at the top of the **Configuration** page.

9.9.3.2. From the Command Line

1. Add all of the custom schema elements to the 389 Directory Server instance used by Identity Management. Adding schema elements is described in [the schema chapter of the Directory Server Administrator's Guide](#).
2. Add the new object class to the list of object classes added to entries. The option for group object classes is **--groupobjectclasses**.

**IMPORTANT**

Always include the *existing* default object classes when the configuration is updated. Otherwise, the current settings will be overwritten. If any object classes required by Identity Management are not included, then subsequent attempts to add an entry will fail with object class violations.

All object classes must be included in the list of object classes. The information passed with the **config-mod** command overwrites the previous values. This can be done by specifying each object class with a **--groupobjectclasses** argument or by listing all of the object classes in a comma-separated list inside curly braces, such as `{attr1,attr2,attr3}`. For long lists, it can be easier to use the curly braces than multiple options. For example:

```
[bjensen@server ~]$ ipa config-mod --
groupobjectclasses={top,groupofnames,nestedgroup,ipausergroup,ipaobject,ipassh
user,employeegroup}
```

9.9.4. Specifying Default User and Group Attributes

Identity Management uses a template when it creates new entries.

For users, the template is very specific. Identity Management uses default values for several core attributes for IdM user accounts. These defaults can define actual values for user account attributes (such as the home directory location) or it can define the format of attribute values, such as the username length. These settings also define the object classes assigned to users.

For groups, the template only defines the assigned object classes.

These default definitions are all contained in a single configuration entry for the IdM server, **cn=ipaconfig,cn=etc,dc=example,dc=com**.

The configuration can be changed using the **ipa config-mod** command.

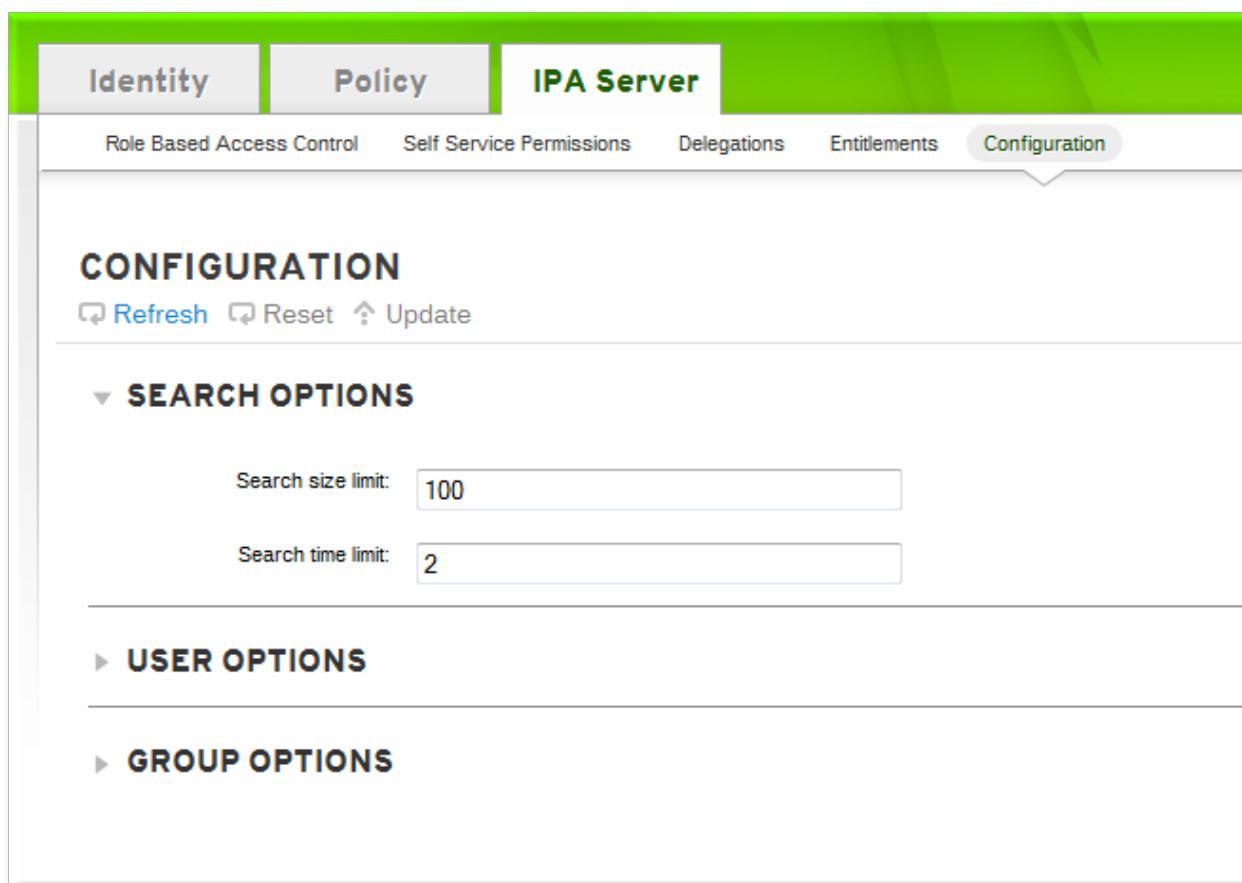
Table 9.3. Default User Parameters

Field	Command-Line Option	Descriptions
Maximum username length	--maxusername	Sets the maximum number of characters for usernames. The default value is eight.
Root for home directories	--homedirectory	Sets the default directory to use for user home directories. The default value is /home .
Default shell	--defaultshell	Sets the default shell to use for users. The default value is /bin/sh .
Default user group	--defaultgroup	Sets the default group to which all newly created accounts are added. The default value is ipausers , which is automatically created during the IdM server installation process.
Default e-mail domain	--emailldomain	Sets the email domain to use to create email addresses based on the new accounts. The default is the IdM server domain.
Search time limit	--searchtimelimit	Sets the maximum amount of time, in seconds, to spend on a search before the server returns results.
Search size limit	--searchrecordslimit	Sets the maximum number of records to return in a search.
User search fields	--usersearch	Sets the fields in a user entry that can be used as a search string. Any attribute listed has an index kept for that attribute, so setting too many attributes could affect server performance.
Group search fields	--groupsearch	Sets the fields in a group entry that can be used as a search string.
Certificate subject base		Sets the base DN to use when creating subject DNs for client certificates. This is configured when the server is set up.
Default user object classes	--userobjectclasses	Defines an object class that is used to create IdM user accounts. This can be invoked multiple times. The complete list of object classes must be given because the list is overwritten when the command is run.

Field	Command-Line Option	Descriptions
Default group object classes	--groupobjectclasses	Defines an object class that is used to create IdM group accounts. This can be invoked multiple times. The complete list of object classes must be given because the list is overwritten when the command is run.
Password expiration notification	--pwdexpnotify	Sets how long, in days, before a password expires for the server to send a notification.
Password plug-in features		Sets the format of passwords that are allowed for users.

9.9.4.1. Viewing Attributes from the Web UI

1. Open the **IPA Server** tab.
2. Select the **Configuration** subtab.
3. The complete configuration entry is shown in three sections, one for all search limits, one for user templates, and one for group templates.



9.9.4.2. Viewing Attributes from the Command Line

The **config-show** command shows the current configuration which applies to all new user accounts. By default, only the most common attributes are displayed; use the **--all** option to show the complete configuration.

```
[bjensen@server ~]$ kinit admin
[bjensen@server ~]$ ipa config-show --all
dn: cn=ipaConfig,cn=etc,dc=example,dc=com
Maximum username length: 32
Home directory base: /home
Default shell: /bin/sh
Default users group: ipausers
Default e-mail domain: example.com
Search time limit: 2
Search size limit: 100
User search fields: uid,givenname,sn,telephonenumber,ou,title
Group search fields: cn,description
Enable migration mode: FALSE
Certificate Subject base: O=EXAMPLE.COM
Default group objectclasses: top, groupofnames, nestedgroup, ipausergroup, ipaobject
Default user objectclasses: top, person, organizationalperson, inetorgperson,
inetuser, posixaccount, krbprincipalaux, krbticketpolicyaux, ipaobject, ipasshuser
Password Expiration Notification (days): 4
Password plugin features: AllowNThash
SELinux user map order: guest_u:s0$xguest_u:s0$user_u:s0$staff_u:s0-
s0:c0.c1023$unconfined_u:s0-s0:c0.c1023
Default SELinux user: unconfined_u:s0-s0:c0.c1023
Default PAC types: MS-PAC, nfs:NONE
cn: ipaConfig
objectclass: nsContainer, top, ipaGuiConfig, ipaConfigObject
```

9.10. Managing User Groups

User groups are a way of centralizing control over important management tasks, particularly access control and password policies. Four groups are created during the installation, specifically for use by IdM operations:

- ▶ ipausers, which contains all users.
- ▶ admins, which contains administrative users. The initial **admin** user belongs to this group.
- ▶ trusted admins, which contains administrative users used to manage Active Directory trusts.
- ▶ editors, which is a special group for users working through the web UI. This group allows users to *edit* other users' entries, though without all of the rights of the admin user.



NOTE

Some operating systems limit the number of groups that can be assigned to system users. For example, Solaris and AIX systems both limit users to 16 groups per user. This can be an issue when using nested groups, when a user may be automatically added to multiple groups.

9.10.1. Types of Groups in IdM

All groups in Identity Management are essentially *static* groups, meaning that the members of the group are manually and explicitly added to the group. Tangentially, IdM allows *nested groups*, where a group is a member of another group. In that case, all of the group members of the member group automatically belong to the parent group, as well.

Automembership rules allow new users to be added to groups automatically, using attributes in the user entry to determine what groups the user should belong to. Automembership rules are covered in [Chapter 21, *Defining Automatic Group Membership for Users and Hosts*](#).

The way groups are defined in IdM is simple, but there are different configuration options for groups which can change what kinds of members can be added.

Some types of groups in IdM are based not on how members are added, but rather where the member entries originate:

- ▶ Internal groups (the default), where all members belong to the IdM domain.
- ▶ External groups, where some or all of the members exist in an identity store outside of the IdM domain. This can be a local system, an Active Directory domain, or a directory service.

Another difference is whether groups are created with POSIX attributes. Most Linux users require some kind of POSIX attributes, but groups which interact with Active Directory or Samba must be non-POSIX. By default, IdM creates non-POSIX groups, but there is an explicit option to create a POSIX group (adding the `posixgroup` object class).

Because groups are easy to create, it is possible to be very flexible in what groups to create and how they are organized. Groups can be defined around organizational divisions like departments, physical locations, or IdM or infrastructure usage guidelines for access controls.

9.10.2. Group Object Classes

When a group entry is created, it is automatically assigned certain LDAP object classes. (LDAP object classes and attributes are discussed in detail in the *Directory Server Deployment Guide* and the *Directory Server Schema Reference*.) For groups, only two attributes truly matter: the name and the description.

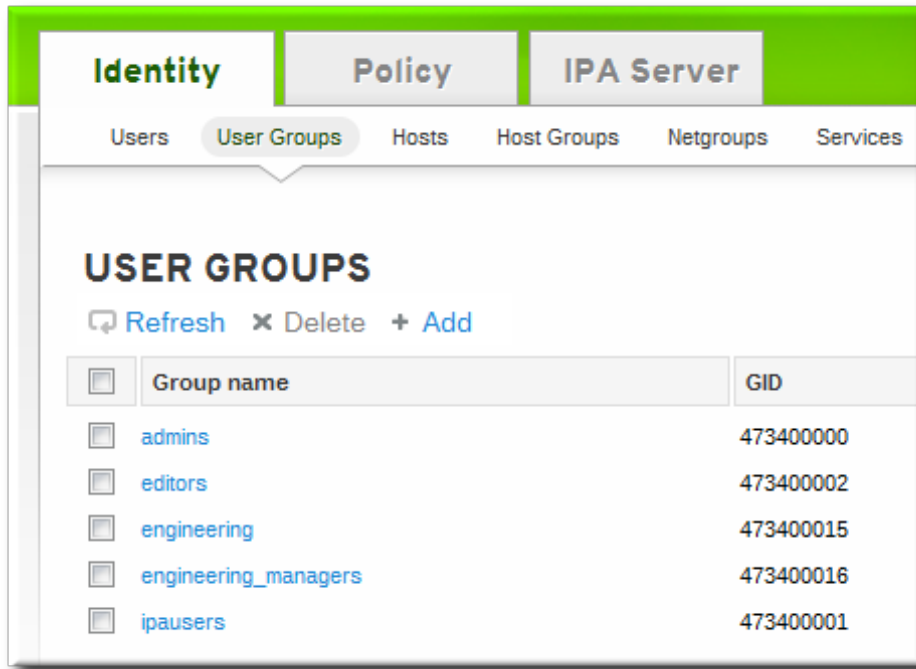
Table 9.4. Default Identity Management Group Object Classes

Description	Object Classes
IdM object classes	ipaobject ipausergroup nestedgroup
Group object classes	groupofnames

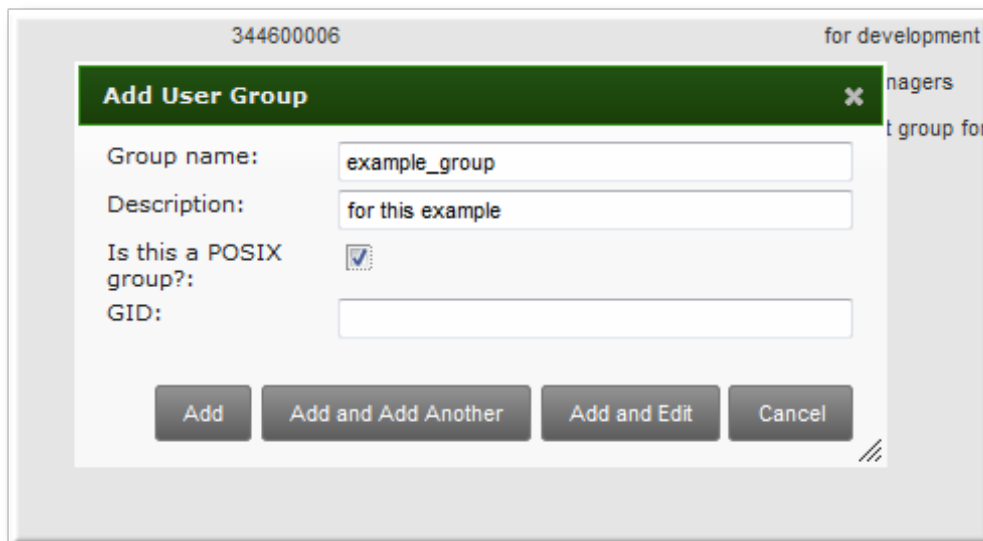
9.10.2.1. Creating User Groups

9.10.2.1.1. With the Web UI

1. Open the **Identity** tab, and select the **User Groups** subtab.
2. Click the **Add** link at the top of the groups list.



3. Enter all of the information for the group.



- » A unique name. This is the identifier used for the group in the IdM domain, and it cannot be changed after it is created. The name cannot contain spaces, but other separators like an underscore (_) are allowed.
- » A text description of the group.
- » Whether the group is a POSIX group, which adds Linux-specific information to the entry. By default, all groups are POSIX groups unless they are explicitly configured not to be. Non-POSIX groups can be created for interoperability with Windows or Samba.
- » Optionally, the GID number for the group. All POSIX groups require a GID number, but IdM automatically assigns the GID number.

Setting a GID number is not necessary because of the risk of collisions. If a GID number is given manually, IdM will not override the specified GID number, even if it is not unique.

4. Click the **Add and Edit** button to go immediately to the member selection page.

5. Select the members, as described in [Section 9.10.2.2.1, "With the Web UI \(Group Page\)"](#).

9.10.2.1.2. With the Command Line

New groups are created using the **group-add** command. (This adds only the group; members are added separately.)

Two attributes are always required: the group name and the group description. If those attributes are not given as arguments, then the script prompts for them.

```
[bjensen@server ~]$ ipa group-add groupName --desc="description" [--nonposix]
```

Additionally, there is one other configuration option, **--nonposix**. (By default, all groups are created as POSIX groups.) To enable interoperability with Windows users and groups and programs like Samba, it is possible to create non-POSIX groups by using the **--nonposix** option. This option tells the script not to add the **posixGroup** object class to the entry.

For example:

```
[bjensen@server ~]$ ipa group-add examplegroup --desc="for examples" --nonposix
-----
Added group "examplegroup"
-----
  Group name: examplegroup
  Description: for examples
  GID: 855800010
```

When no arguments are used, the command prompts for the required group account information:

```
[bjensen@server ~]$ ipa group-add
Group name: engineering
Description: for engineers
-----
Added group "engineering"
-----
  Group name: engineering
  Description: for engineers
  GID: 387115842
```



IMPORTANT

When a group is created without specifying a GID number, then the group entry is assigned the ID number that is next available in the server or replica range. (Number ranges are described more in [Section 9.8, "Managing Unique UID and GID Number Assignments"](#).) This means that a group always has a unique number for its GID number.

If a number is *manually* assigned to a group entry, the server does not validate that the **gidNumber** is unique. It will allow duplicate IDs; this is expected (though discouraged) behavior for POSIX entries.

If two entries are assigned the same ID number, only the first entry is returned in a search for that ID number. However, both entries will be returned in searches for other attributes or with **ipa group-find --all**.

NOTE

You cannot edit the group name. The group name is the primary key, so changing it is the equivalent of deleting the group and creating a new one.

9.10.2.2. Adding Group Members**9.10.2.2.1. With the Web UI (Group Page)****NOTE**

This procedure adds a user to a group. User groups can contain other user groups as their members. These are *nested* groups.

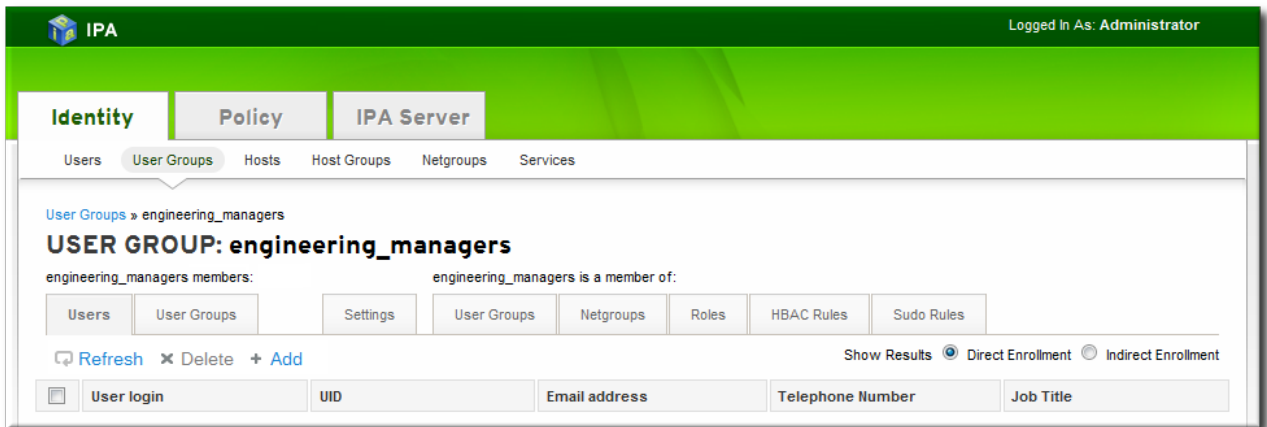
It can take up to several minutes for the members of the child group to show up as members of the parent group. This is especially true on virtual machines where the nested groups have more than 500 members.

When creating nested groups, be careful not to create *recursive* groups. For example, if GroupA is a member of GroupB, do not add GroupB as a member of GroupA. Recursive groups are not supported and can cause unpredictable behavior.

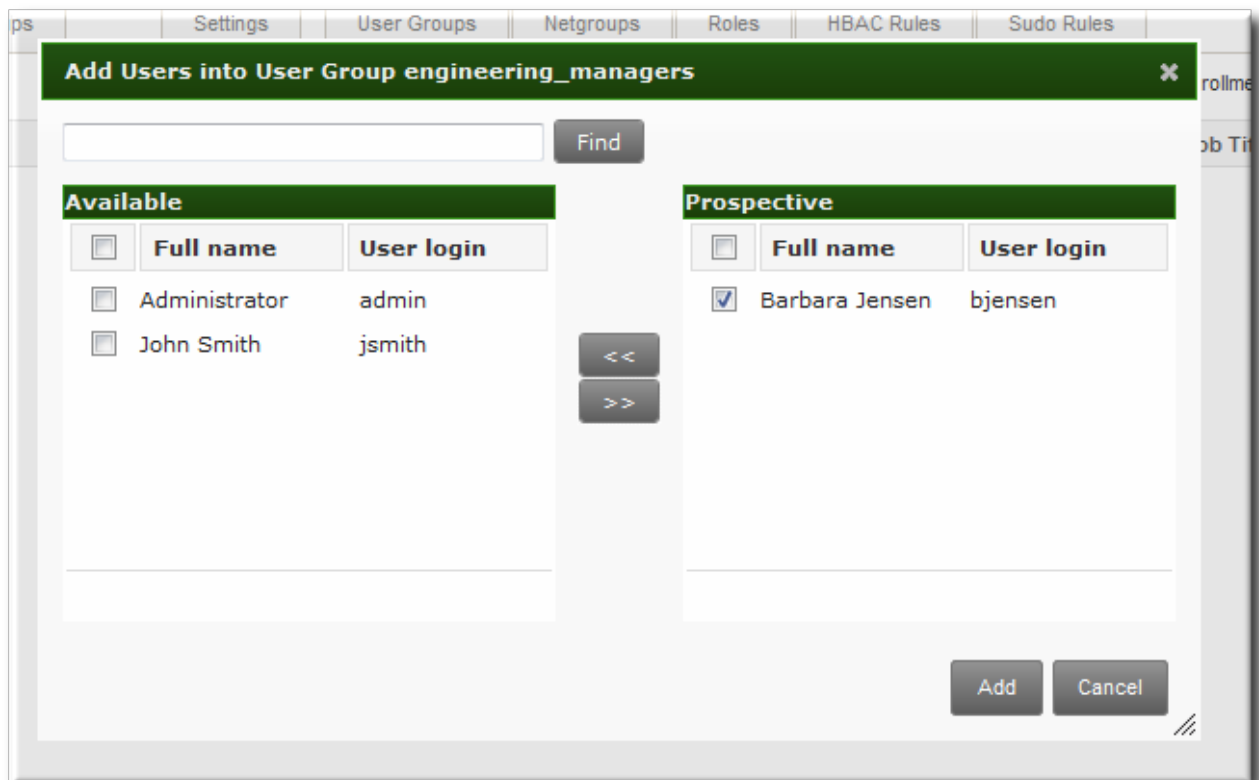
1. Open the **Identity** tab, and select the **User Groups** subtab.
2. Click the name of the group to which to add members.

<input type="checkbox"/>	Group name	GID
<input type="checkbox"/>	admins	473400000
<input type="checkbox"/>	editors	473400002
<input type="checkbox"/>	engineering	473400015
<input type="checkbox"/>	engineering_managers	473400016
<input type="checkbox"/>	ipausers	473400001

3. Click the **Add** link at the top of the task area.



4. Click the checkbox by the names of the users to add, and click the right arrows button, >>, to move the names to the selection box.



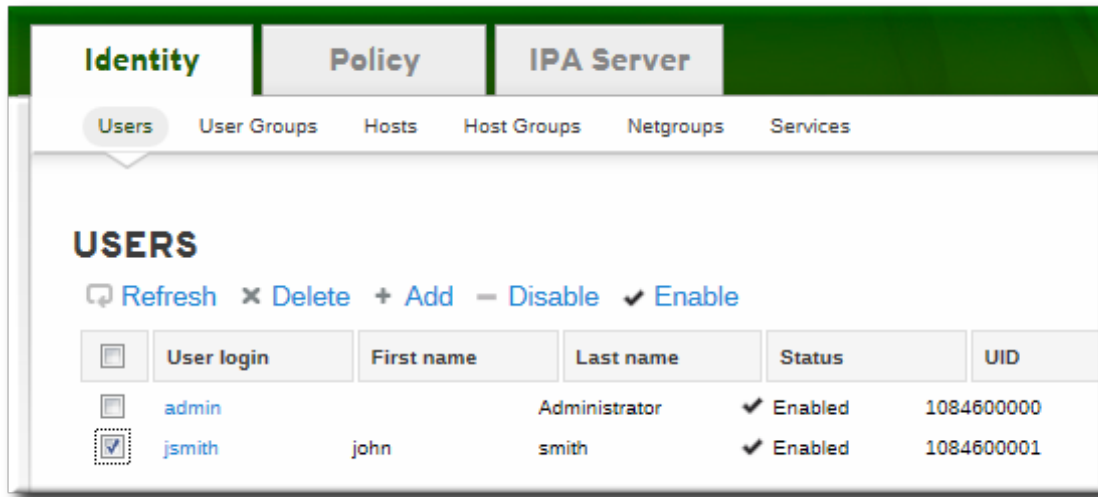
5. Click the **Add** button.

Group members can be users or other user groups. It can take up to several minutes for the members of the child group to show up as members of the parent group. This is especially true on virtual machines where the nested groups have more than 500 members.

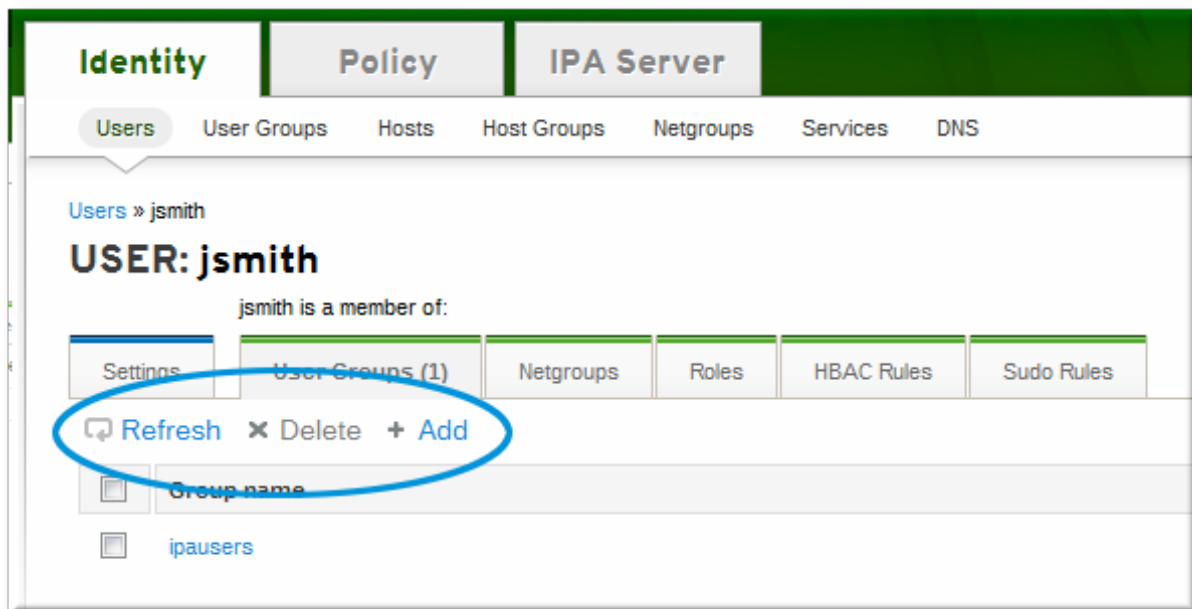
9.10.2.2.2. With the Web UI (User's Page)

Users can also be added to a group through the user's page.

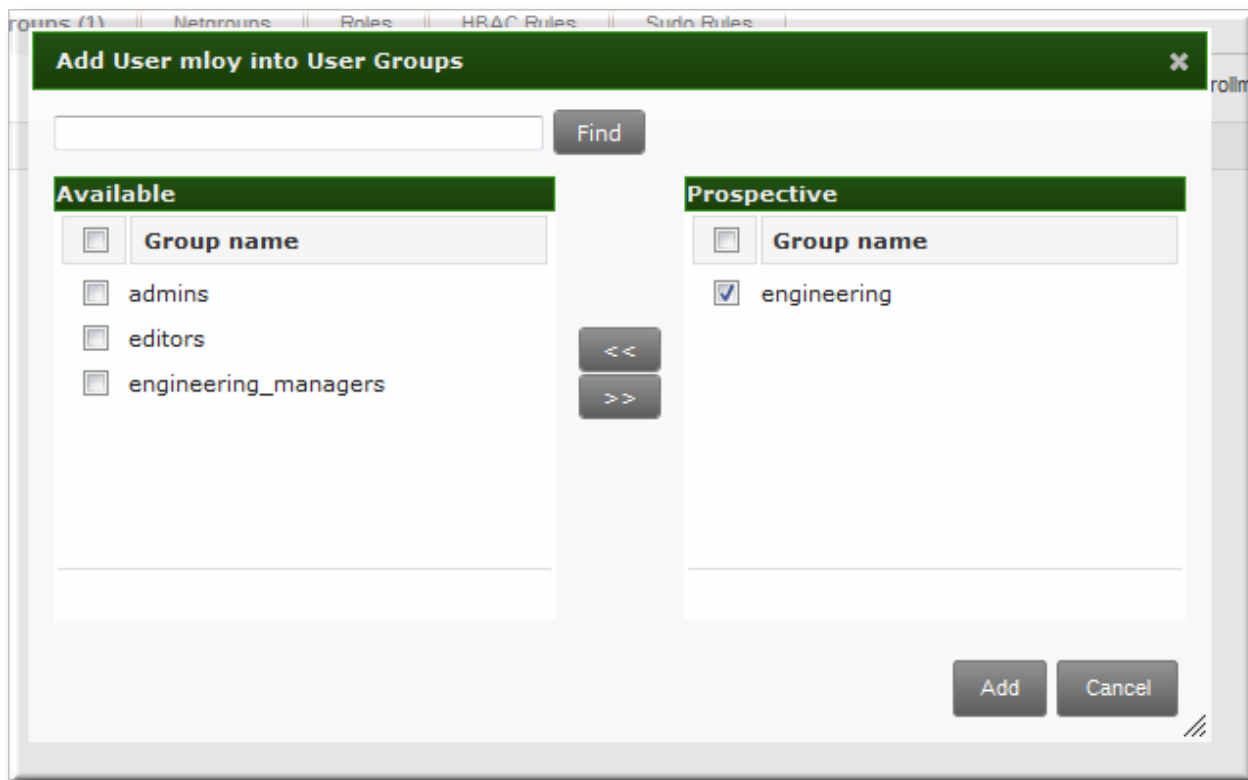
1. Open the **Identity** tab, and select the **Users** subtab.
2. Click the name of the user to edit.



3. Open the **User Groups** tab on the user entry page.
4. Click the **Add** link at the top of the task area.



5. Click the checkbox by the names of the groups for the user to join, and click the right arrows button, >>, to move the groups to the selection box.



6. Click the **Add** button.

9.10.2.2.3. With the Command Line

Members are added to a group using the **group-add-member** command. This command can add both users as group members and other groups as group members.

The syntax of the **group-add-member** command requires only the group name and the users or groups to add. Lists of entries can be set by using the option multiple times with the same command invocation or by listing the options in a comma-separated list inside curly braces, such as `--option={val1,val2,val3}`.

```
[bjensen@server ~]$ ipa group-add-member groupName [--users=user1 ...] [--groups=groups1 ...]
```

For example, this adds three users to the **engineering** group:

```
[bjensen@server ~]$ ipa group-add-member engineering --users=jsmith --users=bjensen
--users=mreynolds
  Group name: engineering
  Description: for engineers
  GID: 387115842
  Member users: jsmith,bjensen,mreynolds
  -----
  Number of members added 3
  -----
```

Likewise, other groups can be added as members, which creates nested groups:

```
[bjensen@server ~]$ ipa group-add-member engineering --groups=dev --groups=qe1 --
groups=dev2
  Group name: engineering
  Description: for engineers
  GID: 387115842
```

```
Member groups: dev,qe1,dev2
```

```
-----
```

```
Number of members added 3
```

```
-----
```

When displaying nested groups, members are listed as members and the members of any member groups are listed as indirect members. For example:

```
[bjensen@server ~]$ ipa group-show examplegroup
Group name: examplegroup
Description: for examples
GID: 93200002
Member users: jsmith,bjensen,mreynolds
Member groups: californiausers
Indirect Member users: sbeckett,acalavicci
```

It can take up to several minutes for the members of the child group to show up as members of the parent group. This is especially true on virtual machines where the nested groups have more than 500 members.



NOTE

When creating nested groups, be careful not to create *recursive* groups. For example, if GroupA is a member of GroupB, do not add GroupB as a member of GroupA. Recursive groups are not supported and can cause unpredictable behavior.

A group member is removed using the **group-remove-member** command.

```
[bjensen@server ~]$ ipa group-remove-member engineering --users=jsmith

Group name: engineering
Description: for engineers
GID: 855800009
Member users: bjensen,mreynolds
-----
Number of members removed 1
-----
```

9.10.2.2.4. Viewing Direct and Indirect Members of a Group

User groups can contain other user groups as members. This is called a *nested group*. This also means that a group has two types of members:

- ▶ *Direct members*, which are added explicitly to the group
- ▶ *Indirect members*, which are members of the group because they are members of another user group which is a member of the group

The IdM web UI has an easy way to view direct and indirect members of a group. The members list is filtered by member type, and this can be toggled by selecting the **Direct** and **Indirect** radio buttons at the top right corner of the members list.

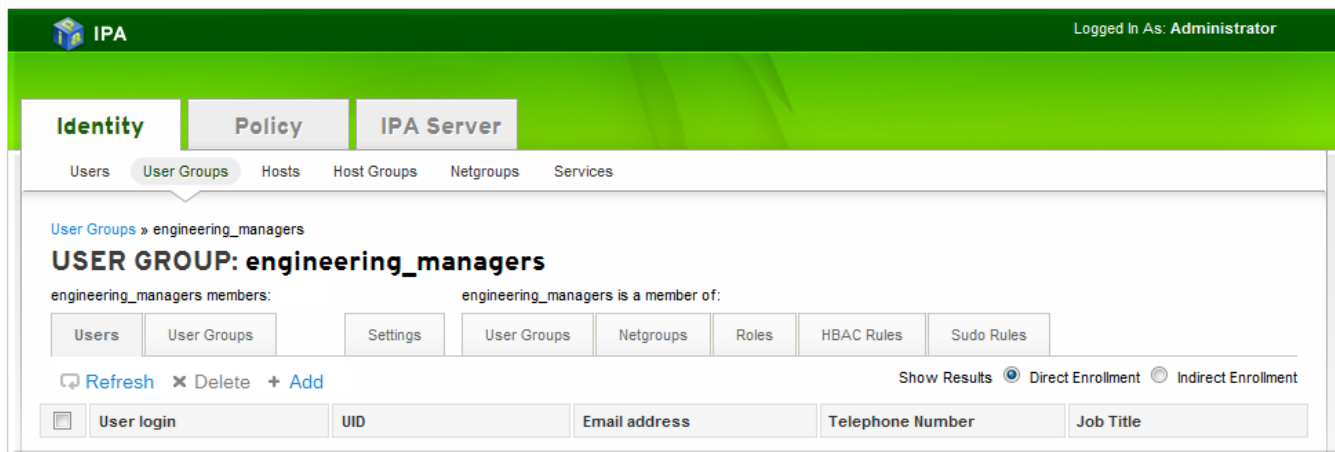


Figure 9.4. Indirect and Direct Members

Being able to track indirect members makes it easier to assign group membership properly, without duplicating membership.

9.10.2.3. Deleting User Groups

When a user group is deleted, only the group is removed. The user accounts of group members (including nested groups) are not affected. Additionally, any access control delegations that apply to that group are removed.

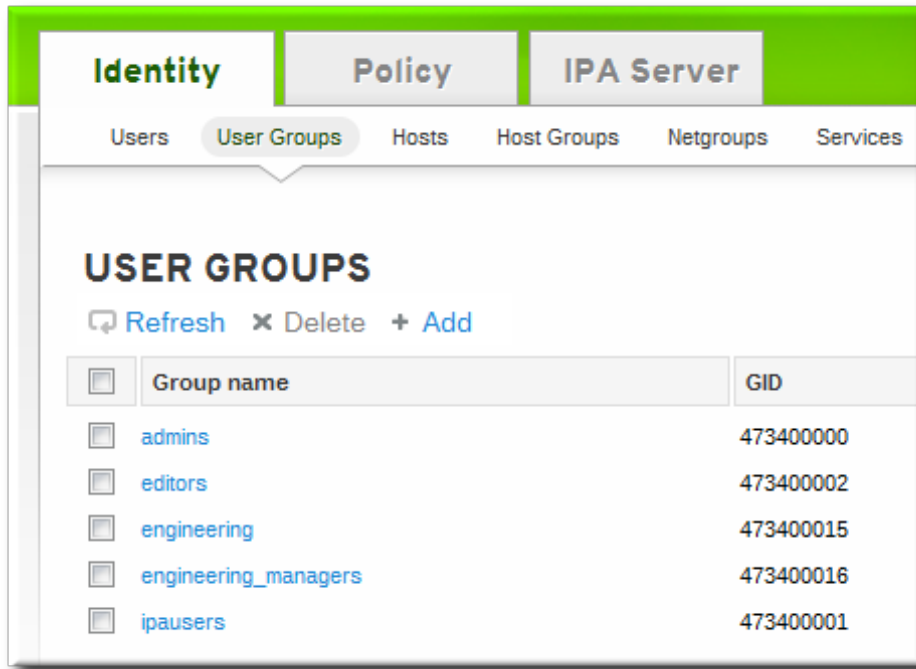


WARNING

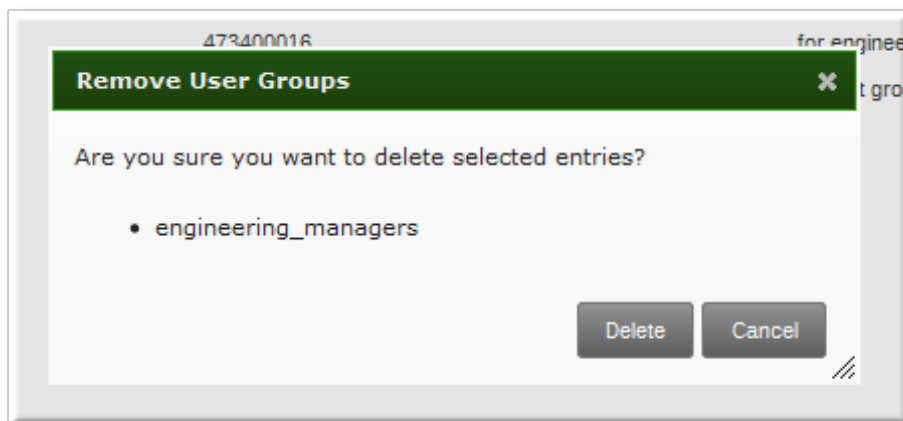
Deleting a group is immediate and permanent. If any group configuration (such as delegations) is required, it must be assigned to another group or a new group created.

9.10.2.3.1. With the Web UI

1. Open the **Identity** tab, and select the **User Groups** subtab.
2. Select the checkbox by the name of the group to delete.



3. Click the **Delete** link at the top of the task area.
4. When prompted, confirm the delete action.



9.10.2.3.2. With the Command Line

The `group-del` command to deletes the specified group. For example:

```
[bjensen@server ~]$ ipa group-del examplegroup
```

9.10.3. Searching for Users and Groups

The user searches in IdM can be run against simple (full word) or partial search strings. The range of attributes that are searched is configured as part of the default IdM configuration, as in [Section 9.9.4, “Specifying Default User and Group Attributes”](#).

9.10.3.1. Setting Search Limits

9.10.3.1.1. Types of Search Limits and Where They Apply

Some searches can result in a large number of entries being returned, possibly even all entries. Search limits improve overall server performance by limiting how long the server spends in a search and how many entries are returned.

Search limits have a dual purpose to improve server performance by reducing the search load and to improve usability by returning a smaller — and therefore easier to browse — set of entries.

The IdM server has several different limits imposed on searches:

- ▶ *The search limit configuration for the IdM server.* This is a setting for the IdM server itself, which is applied to all requests sent to the server from all IdM clients, the IdM CLI tools, and the IdM web UI for normal page display.

By default, this limit is 100 entries.

- ▶ *The time limit configuration for the IdM server.* Much like the search size limit, the time limit sets a maximum amount of time that the IdM server, itself, waits for searches to run. Once it reaches that limit, the server stops the search and returns whatever entries were returned in that time.

By default, this limit is two seconds.

- ▶ *The page size limit.* Although not strictly a search limit, the page size limit does limit how many entries are returned per page. The server returns the set of entries, up to the search limit, and then sorts and displays 20 entries per page. Paging results makes the results more understandable and more viewable.

This is hard-coded to 20 for all searches.

- ▶ *The LDAP search limit (--pkey option).* All searches performed in the UI, and CLI searches which use the **--pkey** option, override the search limit set in the IdM server configuration and use the search limit set in the underlying LDAP directory.

By default, this limit is 2000 entries. It can be edited by editing the 389 Directory Server configuration.

9.10.3.1.2. Setting IdM Search Limits

Search limits set caps on the number of records returned or the time spent searching when querying the database for user or group entries. There are two types of search limits: time limits and size (number) limits.

With the default settings, users are limited to two-second searches and no more than 100 records returned per search.

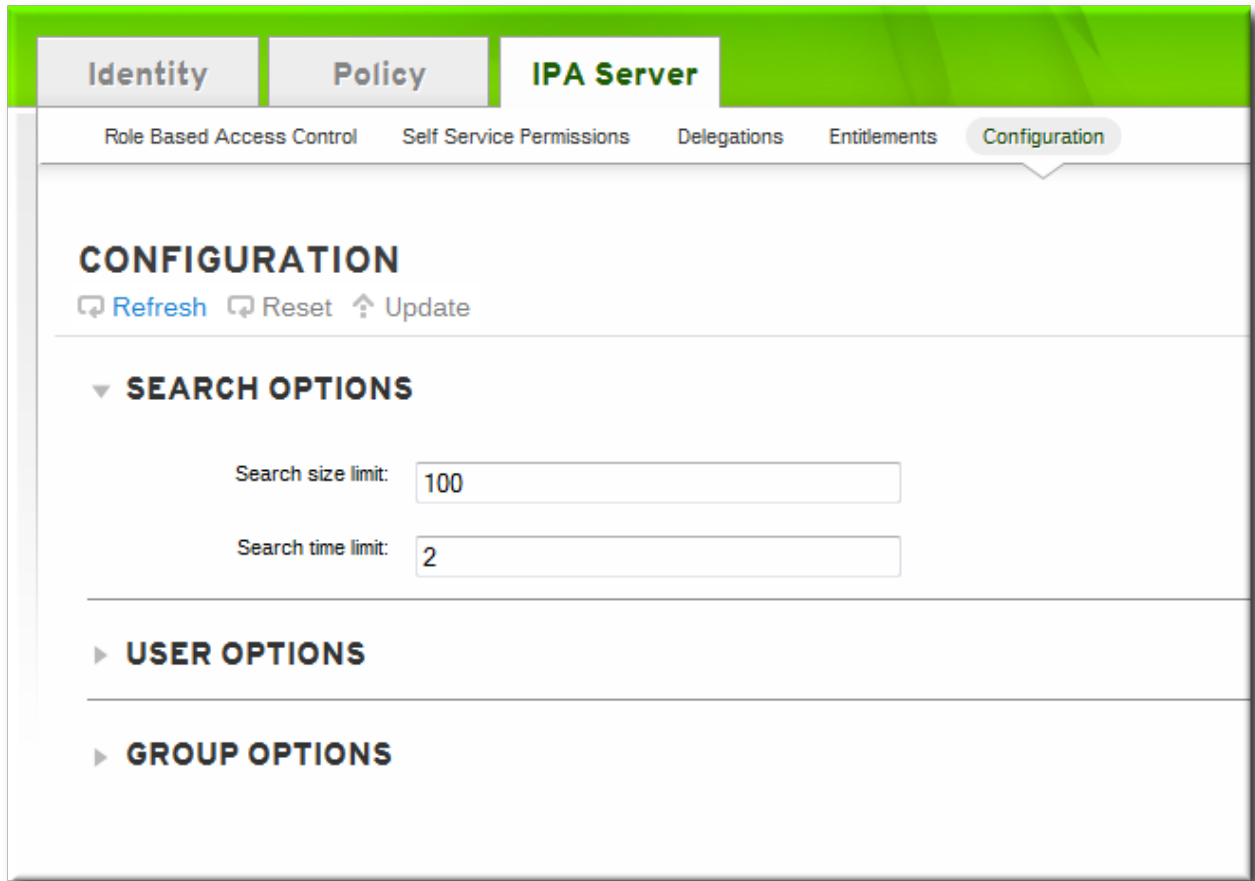


IMPORTANT

Setting search size or time limits too high can negatively affect IdM server performance.

9.10.3.1.2.1. With the Web UI

1. Open the **IPA Server** tab.
2. Select the **Configuration** subtab.
3. Scroll to the **Search Options** area.



4. Change the search limit settings.

- *Search size limit*, the maximum number of records to return in a search.
- *Search time limit*, the maximum amount of time, in seconds, to spend on a search before the server returns results.



TIP

Setting the time limit or size limit value to -1 means that there are no limits on searches.

5. When the changes are complete, click the **Update** link at the top of the **Configuration** page.

9.10.3.1.2.2. With the Command Line

The search limits can be changed using the `config-mod` command.

```
[bjensen@server ~]$ ipa config-mod --searchtimelimit=5 --searchrecordslimit=500
```

```
Max. username length: 32
Home directory base: /home
Default shell: /bin/sh
Default users group: ipausers
Default e-mail domain for new users: example.com
Search time limit: 5
Search size limit: 50
User search fields: uid,givenname,sn,telephonenumber,ou,title
```

```
Group search fields: cn,description
Enable migration mode: FALSE
Certificate Subject base: O=EXAMPLE.COM
Password Expiration Notification (days): 4
```

**TIP**

Setting the time limit or size limit value to -1 means that there are no limits on searches.

9.10.3.1.3. Overriding the Search Defaults

Part of the server configuration is setting global defaults for size and time limits on searches. While these limits are always enforced in the web UI, they can be overridden with any *** -find** command run through the command line.

The **--sizelimit** and **--timelimit** options set alternative size and time limits, respectively, for that specific command run. The limits can be higher or lower, depending on the kinds of results you need.

For example, if the default time limit is 60 seconds and a search is going to take longer, the time limit can be increased to 120 seconds:

```
[jsmith@ipaserver ~]$ ipa user-find smith --timelimit=120
```

9.10.3.2. Setting Search Attributes

A search for users or groups does not automatically search every possible attribute for that attribute. Rather, it searches a specific subset of attributes, and that list is configurable.

When adding attributes to the user or group search fields, make sure that there is a corresponding index within the LDAP directory for that attribute. Searches are performed based on indexes. Most standard LDAP attributes have indexes, but any custom attributes must have indexes created for them. Creating indexes is described in the [indexes chapter in the Directory Server Administrator's Guide](#).

9.10.3.2.1. Default Attributes Checked by Searches

By default, there are six attributes that are indexed for user searches and two that are indexed for group searches. These are listed in [Table 9.5, "Default Search Attributes"](#). All search attributes are searched in a user/group search.

Table 9.5. Default Search Attributes

User Search Attributes	
First name	Last name
Login ID	Job title
Organizational unit	Phone number
Group Search Attributes	
Name	Description

The attributes which are searched in user and group searches can be changed, as described in [Section 9.10.3.2, "Setting Search Attributes"](#) and [Section 9.10.3.2.3, "Changing Group Search Attributes"](#).

9.10.3.2.2. Changing User Search Attributes

9.10.3.2.2.1. From the Web UI

1. Open the **IPA Server** tab.
2. Select the **Configuration** subtab.
3. Scroll to the **User Options** area.

The screenshot shows the 'CONFIGURATION' page with the 'USER OPTIONS' section expanded. The 'User search fields' field contains the text 'uid,givenname,sn,telephonenumber,ou'. Other fields include 'Search size limit' (100), 'Search time limit' (2), 'Default e-mail domain for new users' (example.com), 'Default users group' (ipausers), 'Home directory base' (/home), 'Max. username length' (32), 'Password Expiration Notification (days)' (4), and 'Enable migration mode' (unchecked). A 'Delete' button is visible at the bottom right of the 'Default user objectclasses' field.

4. Add any additional search attributes, in a comma-separated list, in the **User search fields** field.
5. When the changes are complete, click the **Update** link at the top of the **Configuration** page.

9.10.3.2.2. From the Command Line

To change the search attributes, use the `--usersearch` option to set the attributes for user searches.

```
[bjensen@server ~]$ ipa config-mod --usersearch={uid,givenname,sn,telephonenumber,ou,title}
```


**NOTE**

Always give the complete list of search attributes. Whatever values are passed with the configuration argument overwrite the previous settings.

This can be done by specifying each attribute with a `--usersearch` argument or by listing all of the attributes in a comma-separated list inside curly braces, such as `{attr1,attr2,attr3}`. For long lists, it can be easier to use the curly braces than multiple options.

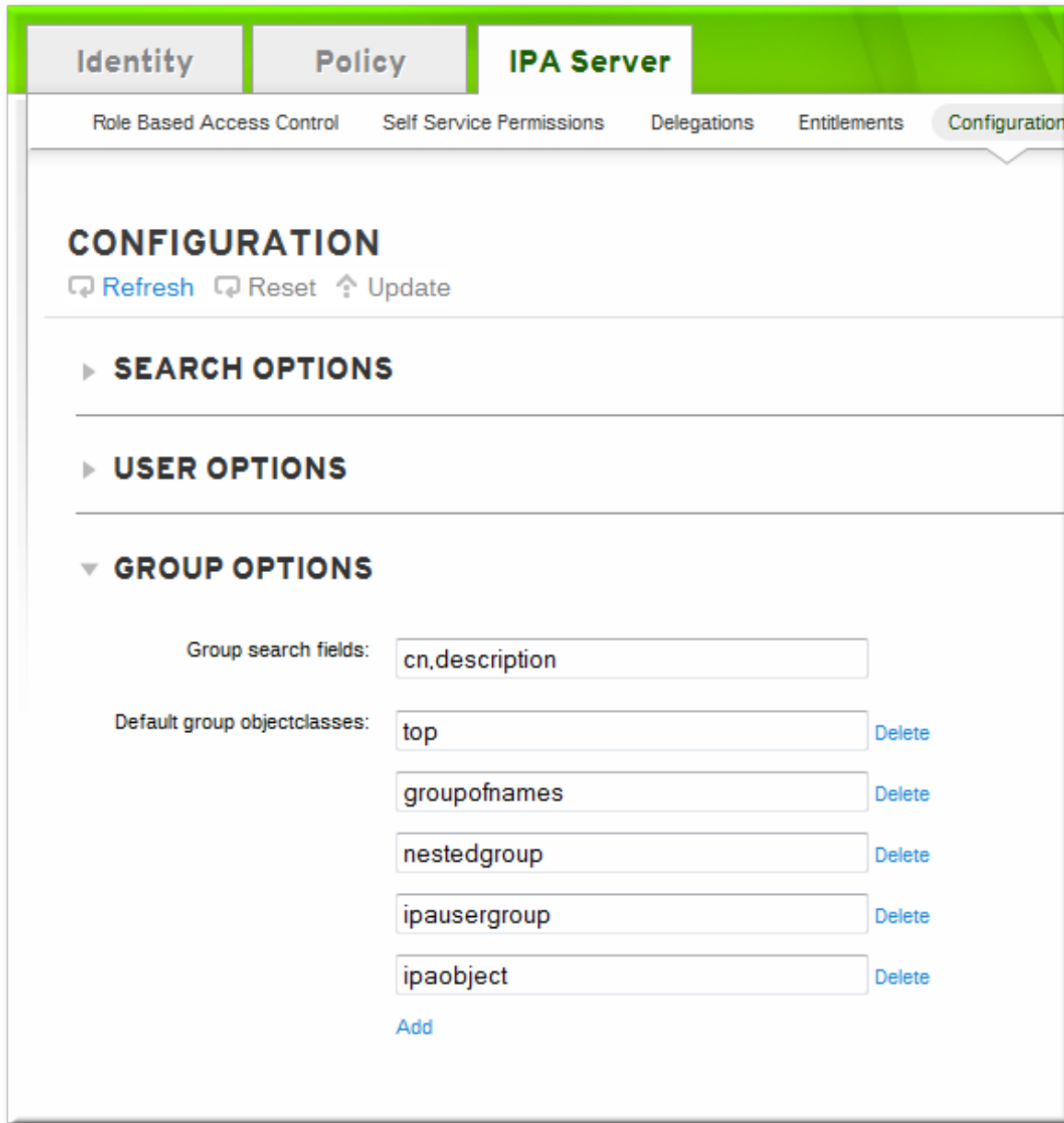
9.10.3.2.3. Changing Group Search Attributes

A search for users or groups does not automatically search every possible attribute for that attribute. Rather, it searches a specific subset of attributes, and that list is configurable.

When adding attributes to the user or group search fields, make sure that there is a corresponding index within the LDAP directory for that attribute. Searches are performed based on indexes. Most standard LDAP attributes have indexes, but any custom attributes must have indexes created for them. Creating indexes is described in the [indexes chapter in the Directory Server Administrator's Guide](#).

9.10.3.2.3.1. From the Web UI

1. Open the **IPA Server** tab.
2. Select the **Configuration** subtab.
3. Scroll to the **Group Options** area.



4. Add any additional search attributes, in a comma-separated list, in the **Group search fields** field.
5. When the changes are complete, click the **Update** link at the top of the **Configuration** page.

9.10.3.2.3.2. From the Command Line

To change the search attributes, use the **--groupsearch** options to set the attributes for group searches.

```
[bjensen@server ~]$ ipa config-mod --groupsearch={cn,description}
```

**NOTE**

Always give the complete list of search attributes. Whatever values are passed with the configuration argument overwrite the previous settings.

This can be done by specifying each attribute with a **--groupsearch** argument or by listing all of the attributes in a comma-separated list inside curly braces, such as `{attr1,attr2,attr3}`. For long lists, it can be easier to use the curly braces than multiple options.

9.10.3.2.4. Limits on Attributes Returned in Search Results

Searches can be performed on attributes that are not displayed in the UI. This means that entries can be returned in a search that do not appear to match the given filter. This is especially common if the search information is very short, which increases the likelihood of a match.

9.10.3.3. Searching for Groups Based on Type

Group definitions are simple, but because it is possible to create automember rules which automatically assign entries to groups, nested groups which include members implicitly, and groups based on member attributes such as POSIX, the reality of the group definitions can be very complex.

There are numerous different options with the **group-find** command which allow groups to be searched based on who the members are and are not and other attributes of the group definition.

For example, user private groups are never displayed in the IdM UI and are not returned in a regular search. Using the **--private** option, however, limits the search results to only private groups.

```
[root@server ~]# ipa group-find --private
-----
1 group matched
-----
  Group name: jsmith
  Description: User private group for jsmith
  GUID: 1084600001
-----
Number of entries returned 1
-----
```

Group searches can also be based on who does or does not belong to a group. This can mean single users, other groups, or even other configuration entries like roles and host-based access control definitions. For example, the first search shows what groups the user **jsmith** belongs to:

```
[root@server ~]# ipa group-find --user=jsmith
-----
1 group matched
-----
  Group name: ipausers
  Description: Default group for all users
  Member users: jsmith
-----
Number of entries returned 1
-----
```

The other search shows all the groups that **jsmith** does *not* belong to:

```
[root@server ~]# ipa group-find --no-user=jsmith
-----
3 groups matched
-----
  Group name: admins
  Description: Account administrators group
  GID: 1084600000
  Member users: admin

  Group name: editors
  Description: Limited admins who can edit other users
  GID: 1084600002

  Group name: trust admins
  Description: Trusts administrators group
  Member users: admin
-----
Number of entries returned 3
-----
```

Some useful group search options are listed in [Table 9.6, “Common Group Search Options”](#).

Table 9.6. Common Group Search Options

Option	Criteria Description
--private	Displays only private groups.
--gid	Displays only the group which matches the complete, specified GID.
--group-name	Displays only groups with that name or part of their name.
--users, --no-users	Displays only groups which have the given users as members (or which do not include the given user).
--in-hbacrules, --not-in-hbac-rules	Displays only groups which belong to a given host-based access control rule (or which do not belong to the rule, for the --not-in option). There are similar options to display (or not) groups which belong to a specified sudo rule and role.
--in-groups, --not-in-groups	Displays only groups which belong to another, specified group (or which do not belong to the group, for the --not-in option). There are similar options to display (or not) groups which belong to a specified netgroup.

[2] The key type is determined automatically from the key itself, if it is not included in the uploaded key.

[3] See [Section 9.8, “Managing Unique UID and GID Number Assignments”](#) for information on changing GID/UID assignment ranges.

Part III. Managing System Identities in a Linux Domain

Chapter 10. Managing Hosts

Both DNS and Kerberos are configured as part of the initial client configuration. This is required because these are the two services that bring the machine within the IdM domain and allow it to identify the IdM server it will connect with. After the initial configuration, IdM has tools to manage both of these services in response to changes in the domain services, changes to the IT environment, or changes on the machines themselves which affect Kerberos, certificate, and DNS services, like changing the client hostname.

This chapter describes how to manage identity services that relate directly to the client machine:

- ▶ DNS entries and settings
- ▶ Machine authentication
- ▶ Hostname changes (which affect domain services)

10.1. About Hosts, Services, and Machine Identity and Authentication

The basic function of an enrollment process is to create a *host* entry for the client machine in the IdM directory. This host entry is used to establish relationships between other hosts and even services within the domain. These relationships are part of *delegating* authorization and control to hosts within the domain.

A host entry contains all of the information about the client within IdM:

- ▶ Service entries associated with the host
- ▶ The host and service principal
- ▶ Access control rules
- ▶ Machine information, such as its physical location and operating system

Some services that run on a host can also belong to the IdM domain. Any service that can store a Kerberos principal or an SSL certificate (or both) can be configured as an IdM service. Adding a service to the IdM domain allows the service to request an SSL certificate or keytab from the domain. (Only the public key for the certificate is stored in the service record. The private key is local to the service.)

An IdM domain establishes a commonality between machines, with common identity information, common policies, and shared services. Any machine which belongs to a domain functions as a client of the domain, which means it uses the services that the domain provides. An IdM domain provides three main services specifically for machines:

An IdM domain establishes a commonality between machines, with common identity information, common policies, and shared services. Any machine which belongs to a domain functions as a client of the domain, which means it uses the services that the domain provides. An IdM domain (as described in [Section 1.2, “Bringing Linux Services Together”](#)) provides three main services specifically for machines:

- ▶ DNS
- ▶ Kerberos
- ▶ Certificate management

Machines are treated as another identity that is managed by IdM. Clients use DNS to identify IdM servers, services, and domain members — which, like user identities are stored in the 389 Directory Server instance for the IdM server. Like users, machines can be authenticated to the domain using Kerberos or

certificates to verify the machine's identity.

From the machine perspective, there are several tasks that can be performed that access these domain services:

- ▶ Joining the DNS domain (*machine enrollment*)
- ▶ Managing DNS entries and zones
- ▶ Managing machine authentication

Authentication in IdM includes machines as well as users. Machine authentication is required for the IdM server to trust the machine and to accept IdM connections from the client software installed on that machine. After authenticating the client, the IdM server can respond to its requests. IdM supports three different approaches to machine authentication:

- ▶ SSH keys. The SSH public key for the host is created and uploaded to the host entry. From there, the System Security Services Daemon (SSSD) uses IdM as an identity provider and can work in conjunction with OpenSSH and other services to reference the public keys located centrally in Identity Management. This is described in [Section 10.5, “Managing Public SSH Keys for Hosts”](#).
- ▶ Key tables (or *keytabs*, a symmetric key resembling to some extent a user password) and machine certificates. Kerberos tickets are generated as part of the Kerberos services and policies defined by the server. Initially granting a Kerberos ticket, renewing the Kerberos credentials, and even destroying the Kerberos session are all handled by the IdM services. Managing Kerberos is covered in [Chapter 17, Managing the Kerberos Domain](#).
- ▶ Machine certificates. In this case, the machine uses an SSL certificate that is issued by the IdM server's certificate authority and then stored in IdM's Directory Server. The certificate is then sent to the machine to present when it authenticates to the server. On the client, certificates are managed by a service called *certmonger*.

10.2. About Host Entry Configuration Properties

A host entry can contain information about the host that is outside its system configuration, such as its physical location, its MAC address, and keys and certificates.

This information can be set when the host entry is created if it is created manually; otherwise, most of that information needs to be added to the host entry after the host is enrolled in the domain.

Table 10.1. Host Configuration Properties

UI Field	Command-Line Option	Description
Description	--desc= <i>description</i>	A description of the host.
Locality	--locality= <i>locality</i>	The geographic location of the host.
Location	--location= <i>location</i>	The physical location of the host, such as its data center rack.
Platform	--platform= <i>string</i>	The host hardware or architecture.
Operating system	--os= <i>string</i>	The operating system and version for the host.

UI Field	Command-Line Option	Description
MAC address	<code>--macaddress=<i>address</i></code>	The MAC address for the host. This is a multi-valued attribute. The MAC address is used by the NIS plug-in to create a NIS ethers map for the host.
SSH public keys	<code>--sshpubkey=<i>string</i></code>	The full SSH public key for the host. This is a multi-valued attribute, so multiple keys can be set.
Principal name (not editable)	<code>--principalname=<i>principal</i></code>	The Kerberos principal name for the host. This defaults to the hostname during the client installation, unless a different principal is explicitly set in the <code>-p</code> . This can be changed using the command-line tools, but cannot be changed in the UI.
Set One-Time Password	<code>--password=<i>string</i></code>	Sets a password for the host which can be used in bulk enrollment.
-	<code>--random</code>	Generates a random password to be used in bulk enrollment.
-	<code>--certificate=<i>string</i></code>	A certificate blob for the host.
-	<code>--updatedns</code>	An attribute switch which sets whether the host can dynamically update its DNS entries if its IP address changes.

10.3. Disabling and Re-enabling Host Entries

Active hosts can be accessed by other services, hosts, and users within the domain. There can be situations when it is necessary to remove a host from activity. However, deleting a host removes the entry and all the associated configuration, and it removes it permanently.

10.3.1. Disabling Host Entries

Disabling a host prevents domain users from access it without permanently removing it from the domain. This can be done by using the `host-disable` command.

For example:

```
[jsmith@ipaserver ~]$ kinit admin
[jsmith@ipaserver ~]$ ipa host-disable server.example.com
```



IMPORTANT

Disabling a host entry not only disables that host. It disables every configured service on that host as well.

10.3.2. Re-enabling Hosts

Disabling a host essentially kills its current, active keytabs. Removing the keytabs effectively removes the host from the IdM domain without otherwise touching its configuration entry.

To re-enable a host, simply use the **ipa-getkeytab** command. The **-s** option sets which IdM server to request the keytab, **-p** gives the principal name, and **-k** gives the file to which to save the keytab.

For example, requesting a new host keytab:

```
[jsmith@ipaserver ~]$ ipa-getkeytab -s ipaserver.example.com -p
host/server.example.com -k /etc/krb5.keytab -D
fqdn=server.example.com,cn=computers,cn=accounts,dc=example,dc=com -w password
```

If the **ipa-getkeytab** command is run on an active IdM client or server, then it can be run without any LDAP credentials (**-D** and **-w**). The IdM user uses Kerberos credentials to authenticate to the domain. To run the command directly on the disabled host, then supply LDAP credentials to authenticate to the IdM server. The credentials should correspond to the host or service which is being re-enabled.

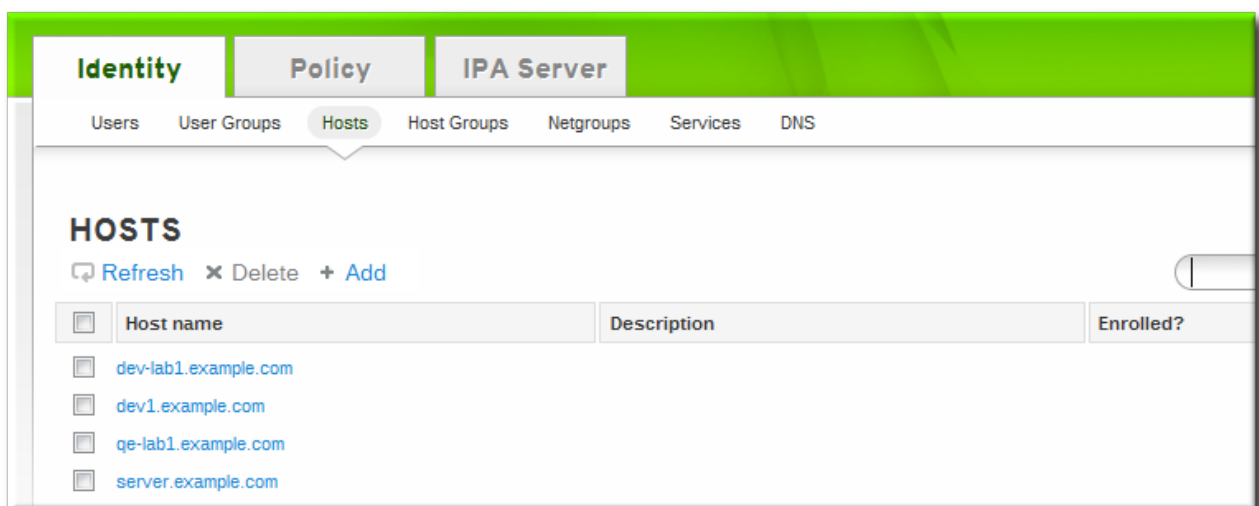
10.4. Creating Certificates for Hosts

By default, the IdM server has an integrated certificate authority. This CA can be used to create, revoke, and issue certificates for hosts in the IdM domain.

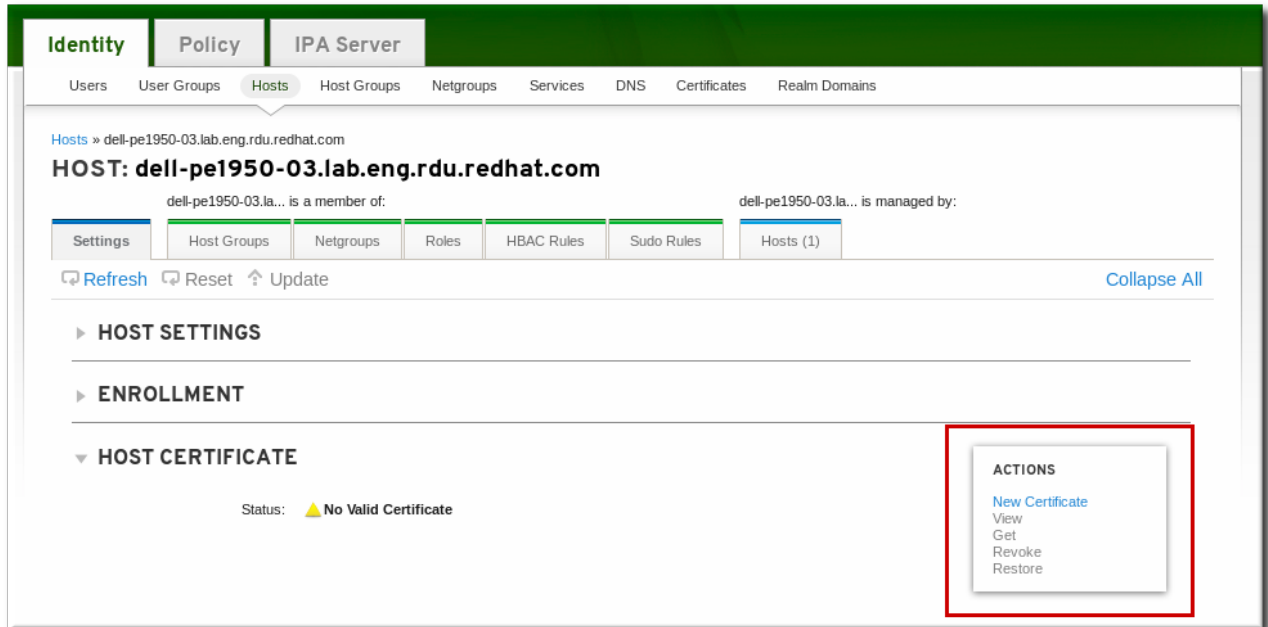
10.4.1. Showing Certificates

10.4.1.1. In the Host Entry in the UI

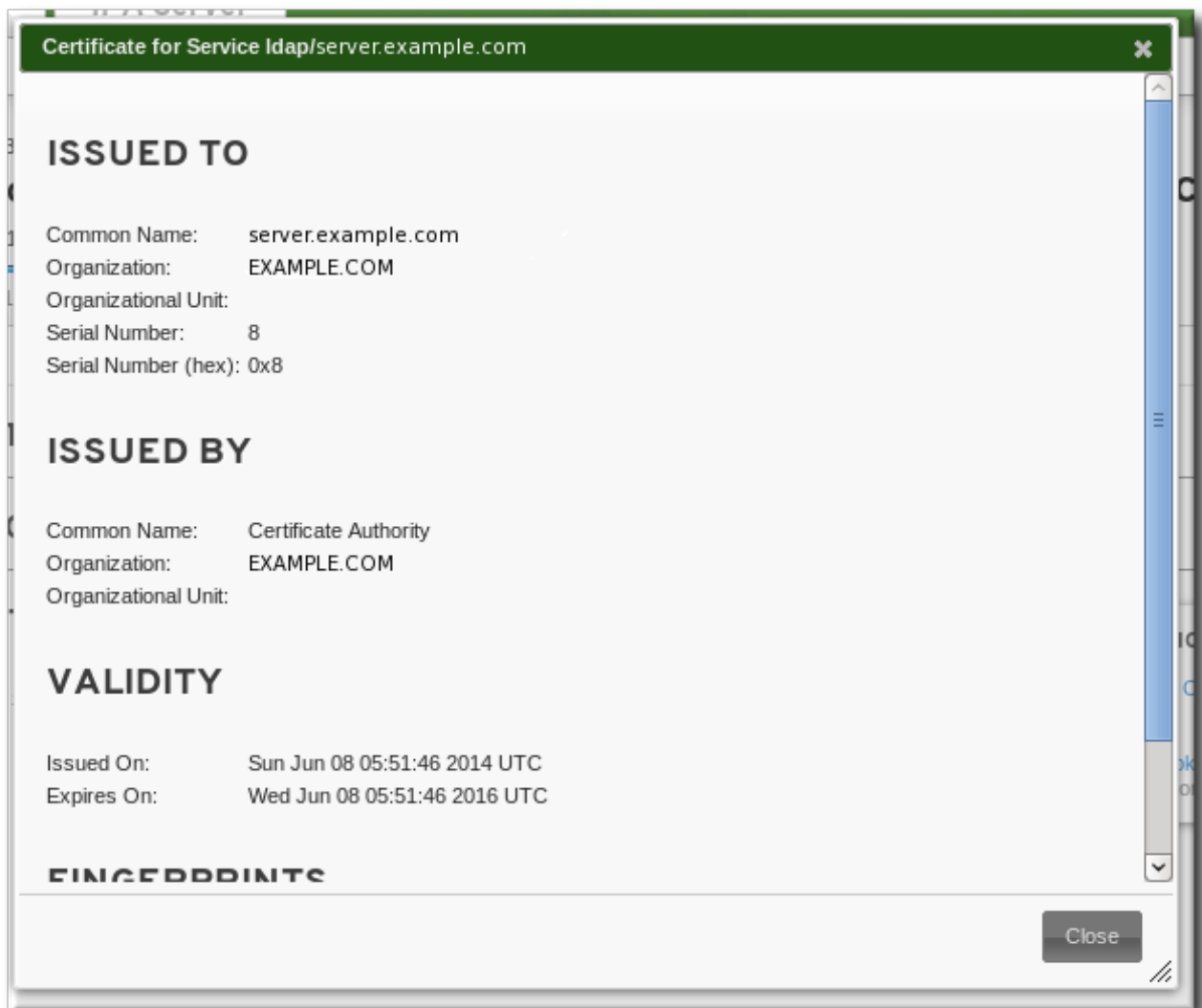
1. Open the **Identity** tab, and select the **Hosts** subtab.
2. Click the name of the host.



3. In the **Settings** tab, scroll to the **Host Certificate** tab at the bottom.



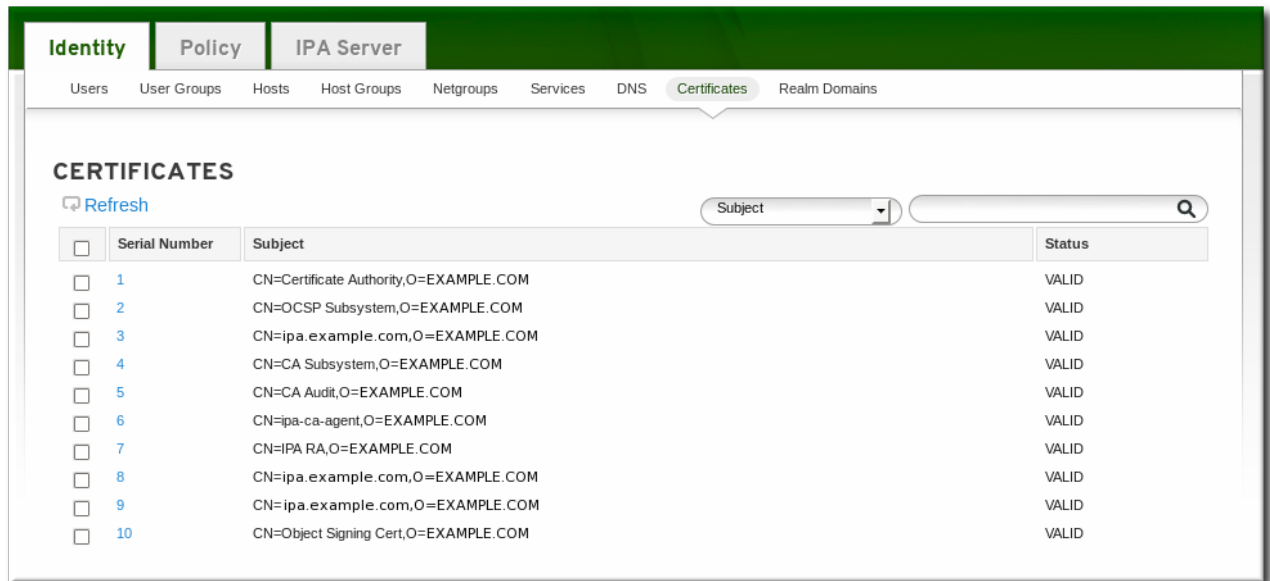
4. If a certificate has been issued, click the **View** link to display the details about the certificate. To retrieve the full certificate, click the **Get** link.



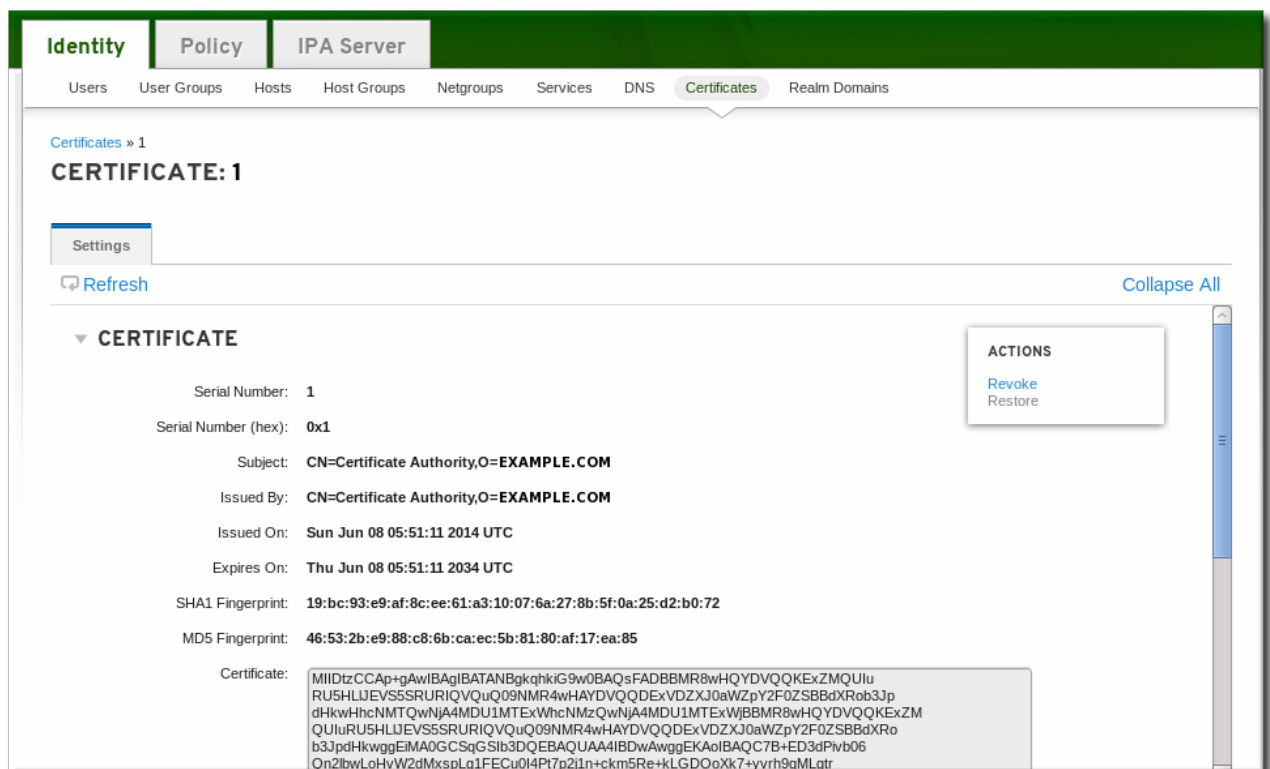
10.4.1.2. In the Certificate List in the UI

1. Open the **Identity** tab, and select the **Certificates** subtab.

- Click the serial number of the certificate to view.



- The top of the certificate entry shows the details of the certificate, such as its CN. The full certificate blob is available at the bottom of the page.



10.4.1.3. In the Command Line

All of the certificates which have been issued by the IdM CA are listed with the `ipa cert-find` command.

```
[root@server ~]# kinit admin
[root@server ~]# ipa cert-find
-----
10 certificates matched
-----
Serial number (hex): 0x1
Serial number: 1
```

```
Status: VALID
Subject: CN=Certificate Authority,O=EXAMPLE.COM
...
-----
Number of entries returned 10
-----
```

With a large number of certificates, it can be easier to search for a specific certificate by serial number or by an issue date. To search by a serial number, simply include it with the **cert-show** command.

```
[root@server ~]# ipa cert-show 132
Serial number: 132
Certificate: MIIDtzCCAp+gAwIBAgIBATANBgkqhkiG9w0BAQsFADBBMR8wHQYDVQKEXZMQUIu
...
LxIQjrEftJmoBgb/TWRlwGEWy1ayr4iTEf1ayZ+RGNy1La1EAtk9RLjEjg==
Subject: CN=Certificate Authority,O=EXAMPLE.COM
Issuer: CN=Certificate Authority,O=EXAMPLE.COM
Not Before: Sun Jun 08 05:51:11 2014 UTC
Not After: Thu Jun 08 05:51:11 2034 UTC
Fingerprint (MD5): 46:53:2b:e9:88:c8:6b:ca:ec:5b:81:80:af:17:ea:85
Fingerprint (SHA1): 19:bc:93:e9:af:8c:ee:61:a3:10:07:6a:27:8b:5f:0a:25:d2:b0:72
Serial number (hex): 0x132
Serial number: 132
```

The **--issuedon-from** and **--issuedon-to** options can set start/end points or a period of time to use to search for certificates.

```
ipa cert-find --issuedon-from=2013-02-01 --issuedon-to=2014-02-07
```

10.4.2. Revoking and Restoring Certificates

Every certificate has a specified expiration date, but there can be times when it is necessary to terminate (revoke) a certificate before that expiration. Revoking a certificate makes it invalid, so the host cannot use it for authentication.

When a certificate is revoked, there has to be a reason given. There are several different reasons — it was compromised, the entity has changed, the host is being pulled from service, or it has been replaced by a different certificate. The possible reasons are listed in [Table 10.2, “Revocation Reasons”](#).

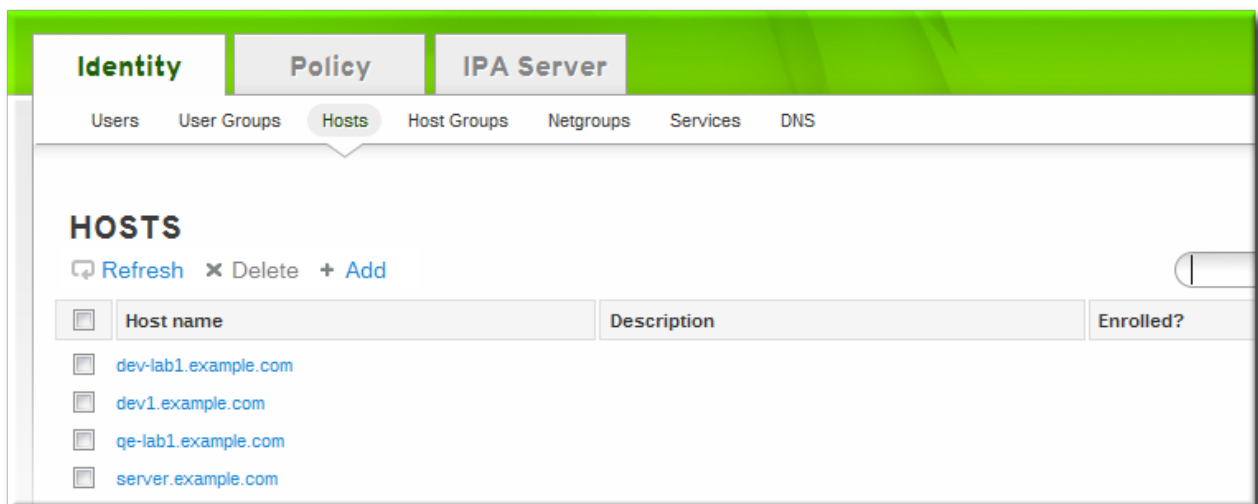
Table 10.2. Revocation Reasons

ID	Reason	Description
0	Unspecified	
1	Key Compromised	The underlying key was compromised. This could mean a token was lost or file was improperly accessed.
2	CA Compromised	The CA which issued the certificate was compromised.

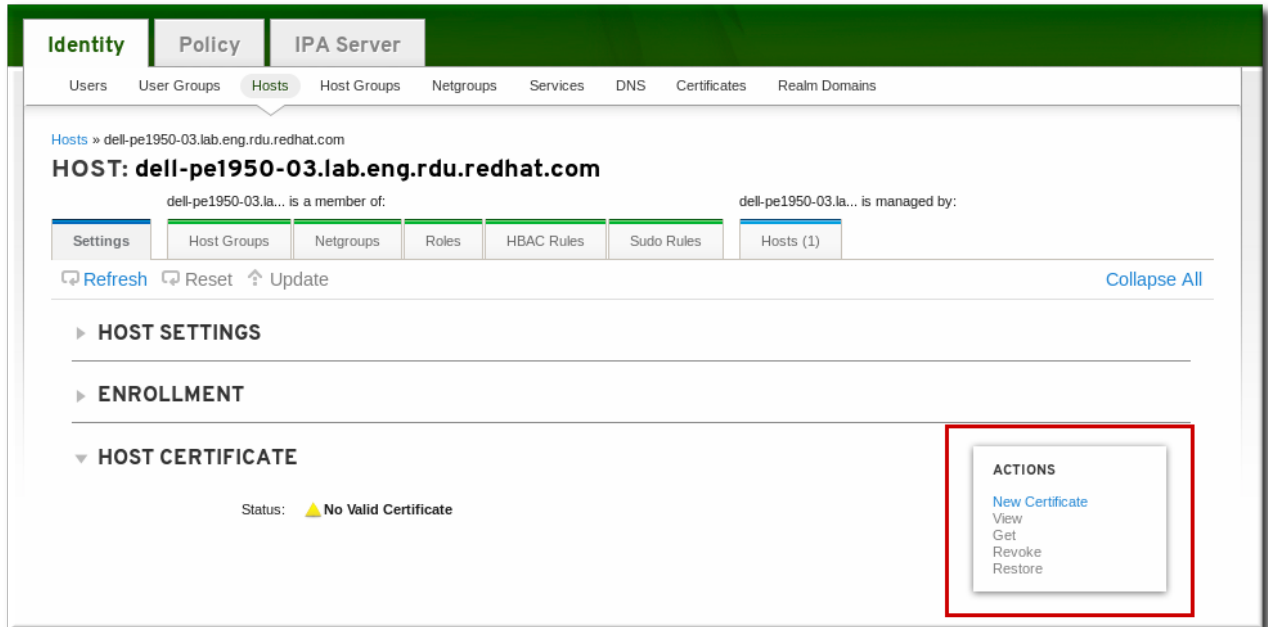
ID	Reason	Description
3	Affiliation Changed	The person or host to which the certificate was issued is changing affiliations. This could mean that the person has left the company (or the host is being retired) or that it has moved departments, if the affiliation is tied to an organizational structure.
4	Superseded	The certificate has been replaced by a newer certificate.
5	Cessation of Operation	The host is being decommissioned.
6	Certificate Hold	The certificate is temporarily revoked. This is the only revocation reason that allows the certificate to be restored.
8	Remove from CRL	The certificate is not included in the certificate revocation list.
9	Privilege Withdrawn	The host should no longer be issued the certificate.
10	A Authority Compromise	The AA was compromised.

10.4.2.1. In the Host Entry in the UI

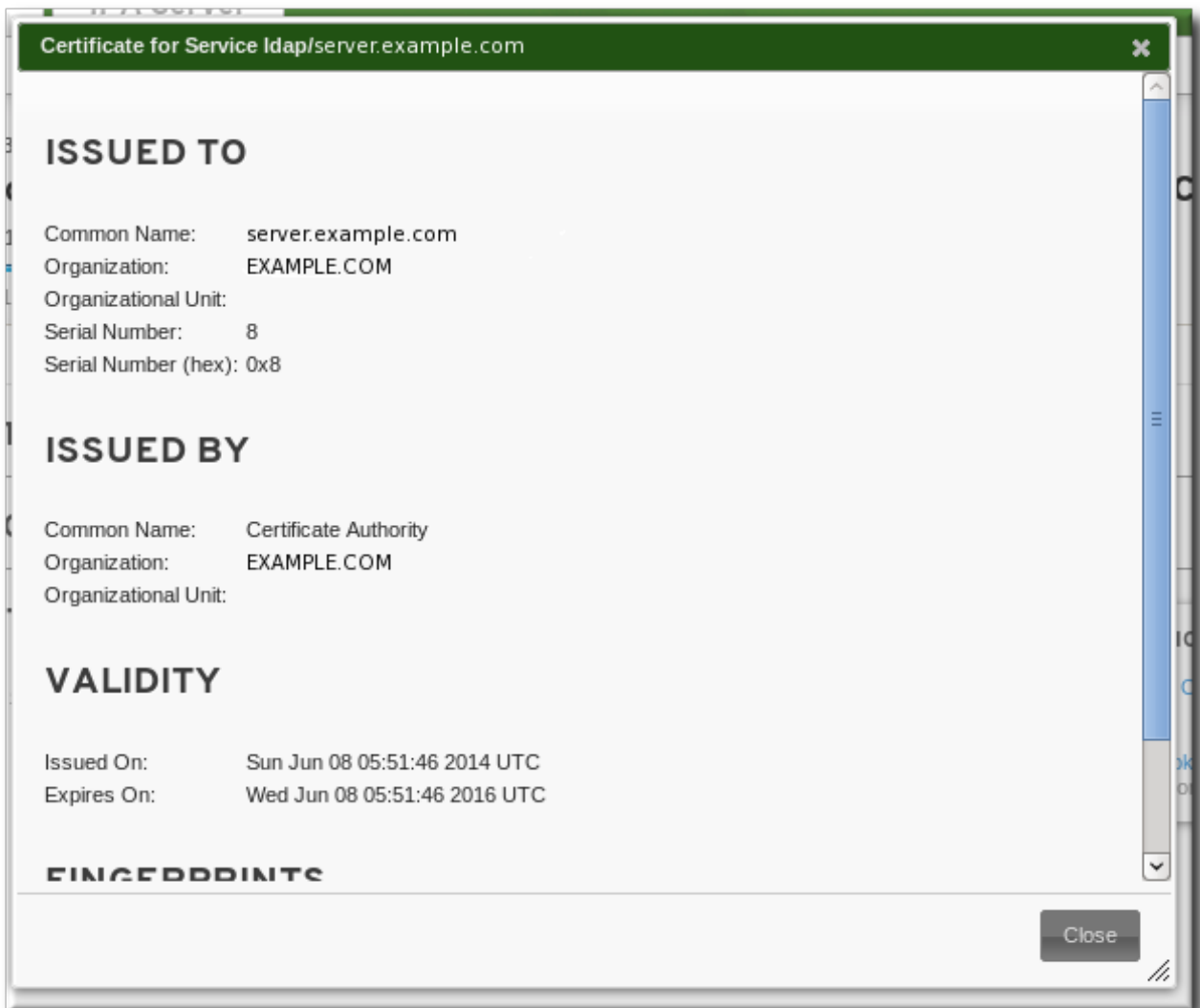
1. Open the **Identity** tab, and select the **Hosts** subtab.
2. Click the name of the host.



3. In the **Settings** tab, scroll to the **Host Certificate** tab at the bottom.



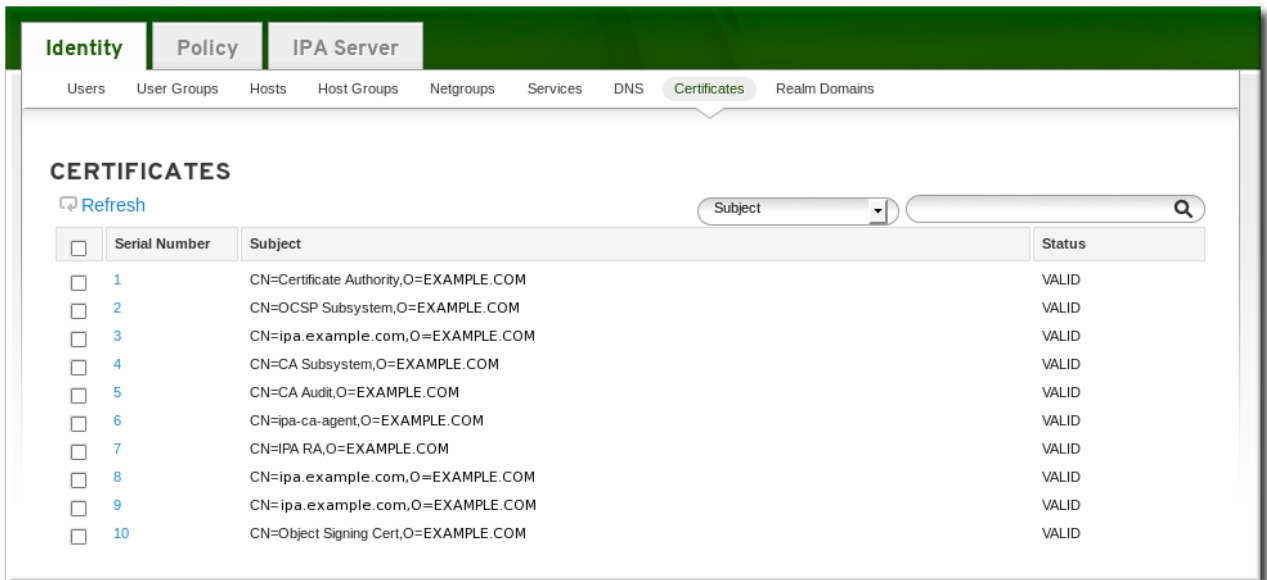
4. In the **Actions** area, click the **Revoke** link.
5. Select the reason for the revocation from the drop-down menu, and click the **Revoke** link. [Table 10.2, "Revocation Reasons"](#) describes the different options for revoking a certificate.



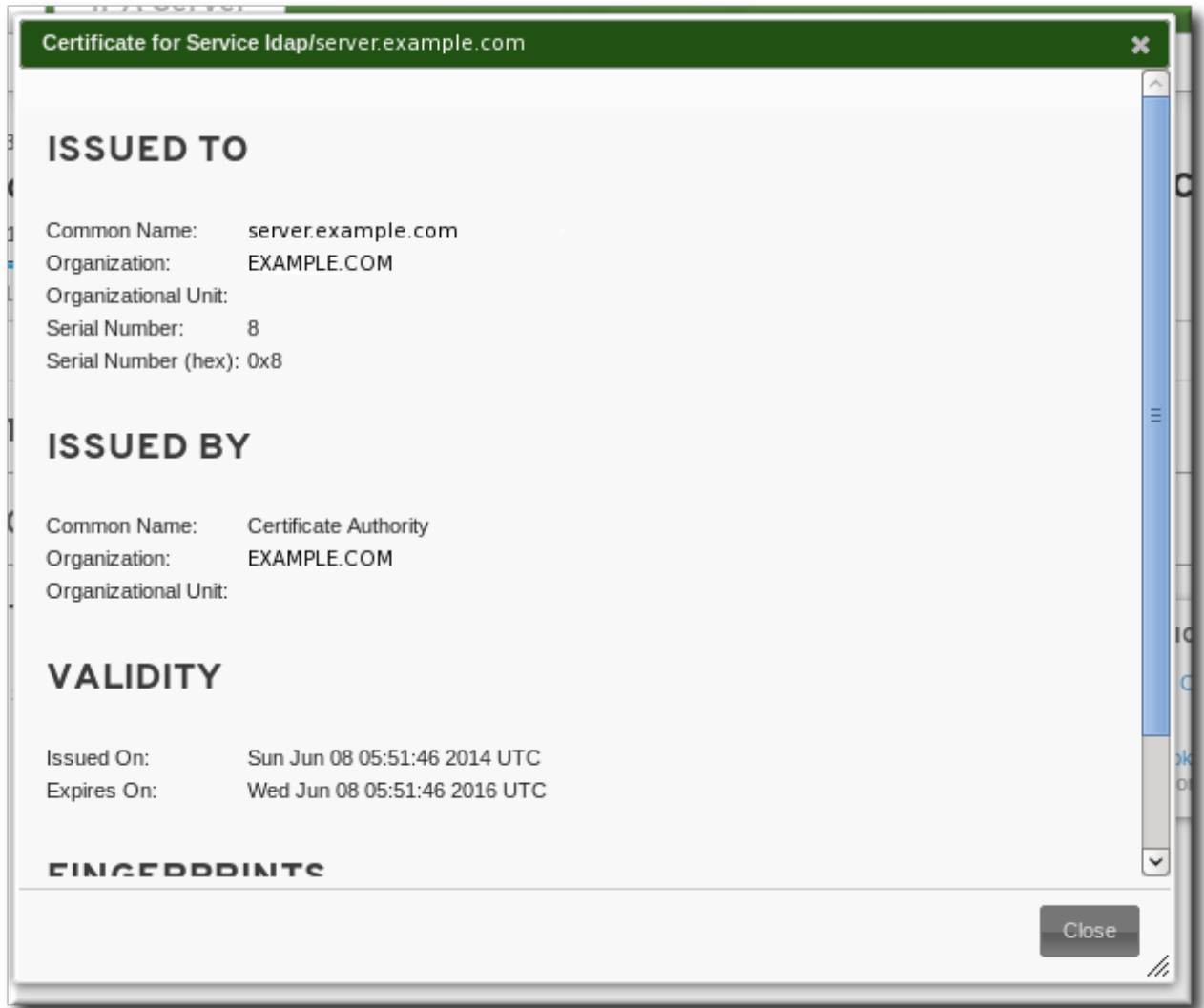
If the reason for the revocation is a certificate hold, then the certificate can be restored later by clicking the **Restore** link in the certificate actions menu.

10.4.2.2. In the Certificate List in the UI

1. Open the **Identity** tab, and select the **Certificates** subtab.
2. Click the serial number of the certificate to view.



3. In the **Actions** area, click the **Revoke** link.
4. Select the reason for the revocation from the drop-down menu, and click the **Revoke** link. [Table 10.2, "Revocation Reasons"](#) describes the different options for revoking a certificate.



If the reason for the revocation is a certificate hold, then the certificate can be restored later by clicking the **Restore** link in the certificate actions menu.

10.4.2.3. In the Command Line

To revoke a certificate from the command line, specify the certificate serial number and give the reason for the revocation in the **--revocation-reason** option.

```
[root@server ~]# kinit admin
[root@server ~]# ipa cert-revoke --revocation-reason=6 1032
```

If the reason for the revocation is a certificate hold (6), then the certificate can be restored with the **cert-remove-hold** command.

```
[root@server ~]# ipa cert-remove-hold 1032
```

10.4.3. Requesting New Host Certificates

The certificate request must be generated with a third-party tool such as **certutil**. The resulting certificate request can be submitted through the IdM web UI or command-line tools.

The host must already exist for a certificate to be requested. A certificate cannot be requested for a new host before it is created.

10.4.3.1. In the UI

1. Generate a certificate request for the host. For example:

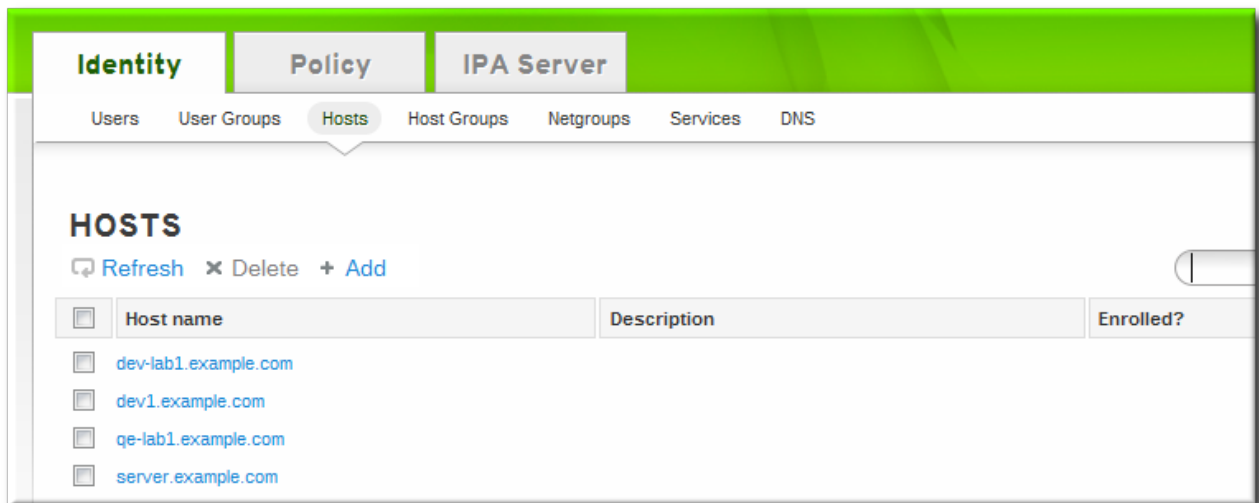
First, create a set of certificate databases that can be used to create and store the certificate locally.

```
[root@server ~]# certutil -N -d ~/test-certs/
```

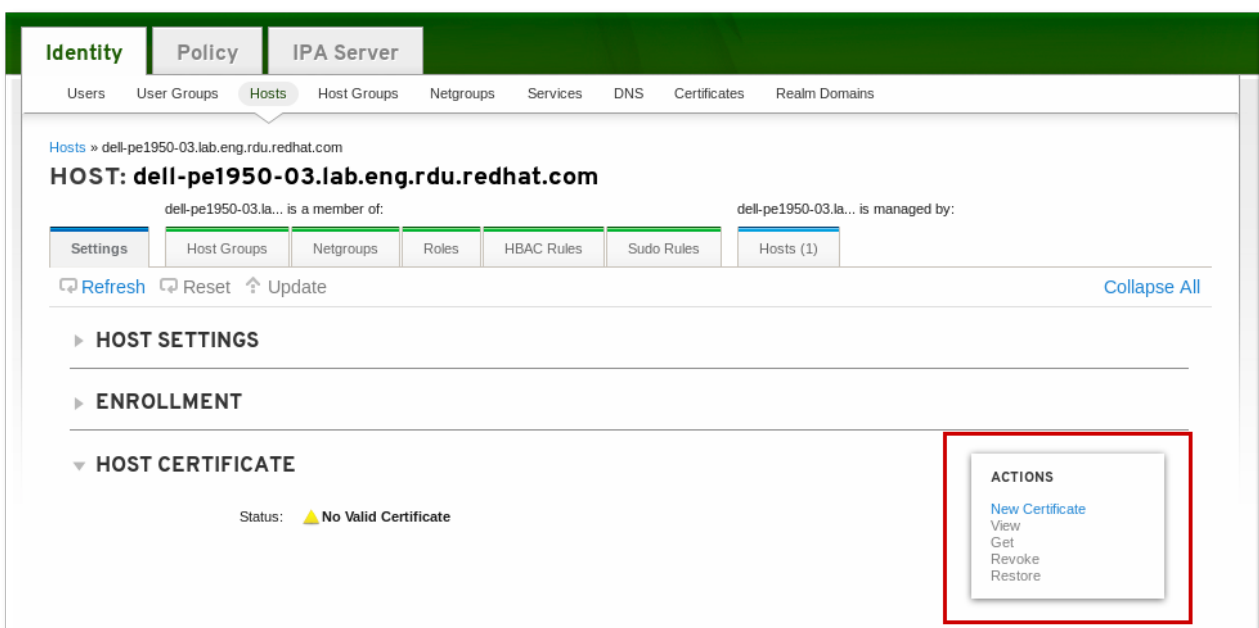
Then, create the certificate request.

```
[root@server ~]# certutil -R -d ~/test-certs -R -a -g 256 -s
"CN=server.example.com,O=EXAMPLE.COM" -o ~/test-certs/host.csr
```

2. Copy the text of the new certificate request.
3. Open the **Identity** tab, and select the **Hosts** subtab.
4. Click the name of the host.

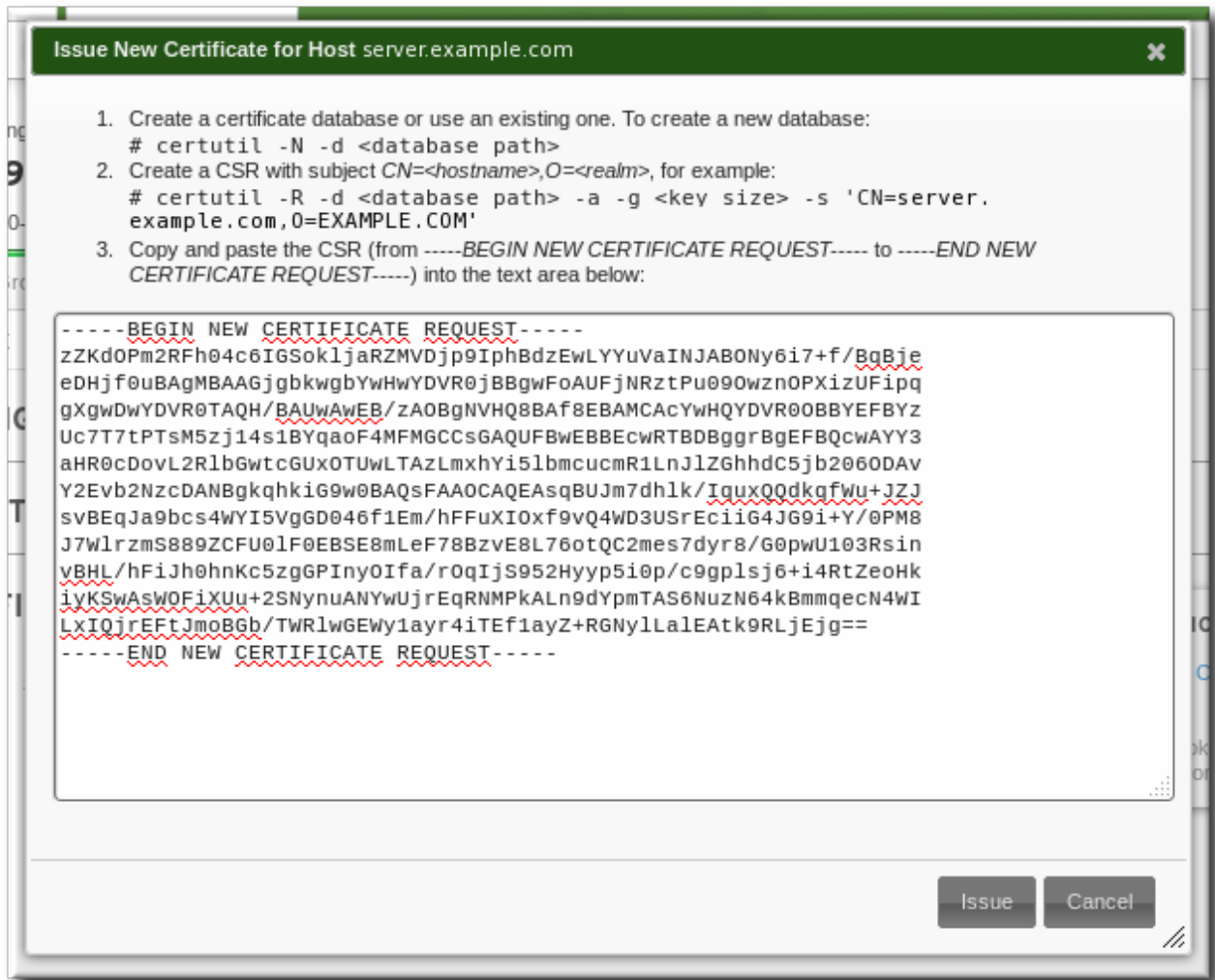


5. In the **Settings** tab, scroll to the **Host Certificate** tab at the bottom.



6. In the **Actions** area, click the **Request** link.

- Paste in the body of the certificate request, including the **BEGIN NEW CERTIFICATE REQUEST** and **END NEW CERTIFICATE REQUEST** lines.



- Click the **Issue** button.

10.4.3.2. In the Command Line

- Generate a certificate request for the host. For example:

First, create a set of certificate databases that can be used to create and store the certificate locally.

```
[root@server ~]# certutil -N -d ~/test-certs/
```

Then, create the certificate request.

```
[root@server ~]# certutil -R -d ~/test-certs -R -a -g 256 -s
"CN=server.example.com,O=EXAMPLE.COM" -o ~/test-certs/host.csr
```

- Submit the PEM file of the certificate request to the IdM server. Along with the request itself, specify the Kerberos principal to create and associate with the newly-issued certificate.

```
[root@server ~]# ipa cert-request --principal=host/server.example.com host.csr
```

10.5. Managing Public SSH Keys for Hosts

OpenSSH uses *public keys* to authenticate hosts. One machine attempts to access another machine and presents its key pair. The first time the host authenticates, the administrator on the target machine has to approve the request manually. The machine then stores the host's public key in a **known_hosts** file. Any time that the remote machine attempts to access the target machine again, the target machine simply checks its **known_hosts** file and then grants access automatically to approved hosts.

There are a few problems with this system:

- ▶ The **known_hosts** file stores host entries in a triplet of the host IP address, hostname, and key. This file can rapidly become out of date if the IP address changes (which is common in virtual environments and data centers) or if the key is updated.
- ▶ SSH keys have to be distributed manually and separately to all machines in an environment.
- ▶ Administrators have to approve host keys to add them to the configuration, but it is difficult to verify either the host or key issuer properly, which can create security problems.

On Red Hat Enterprise Linux, the System Security Services Daemon (SSSD) can be configured to cache and retrieve host SSH keys so that applications and services only have to look in one location for host keys. Because SSSD can use Identity Management as one of its identity information providers, Identity Management provides a universal and centralized repository of keys. Administrators do not need to worry about distributing, updating, or verifying host SSH keys.

10.5.1. About the SSH Key Format

When keys are uploaded to the IdM entry, the key format can be either an [OpenSSH-style key](#) or a raw [RFC 4253-style blob](#). Any RFC 4253-style key is automatically converted into an OpenSSH-style key before it is imported and saved into the IdM LDAP server.

The IdM server can identify the type of key, such as an RSA or DSA key, from the uploaded key blob. However, in a key file such as `~/.ssh/known_hosts`, a key entry is identified by the hostname and IP address of the server, its type, then lastly the key itself. For example:

```
host.example.com,1.2.3.4 ssh-rsa AAA...ZZZ==
```

This is slightly different than a user public key entry, which has the elements in the order *type key== comment*:

```
"ssh-rsa ABCD1234...== ipaclient.example.com"
```

All three parts from the key file can be uploaded to and viewed for the host entry. In that case, the host public key entry from the `~/.ssh/known_hosts` file needs to be reordered to match the format of a user key, *type key== comment*:

```
ssh-rsa AAA...ZZZ== host.example.com,1.2.3.4
```

The key type can be determined automatically from the content of the public key, and the comment is optional, to make identifying individual keys easier. The only required element is the public key blob itself.

10.5.2. About ipa-client-install and OpenSSH

The **ipa-client-install** script, by default, configures an OpenSSH server and client on the IdM client machine. It also configures SSSD to perform host and user key caching. Essentially, simply configuring the client does all of the configuration necessary for the host to use SSSD, OpenSSH, and Identity Management for key caching and retrieval.

If the SSH service is enabled with the client installation (which is the default), then an RSA key is created when the **ssh** service is first started.



NOTE

When the machine is added as an IdM client using **ipa-client-install**, the client is created with two SSH keys, RSA and DSS.

There is an additional client configuration option, **--ssh-trust-dns**, which can be run with **ipa-client-install** and automatically configures OpenSSH to trust the IdM DNS records, where the key fingerprints are stored.

Alternatively, it is possible to disable OpenSSH at the time the client is installed, using the **--no-sshd** option. This prevents the install script from configuring the OpenSSH server.

Another option, **--no-dns-sshfp**, prevents the host from creating DNS SSHFP records with its own DNS entries. This can be used with or without the **--no-sshd** option.

10.5.3. Uploading Host SSH Keys Through the Web UI

1. The key for a host can probably be retrieved from a `~/ .ssh/known_hosts`. For example:

```
server.example.com,1.2.3.4 ssh-rsa
AAAAB3NzaC1yc2EAAAABIwAAAQEAQvjbVvSFSkTU0wQW4e0weeo0DZZ08F9Ud21x1Ly6F0hzwpxFGIy
xvXZ52+siHBHbbqGL5+14N7UvElruys1IHx9LYUR/pPKSMXCGyboLy5aTN150Q5EHwrhVnFDIKXkvp
45945R7SKYCUtRumm0Iw6wq0XD4o+ILeVbV3wmcB1bXs36ZvC/M6rieFn9PcJmh6vNCvIsbMY6S+F
hkWUTTiOXJjUDYRLlwM273FfWhzHK+SSQXeBp/zIn1gFvJhSZMRi9HZpDoqxLbBB9QIdIw6U4MIjNm
KsSI/ASpkFm2GuQ7ZK9KuMItY2AoCuIRmRAdf8iYNHBTXNfFurGogXwRDjQ==
```

If necessary, generate a host key. When using the OpenSSH tools, make sure to use a blank passphrase and to save the key to a different location than the user's `~/ .ssh/` directory, so it will not overwrite any existing keys.

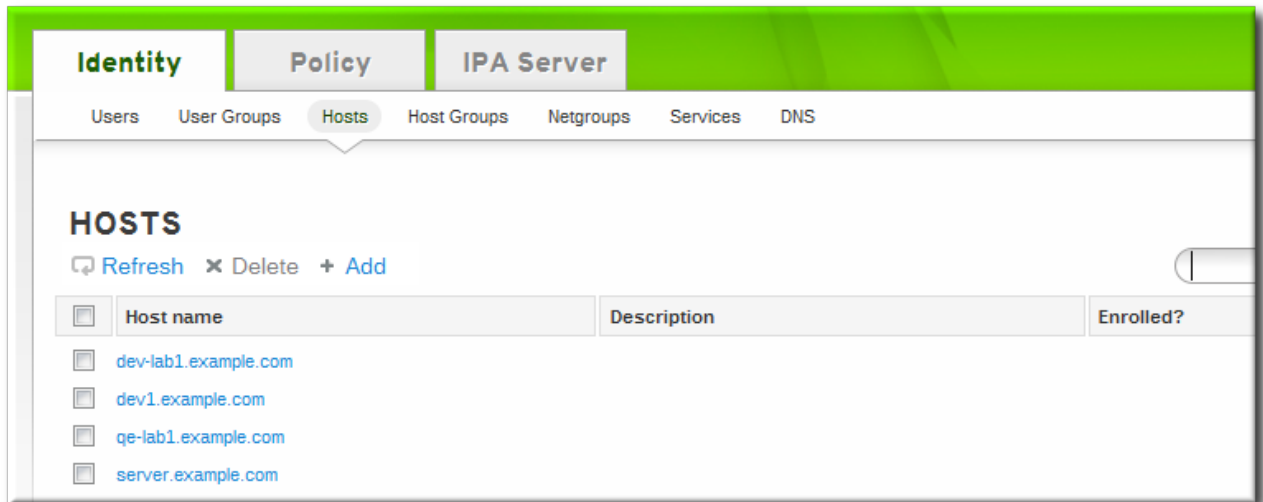
```
[jsmith@server ~]$ ssh-keygen -t rsa -C "server.example.com,1.2.3.4"
Generating public/private rsa key pair.
Enter file in which to save the key (/home/jsmith/.ssh/id_rsa):
/home/jsmith/.ssh/host_keys
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/jsmith/.ssh/host_keys.
Your public key has been saved in /home/jsmith/.ssh/host_keys.pub.
The key fingerprint is:
4f:61:ee:2c:f7:d7:da:41:17:93:de:1d:19:ac:2e:c8 server.example.com
The key's randomart image is:
+--[ RSA 2048 ]-----+
|           .. |
|            .+|
|             o  .* |
|            o . . . * |
|           S + . o+ |
|            E . . . |
|           . = . o |
|            o . .o |
|             . . . . |
+-----+

```

- Copy the public key from the key file. The full key entry has the form *hostname,IP type key==*. Only the *key==* is required, but the entire entry can be stored. To use all elements in the entry, rearrange the entry so it has the order *type key== [hostname,IP]*

```
[jsmith@server ~]$ cat /home/jsmith/.ssh/host_keys.pub
ssh-rsa AAAAB3NzaC1yc2E...tJG1PK2Mq++wQ== server.example.com,1.2.3.4
```

- Open the **Identity** tab, and select the **Hosts** subtab.
- Click the name of the host to edit.



- In the **Host Settings** area of the **Settings** tab, click the **SSH public keys: Add** link.

The screenshot shows the Red Hat Identity Management (IdM) web interface. At the top, there are tabs for 'Identity', 'Policy', and 'IPA Server'. Below these, there are sub-tabs for 'Users', 'User Groups', 'Hosts', 'Host Groups', 'Netgroups', and 'Services'. The 'Hosts' tab is selected, and the page title is 'HOST: server.example.com'. Below the title, there are buttons for 'Settings', 'Host Groups', 'Netgroups', 'Roles', 'HBAC Rules', 'Sudo Rules', and 'Hosts (1)'. There are also buttons for 'Refresh', 'Reset', and 'Update'. The 'HOST SETTINGS' section is expanded, showing the following fields:

- Host name: server.example.com
- Principal name: host/server.example.com@RHTS.ENG.BOS.REDHAT.COM
- Description: (empty text area)
- Locality: (empty text input)
- Location: (empty text input)
- Platform: (empty text input)
- Operating system: (empty text input)
- SSH public keys: Add (highlighted with a red box)
- MAC address: Add

- The UI opens a new link, **New: key not set Show/Set key**. Click the **Show/Set key** link.

▼ HOST SETTINGS

Host name: **server.example.com**

Principal name: **host/server.example.com@RHTS.ENG.BOS.REDHAT.COM**

Description:

Locality:

Location:

Platform:

Operating system:

SSH public keys: **New: key not set** [Show/Set key](#) [undo](#)

[Add](#) [undo all](#)

MAC address: [Add](#)

- Paste in the public key for the host, and click the **Set** button.

Metaruns Roles HRAC Rules Sudo Rules Hosts (1)

Set SSH key ✕

SSH public key:

```
ssh-rsa
AAAAB3NzaC1yc2EAAAABIwAAAQEA1+Rpdb1Y7UNTS8xH2IrvF1vtse5ort4ziqay8i
9vH7+p1fyKJ6x5fZ0YAXgAbR/Q3nW4P0TQ0UsY3d5hNDCsIueIqBr461gJ97rv7FJ4jca
/bdLxV4ImHkLaz5PEd5JJGkJSukA4sugvUwzr7UOnhzma9E8H+7EiIM6JX2CqhajK0YT
2I9T9dYfRS
/VJ5dzZxkG1ZE+Syu3m4D5kJAQEjgKuaPgKYP3LSPdGT1KnSZwOolfav+buFmmwd6Smr
ThFGhz7/0F/HX5sjhk2kFOR5cgdDjuaF0d
/Ve3+ZhNIfb2txBE7T5HqUXekTbfusKcsUUbGrjtOkCPCyz4JcN+Q==
server.example.com
```

[Set](#) [Cancel](#)

The **SSH public keys** field now shows **New: key set**. Clicking the **Show/Set key** link opens the submitted key.

8. To upload multiple keys, click the **Add** link below the list of public keys, and upload the other keys.
9. When all the keys have been submitted, click the **Update** link at the top of the host's page to save the changes.

When the public key is saved, the entry is displayed as the key fingerprint, the comment (if one was included), and the key type ^[4].

▼ HOST SETTINGS

Host name: **server.example.com**

Principal name: **host/server.example.com@RHTS.ENG.BOS.REDHAT.COM**

Description:

Locality:

Location:

Platform:

Operating system:

SSH public keys: **BC:BD:BF:81:51:A5:74:07:C2:D5:EE:11:8C:95:48:3C server.example.com (ssh-rsa)** [Show/Set key](#) [Delete](#)

[Add](#)

MAC address: [Add](#)

Figure 10.1. Saved Public Key

After uploading the host keys, configure SSSD to use Identity Management as one of its identity domains and set up OpenSSH to use the SSSD tooling for managing host keys.

After uploading the host keys, configure SSSD to use Identity Management as one of its identity domains and set up OpenSSH to use the SSSD tooling for managing host keys. This is covered in the [Red Hat Enterprise Linux Deployment Guide](#).

10.5.4. Adding Host Keys from the Command Line

Host SSH keys are added to host entries in IdM, either when the host is created using **host-add** or by modifying the entry later.



NOTE

RSA and DSS host keys are created by the **ipa-client-install** command, unless the SSH service is explicitly disabled in the installation script.

1. Run the **host-mod** command with the **--sshpubkey** option to upload the 64 bit-encoded public key to the host entry.

Adding a host key also changes the DNS SSHFP entry for the host, so also use the **--updatedns** option to update the host's DNS entry.

For example:

```
[jsmith@server ~]$ ipa host-mod --sshpubkey="ssh-rsa 12345abcde==" --updatedns
host1.example.com
```

With a real key, the key is longer and usually ends with an equals sign (=).

To upload multiple keys, pass a comma-separated list of keys inside a set of curly braces with a single **--sshpubkey** option:

```
--sshpubkey={12345abcde==, key2==, key3==}
```

It is also possible to use the **--sshpubkey** option multiple times with the same command invocation.



TIP

A host can have multiple public keys.

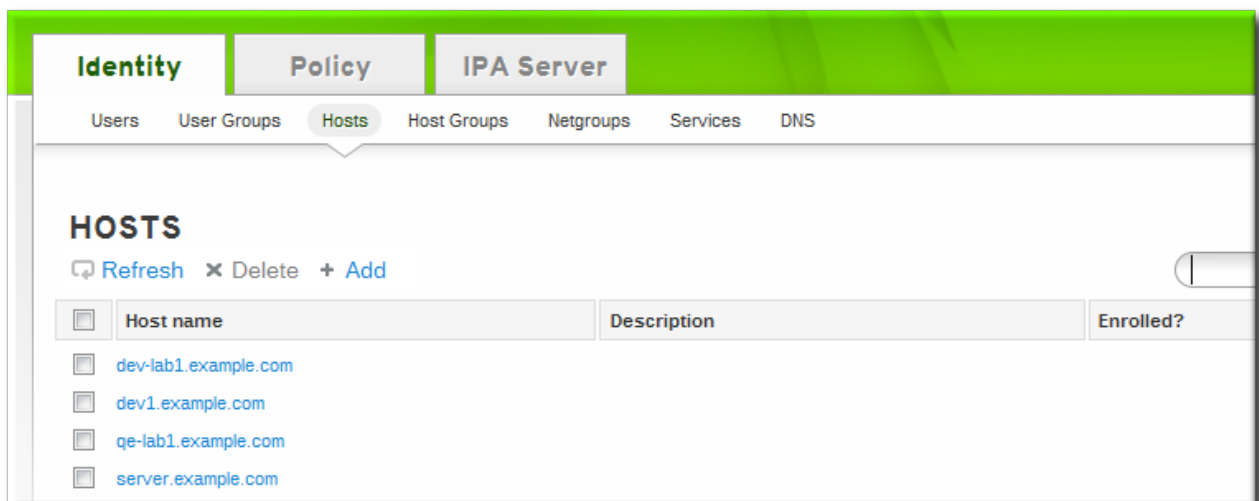
2. After uploading the host keys, configure SSSD to use Identity Management as one of its identity domains and set up OpenSSH to use the SSSD tooling for managing host keys. This is covered in the [Red Hat Enterprise Linux Deployment Guide](#).

10.5.5. Removing Host Keys

Host keys can be removed once they expire or are no longer valid.

To remove an individual host key, it is easiest to remove the key through the web UI:

1. Open the **Identity** tab, and select the **Hosts** subtab.
2. Click the name of the host to edit.



3. Open the **Host Settings** area of the **Settings** tab.

4. Click the **Delete** link by the fingerprint of the key to remove.

▼ HOST SETTINGS

Host name: **server.example.com**

Principal name: **host/server.example.com@RHTS.ENG.BOS.REDHAT.COM**

Description:

Locality:

Location:

Platform:

Operating system:

SSH public keys: **BC:BD:BF:81:51:A5:74:07:C2:D5:EE:11:8C:95:48:3C server.example.com (ssh-rsa)** [Show/Set key](#) [Delete](#)

[Add](#)

MAC address: [Add](#)

5. Click the **Update** link at the top of the host's page to save the changes.

The command-line tools can be used to remove all keys. This is done by running **ipa host-mod** with the **--sshpubkey=** set to a blank value; this removes *all* public keys for the host. Also, use the **--updatedns** option to update the host's DNS entry. For example:

```
[jsmith@server ~]$ kinit admin
[jsmith@server ~]$ ipa host-mod --sshpubkey= --updatedns host1.example.com
```

10.6. Setting Ethers Information for a Host

NIS can host an ethers table which can be used manage DHCP configuration files for systems based on their platform, operating system, DNS domain, and MAC address — all information stored in host entries in IdM.

In Identity Management, each system is created with a corresponding ethers entry in the directory, in the **ou=ethers** subtree.

```
cn=server,ou=ethers,dc=example,dc=com
```

This entry is used to create a NIS map for the ethers service which can be managed by the NIS compatibility plug-in in IdM.

To configure NIS maps for ethers entries:

1. Add the MAC address attribute to a host entry. For example:

```
[jsmith@server ~]$ kinit admin
[jsmith@server ~]$ ipa host-mod --macaddress=12:34:56:78:9A:BC
server.example.com
```

2. Open the `nsswitch.conf` file.
3. Add a line for the ethers service, and set it to use LDAP for its lookup.

```
ethers: ldap
```

4. Check that the ethers information is available for the client.

```
[root@server ~]# getent ethers server.example.com
```

10.7. Managing Host Groups

Host groups are a way of centralizing control over important management tasks, particularly access control.

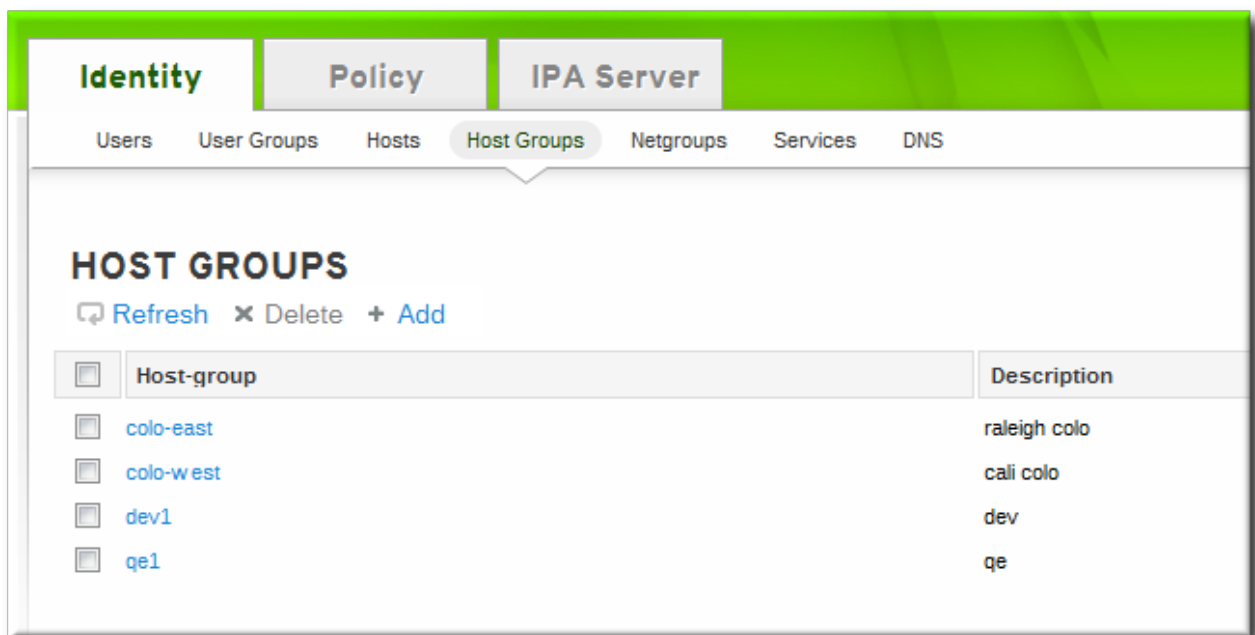
All groups in Identity Management are essentially *static* groups, meaning that the members of the group are manually and explicitly added to the group. Tangentially, IdM allows *nested groups*, where a group is a member of another group. In that case, all of the group members of the member group automatically belong to the parent group, as well.

Because groups are easy to create, it is possible to be very flexible in what groups to create and how they are organized. Groups can be defined around organizational divisions like departments, physical locations, or IdM or infrastructure usage guidelines for access controls.

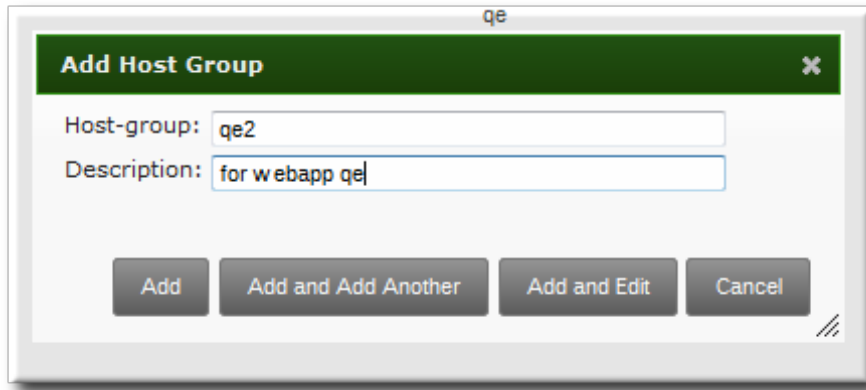
10.7.1. Creating Host Groups

10.7.1.1. Creating Host Groups from the Web UI

1. Open the **Identity** tab, and select the **Host Groups** subtab.
2. Click the **Add** link at the top of the groups list.



3. Enter the name and a description for the group.



4. Click the **Add and Edit** button to go immediately to the member selection page.
5. Select the members, as described in [Section 10.7.2.2, “Adding Host Group Members from the Web UI”](#).

10.7.1.2. Creating Host Groups from the Command Line

New groups are created using the **hostgroup-add** command. (This adds only the group; members are added separately.)

Two attributes are always required: the group name and the group description. If those attributes are not given as arguments, then the script prompts for them.

```
$ ipa hostgroup-add groupName --desc="description"
```

10.7.2. Adding Host Group Members

10.7.2.1. Showing and Changing Group Members

Members can be added to a group through the group configuration. There are tabs for all the member types which can belong to the group, and an administrator picks all of the matching entries and adds them as members.

However, it is also possible for an entity to be added to a group through its own configuration. Each entry has a list of tabs that displays group types that the entry can join. The list of all groups of that type is displayed, and the entity can be added to multiple groups at the same time.

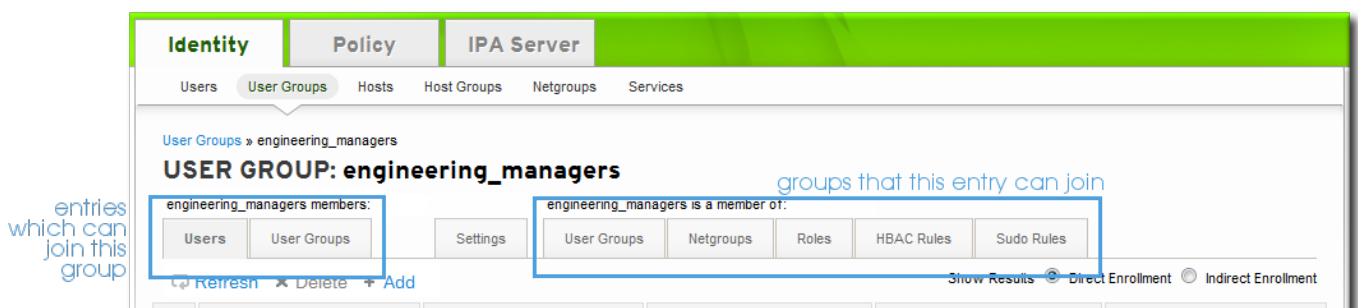
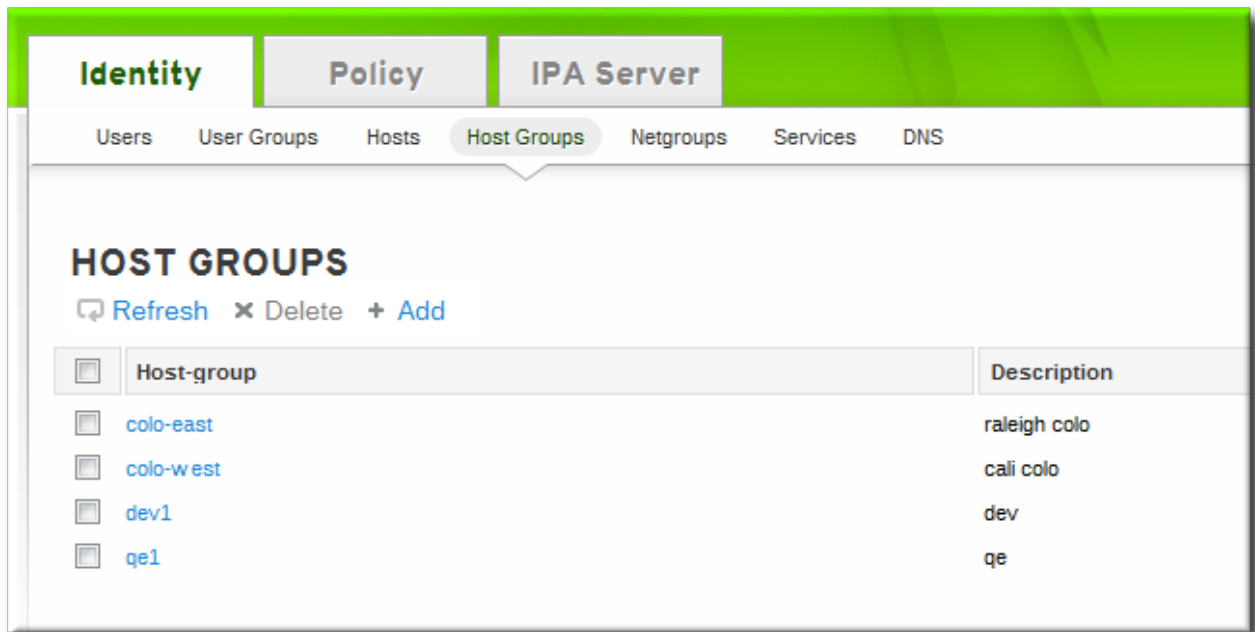


Figure 10.2. Member Of...

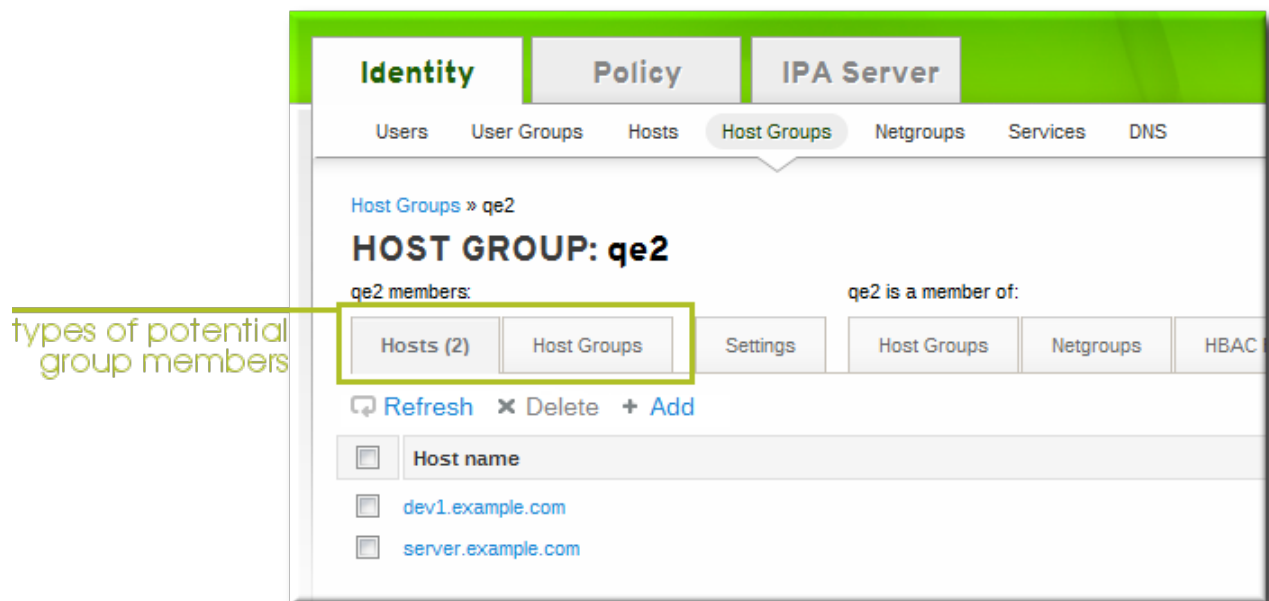
10.7.2.2. Adding Host Group Members from the Web UI

1. Open the **Identity** tab, and select the **Host Groups** subtab.

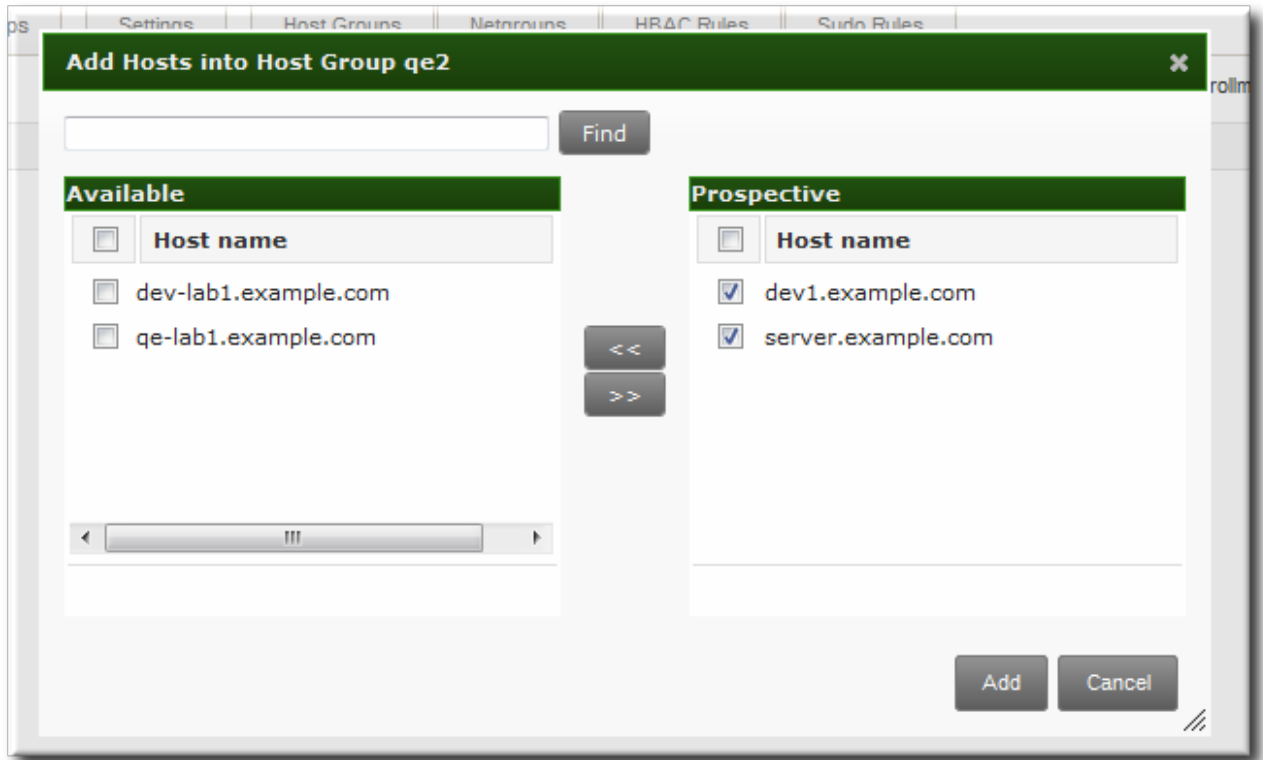
- Click the name of the group to which to add members.



- Click the **Add** link at the top of the task area.



- Click the checkbox by the names of the hosts to add, and click the right arrows button, >>, to move the hosts to the selection box.



5. Click the **Add** button.

10.7.2.3. Adding Host Group Members from the Command Line

Members are added to a host group using the **hostgroup-add-member** command. This command can add both hosts as group members and other groups as group members.

The syntax of the **hostgroup-add-member** command requires only the group name and the hosts to add. Lists of entries can be set by using the option multiple times with the same command or by listing the options in a comma-separated list inside curly braces, such as `--option={val1,val2,val3}`.

```
$ ipa hostgroup-add-member groupName [--hosts=host1 ...] [--hostgroups=hostGroup1 ...]
```

For example, this adds three hosts to the **caligroup** group:

```
$ ipa hostgroup-add-member caligroup --hosts=ipaserver.example.com --
hosts=client1.example.com --hosts=client2.example.com
Group name: caligroup
Description: for machines in california
GID: 387115842
Member hosts: ipaserver.example.com,client1.example.com,client2.example.com
-----
Number of members added 3
-----
```

Likewise, other groups can be added as members, which creates nested groups:

```
$ ipa hostgroup-add-member caligroup --groups=mountainview --groups=sandiego
Group name: caligroup
Description: for machines in california
GID: 387115842
```

```
Member groups: mountainview,sandiego
```

```
-----
```

```
Number of members added 2
```

```
-----
```

[4] The key type is determined automatically from the key itself, if it is not included in the uploaded key.

Chapter 11. Managing Services

Some services that run on a host can also belong to the IdM domain. Any service that can store a Kerberos principal or an SSL certificate (or both) can be configured as an IdM service. Adding a service to the IdM domain allows the service to request an SSL certificate or keytab from the domain. (Only the public key for the certificate is stored in the service record. The private key is local to the service.)

An IdM domain establishes a commonality between machines, with common identity information, common policies, and shared services. Any machine which belongs to a domain functions as a client of the domain, which means it uses the services that the domain provides. An IdM domain (as described in [Section 1.2, “Bringing Linux Services Together”](#)) provides three main services specifically for machines:

- ▶ DNS
- ▶ Kerberos
- ▶ Certificate management

11.1. Adding and Editing Service Entries and Keytabs

As with host entries, service entries for the host (and any other services on that host which will belong to the domain) must be added manually to the IdM domain. This is a two step process. First, the service entry must be created, and then a keytab must be created for that service which it will use to access the domain.

By default, Identity Management saves its HTTP keytab to `/etc/httpd/conf/ipa.keytab`.



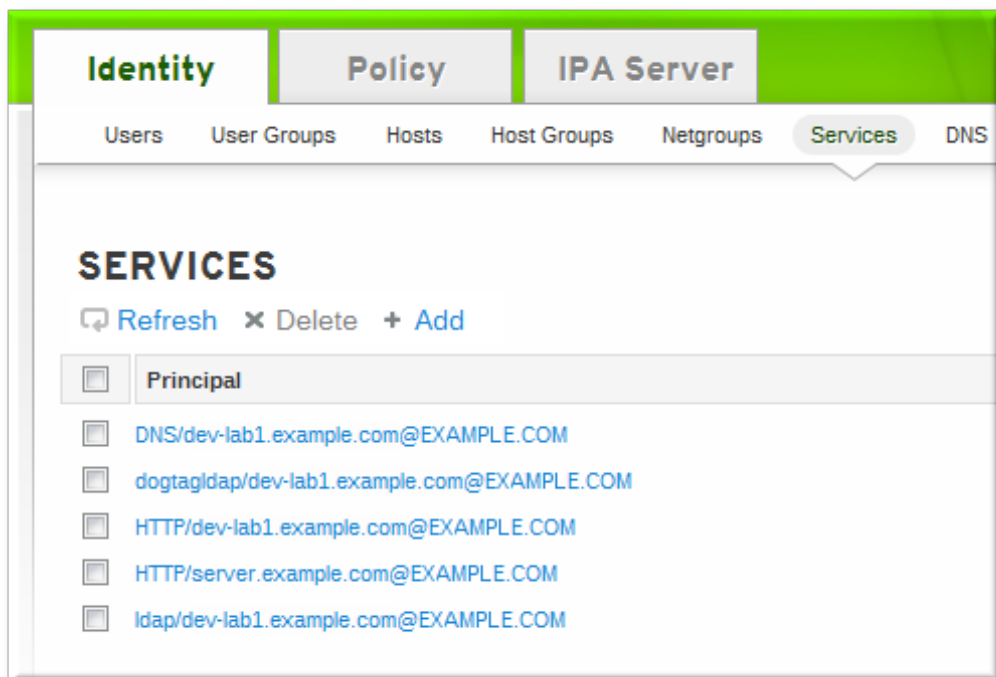
NOTE

This keytab is used for the web UI. If a key were stored in `ipa.keytab` and that keytab file is deleted, the IdM web UI will stop working, because the original key would also be deleted.

Similar locations can be specified for each service that needs to be made Kerberos aware. There is no specific location that must be used, but, when using `ipa-getkeytab`, you should avoid using `/etc/krb5.keytab`. This file should not contain service-specific keytabs; each service should have its keytab saved in a specific location and the access privileges (and possibly SELinux rules) should be configured so that only this service has access to the keytab.

11.1.1. Adding Services and Keytabs from the Web UI

1. Open the **Identity** tab, and select the **Services** subtab.
2. Click the **Add** link at the top of the services list.



3. Select the service type from the drop-down menu, and give it a name.
4. Select the hostname of the IdM host on which the service is running. The hostname is used to construct the full service principal name.



5. Click the **Add** button to save the new service principal.
6. Use the **ipa-getkeytab** command to generate and assign the new keytab for the service principal.

```
[root@ipaserver ~]# # ipa-getkeytab -s ipaserver.example.com -p
HTTP/server.example.com -k /etc/httpd/conf/krb5.keytab -e aes256-cts
```

- The realm name is optional. The IdM server automatically appends the Kerberos realm for which it is configured. You cannot specify a different realm.

- ▶ The hostname must resolve to a DNS A record for it to work with Kerberos. You can use the **--force** flag to force the creation of a principal should this prove necessary.
- ▶ The **-e** argument can include a list of encryption types to include in the keytab. This supersedes any default encryption type. Lists of entries can be set by using the option multiple times with the same command invocation or by listing the options in a comma-separated list inside curly braces, such as `--option={val1,val2,val3}`.



WARNING

Creating a new key resets the secret for the specified principal. This means that all other keytabs for that principal are rendered invalid.

11.1.2. Adding Services and Keytabs from the Command Line

1. Create the service principal. The service is recognized through a name like *service/FQDN*:

```
# ipa service-add serviceName/hostname
```

For example:

```
$ ipa service-add HTTP/server.example.com
-----
Added service "HTTP/server.example.com@EXAMPLE.COM"
-----
Principal: HTTP/server.example.com@EXAMPLE.COM
Managed by: ipaserver.example.com
```

2. Create the service keytab file using the **ipa-getkeytab** command. This command is run on the client in the IdM domain. (Actually, it can be run on any IdM server or client, and then the keys copied to the appropriate machine. However, it is simplest to run the command on the machine with the service being created.)

The command requires the Kerberos service principal (**-p**), the IdM server name (**-s**), the file to write (**-k**), and the encryption method (**-e**). Be sure to copy the keytab to the appropriate directory for the service.

For example:

```
# ipa-getkeytab -s server.example.com -p HTTP/server.example.com -k
/etc/httpd/conf/krb5.keytab -e aes256-cts
```

- ▶ The realm name is optional. The IdM server automatically appends the Kerberos realm for which it is configured. You cannot specify a different realm.
- ▶ The hostname must resolve to a DNS A record for it to work with Kerberos. You can use the **--force** flag to force the creation of a principal should this prove necessary.
- ▶ The **-e** argument can include a comma-separated list of encryption types to include in the keytab. This supersedes any default encryption type. Lists of entries can be set by using the option multiple times with the same command invocation or by listing the options in a comma-separated list inside curly braces, such as `--option={val1,val2,val3}`.

**WARNING**

The `ipa-getkeytab` command resets the secret for the specified principal. This means that all other keytabs for that principal are rendered invalid.

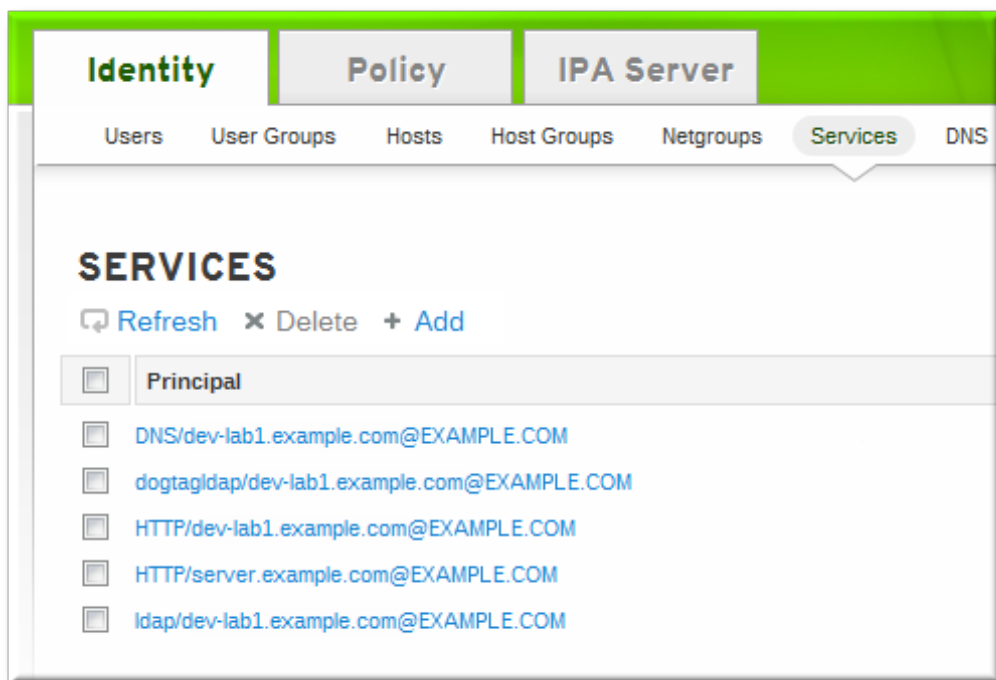
11.2. Creating Certificates for Services

By default, the IdM server has an integrated certificate authority. This CA can be used to create, revoke, and issue certificates for services in the IdM domain.

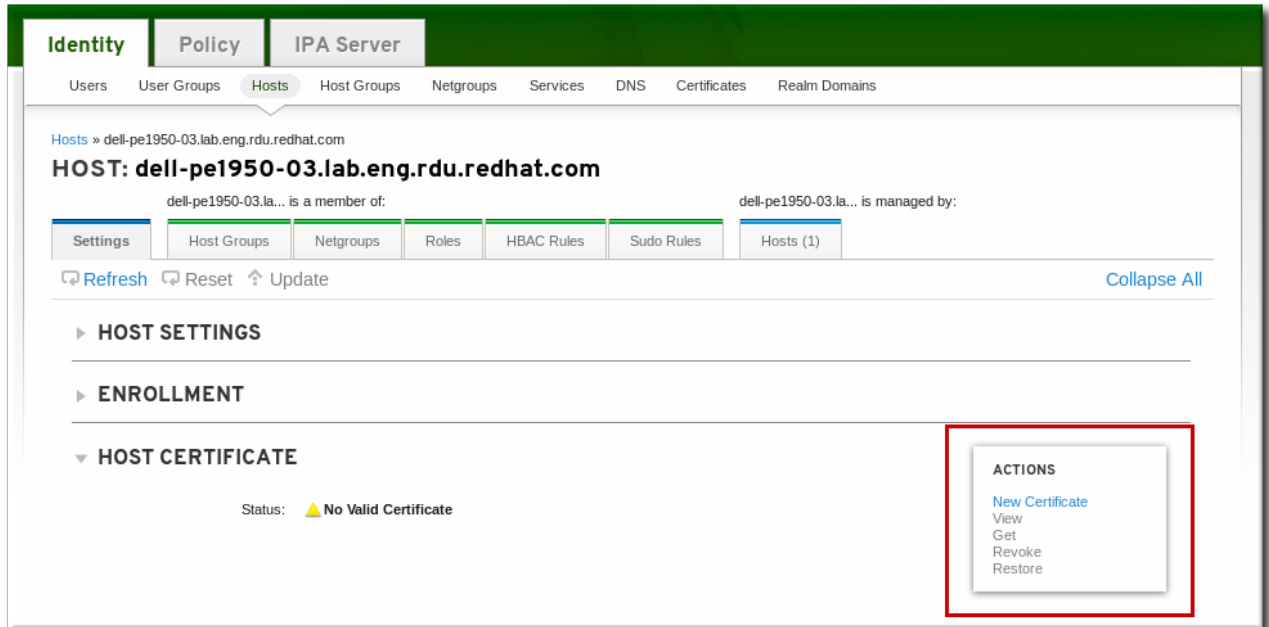
11.2.1. Showing Certificates

11.2.1.1. In the Service Entry in the UI

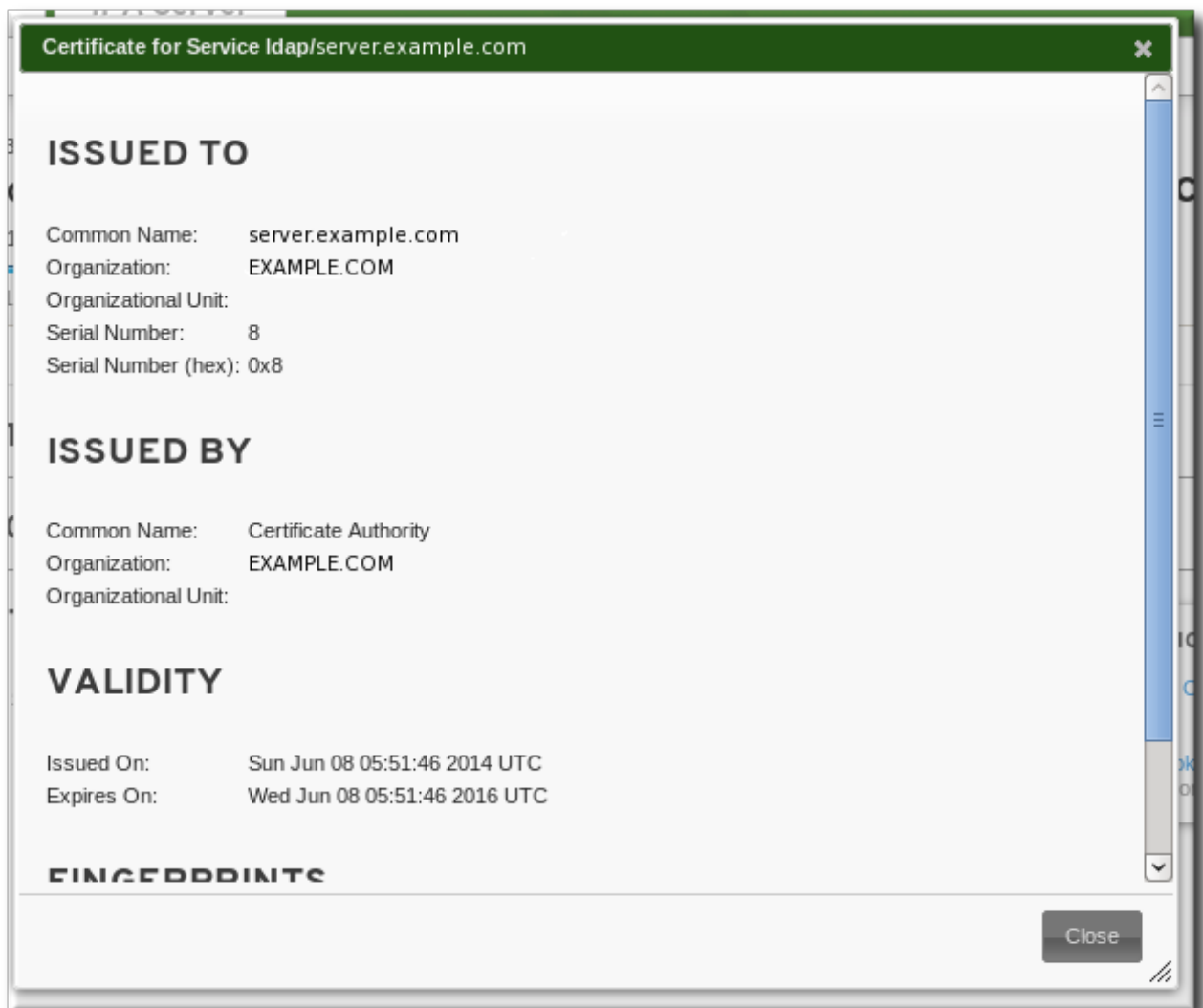
1. Open the **Identity** tab, and select the **Services** subtab.
2. Click the name of the service.



3. In the **Settings** tab, scroll to the **Service Certificate** tab at the bottom.



4. If a certificate has been issued, click the **View** link to display the details about the certificate. To retrieve the full certificate, click the **Get** link.



11.2.1.2. In the Certificate List in the UI

1. Open the **Identity** tab, and select the **Certificates** subtab.


```
Status: VALID
Subject: CN=Certificate Authority,O=EXAMPLE.COM
...
-----
Number of entries returned 10
-----
```

With a large number of certificates, it can be easier to search for a specific certificate by serial number or by an issue date. To search by a serial number, simply include it with the **cert-show** command.

```
[root@server ~]# ipa cert-show 132
Serial number: 132
Certificate: MIIDtzCCAp+gAwIBAgIBATANBgkqhkiG9w0BAQsFADBBMR8wHQYDVQKEXZMQUIu
...
LxIQjrEftJmoBGB/TWRlwGEWy1ayr4iTEf1ayZ+RGNy1La1EAtk9RLjEjg==
Subject: CN=Certificate Authority,O=EXAMPLE.COM
Issuer: CN=Certificate Authority,O=EXAMPLE.COM
Not Before: Sun Jun 08 05:51:11 2014 UTC
Not After: Thu Jun 08 05:51:11 2034 UTC
Fingerprint (MD5): 46:53:2b:e9:88:c8:6b:ca:ec:5b:81:80:af:17:ea:85
Fingerprint (SHA1): 19:bc:93:e9:af:8c:ee:61:a3:10:07:6a:27:8b:5f:0a:25:d2:b0:72
Serial number (hex): 0x132
Serial number: 132
```

The **--issuedon-from** and **--issuedon-to** options can set start/end points or a period of time to use to search for certificates.

```
ipa cert-find --issuedon-from=2013-02-01 --issuedon-to=2014-02-07
```

11.2.2. Revoking and Restoring Certificates

Every certificate has a specified expiration date, but there can be times when it is necessary to terminate (revoke) a certificate before that expiration. Revoking a certificate makes it invalid, so the service cannot use it for authentication.

When a certificate is revoked, there has to be a reason given. There are several different reasons — it was compromised, the entity has changed, the service is being pulled from service, or it has been replaced by a different certificate. The possible reasons are listed in [Table 11.1, “Revocation Reasons”](#).

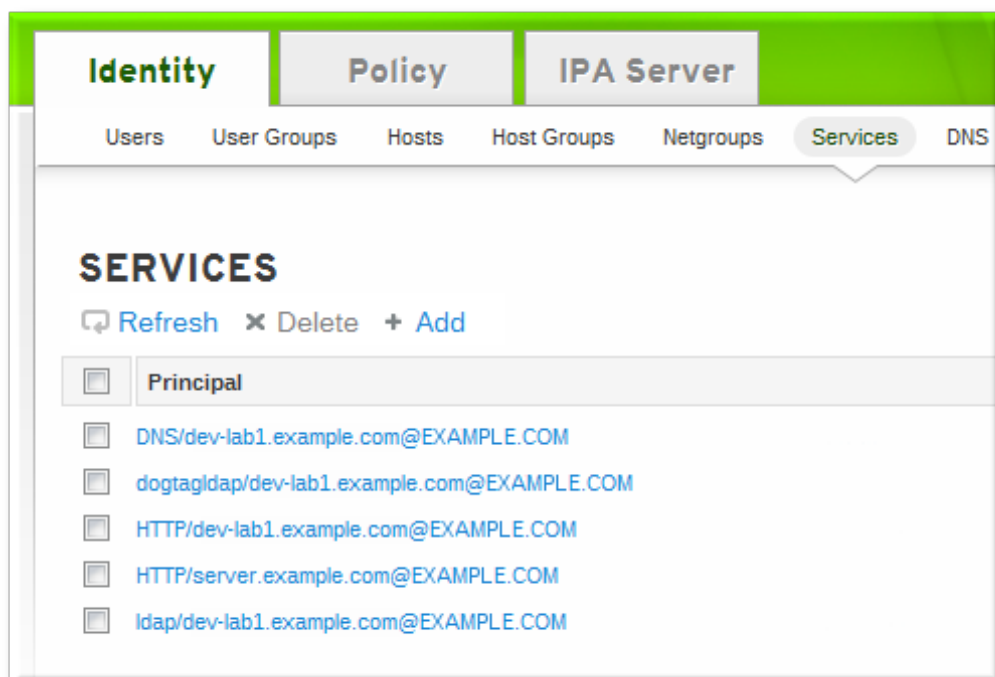
Table 11.1. Revocation Reasons

ID	Reason	Description
0	Unspecified	
1	Key Compromised	The underlying key was compromised. This could mean a token was lost or file was improperly accessed.
2	CA Compromised	The CA which issued the certificate was compromised.

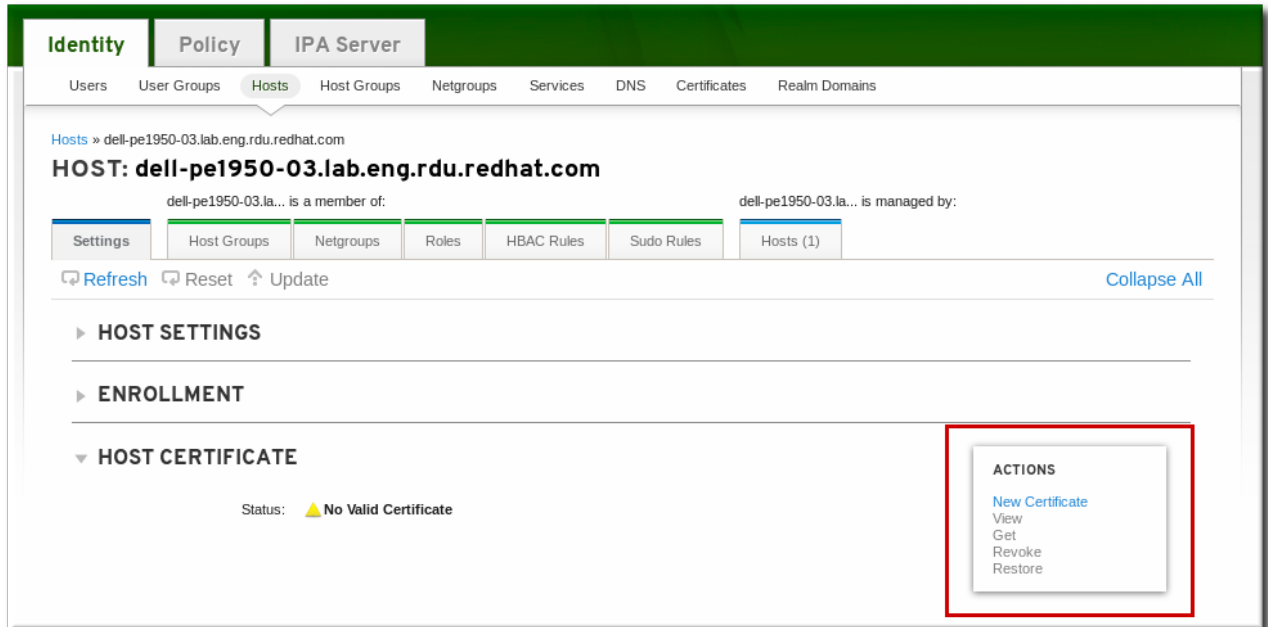
ID	Reason	Description
3	Affiliation Changed	The person or service to which the certificate was issued is changing affiliations. This could mean that the person has left the company (or the service is being retired) or that it has moved departments, if the affiliation is tied to an organizational structure.
4	Superseded	The certificate has been replaced by a newer certificate.
5	Cessation of Operation	The service is being decommissioned.
6	Certificate Hold	The certificate is temporarily revoked. This is the only revocation reason that allows the certificate to be restored.
8	Remove from CRL	The certificate is not included in the certificate revocation list.
9	Privilege Withdrawn	The service should no longer be issued the certificate.
10	A Authority Compromise	The AA was compromised.

11.2.2.1. In the Service Entry in the UI

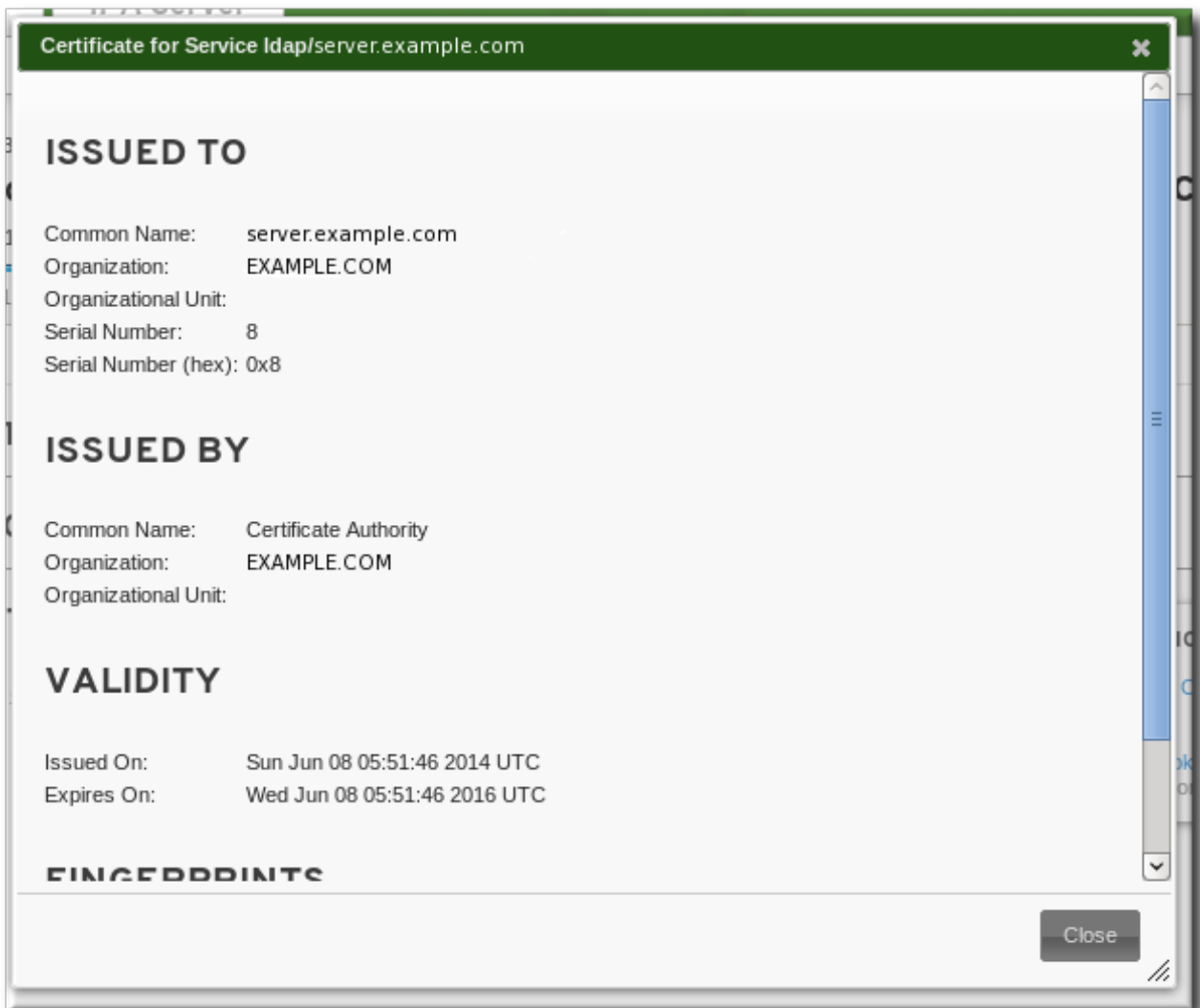
1. Open the **Identity** tab, and select the **Services** subtab.
2. Click the name of the service.



3. In the **Settings** tab, scroll to the **Service Certificate** tab at the bottom.



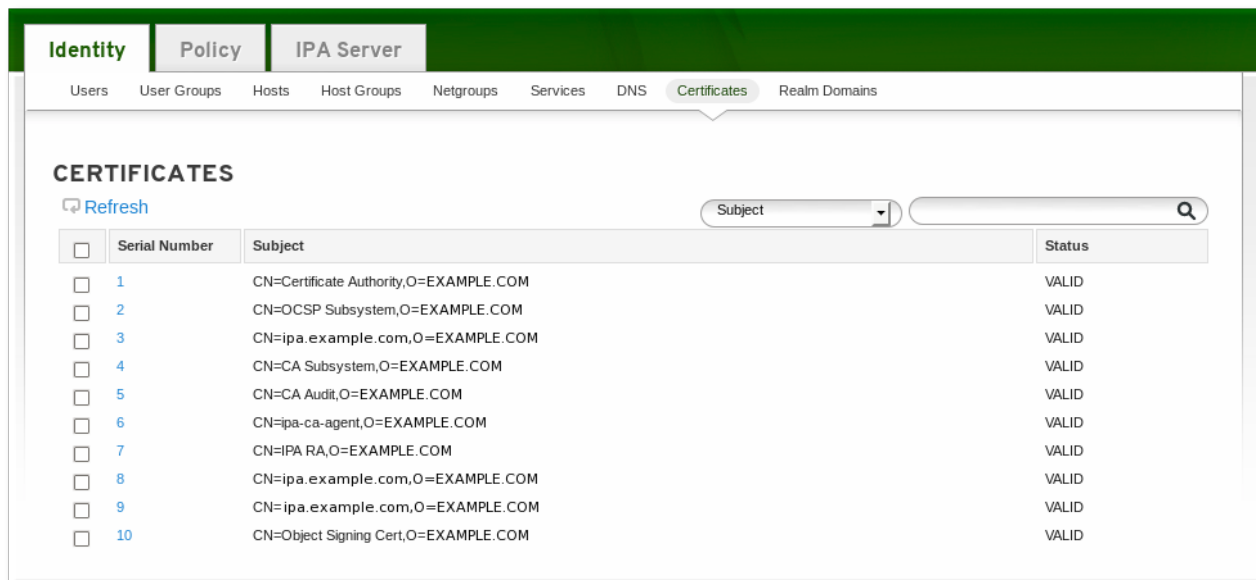
4. In the **Actions** area, click the **Revoke** link.
5. Select the reason for the revocation from the drop-down menu, and click the **Revoke** link. [Table 11.1, “Revocation Reasons”](#) describes the different options for revoking a certificate.



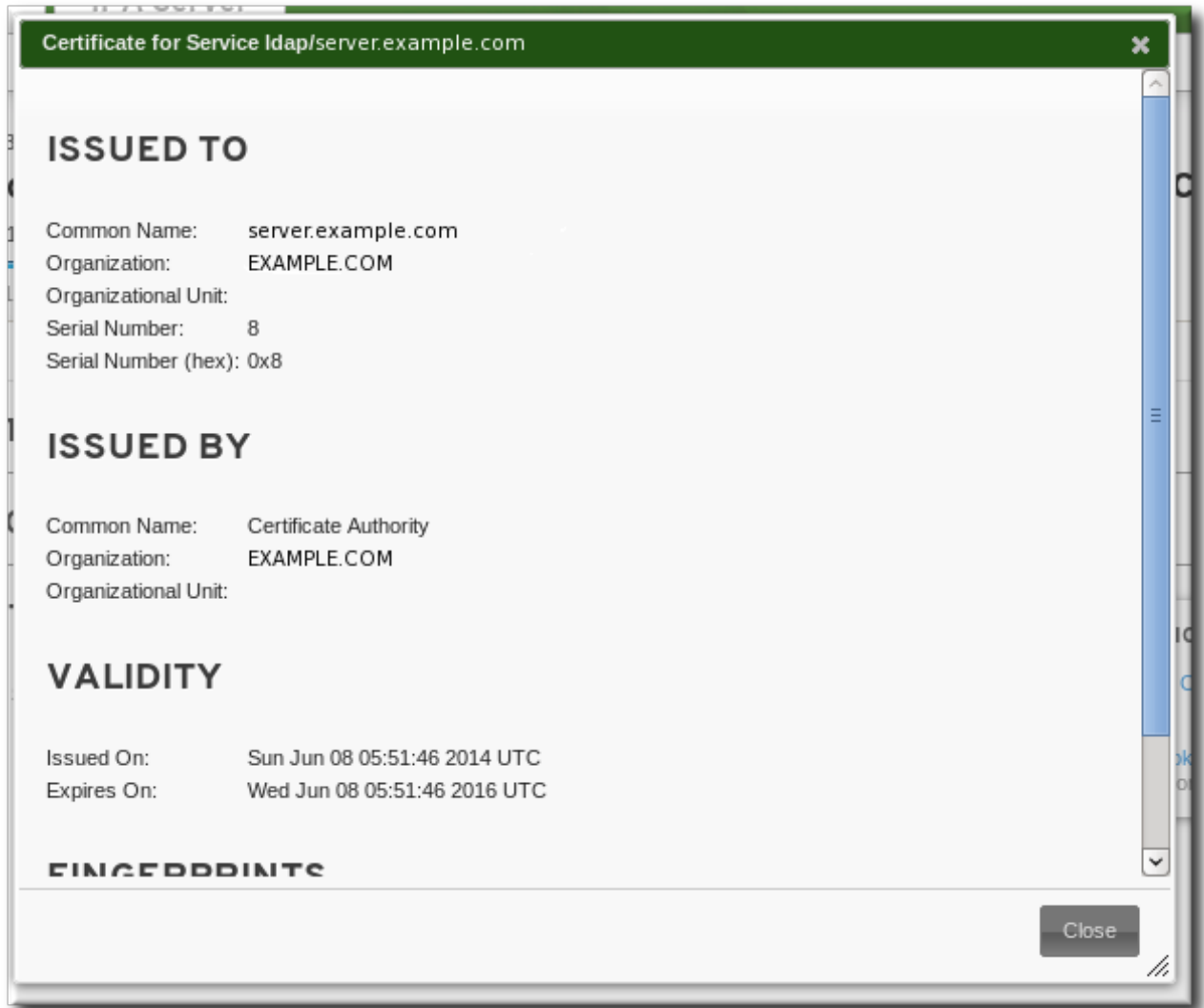
If the reason for the revocation is a certificate hold, then the certificate can be restored later by clicking the **Restore** link in the certificate actions menu.

11.2.2.2. In the Certificate List in the UI

1. Open the **Identity** tab, and select the **Certificates** subtab.
2. Click the serial number of the certificate to view.



3. In the **Actions** area, click the **Revoke** link.
4. Select the reason for the revocation from the drop-down menu, and click the **Revoke** link. [Table 11.1, “Revocation Reasons”](#) describes the different options for revoking a certificate.



If the reason for the revocation is a certificate hold, then the certificate can be restored later by clicking the **Restore** link in the certificate actions menu.

11.2.2.3. In the Command Line

To revoke a certificate from the command line, specify the certificate serial number and give the reason for the revocation in the **--revocation-reason** option.

```
[root@server ~]# kinit admin
[root@server ~]# ipa cert-revoke --revocation-reason=6 1032
```

If the reason for the revocation is a certificate hold (6), then the certificate can be restored with the **cert-remove-hold** command.

```
[root@server ~]# ipa cert-remove-hold 1032
```

11.2.3. Requesting New Service Certificates

The certificate request must be generated with a third-party tool such as **certutil**. The resulting certificate request can be submitted through the IdM web UI or command-line tools.

The service must already exist for a certificate to be requested. If the service does not yet exist, then with the command line, there is an option to create the service as part of requesting the certificate.

11.2.3.1. In the UI

1. Generate a certificate request for the service. For example:

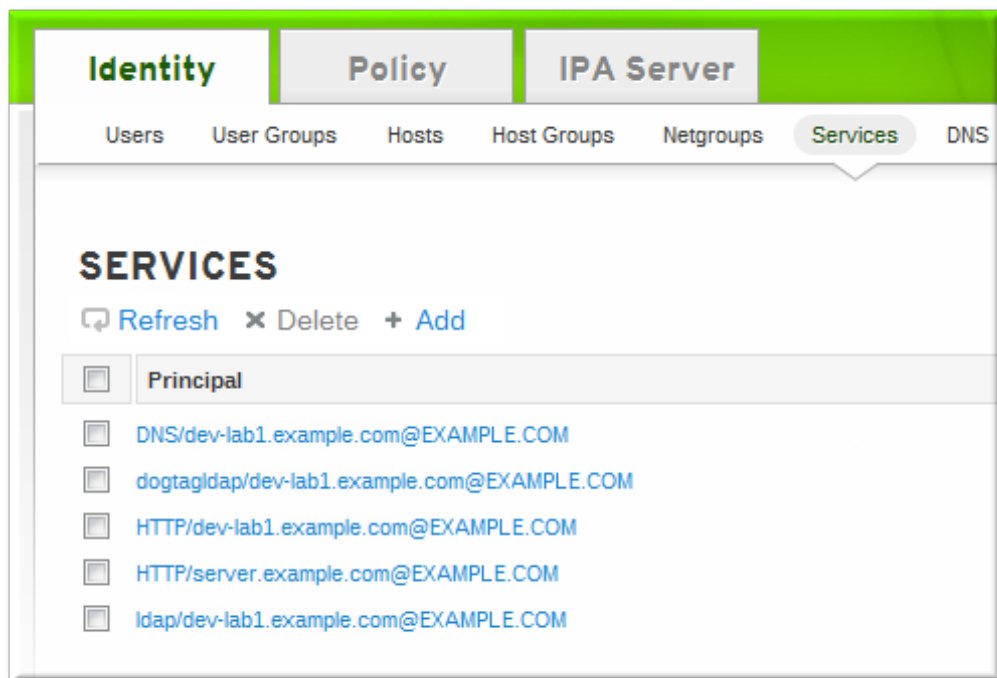
First, create a set of certificate databases that can be used to create and store the certificate locally.

```
[root@server ~]# certutil -N -d ~/test-certs/
```

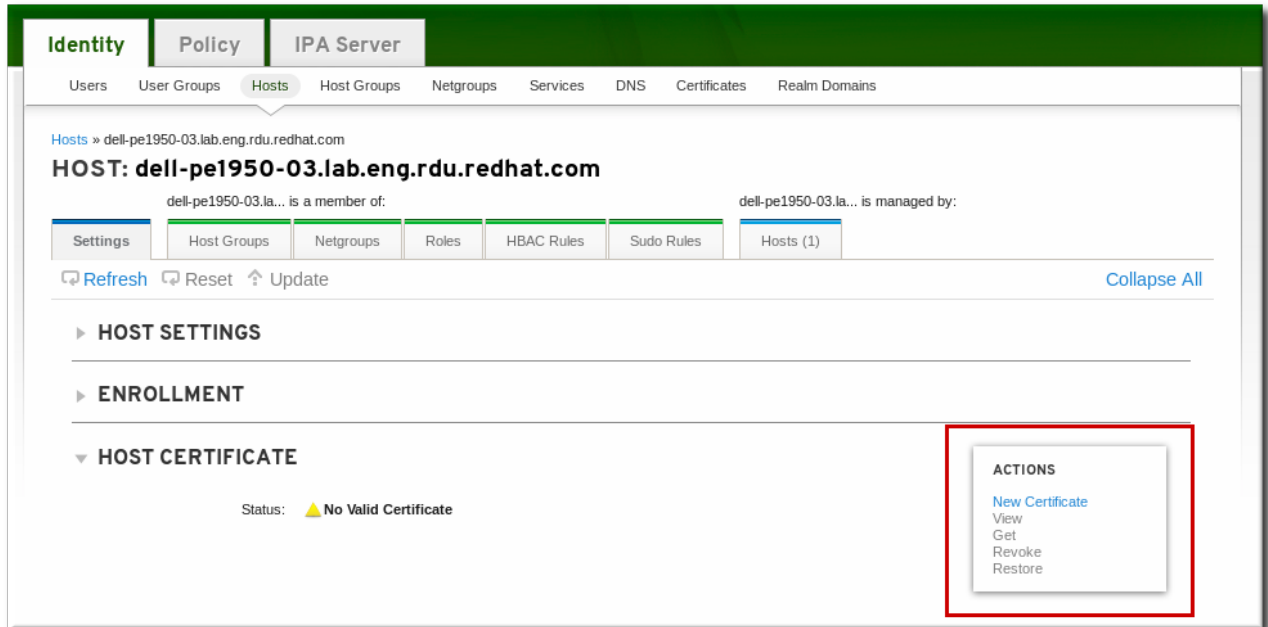
Then, create the certificate request.

```
[root@server ~]# certutil -R -d ~/test-certs -R -a -g 256 -s  
"CN=server.example.com,O=EXAMPLE.COM" -o ~/test-certs/service.csr
```

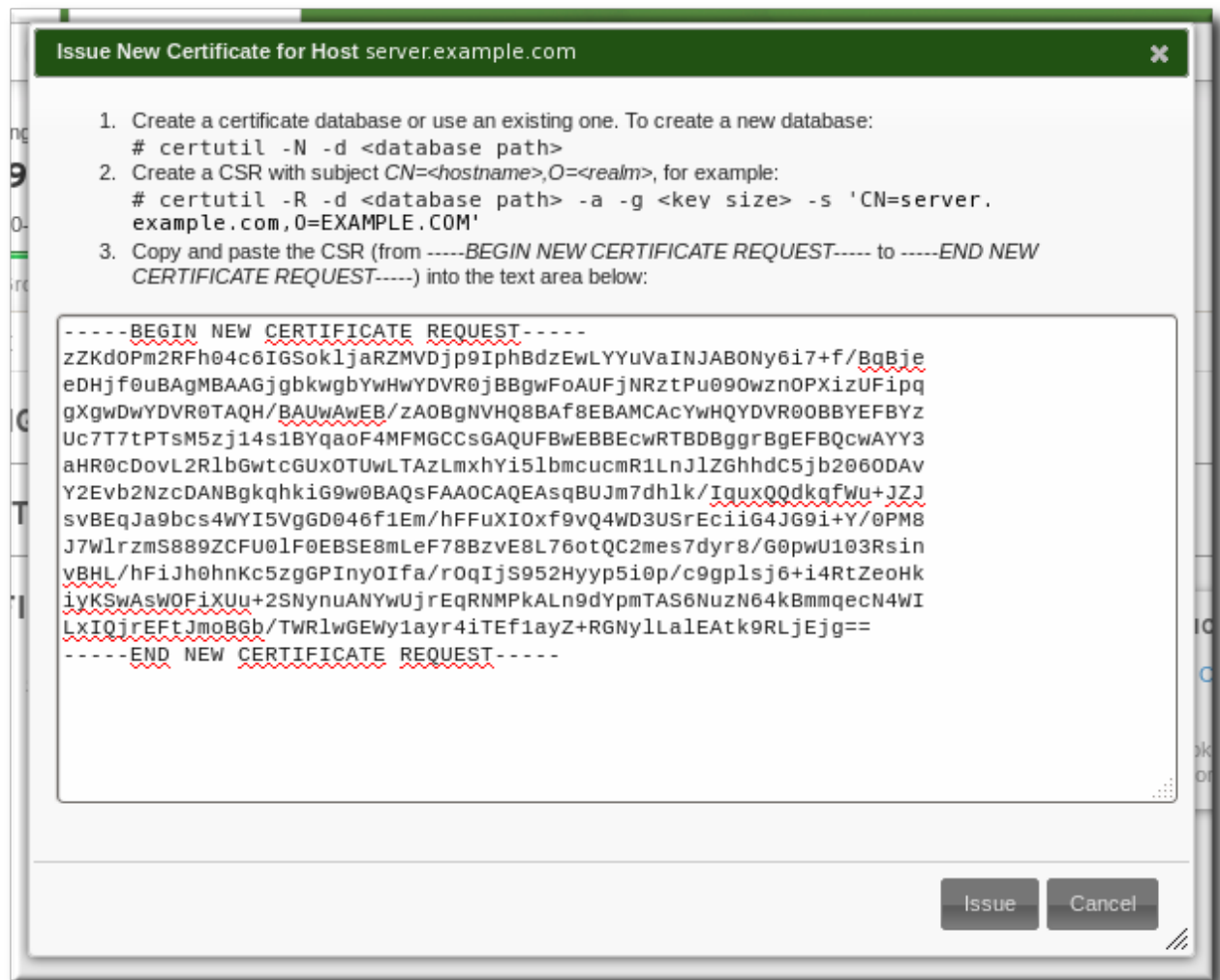
2. Copy the text of the new certificate request.
3. Open the **Identity** tab, and select the **Services** subtab.
4. Click the name of the service.



5. In the **Settings** tab, scroll to the **Service Certificate** tab at the bottom.



6. In the **Actions** area, click the **Request** link.
7. Paste in the body of the certificate request, including the **BEGIN NEW CERTIFICATE REQUEST** and **END NEW CERTIFICATE REQUEST** lines.



8. Click the **Issue** button.

11.2.3.2. In the Command Line

1. Generate a certificate request for the service. For example:

First, create a set of certificate databases that can be used to create and store the certificate locally.

```
[root@server ~]# certutil -N -d ~/test-certs/
```

Then, create the certificate request.

```
[root@server ~]# certutil -R -d ~/test-certs -R -a -g 256 -s
"CN=server.example.com,O=EXAMPLE.COM" -o ~/test-certs/service.csr
```

2. Submit the PEM file of the certificate request to the IdM server. Along with the request itself, specify the Kerberos principal to create and associate with the newly-issued certificate.

If the service does not already exist, then use the **--add** option to create the service, and then issue the certificate.

```
[root@server ~]# ipa cert-request -add --principal=ldap/server.example.com
service.csr
```

11.3. Storing Certificates in NSS Databases

When services use certificates, the certificates and keys can be stored in NSS databases (which may also be used by the services themselves, as well as Identity Management).

1. Create the NSS databases.

```
$ certutil -N -d /path/to/database/dir
```

2. Request the certificate using **certutil**, an NSS tool.

```
$ certutil -R -s "CN=client1.example.com,O=EXAMPLE.COM" -d
/path/to/database/dir -a > example.csr
```

If the IdM domain is using Certificate System for its CA, only the CN of the subject name is used. With a self-signed CA, the subject must match the configured certificate subject base. The IdM server rejects requests with a subject base that differs from this value.

11.4. Configuring Clustered Services

The IdM server is not *cluster aware*. However, it is possible to configure a clustered service to be part of IdM by synchronizing Kerberos keys across all of the participating hosts and configuring services running on the hosts to respond to whatever names the clients use.

1. Enroll all of the hosts in the cluster into the IdM domain.
2. Create any service principals and generate the required keytabs.
3. Collect any keytabs that have been set up for services on the host, including the host keytab at **/etc/krb5.keytab**.
4. Use the **ktutil** command to produce a single keytab file that contains the contents of all of the keytab files.

- a. For each file, use the **rkt** command to read the keys from that file.
 - b. Use the **wkt** command to write all of the keys which have been read to a new keytab file.
5. Replace the keytab files on each host with the newly-created combined keytab file.
 6. At this point, each host in this cluster can now impersonate any other host.
 7. Some services require additional configuration to accommodate cluster members which do not reset hostnames when taking over a failed service.
 - ▶ For **sshd**, set **GSSAPIStrictAcceptorCheck no** in **/etc/ssh/sshd_config**.
 - ▶ For **mod_auth_kerb**, set **KrbServiceName Any** in **/etc/httpd/conf.d/auth_kerb.conf**.



NOTE

For SSL servers, the subject name or a subject alternative name for the server's certificate must appear correct when a client connects to the clustered host. If possible, share the private key among all of the hosts.

If each cluster member contains a subject alternative name which includes the names of all the other cluster members, that satisfies any client connection requirements.

11.5. Using the Same Service Principal for Multiple Services

Within a cluster, the same service principal can be used for multiple services, spread across different machines.

1. Retrieve a service principal using the **ipa-getkeytab** command.

```
# ipa-getkeytab -s kdc.example.com -p HTTP/server.example.com -k
/etc/httpd/conf/krb5.keytab -e aes256-cts
```

2. Either direct multiple servers or services to use the same file, or copy the file to individual servers as required.

11.6. Disabling and Re-enabling Service Entries

Active services can be accessed by other services, hosts, and users within the domain. There can be situations when it is necessary to remove a host or a service from activity. However, deleting a service or a host removes the entry and all the associated configuration, and it removes it permanently.

11.6.1. Disabling Service Entries

Disabling a service prevents domain users from access it without permanently removing it from the domain. This can be done by using the **service-disable** command.

For a service, specify the principal for the service. For example:

```
[jsmith@ipaserver ~]$ kinit admin
$ ipa service-disable http/server.example.com
```

**IMPORTANT**

Disabling a host entry not only disables that host. It disables every configured service on that host as well.

11.6.2. Re-enabling and Services

Disabling a service essentially kills its current, active keytabs. Removing the keytabs effectively removes the service from the IdM domain without otherwise touching its configuration entry.

To re-enable a service, simply use the **ipa-getkeytab** command. The **-s** option sets which IdM server to request the keytab, **-p** gives the principal name, and **-k** gives the file to which to save the keytab.

For example, requesting a new HTTP keytab:

```
[root@ipaserver ~]# ipa-getkeytab -s ipaserver.example.com -p  
HTTP/server.example.com -k /etc/httpd/conf/krb5.keytab -e aes256-cts
```

If the **ipa-getkeytab** command is run on an active IdM client or server, then it can be run without any LDAP credentials (**-D** and **-w**). The IdM user uses Kerberos credentials to authenticate to the domain. To run the command directly on a disabled host, then supply LDAP credentials to authenticate to the IdM server. The credentials should correspond to the host or service which is being re-enabled.

Chapter 12. Delegating User Access to Hosts and Services

As discussed in [Section 1.3, “Relationships Between Servers and Clients”](#), within the IdM domain, *manage* means being able to retrieve a keytab and certificates for another host or service. Every host and service has a *managedby* entry which lists what hosts or services can manage it. By default, a host can manage itself and all of its services. It is also possible to allow a host to manage other hosts, or services on other hosts, by updating the appropriate delegations or providing a suitable *managedby* entry.

An IdM service can be managed from any IdM host, as long as that host has been granted, or *delegated*, permission to access the service. Likewise, hosts can be delegated permissions to other hosts within the domain.

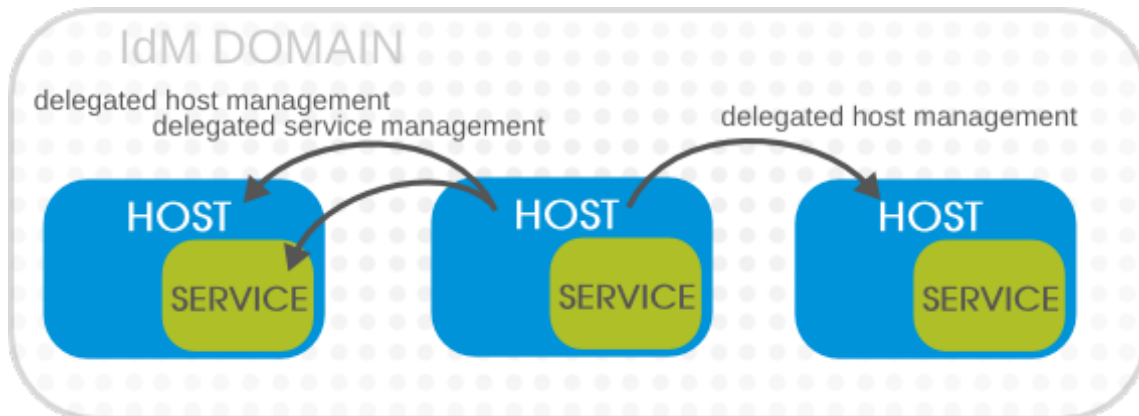


Figure 12.1. Host and Service Delegation



NOTE

If a host is delegated authority to another host through a **managedBy** entry, it does not mean that the host has also been delegated management for all services on that host. Each delegation has to be performed independently.

12.1. Delegating Service Management

A host is delegated control over a service using the **service-add-host** command. There are two parts to delegating the service: specifying the principal and identifying the hosts with the control:

```
# ipa service-add-host principal --hosts=hostnames
```

For example:

```
[root@server]# ipa service-add-host http/web.example.com --
hosts=client1.example.com
```

Once the host is delegated authority, the host principal can be used to manage the service:

```
[root@server]# kinit -kt /etc/krb5.keytab host/`hostname`
# ipa-getkeytab -s `hostname` -k /tmp/test.keytab -p http/web.example.com
Keytab successfully retrieved and stored in: /tmp/test.keytab
```


To create a ticket for this service, create a certificate request on the host with the delegated authority and use the **cert-request** command to create a service entry and load the certification information:

```
[root@server ]# ipa cert-request --add --principal=http/web.example.com web.csr
Certificate: MIICETCCAXqgA...[snip]
Subject: CN=web.example.com,O=EXAMPLE.COM
Issuer: CN=EXAMPLE.COM Certificate Authority
Not Before: Tue Feb 08 18:51:51 2011 UTC
Not After: Mon Feb 08 18:51:51 2016 UTC
Fingerprint (MD5): c1:46:8b:29:51:a6:4c:11:cd:81:cb:9d:7c:5e:84:d5
Fingerprint (SHA1):
01:43:bc:fa:b9:d8:30:35:ee:b6:54:dd:a4:e7:d2:11:b1:9d:bc:38
Serial number: 1005
```

12.2. Delegating Host Management

Hosts are delegated authority over other hosts through the **host-add-managedby** command. This creates a **managedby** entry. Once the **managedby** entry is created, then the host can retrieve a keytab for the host it has delegated authority over.

1. Log in as the admin user.

```
[root@server ]# kinit admin
```

2. Add the **managedby** entry. For example, this delegates authority over *client2* to *client1*.

```
[root@server ]# ipa host-add-managedby client2.example.com --
hosts=client1.example.com
```

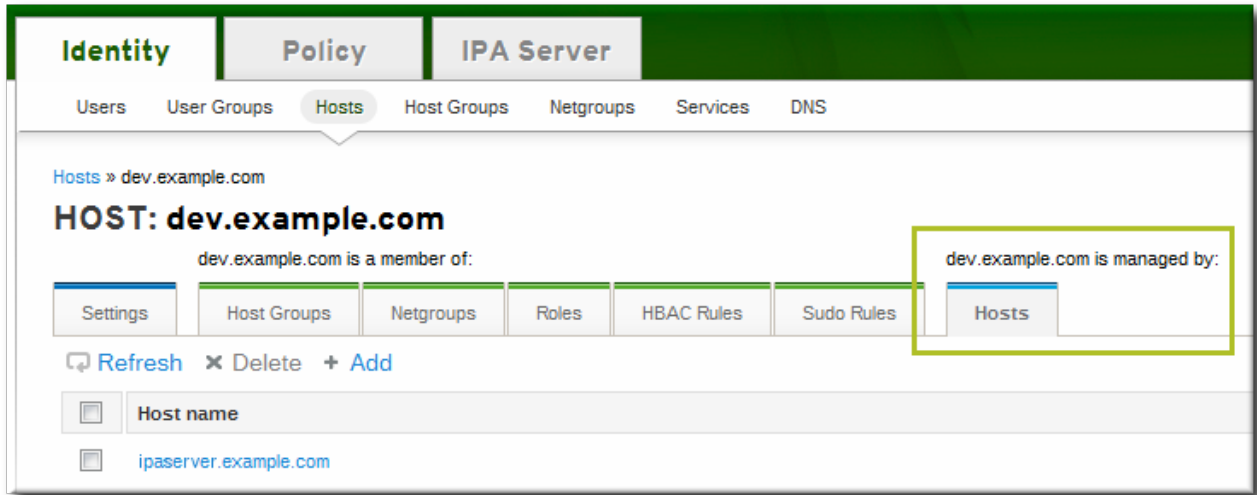
3. Obtain a ticket as the host **client1** and then retrieve a keytab for **client2**:

```
[root@server ]# kinit -kt /etc/krb5.keytab host/`hostname`
[root@server ~]# ipa-getkeytab -s `hostname` -k /tmp/client2.keytab -p
host/client2.example.com
Keytab successfully retrieved and stored in: /tmp/client2.keytab
```

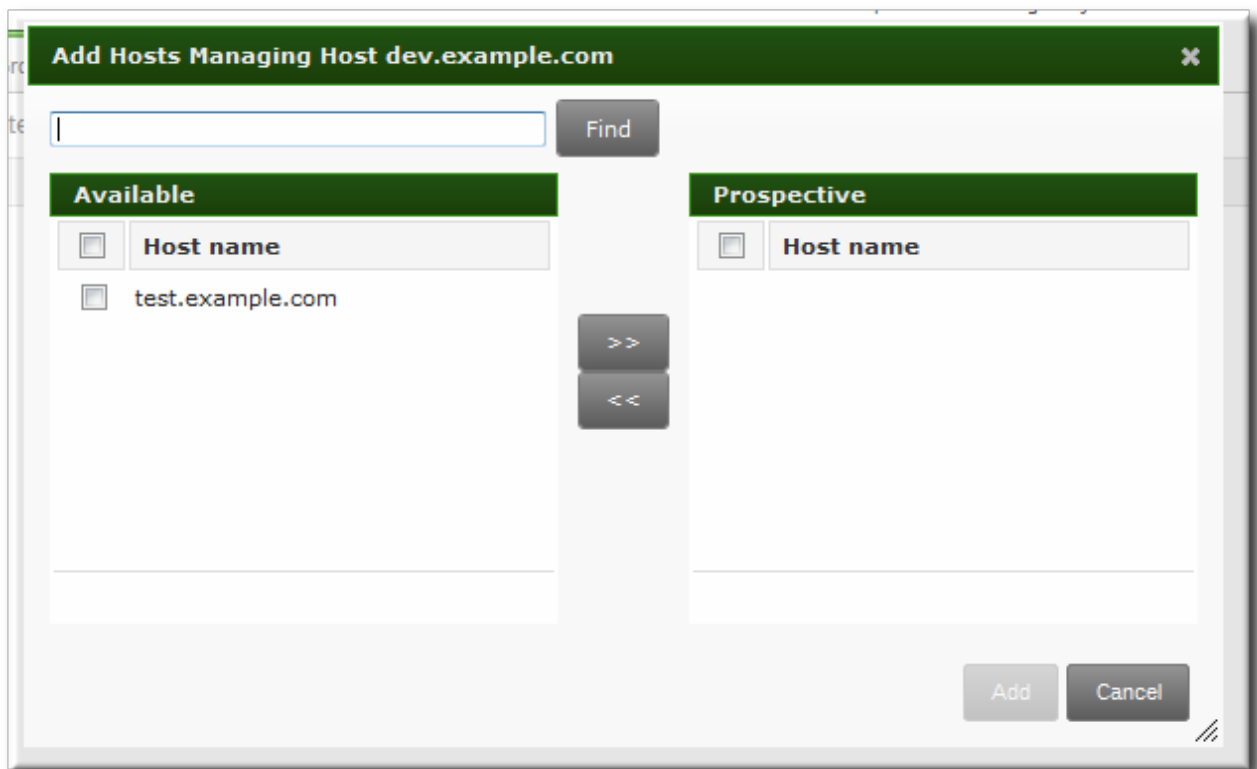
12.3. Delegating Host or Service Management in the Web UI

Each host and service entry has a configuration tab that indicates what hosts have been delegated management control over that host or service.

1. Open the **Identity** tab, and select the **Hosts** or **Services** subtab.
2. Click the name of the host or service *that you are going to grant delegated management to*.
3. Click the **Hosts** subtab on the far right of the host/service entry. This is the tab which lists hosts *which can manage* the selected host/service.



4. Click the **Add** link at the top of the list.
5. Click the checkbox by the names of the hosts to which to delegate management for the host/service. Click the right arrows button, **>>**, to move the hosts to the selection box.



6. Click the **Add** button to close the selection box and to save the delegation settings.

12.4. Accessing Delegated Services

For both services and hosts, if a client has delegated authority, it can obtain a keytab for that principal on the local machine. For services, this has the format `service/hostname@REALM`. For hosts, the `service` is **host**.

With `kinit`, use the `-k` option to load a keytab and the `-t` option to specify the keytab.

For example, to access a host:

```
[root@server ]# kinit -kt /etc/krb5.keytab host/ipa.example.com@EXAMPLE.COM
```

To access a service:

```
[root@server ]# kinit -kt /etc/httpd/conf/krb5.keytab  
http/ipa.example.com@EXAMPLE.COM
```

Chapter 13. Integrating with NIS Domains and Netgroups

Network information service (NIS) is one of the most common ways to manage identities and authentication on Unix networks. It is simple and easy to use, but it also has inherent security risks and a lack of flexibility that can make administering NIS domains problematic.

Identity Management supplies a way to integrate netgroups and other NIS data into the IdM domain, which incorporates the stronger security structure of IdM over the NIS configuration. Alternatively, administrators can simply migrate user and host identities from a NIS domain into the IdM domain.

13.1. About NIS and Identity Management

Network information service (NIS) centrally manages authentication and identity information such as users and passwords, hosts and IP addresses, and POSIX groups. This was originally called *Yellow Pages* (abbreviated YP) because of its simple focus on identity and authentication lookups.

NIS is considered too insecure for most modern network environments because it provides no host authentication mechanisms and it transmits all of its information over the network unencrypted, including password hashes. Still, while NIS has been falling out of favor with administrators, it is still actively used by many system clients. There are ways to work around those insecurities by integrating NIS with other protocols which offer enhanced security.

In Identity Management, NIS objects are integrated into IdM using the underlying LDAP directory. LDAP services offer support for NIS objects (as defined in [RFC 2307](#)), which Identity Management customizes to provide better integration with other domain identities. The NIS object is created inside the LDAP service and then a module like `nss_ldap` or SSSD fetches the object using an encrypted LDAP connection.

NIS entities are stored in *netgroups*. A netgroup allows nesting (groups inside groups), which standard Unix groups don't support. Also, netgroups provide a way to group hosts, which is also missing in Unix group.

NIS groups work by defining users and hosts as members of a larger domain. A netgroup sets a trio of information — host, user, domain. This is called a *triple*.

```
host, user, domain
```

A netgroup triple associates the user or the host with the domain; it does not associate the user and the host with each other. Therefore, a triple usually defines a host or a user for better clarity and management.

```
host.example.com, , nisdomain.example.com
-, jsmith, nisdomain.example.com
```

NIS distributes more than just netgroup data. It stores information about users and passwords, groups, network data, and hosts, among other information. Identity Management can use a NIS listener to map passwords, groups, and netgroups to IdM entries.

In IdM LDAP entries, the users in a netgroup can be a single user or a group; both are identified by the *memberUser* parameter. Likewise, hosts can be either a single host or a host group; both are identified by the *memberHost* attribute.

```
dn: ipaUniqueID=d4453480-cc53-11dd-ad8b-0800200c9a66, cn=ng, cn=accounts, ...
objectclass: top
objectclass: ipaAssociation
objectclass: ipaNISNetgroup
ipaUniqueID: d4453480-cc53-11dd-ad8b-0800200c9a66
cn: netgroup1
```

```
memberHost: fqdn=host1.example.com,cn=computers,cn=accounts,...
memberHost: cn=VirtGuests,cn=hostgroups,cn=accounts,...
memberUser: cn=jsmith,cn=users,cn=accounts,...
memberUser: cn=bjensen,cn=users,cn=accounts,...
memberUser: cn=Engineering,cn=groups,cn=accounts,...
nisDomainName: nisdomain.example.com
```

In Identity Management, these netgroup entries are handled using the **netgroup-*** commands, which show the basic LDAP entry:

```
[root@server ~]# ipa netgroup-show netgroup1
Netgroup name: netgroup1
Description: my netgroup
NIS domain name: nisdomain
Member User: jsmith
Member User: bjensen
Member User: Engineering
Member Host: host1.example.com
Member Host: VirtGuests
```

When a client attempts to access the NIS netgroup, then Identity Management translates the LDAP entry into a traditional NIS map and sends it to a client over the NIS protocol (using a NIS plug-in) or it translates it into an LDAP format that is compliant with RFC 2307 or RFC 2307bis.

13.2. Setting the NIS Port for Identity Management

The IdM server binds to its NIS services over a random port that is selected when the server starts. It sends that port assignment to the portmapper so that NIS clients know what port to use to contact the IdM server.

Administrators may need to open a firewall for NIS clients or may have other services that need to know the port number in advance and need that port number to remain the same. In that case, an administrator can specify the port to use.



NOTE

Any available port number below 1024 can be used for the NIS Plug-in setting.

The NIS configuration is in the NIS Plug-in in Identity Management's internal Directory Server instance. To specify the port:

1. Enable the NIS listener and compatibility plug-ins:

```
[root@ipaserver ~]# ipa-nis-manage enable
[root@ipaserver ~]# ipa-compat-manage enable
```

2. Edit the plug-in configuration and add the port number as an argument. For example, to set the port to 514:

```
[root@ipaserver ~]# ldapmodify -x -D 'cn=directory manager' -w secret

dn: cn=NIS Server,cn=plugins,cn=config
changetype: modify
```

```
add: nsslapd-pluginarg0
nsslapd-pluginarg0: 514

modifying entry "cn=NIS Server,cn=plugins,cn=config"
```

- Restart the Directory Server to load the new plug-in configuration.

```
[root@ipaserver ~]# systemctl restart dirsrv.service
```

13.3. Creating Netgroups

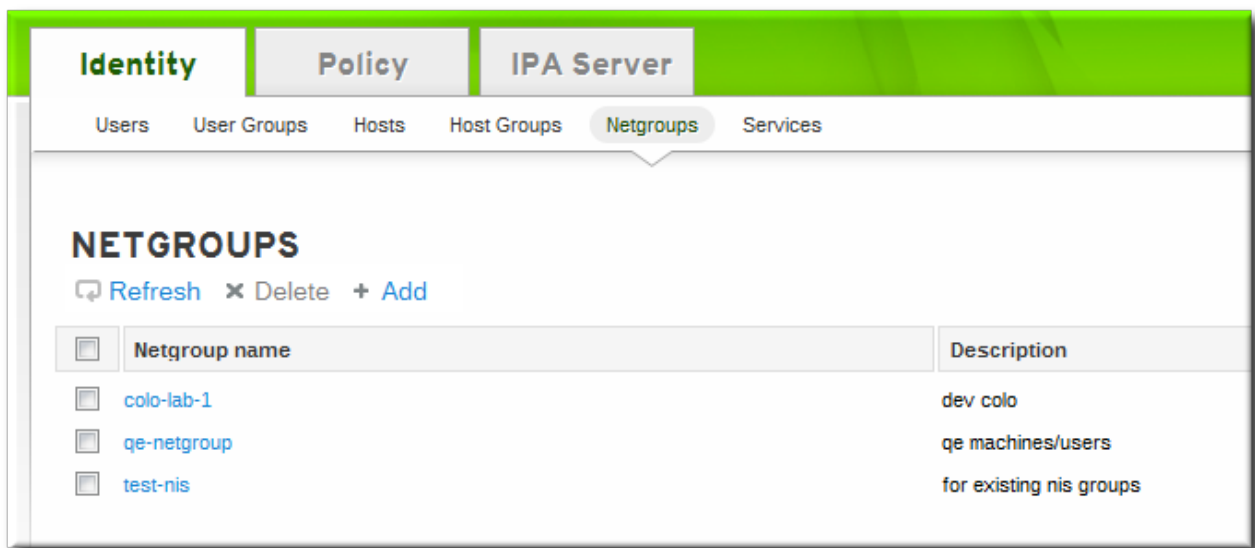
All netgroups in Identity Management are essentially *static* groups, meaning that the members of the group are manually and explicitly added to the group. Tangentially, IdM allows *nested groups*, where a group is a member of another group. In that case, all of the group members of the member group automatically belong to the parent group, as well.

Netgroups are added in two steps: the group itself is created, and then members are added to it.

13.3.1. Adding Netgroups

13.3.1.1. With the Web UI

- Open the **Identity** tab, and select the **Netgroups** subtab.
- Click the **Add** link at the top of the netgroups list.



- Enter both a unique name and a description for the netgroup. Both the name and description are required.

The group name is the identifier used for the netgroup in the IdM domain, and it cannot be changed after it is created. The name cannot contain spaces, but other separators like an underscore (_) are allowed.

4. Click the **Add and Edit** button to go immediately to the netgroup's edit pages.
5. Optionally, set the NIS domain for the netgroup. This defaults to the IdM domain, but it can be changed.
 - a. Click the **Settings** tab.
 - b. Enter the name of the alternate NIS domain in the **NIS domain name** field.

The **NIS domain name** field sets the domain that appears in the netgroup triple. It does *not* affect which NIS domain the Identity Management listener responds to.

6. Add members, as described in [Section 13.3.2.1, "With the Web UI"](#).

13.3.1.2. With the Command Line

New netgroups are added using the `netgroup-add` command. This adds only the group; members are added separately. Two attributes are always required: the group name and the group description. If those attributes are not given as arguments, then the script prompts for them. There is also an option to set the NIS domain name to use for the group; this defaults to the IdM domain, but it can be set to something

different, depending on the network configuration.

```
[jsmith@server ~]$ ipa netgroup-add --desc="description" [--nisdomain=domainName]
groupName
```

For example:

```
[root@server ~][root@server ~]# ipa netgroup-add --desc="my new netgroup" example-
netgroup
[root@server ~]# ipa netgroup-add-member --hosts=ipa.example.com example-netgroup
[root@server ~]# ypcat -d example.com -h ipa.example.com netgroup
(ipa.example.com, -, example.com)
```



NOTE

The `--nisdomain` option sets the domain that appears in the netgroup triple. It does *not* affect which NIS domain the Identity Management listener responds to.

13.3.2. Adding Netgroup Members



NOTE

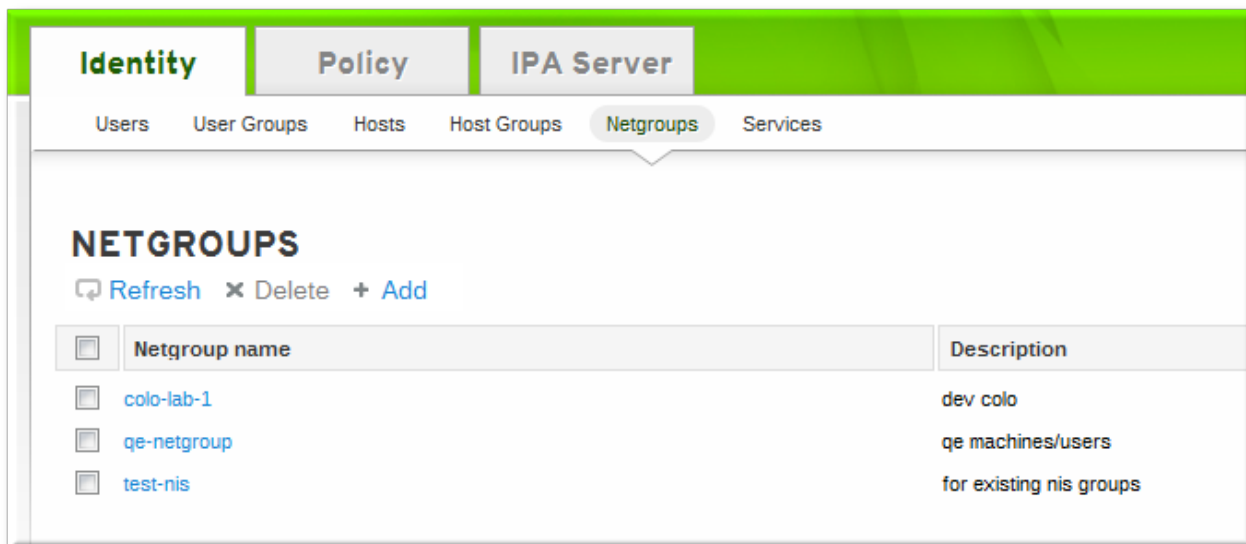
Netgroups can contain user groups, host groups, and other netgroups as their members. These are *nested* groups.

It can take up to several minutes for the members of the child group to show up as members of the parent group. This is especially true on virtual machines where the nested groups have more than 500 members.

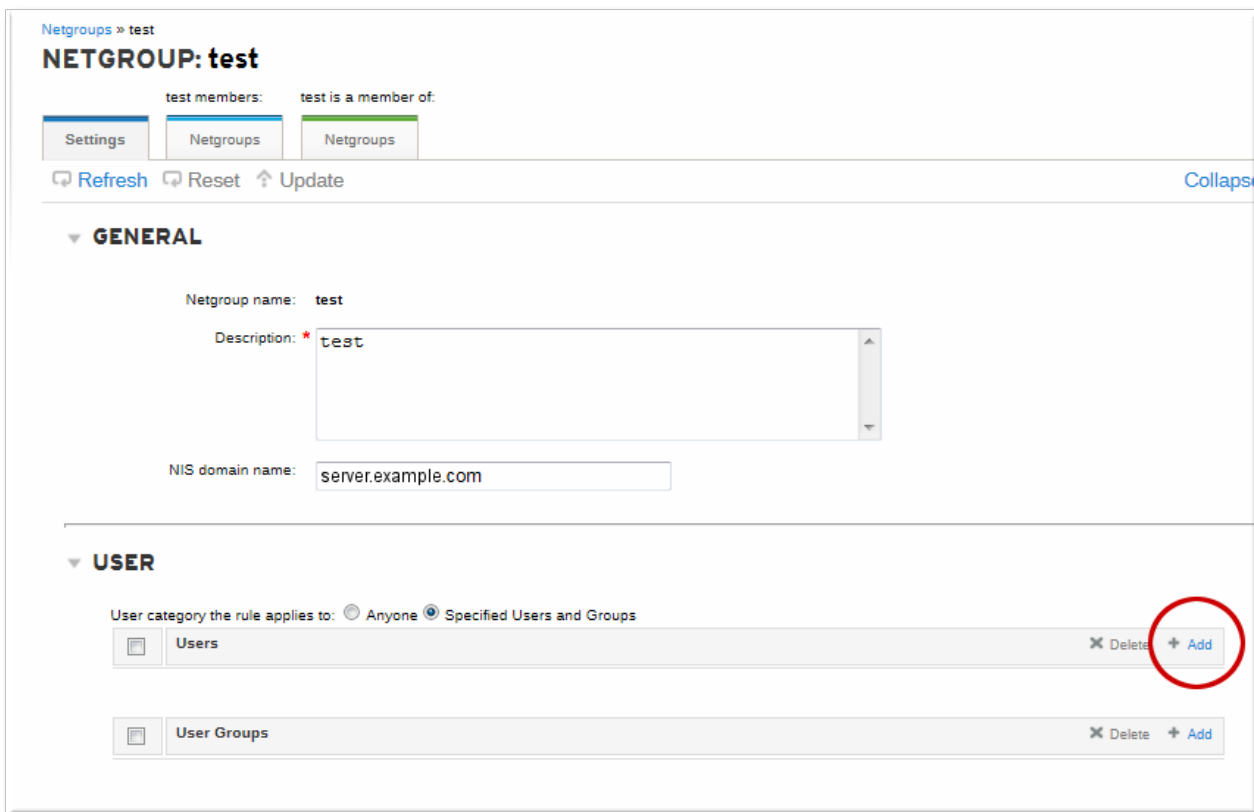
When creating nested groups, be careful not to create *recursive* groups. For example, if GroupA is a member of GroupB, do not add GroupB as a member of GroupA. Recursive groups are not supported and can cause unpredictable behavior.

13.3.2.1. With the Web UI

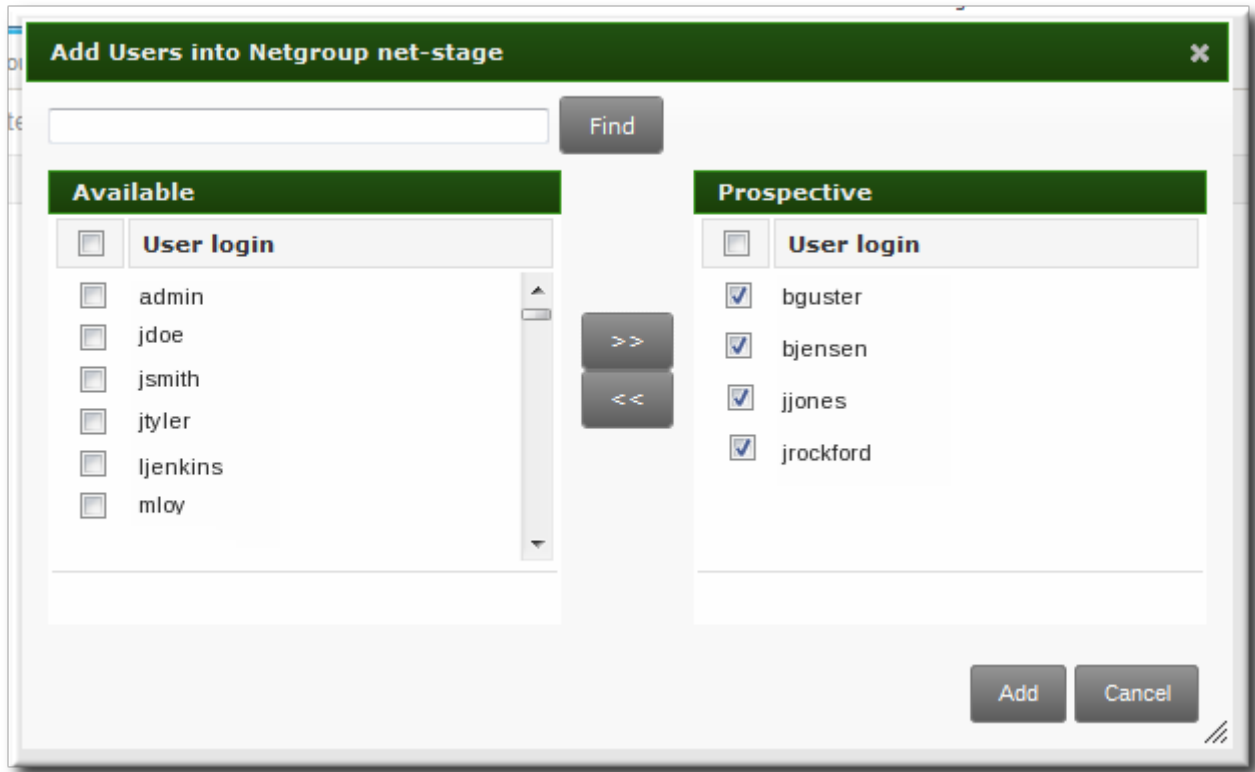
1. Open the **Identity** tab, and select the **Netgroups** subtab.
2. Click the name of the netgroup to which to add members.



3. Select the tab for the type of netgroup member to add. Netgroups can have users, user groups, hosts, host groups, and other netgroups as members.
4. Click the **Add** link at the top of the task area.



5. Click the checkbox by the names of the users to add, and click the right arrows button, >>, to move the names to the selection box.



6. Click the **Add** button.

13.3.2.2. With the Command Line

Once the group is configured, begin adding netgroup members with the **netgroup-add-member** command. Users, groups, hosts, host groups, and other netgroups can all be added to the netgroup entry. The entry name of the NIS group being edited usually comes at the end of the command:

```
# ipa netgroup-add-member --users=users --groups=groups --hosts=hosts --
hostgroups=hostGroups --netgroups=netgroups groupName
```

To set more than one member, either use the option multiple times or use a comma-separated list inside a set of curly braces (for example, `--option={val1,val2,val3}`). For example, this sets two users and two hosts with the other configuration:

```
[root@server ~]# ipa netgroup-add-member --users=jsmith --users=bjensen --
groups=ITadmin --hosts=host1.example.com --hosts=host2.example.com --
hostgroups=EngDev --netgroups=nisgroup2 example-group
```

13.4. Exposing Automount Maps to NIS Clients

When the NIS service is enabled on a system, the IdM server is automatically configured to set the NIS domain to the IdM domain's name, and to include IdM users, groups, and netgroups as passwd, group, and netgroup maps in the NIS domain.

If any automount maps are already defined, these maps need to be manually added to the NIS configuration in Identity Management for them to be exposed to NIS clients. The NIS server is managed by a special plug-in entry in the IdM LDAP directory; this is a container entry, and each NIS domain and map used by the NIS server is configured as a child entry beneath that container. The NIS domain entry in the must have the name of the NIS domain, the name of the NIS map, how to find the directory entries to use as the NIS map's contents, and which attributes to use as the NIS map's key and value. Most of these settings will be the same for every map.

The IdM server stores the automount maps, grouped by automount location, in the **cn=automount** branch of the IdM directory tree.

The NIS domain and map is added using LDAP tools, like **ldapadd**, and editing the directory directly. For example, this adds an automount map that is named **auto.example** in a location named **default** and for a server named **nisserver**:

```
[root@server ~]# ldapadd -h nisserver.example.com -x -D "cn=Directory Manager" -w
secret

dn: nis-domain=example.com+nis-map=auto.example,cn=NIS Server,cn=plugins,cn=config
objectClass: extensibleObject
nis-domain: example.com
nis-map: auto.example
nis-filter: (objectclass=automount)
nis-key-format: %{automountKey}
nis-value-format: %{automountInformation}
nis-base: automountmapname=auto.example,cn=default,cn=automount,dc=example,dc=com
```

A similar add operation needs to be run for every map that is configured.

13.5. Migrating from NIS to IdM

There is no direct migration path from NIS to Identity Management. This is a manual process with three major steps: setting up netgroup entries in IdM, exporting the existing data from NIS, and importing that data into IdM. There are several options for how to set up the IdM environment and how to export data; the best option depends on the type of data and the overall network environment that you have.

13.5.1. Preparing Netgroup Entries in IdM

The first step is to identify what kinds of identities are being managed by NIS. Frequently, a NIS server is used for either user entries or host entries, but not for both, which can simplify the data migration process.

For user entries

Determine what applications are using the user information in the NIS server. While some clients (like **sudo**) require NIS netgroups, many clients can use Unix groups instead. If no netgroups are required, then simply create corresponding user accounts in IdM and delete the netgroups entirely. Otherwise, create the user entries in IdM and then create an IdM-managed netgroup and add those users as members. This is described in [Section 13.3, "Creating Netgroups"](#).

For host entries

Whenever a host group is created in IdM, a corresponding shadow NIS group is automatically created. These netgroups can then be managed using the **ipa-host-net-manage** command.

For a direct conversion

It may be necessary to have an exact conversion, with every NIS user and host having an exact corresponding entry in IdM. In that case, each entry can be created using the original NIS names:

1. Create an entry for every user referenced in a netgroup.
2. Create an entry for every host referenced in a netgroup.
3. Create a netgroup with the same name as the original netgroup.
4. Add the users and hosts as direct members of the netgroup. Alternatively, add the users and hosts

into IdM groups or other netgroups, and then add those groups as members to the netgroup.

13.5.2. Enabling the NIS Listener in Identity Management

The IdM Directory Server can function as a limited NIS server. The **slapi-nis** plug-in sets up a special NIS listener that receives incoming NIS requests and manages the NIS maps within the Directory Server. Identity Management uses three NIS maps:

- ▶ passwd
- ▶ group
- ▶ netgroup

Using IdM as an intermediate NIS server offers a reasonable way to handle NIS requests while migrating NIS clients and data.

The **slapi-nis** plug-in is not enabled by default. To enable NIS for Identity Management:

1. Obtain new Kerberos credentials as an IdM admin user.

```
[root@ipaserver ~]# kinit admin
```

2. Enable the NIS listener and compatibility plug-ins:

```
[root@ipaserver ~]# ipa-nis-manage enable
[root@ipaserver ~]# ipa-compat-manage enable
```

3. Restart the DNS and Directory Server service:

```
[root@server ~]# systemctl start rpcbind.service
[root@server ~]# systemctl restart dirsrv.service
```

13.5.3. Exporting and Importing the Existing NIS Data

NIS can contain information for users, groups, DNS and hosts, netgroups, and automount maps. Any of these entry types can be migrated over to the IdM server.

Migration is performed by exporting the data using **ypcat** and then looping through that output and creating the IdM entries with the corresponding **ipa *-add** commands. While this could be done manually, it is easiest to script it. These examples use a shell script.

13.5.3.1. Importing User Entries

The **/etc/passwd** file contains all of the NIS user information. These entries can be used to create IdM user accounts with UID, GID, gecos, shell, home directory, and name attributes that mirror the NIS entries.

For example, this is **nis-user.sh**:

```
#!/bin/sh
# 1 is the nis domain, 2 is the nis master server
ypcat -d $1 -h $2 passwd > /dev/shm/nis-map.passwd 2>&1

IFS=$'\n'
for line in $(cat /dev/shm/nis-map.passwd); do
    IFS=' '
    username=$(echo $line|cut -f1 -d:)
```

```

# Not collecting encrypted password because we need cleartext password to
create kerberos key
uid=$(echo $line|cut -f3 -d:)
gid=$(echo $line|cut -f4 -d:)
gecos=$(echo $line|cut -f5 -d:)
homedir=$(echo $line|cut -f6 -d:)
shell=$(echo $line|cut -f7 -d:)

# Now create this entry
echo passw0rd1|ipa user-add $username --first=NIS --last=USER --password --
gidnumber=$gid --uid=$uid --gecos=$gecos --homedir=$homedir --shell=$shell
ipa user-show $username
done

```

This can be run for a given NIS domain:

```

[root@nis-server ~]# kinit admin
[root@nis-server ~]# ./nis-user.sh nisdomain nis-master.example.com

```



NOTE

This script does not migrate user passwords. Rather, it creates a temporary password which users are then prompted to change when they next log in.

13.5.3.2. Importing Group Entries

The `/etc/group` file contains all of the NIS group information. These entries can be used to create IdM user group accounts with the GID, gecos, shell, home directory, and name attributes that mirror the NIS entries.

For example, this is `nis-group.sh`:

```

#!/bin/sh
# 1 is the nis domain, 2 is the nis master server
ypcat -d $1 -h $2 group > /dev/shm/nis-map.group 2>&1

IFS=$'\n'
for line in $(cat /dev/shm/nis-map.group); do
    IFS=' '
    groupname=$(echo $line|cut -f1 -d:)
    # Not collecting encrypted password because we need cleartext password to
    create kerberos key
    gid=$(echo $line|cut -f3 -d:)
    members=$(echo $line|cut -f4 -d:)

    # Now create this entry
    ipa group-add $groupname --desc=NIS_GROUP_$groupname --gid=$gid
    if [ -n "$members" ]; then
        ipa group-add-member $groupname --users=$members
    fi
    ipa group-show $groupname
done

```

This can be run for a given NIS domain:

```

[root@nis-server ~]# kinit admin
[root@nis-server ~]# ./nis-group.sh nisdomain nis-master.example.com

```

13.5.3.3. Importing Host Entries

The `/etc/hosts` file contains all of the NIS host information. These entries can be used to create IdM host accounts that mirror the NIS entries.

For example, this is `nis-hosts.sh`:

```
#!/bin/sh
# 1 is the nis domain, 2 is the nis master server
ypcat -d $1 -h $2 hosts | egrep -v "localhost|127.0.0.1" > /dev/shm/nis-map.hosts
2>&1

IFS=$'\n'
for line in $(cat /dev/shm/nis-map.hosts); do
    IFS=' '
    ipaddress=$(echo $line|awk '{print $1}')
    hostname=$(echo $line|awk '{print $2}')
    master=$(ipa env xmlrpc_uri |tr -d '[:space:]'|cut -f3 -d'|cut -f3 -d/)
    domain=$(ipa env domain|tr -d '[:space:]'|cut -f2 -d:)
    if [ $(echo $hostname|grep "\." |wc -l) -eq 0 ]; then
        hostname=$(echo $hostname.$domain)
    fi
    zone=$(echo $hostname|cut -f2- -d.)
    if [ $(ipa dnszone-show $zone 2>/dev/null | wc -l) -eq 0 ]; then
        ipa dnszone-add --name-server=$master --admin-email=root.$master
    fi
    ptrzone=$(echo $ipaddress|awk -F. '{print $3 "." $2 "." $1 ".in-addr.arpa."}')
    if [ $(ipa dnszone-show $ptrzone 2>/dev/null|wc -l) -eq 0 ]; then
        ipa dnszone-add $ptrzone --name-server=$master --admin-
email=root.$master
    fi
    # Now create this entry
    ipa host-add $hostname --ip-address=$ipaddress
    ipa host-show $hostname
done
```

This can be run for a given NIS domain:

```
[root@nis-server ~]# kinit admin
[root@nis-server ~]# ./nis-hosts.sh nisdomain nis-master.example.com
```



NOTE

This script example does not account for special host scenarios, such as using aliases.

13.5.3.4. Importing Netgroup Entries

The `/etc/netgroup` file contains all of the NIS netgroup information. These entries can be used to create IdM netgroup accounts that mirror the NIS entries.

For example, this is `nis-netgroup.sh`:

```
#!/bin/sh
# 1 is the nis domain, 2 is the nis master server
ypcat -k -d $1 -h $2 netgroup > /dev/shm/nis-map.netgroup 2>&1
```

```

IFS=$'\n'
for line in $(cat /dev/shm/nis-map.netgroup); do
    IFS=' '
    netgroupname=$(echo $line|awk '{print $1}')
    triples=$(echo $line|sed "s/^\$netgroupname //" )
    echo "ipa netgroup-add $netgroupname --desc=NIS_NG_$netgroupname"
    if [ $(echo $line|grep "(,|wc -l) -gt 0 ] ; then
        echo "ipa netgroup-mod $netgroupname --hostcat=all"
    fi
    if [ $(echo $line|grep ",,|wc -l) -gt 0 ] ; then
        echo "ipa netgroup-mod $netgroupname --usercat=all"
    fi
    for triple in $triples; do
        triple=$(echo $triple|sed -e 's/-//g' -e 's/(//' -e 's/)//')
        if [ $(echo $triple|grep ",.*,"|wc -l) -gt 0 ] ; then
            hostname=$(echo $triple|cut -f1 -d,)
            username=$(echo $triple|cut -f2 -d,)
            domain=$(echo $triple|cut -f3 -d,)
            hosts=""; users=""; doms="";
            [ -n "$hostname" ] && hosts="--hosts=$hostname"
            [ -n "$username" ] && users="--users=$username"
            [ -n "$domain" ] && doms="--nisdomain=$domain"
            echo "ipa netgroup-add-member $hosts $users $doms"
        else
            netgroup=$triple
            echo "ipa netgroup-add $netgroup --desc=NIS_NG_$netgroup"
        fi
    done
done

```

As explained briefly in [Section 13.1, “About NIS and Identity Management”](#), NIS entries exist in a set of three values, called a triple. The triple is *host,user,domain*, but not every component is required; commonly, a triple only defines a host and domain or user and domain. The way this script is written, the **ipa netgroup-add-member** command always adds a host, user, and domain triple to the netgroup.

```

if [ $(echo $triple|grep ",.*,"|wc -l) -gt 0 ] ; then
    hostname=$(echo $triple|cut -f1 -d,)
    username=$(echo $triple|cut -f2 -d,)
    domain=$(echo $triple|cut -f3 -d,)
    hosts=""; users=""; doms="";
    [ -n "$hostname" ] && hosts="--hosts=$hostname"
    [ -n "$username" ] && users="--users=$username"
    [ -n "$domain" ] && doms="--nisdomain=$domain"
    echo "ipa netgroup-add-member $hosts $users $doms"

```

Any missing element is added as a blank, so the triple is properly migrated. For example, for the triple **server,,domain** the options with the member add command are **--hosts=server --users="" --nisdomain=domain**.

This can be run for a given NIS domain by specifying the NIS domain and NIS server:

```

[root@nis-server ~]# kinit admin
[root@nis-server ~]# ./nis-hosts.sh nisdomain nis-master.example.com

```

13.5.3.5. Importing Automount Maps

Automount maps are actually a series of nested and inter-related entries that define the location (the parent entry), and then associated keys and maps.

While the data are the same in the NIS and IdM entries, the way that data are defined is different. The NIS information is exported and then used to construct an LDAP entry for the automount location and associated map; it then creates an entry for every configured key for the map.

Unlike the other NIS migration script examples, this script takes options to create an automount location and a map name, along with the migrated NIS domain and server.

```
#!/bin/sh
# 1 is for the automount entry in ipa

ipa automountlocation-add $1

# 2 is the nis domain, 3 is the nis master server, 4 is the map name
ypcat -k -d $2 -h $3 $4 > /dev/shm/nis-map.$4 2>&1

ipa automountmap-add $1 $4

basedn=$(ipa env basedn|tr -d '[:space:]'|cut -f2 -d:)
cat > /tmp/amap.ldif <<EOF
dn: nis-domain=nisdomain.example.com+nis-map=$4,cn=NIS Server,cn=plugins,cn=config
objectClass: extensibleObject
nis-domain: $3
nis-map: $4
nis-base: automountmapname=$4,cn=nis,cn=automount,$basedn
nis-filter: (objectclass=*)
nis-key-format: %{automountKey}
nis-value-format: %{automountInformation}
EOF
ldapadd -x -h $3 -D "cn=directory manager" -w secret -f /tmp/amap.ldif

IFS=$'\n'
for line in $(cat /dev/shm/nis-map.$4); do
    IFS=" "
    key=$(echo "$line" | awk '{print $1}')
    info=$(echo "$line" | sed -e "s#^$key[ \t]*##")
    ipa automountkey-add nis $4 --key="$key" --info="$info"
done
```

This can be run for a given NIS domain:

```
[root@nis-server ~]# kinit admin
[root@nis-server ~]# ./nis-hosts.sh location nisdomain nis-master.example.com map
```

13.5.4. Setting Weak Password Encryption for NIS User Authentication to IdM

A NIS server can handle CRYPT password hashes. Once an existing NIS server is migrated to IdM (and its underlying LDAP database), it may still be necessary to preserve the NIS-supported CRYPT passwords. However, the LDAP server does not use CRYPT hashes by default. It uses salted SHA (SSHA) or SSHA-256. If the 389 Directory Server password hash is not changed, then NIS users cannot authenticate to the IdM domain, and **kinit** fails with password failures.

To set the underlying 389 Directory Server to use CRYPT as the password hash, change the **passwordStorageScheme** attribute using **ldapmodify**:

```
[root@server ~]# ldapmodify -D "cn=directory server" -w secret -p 389 -h
ipaserver.example.com

dn: cn=config
```



```
changetype: modify  
replace: passwordStorageScheme  
passwordStorageScheme: crypt
```



NOTE

Changing the password storage scheme only applies the scheme to new passwords; it does not retroactively change the encryption method used for existing passwords.

If weak crypto is required for password hashes, it is better to change the setting as early as possible so that more user passwords use the weaker password hash.

Chapter 14. Managing DNS

If the IdM server was installed with DNS configured, then all of the DNS entries for the domain — host entries, locations, records — can be managed using the IdM tools.

14.1. About DNS in IdM

DNS is one of the services that can be configured and maintained by the IdM domain. DNS is critical to the performance of the IdM domain; DNS is used for the Kerberos services and SSL connections for all servers and clients and for connections to domain services like LDAP.

While IdM can use an external DNS service, there is a lot more flexibility and control over IdM — DNS interactions when the DNS service is configured within the domain. For example, DNS records and zones can be managed within the domain using IdM tools, and clients can update their own DNS records dynamically. When a host is added to IdM, a DNS record is automatically created in IdM's DNS service for that host machine.

IdM stores all DNS information as LDAP entries. Every resource record for each machine is stored for the domain. For example, the `client1` resource has three IPv4 (A) records and one IPv6 (AAAA) record:

```
dn: idnsname=client1,idnsname=example.com,cn=dns,dc=example,dc=com
idnsname: client1
arecord: 10.0.0.1
arecord: 10.0.0.2
arecord: 10.0.0.3
aaaarecord: fc00::1
objectclass: top
objectclass: idnsrecord
```

The schema used to define the DNS entries is in the `/usr/share/ipa/60basev2.ldif` schema file [5].

The BIND service communicates with the Directory Server using the system `bind-dyndb-ldap` plug-in. When Identity Management is configured to manage DNS, IdM creates a `dynamic-db` configuration section in the `/etc/named.conf` file for the BIND service. This configures the `bind-dyndb-ldap` plug-in for the BIND (`named`) service.

When this plug-in is properly configured, it delivers the DNS records from the Directory Server to the `named` service. The configuration can be changed to adapt the behavior of the plug-in and, therefore, the LDAP-BIND interactions.

14.2. Using IdM and DNS Service Discovery with an Existing DNS Configuration

To help create and configure a suitable DNS setup, the IdM installation script creates a sample zone file. During the installation, IdM displays a message similar to the following:

```
Sample zone file for bind has been created in /tmp/sample.zone.F_uMf4.db
```

If a DNS server is already configured in the network, then the configuration in the IdM-generated file can be added to the existing DNS zone file. This allows IdM clients to find . For example, this DNS zone configuration is created for an IdM server with the KDC and DNS servers all on the same machine in the `EXAMPLE.COM` realm:

Example 14.1. Default IdM DNS File

```

; ldap servers
_ldap._tcp          IN SRV 0 100 389      ipaserver.example.com.

;kerberos realm
_kerberos           IN TXT EXAMPLE.COM

; kerberos servers
_kerberos._tcp      IN SRV 0 100 88       ipaserver.example.com.
_kerberos._udp      IN SRV 0 100 88       ipaserver.example.com.
_kerberos-master._tcp IN SRV 0 100 88       ipaserver.example.com.
_kerberos-master._udp IN SRV 0 100 88       ipaserver.example.com.
_kpasswd._tcp        IN SRV 0 100 464      ipaserver.example.com.
_kpasswd._udp        IN SRV 0 100 464      ipaserver.example.com.

```

TIP

If DNS services are hosted by a server outside the IdM domain, then an administrator can add the lines in [Example 14.1, “Default IdM DNS File”](#) to the existing DNS zone file. This allows IdM clients and servers to continue to use DNS service discovery to find the LDAP and Kerberos servers (meaning, the IdM servers) that are required for them to participate in the IdM domain.

14.3. DNS Notes

- ▶ Wildcards cannot be used when configuring DNS names. Only explicit DNS domain names are supported.
- ▶ The **rndc** service is not configured by the **--setup-dns** option. This service must be configured manually after the IdM server is configured.

14.4. Adding or Updating DNS Services After Installation

DNS can be configured as part of the IdM server installation, simply by using the **--setup-dns** option. If DNS is not configured then, it can be configured later using the **ipa-dns-install** command.

The **ipa-dns-install** command also updates the DNS services on the IdM server.

```
[root@server ~]# ipa-dns-install -p secret --ip-address=1.2.34.56 --no-forwarders
```

- ▶ **-p** gives the password for the Directory Manager user in the 389 Directory Server. All of the DNS entries are stored in the LDAP directory, so this directory must be accessed to add the DNS configuration.
- ▶ **--ip-address** gives the IP address for the master DNS server.
- ▶ **--no-forwarders** means that there are no forwarders used with the DNS service, only root servers. Alternatively, use the **--forwarder** option to define a forward to use; to specify multiple forwarders, use the **--forwarder** option multiple times.
- ▶ Reverse DNS is configured automatically. It is possible to disable reverse DNS by using the **--no-reverse** option.

If an existing reverse DNS zone is already configured, using the `--no-reverse` option uses the existing reverse zone rather than creating a new reverse zone.

- The IdM server, unless it is explicitly disabled, leaves a persistent search open with its Directory Server and capture any new zone changes immediately.

14.5. Setting up the rndc Service

The `ipa-dns-install` command does not automatically configure the system's `rndc` service. This must be configured manually, after DNS is configured for IdM.

1. Create the `rndc` configuration file and key.

```
[root@server ~]# /usr/sbin/rndc-confgen -a
[root@server ~]# /sbin/restorecon /etc/rndc.conf
```

This may require some user input to create entropy while the key is being created.

2. Change the owner and permissions of the `rndc` key file.

```
[root@server ~]# chown root:named /etc/rndc.key
[root@server ~]# chmod 0640 /etc/rndc.key
```

14.6. Updating the DNS Configuration After Migrating from Red Hat Enterprise Linux 6

BIND 9.9, which is the version supported in Red Hat Enterprise Linux 7, changes the way that it handles queries for reverse zones. This particularly affects queries which use DNS delegation.

[RFC 1918](#) defines how to allocate addresses within a private network. If an environment was using DNS delegation for RFC 1918 addresses, then it was possible for local queries to leak to the public Internet and increase the load on nameservers. A new standard, [RFC 6303](#), defines a different way to handle local or private queries by creating automatic empty zones for RFC 1918 address spaces.

With existing DNS environments, however, this new default configuration can cause queries for PTR records not to be forwarded and to an *NXDomain* (non-existent domain) response.

For example, this zone configuration has a single zone and forwarder (`1.2.3.4`):

```
zone "3.10.in-addr.arpa" {
    type forward;
    forward only;
    forwarders { 1.2.3.4; } ;
};
```

In older versions of BIND, this would query the specified forwarder and return its response. In BIND 9.9, this returns the `NXDomain` error.

BIND 9.9 enables empty zones. For this example, it creates an empty zone for the domain, `10.in-addr.arpa`, but it does not automatically delegate any authority to the `3.10.in-addr.arpa` subdomain. The forward declaration does not do anything because the `named` service does not recurse.

If forward zones are being used in the IdM configuration, then this BIND change can negatively affect DNS queries. There are several ways to address this:

- ▶ Disable all empty zones by changing the `named.conf` file setting:

```
empty-zones-enable no;
```

- ▶ Disable a specific empty zone, such as `10.in-addr.arpa`.

```
disable-empty-zone "10.in-addr.arpa";
```

- ▶ Create a real master zone (for example, for `10.in-addr.arpa`) and then delegate authority to a subdomain (for `3.10.in-addr.arpa`).
- ▶ Configure the original zone as a stub zone or a slave zone to the original forwarder.

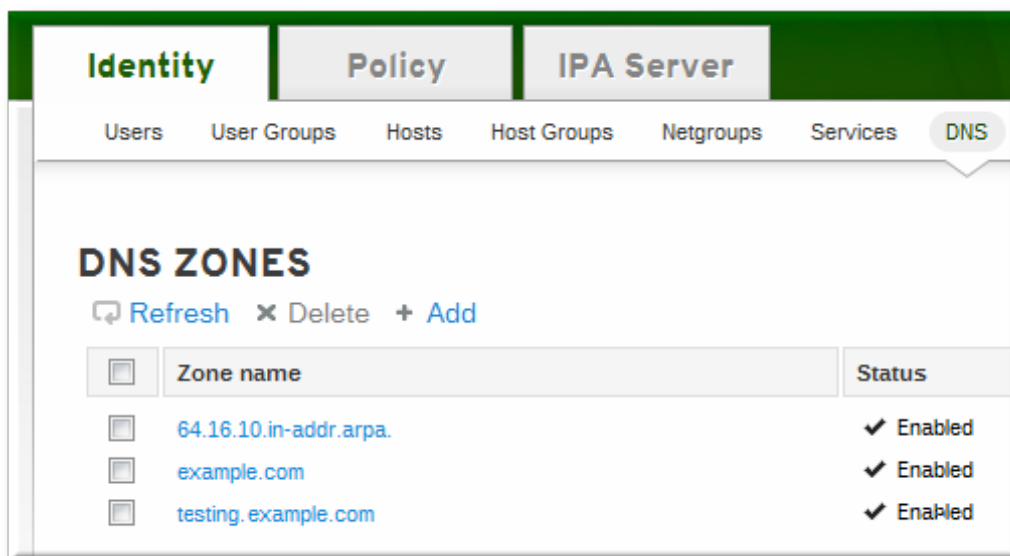
```
zone "3.10.in-addr.arpa" {
    type stub;
    masters { 1.2.3.4; } ;
};
```

14.7. Managing DNS Zone Entries

14.7.1. Adding Forward DNS Zones

14.7.1.1. From the Web UI

1. Open the **Identity** tab, and select the **DNS** subtab.
2. Click the **Add** link at the top of the list of DNS zones.



3. Fill in the information about the new DNS zone. The **Zone Name** is required; this is the actual domain name. The other information about the administrator email and the authoritative name server are optional.

**NOTE**

If an email is given for the administrator, then replace the at symbol (@) with a period (.) to maintain compatibility with the zone file.

- Click the **Add and Edit** button to go directly to the DNS zone page. In the **Settings** tab, it is possible to reset the default zone configuration to enable dynamic binds ([Section 14.7.5.1, “Enabling Dynamic DNS Updates in the Web UI”](#)) or change other default records information ([Section 14.7.2.2, “Editing the Zone Configuration in the Web UI”](#)). It is also possible to begin adding new DNS resource records ([Section 14.8.1.1, “Adding DNS Resource Records from the Web UI”](#)) in the **DNS Resource Records** tab.

Record name	Record Type	Data
@	NS	example.com.
dns	CNAME	dns.example.com

14.7.1.2. From the Command Line

The `ipa dnszone-add` command adds a new zone to the DNS domain. At a minimum, this requires the name of the new subdomain:

```
$ ipa dnszone-add domainName
```

If the name is not given, the script prompts for it. Other command-line options can also be passed with the `ipa dnszone-add` command.

To add a zone entry:

1. Add the new zone. For example:

```
[root@server ~]# ipa dnszone-add newserver.example.com --admin-
email=admin@example.com --minimum=3000 --dynamic-update
```

2. Reload the name service.

```
[root@server ~]# rndc reload
```



TIP

To make new resource records immediately resolvable without restarting the name service, enable persistent searches with the `named` service or configure the BIND service to poll the Directory Server automatically for zone changes. See [Section 14.9.2, “Disabling Persistent Searches”](#).

14.7.2. Adding Additional Configuration for DNS Zones

A zone is created with a certain amount of configuration for things like its refresh periods, transfer settings, and cache settings, set to default values.

Example 14.2. Default DNS Zone Entry Settings


```
[root@server ~]# ipa dnszone-show server.example.com
Zone name: server.example.com
Authoritative nameserver: dns.example.com
Administrator e-mail address: admin.example.com.
SOA serial: 1377691702
SOA refresh: 3600
SOA retry: 900
SOA expire: 1209600
SOA minimum: 3000
Active zone: TRUE
Allow query: any;
Allow transfer: none;
```

14.7.2.1. DNS Zone Configuration Attributes

All of the possible zone settings are listed in [Table 14.1, “Zone Attributes”](#). Along with setting the actual information for the zone, the settings define how the DNS server handles the *start of authority* (SOA) record entries and how it updates its records from the DNS name server.

Table 14.1. Zone Attributes

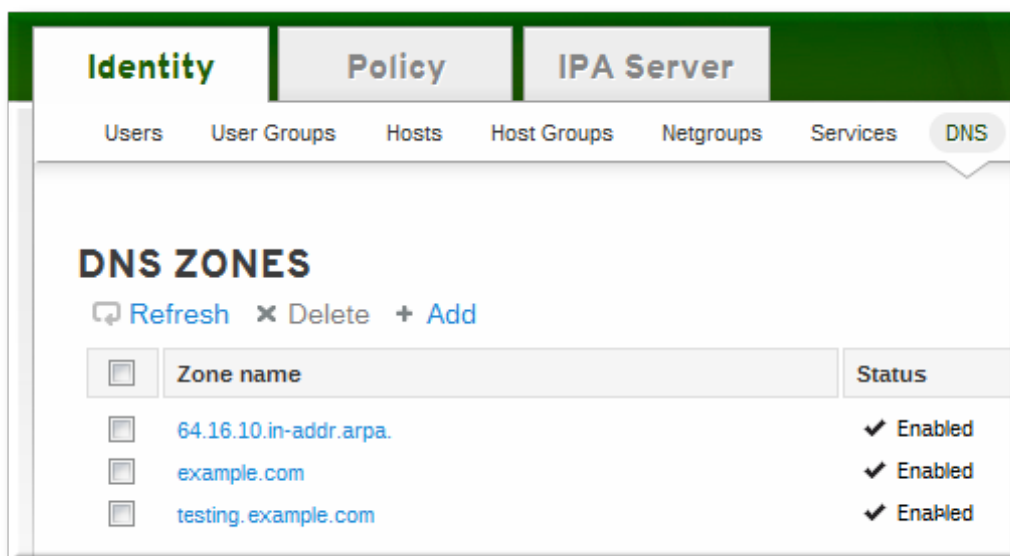
Attribute	Command-Line Option	Description
Zone name	--name	Sets the name of the zone.
Authoritative nameserver	--name-server	Sets the fully-qualified domain name of the DNS name server.

Attribute	Command-Line Option	Description
Administrator e-mail address	--admin-email	Sets the email address to use for the zone administrator. This defaults to the root account on the host.
SOA serial	--serial	Sets a version number for the SOA record file.
SOA refresh	--refresh	Sets the interval, in seconds, for a secondary DNS server to wait before requesting updates from the primary DNS server.
SOA retry	--retry	Sets the time, in seconds, to wait before retrying a failed refresh operation.
SOA expire	--expire	Sets the time, in seconds, that a secondary DNS server will try to perform a refresh update before ending the operation attempt.
SOA minimum	--minimum	Sets the minimum amount of time, in seconds, that data are kept in cache.
SOA time to live	--ttl	Sets the maximum time, in seconds, that information is kept in the data cache.
SOA class	--class	Sets the type of record. This is almost always IN, which stands for Internet.
BIND update policy	--update-policy	Sets the permissions allowed to clients in the DNS zone.
Dynamic update	--dynamic-update=TRUE FALSE	Enables dynamic updates to DNS records for clients.
<div style="text-align: right;">  IMPORTANT </div> <p>If this is set to false, IdM client machines will not be able to add or update their IP address. See Section 14.7.5, “Enabling Dynamic DNS Updates” for more information.</p>		
Name server	--ip-address	Adds the DNS name server by its IP address.
Allow transfer	--allow-transfer= <i>string</i>	Gives a semi-colon-separated list of IP addresses or network names which are allowed to transfer the given zone.
Allow query	--allow-query	Gives a semi-colon-separated list of IP addresses or network names which are allowed to issue DNS queries.

Attribute	Command-Line Option	Description
Allow PTR sync	<code>--allow-sync-ptr=1 0</code>	Sets whether A or AAAA records (forward records) for the zone will be automatically synchronized with the PTR (reverse) records.
Zone forwarders	<code>--forwarder=string</code>	Specifies a forwarder specifically configured for the DNS zone. This is separate from any global forwarders used in the IdM domain. To specify multiple forwarders, use the option multiple times.
Forward policy	<code>--forward-policy=only first</code>	Sets whether the zone will only forward requests to configured the DNS name servers (a <i>forward-only</i> zone) or whether it will check the forwarders first for DNS records and then check its own local records.

14.7.2.2. Editing the Zone Configuration in the Web UI

1. Open the **Identity** tab, and select the **DNS** subtab.
2. Click the name of the DNS zone to edit.



3. Open the **Settings** tab.
4. Change any of the DNS zone settings. The full list of attributes is described in [Table 14.1, “Zone Attributes”](#). There are some common attributes to change:
 - » *Authoritative name server*, the fully-qualified domain name of the DNS name server.
 - » *Dynamic update*, to enable dynamic updates to DNS records for clients.
 - » *SOA refresh*, the interval, in seconds, for a secondary DNS server to wait before requesting updates from the primary DNS server.

The screenshot displays the 'DNS ZONE: example.com' configuration page. At the top, there are tabs for 'Identity', 'Policy', and 'IPA Server'. Below these are navigation links for 'Users', 'User Groups', 'Hosts', 'Host Groups', 'Netgroups', 'Services', and 'DNS'. The page title is 'DNS ZONE: example.com'. There are 'Search' and 'Settings' tabs, and action buttons for 'Refresh', 'Reset', and 'Update'. The main section is titled 'DNS ZONE SETTINGS' and contains the following fields:

- Zone name: example.com
- Status: Enabled Disabled
- Authoritative nameserver: * example.com.
- Administrator e-mail address: * hostmaster.example.com.
- SOA serial: * 2012130201
- SOA refresh: * 3600
- SOA retry: * 900
- SOA expire: * 1209600
- SOA minimum: * 3600
- SOA time to live: (empty field)
- SOA class: (dropdown menu)
- Dynamic update: True False
- BIND update policy: (empty field)

5. Click the **Update** link at the top of the settings page.

14.7.2.3. Editing the Zone Configuration in the Command Line

The zone can be created with additional attributes and values different from the default by passing additional options with the **dnszone-add** command. Likewise, attributes can be added or modified in the zone entry by passing the same attribute options with the **dnszone-mod** command. These are listed in [Table 14.1, “Zone Attributes”](#).

If an attribute does not exist in the DNS zone entry, then the **dnszone-mod** command adds the attribute. If the attribute exists, then it overwrites the current value with the specified value.

For example, setting a time to live for SOA records, adds a new attribute to the DNS zone entry (since there was no previous default value):

```
[jsmith@server ~]$ kinit admin
[jsmith@server ~]$ ipa dnszone-mod server.example.com --ttl=1800

Zone name: server.example.com
Authoritative nameserver: dns.example.com
Administrator e-mail address: admin.example.com.
SOA serial: 1377691702
SOA refresh: 3600
SOA retry: 900
SOA expire: 1209600
SOA minimum: 3000
SOA time to live: 1800
Active zone: TRUE
Allow query: any;
Allow transfer: none;
```

14.7.3. Adding Reverse DNS Zones

The process to add a reverse zone is the same as for a forward zone, as described in [Section 14.7.1, “Adding Forward DNS Zones”](#). However, the required information is different.

There are two ways to identify a reverse DNS zone:

- ▶ By zone name, in the format *reverse_ip_address.in-addr.arpa*.
- ▶ By network address, in the format *network_ip_address/subnet_mask_bit_count*

When creating a reverse zone by the zone name, set it up exactly as creating a forward zone, only reverse the order of the components of the IP address. For example, if the IP address is 1.2.3.4, then the reverse zone name is 3.2.1.in-addr.arpa. (with the trailing period).

In the web UI, this is set in the **Zone name** field.

The screenshot shows a web-based dialog box titled "Add DNS Zone". It has a green header bar with a close button (X). The dialog contains several input fields and a checkbox. The "Zone name" field is selected with a radio button and is highlighted with a red rectangular box; it contains the text "206.65.10.in-addr.arpa.". Below it is the "Reverse zone IP network" field, which is currently empty. Further down are fields for "Authoritative nameserver:" and "Administrator e-mail address:", both empty. At the bottom left is a "Force:" checkbox, which is also unchecked. At the bottom right are four buttons: "Add", "Add and Add Another", "Add and Edit", and "Cancel".

Figure 14.1. Creating a Reverse Zone by Name

With the command-line tools, the zone is created by name like this:

```
[bjensen@server ~]$ kinit
[bjensen@server]$ ipa dnszone-add 206.65.10.in-addr.arpa.
```

To create the reverse zone by its IP network, set the network information to the (forward-style) IP address, with the subnet mask bit count. The bit count must be a multiple of eight for IPv4 addresses or a multiple of four for IPv6 addresses.

In the web UI, this is set in the **Reverse zone IP network** field.

The screenshot shows a web form titled "Add DNS Zone" with a close button (X) in the top right corner. The form contains several input fields and a checkbox. The "Reverse zone IP network" field is selected with a radio button and is highlighted with a red rectangular box. The text "6.arpa" is visible in the top left corner of the form area.

Figure 14.2. Creating a Reverse Zone by IP Network

With the command-line tools, the zone is created by IP network like this:

```
[bjensen@server ~]$ kinit
[bjensen@server]$ ipa dnszone-add 10.65.206.0/24
```

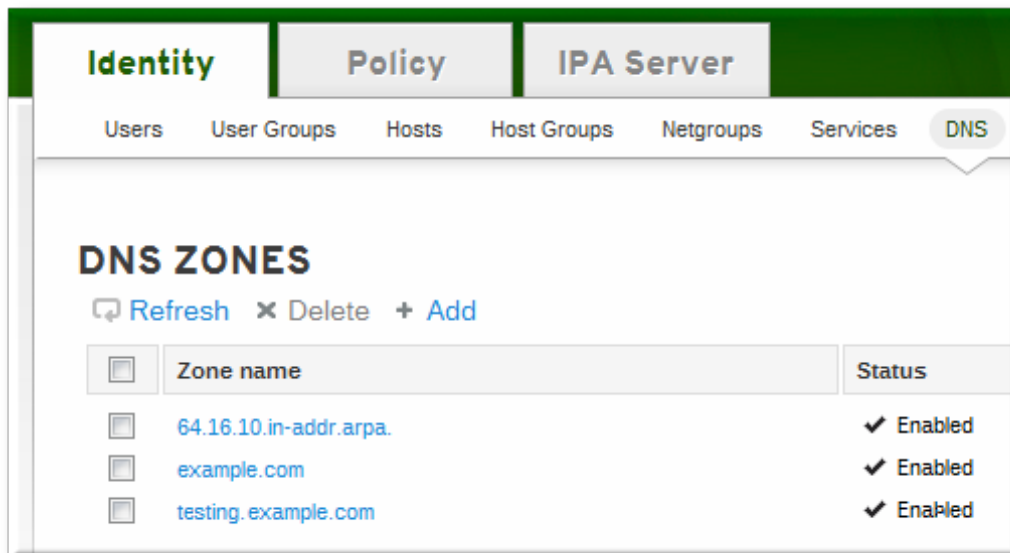
14.7.4. Enabling and Disabling Zones

Active zones can have clients added to them, are available for lookups, and are used by IdM services like Kerberos. Deleting a DNS zone removes the zone entry and all the associated configuration.

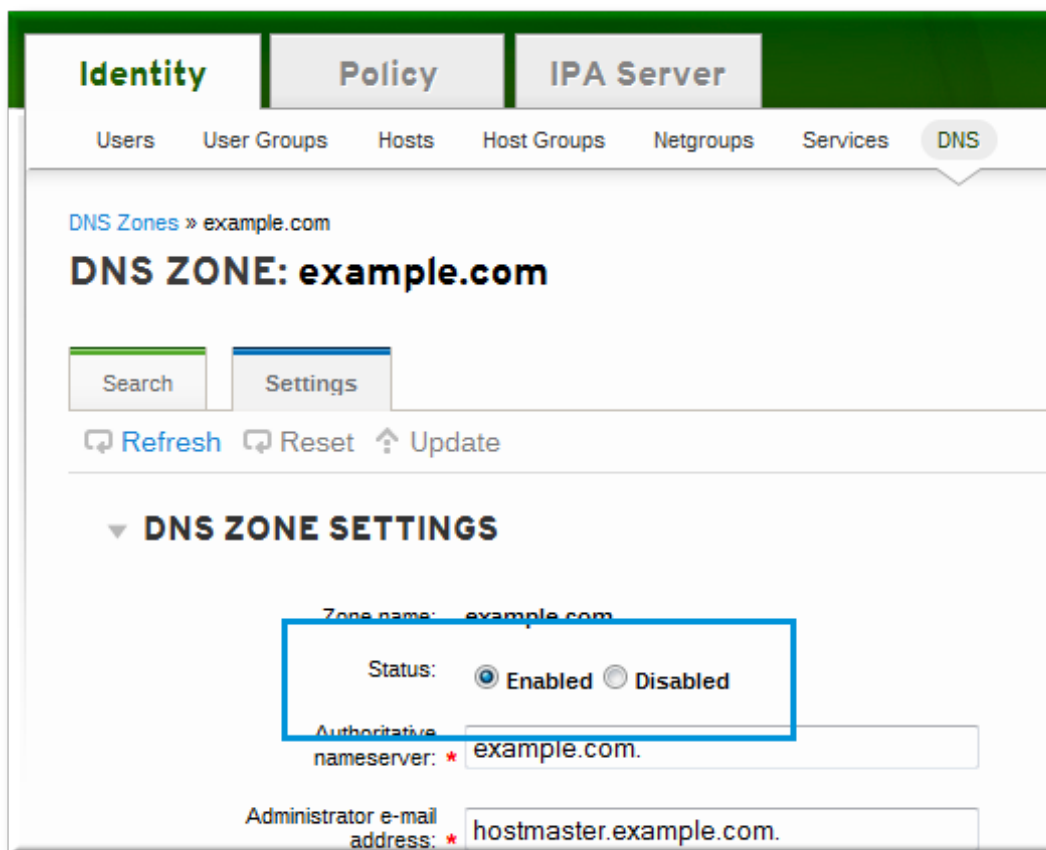
There can be situations when it is necessary to remove a zone from activity without permanently removing the zone. This is done by *disabling* the zone.

14.7.4.1. Disabling Zones in the Web UI

1. Open the **Identity** tab, and select the **DNS** subtab.
2. Click the name of the DNS zone to edit.



3. Open the **Settings** tab.
4. Scroll down to the **Active zone** field. To disable the zone, set the value to **Disabled**.



5. Click the **Update** link at the top of the settings page.

14.7.4.2. Disabling Zones in the Command Line

Disabling a zone is done by using the `dnszone-disable` command.

For example:

```
[jsmith@server ~]$ kinit admin
[jsmith@server ~]$ ipa dnszone-disable server.example.com
-----
Disabled DNS zone "server.example.com"
-----
```

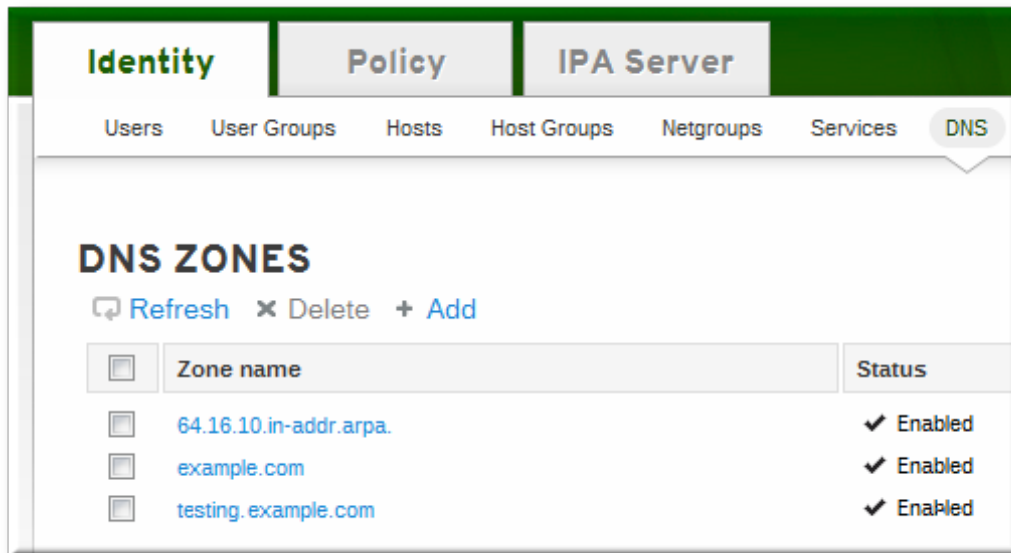
When the zone needs to be brought back online, it can be re-enabled using the **dnszone-enable** command.

14.7.5. Enabling Dynamic DNS Updates

Dynamic DNS updates are not enabled by default for new DNS zones in IdM. If dynamic updates are not allowed, then it may not be possible for the **ipa-client-install** script to join a client to the domain because it cannot add a DNS record pointing to the new client.

14.7.5.1. Enabling Dynamic DNS Updates in the Web UI

1. Open the **Identity** tab, and select the **DNS** subtab.
2. Click the name of the DNS zone to edit.



3. Open the **Settings** tab.
4. Scroll down to the **Dynamic update** field, and set the value to True.

The screenshot shows the 'DNS ZONE: example.com' settings page. At the top, there are tabs for 'Identity', 'Policy', and 'IPA Server'. Below these are navigation links for 'Users', 'User Groups', 'Hosts', 'Host Groups', 'Netgroups', 'Services', and 'DNS'. The page title is 'DNS ZONE: example.com'. There are 'Search' and 'Settings' buttons, and 'Refresh', 'Reset', and 'Update' actions. The 'DNS ZONE SETTINGS' section includes the following fields:

- Zone name: example.com
- Status: Enabled Disabled
- Authoritative nameserver: * example.com.
- Administrator e-mail address: * hostmaster.example.com.
- SOA serial: * 2012130201
- SOA refresh: * 3600
- SOA retry: * 900
- SOA expire: * 1209600
- SOA minimum: * 3600
- SOA time to live: (empty field)
- SOA class: (dropdown menu)
- Dynamic update: True False
- BIND update policy: (empty field)

5. Click the **Update** link at the top of the settings page.

14.7.5.2. Enabling Dynamic DNS Updates in the Command Line

To allow dynamic updates to the DNS zones, set the `--dynamic-update` option.

```
[jsmith@server ~]$ ipa dnszone-mod server.example.com --dynamic-update=TRUE
```

14.7.5.3. Setting a Time-to-live Value for Dynamic Updates

There are two parts to dynamic updates: the local clients must be configured to send dynamic updates, and the zone must be configured to allow them.

Clients can be automatically set up to send DNS updates when they are enrolled in the domain, by using the `--enable-dns-updates` option with the install script.

```
[root@client ~]# ipa-client-install --enable-dns-updates
```

The DNS zone has a time-to-live value set for records within its SOA configuration — however, the time-to-live for the dynamic updates is managed on the local system by the System Security Service Daemon (SSSD). To change the time-to-live value for the dynamic updates, edit the SSSD file to set a value; the default is 1200 seconds.

1. Open the SSSD configuration file.

```
[root@server ~]# vim /etc/sss/sss.conf
```

2. Find the domain section for the IdM domain.

```
[domain/ipa.example.com]
```

3. If dynamic updates have not been enabled for the client, then set the `dyndns_update` value to true.

```
dyndns_updates = true
```

4. Add or edit the `dyndns_ttl` parameter to set the value, in seconds, for the update time-to-live.

```
dyndns_ttl = 2400
```

14.7.6. Configuring Forwarders and Forward Policy

A *DNS forwarder* is a server which passes DNS queries on to another, external DNS name server for resolution. Within the IdM DNS domain, there are three configuration properties that define how forwarders are used:

- ▶ A list of global forwarders which are used by all zones in IdM
- ▶ A list of forwarders which are used by a single, specific zone (as part of the zone configuration)
- ▶ A policy which defines how the zone sends requests to the forwarders

14.7.6.1. Configuring Forwarders in the UI

As with the other DNS zone settings ([Section 14.7.2.2, “Editing the Zone Configuration in the Web UI”](#)), the forwarder configuration is in the **Settings** tab for the given DNS zone.

There are two areas to edit:

- ▶ To add a forwarder, fill in the field or click **Add** to add a new IP address to the forwarder list.
- ▶ By default, the zone uses the forwarders only for servicing name resolution requests; this is called a *forward-only zone*. A forward-only zone does not check its own name records. Only the forwarder server records are checked. If the record does not exist on the configured forwarders, then the zone returns a negative response to the client. Alternatively, the zone can check the forwarder records first, and then fallback on its own resource records. This has a *first* policy.

The screenshot shows the 'Settings' tab for a DNS zone configuration. At the top, there are tabs for 'DNS Resource Records' and 'Settings', and buttons for 'Refresh', 'Reset', and 'Update'. The settings are organized into several sections:

- SOA Parameters:** SOA refresh: 3600, SOA retry: 900, SOA expire: 1209600, SOA minimum: 3600, SOA time to live: (empty), SOA class: (dropdown menu).
- Dynamic update:** Radio buttons for 'True' (selected) and 'False'.
- BIND update policy:** A text area containing the following text:


```
grant EXAMPLE.COM krb5-self * A; grant
EXAMPLE.COM krb5-self * AAAA; grant
EXAMPLE.COM krb5-self * SSHFP;
```

 An 'undo' button is located to the right of the text area.
- Allow query:** A dropdown menu set to 'any', with 'Delete' and 'Add' buttons.
- Allow transfer:** A dropdown menu set to 'none', with 'Delete' and 'Add' buttons.
- Zone forwarders:** A section highlighted with a red box. It contains two input fields: the first has '192.68.0.0' and the second has '192.68.0.1|'. Each field has an 'undo' button. Below the fields are 'Add' and 'undo all' buttons.
- Forward policy:** Radio buttons for 'Forward first' (selected), 'Forward only', and 'Forwarding disabled'.
- Allow PTR sync:** A checkbox that is currently unchecked.

Figure 14.3. Forwarders in the DNS Zone Configuration

14.7.6.2. Configuring Forwarders in the Command Line

The forwarder settings can be edited by using the **dnszone-mod** command to update the zone settings. This can be used to set the list of DNS forwarders and the forwarding policy, as in the UI.

Additionally, the **dnsconfig** command can be used to set a global list of forwarders for all zones by editing the DNS configuration files.

Example 14.3. Configuring Global Forwarders

Global forwarders are configured as part of the IdM server configuration itself. Forwarders are (optionally) set up when the server is installed with the **setup-dns** option or when the **ipa-dns-install** script is used.

After server configuration, the list of global forwarders can be edited using the **dnsconfig-mod** command. For example:

```
[jsmith@server ~]$ ipa dnsconfig-mod --forwarder=0.9.8.7
Global forwarders: 0.9.8.7
```

Example 14.4. Configuring Zone Forwarders

Forwarders can be configured to be used with a specific DNS zone as part of the zone configuration. The **--forwarder** option can be used multiple times to create a list of forwarders to use with the zone.

For example:

```
[jsmith@server ~]$ ipa dnszone-mod --forwarder=192.0.2.0 --forwarder=198.51.100.0
example.com

Zone name: example.com
...
Zone forwarders: 192.0.2.0, 198.51.100.0
```



NOTE

DNS forwarders must be specified as IP addresses, not as hostnames.

Example 14.5. Configuring Forwarder Policy for a Zone

Once forwarders are configured, there are different ways that the zone can use them to service requests.

The zone can use the forwarders only for servicing name resolution requests; this is called a *forward-only zone*. A forward-only zone does not check its own name records. Only the forwarder server records are checked. If the record does not exist on the configured forwarders, then the zone returns a negative response to the client.

Alternatively, the zone can check the forwarder records first, and then fallback on its own resource records. This has a *first* policy.

This configuration is set in the `--forward-policy` option, using a policy of either **only** or **first**. For example:

```
[jsmith@server ~]$ ipa dnszone-mod --forward-policy=only example.com

Zone name: example.com
...
Zone forwarders: 1.2.3.4;5.6.7.8
Forward policy: only
```

14.7.7. Enabling Zone Transfers

Name servers maintain authoritative data for the zones; as changes are made to the zones, those changes must be sent to and distributed among the name servers for the DNS domain. A *zone transfer* moves resource records from one name server to another. An *authoritative transfer* (AXFR) is a zone transfer which includes that authoritative data for the zone (as opposed to an incremental transfer, which only delivers the most immediate zone change).

Zone transfers are defined in [RFC 1034](#) and [RFC 5936](#).

14.7.7.1. Enabling Zone Transfers in the UI

As with the other DNS zone settings ([Section 14.7.2.2, "Editing the Zone Configuration in the Web UI"](#)), the zone transfer configuration is in the **Settings** tab for the given DNS zone.

Set a list of name servers to which the zone records can be transferred. Fill in the field or click **Add** to add a new IP address to the name server list.

DNS Resource Records Settings

Refresh Reset Update

Administrator e-mail address: undo

SOA serial:

SOA refresh:

SOA retry:

SOA expire:

SOA minimum:

SOA time to live:

SOA class:

Dynamic update: True False

BIND update policy:

```
grant EXAMPLE.COM krb5-self * A; grant
EXAMPLE.COM krb5-self * AAAA; grant
EXAMPLE.COM krb5-self * SSHFP;
```

undo

Allow query: Delete

Add

Allow transfer: undo

undo

Add undo all

Zone forwarders: Add

Forward policy: Forward first Forward only Forwarding disabled

Allow PTR sync:

Figure 14.4. DNS Zone Transfer Settings

14.7.7.2. Enabling Zone Transfers in the Command Line

Zone transfers can be enabled when the zone is created or when it is modified by using the **--allow-transfer** option to set a list of name servers to which the zone records can be transferred.

For example:

```
[jsmith@server ~]$ ipa dnszone-mod --allow-transfer=0.0.0.0;1.2.3.4;5.6.7.8 example-zone
```

The default is **any**, which the zone to be transferred anywhere in the DNS domain.

Once it is enabled in the **bind** service, IdM DNS zones can be transferred, by name, by clients like **dig**:

```
[root@server ~]# dig @ipa-server zone_name AXFR
```

14.7.8. Defining DNS Queries

To resolve hostnames within the DNS domain, a DNS client issues a query to the DNS name server. For some security contexts or for performance, it may be advisable to restrict what clients can query DNS records in the zone.

DNS queries can be configured when the zone is created or when it is modified by using the **--allow-query** option to set a list of clients which are allowed to issue queries.

For example:

```
[jsmith@server ~]$ ipa dnszone-mod --allow-query=0.0.0.0;1.2.3.4;5.6.7.8 example-zone
```

The default is **any**, which allows the zone to be queried by any client.

14.7.9. Synchronizing Forward and Reverse Zone Entries

Forward entries (A and AAAA) are configured separately from reverse entries (PTR). Because these entries are configured independently, it is possible for forward entries to exist without corresponding reverse entries, and vice versa.

There are some DNS setting requirements for PTR synchronization to work:

- ▶ Both forward and reverse zones must be managed by the IdM server.
- ▶ Both zones must have dynamic updates enabled.

Enabling dynamic updates is covered in [Section 14.7.5, “Enabling Dynamic DNS Updates”](#).

- ▶ The PTR record will be updated only if the name of the requesting client matches the name in the PTR record.



IMPORTANT

Changes made through the IdM web UI, through the IdM command-line tools, or by editing the LDAP entry directly **do not** update the PTR record. Only changes made by the DNS service itself trigger PTR record synchronization.



WARNING

A client system can update its own IP address. This means that a compromised client can be used to overwrite PTR records by changing its IP address.

14.7.9.1. Configuring Zone Entry Sync in the UI



NOTE

This is set on the *forward* zone server, not the reverse DNS server.

As with the other DNS zone settings (Section 14.7.2.2, “Editing the Zone Configuration in the Web UI”), the zone transfer configuration is in the **Settings** tab for the given DNS zone.

The PTR synchronization is enabled by selecting the **Allow PTR Sync** checkbox.

The screenshot shows the 'Settings' tab for a DNS zone. The 'Allow PTR sync' checkbox is circled in red. The form contains the following fields and controls:

- Administrator e-mail address:** undo
- SOA serial:**
- SOA refresh:**
- SOA retry:**
- SOA expire:**
- SOA minimum:**
- SOA time to live:**
- SOA class:**
- Dynamic update:** True False
- BIND update policy:**

```
grant EXAMPLE.COM krb5-self * A; grant
EXAMPLE.COM krb5-self * AAAA; grant
EXAMPLE.COM krb5-self * SSHFP;
```

undo
- Allow query:** Delete
Add
- Allow transfer:** Delete
Add
- Zone forwarders:** Add
- Forward policy:** Forward first Forward only Forwarding disabled
- Allow PTR sync:**

Figure 14.5. DNS Zone Sync Settings

14.7.9.2. Configuring Zone Entry Sync in the Command Line

A DNS zone can be configured to allow its forward and reverse entries to be synchronized automatically, by setting the `--allow-sync-ptr` option to `1`. This can be done when the zone is created or when it is edited.

**NOTE**

This is set on the *forward* zone server, not the reverse DNS server.

For example, for editing an existing entry:

```
[jsmith@server ~]$ ipa dnszone-mod --allow-sync-ptr=1 example-zone
```

The default is **0**, which disables synchronization and has better server performance.

14.7.10. Setting DNS Access Policies

The IdM DNS domain can define access controls, based on grant/deny rules, for zones. This creates an **update-policy** statement in the `/etc/named.conf` file, which defines the DNS access rule.

**IMPORTANT**

If the update policy is set to false, IdM client machines will not be able to add or update their IP address. See [Section 14.7.5, “Enabling Dynamic DNS Updates”](#) for more information.

14.7.10.1. Setting DNS Access Policies in the UI

A zone access policy is an *access control instruction* which sets a general grant or deny rule over a very specific part of the DNS zone. The full statement covers the zone name and how clients are allowed to edit specific records and record types within the zone.

```
grant|deny zoneName policyName recordName recordType
```

As with the other DNS zone settings ([Section 14.7.2.2, “Editing the Zone Configuration in the Web UI”](#)), the zone transfer configuration is in the **Settings** tab for the given DNS zone.

The access policies are set in a semi-colon separated list in the **BIND update policy** text box.

Figure 14.6. DNS Update Policy Settings

The full list of supported record types is in [Table 14.2, “DNS Record Types”](#).

14.7.10.2. Setting DNS Access Policies in the Command Line

When using the command-line tools, the policy is set using the `--update-policy` option, with the access control rule in a statement after it.

```
--update-policy "grant|deny zoneName policyName recordName recordType"
```

- ▶ *zoneName* is the IdM DNS zone to which to apply the rule.
- ▶ *policyName* is the name to use for the BIND rule.
- ▶ *recordName* sets the resource records to which to apply the rule. Using an asterisk (*) is used for self rules.
- ▶ *recordType* is the record type the rule applies to. Update access rules are applied individually for each record type, even within the same DNS zone entry.

The full list of supported record types is in [Table 14.2, “DNS Record Types”](#).

For example, to grant the **EXAMPLE.COM** zone the ability to edit its own A and AAAA resource record entries:

```
$ ipa dnszone-mod example.com --update-policy="grant EXAMPLE.COM krb5-self * A; grant EXAMPLE.COM krb5-self * AAAA;"
```


14.8. Managing DNS Record Entries

14.8.1. Adding Records to DNS Zones

IdM supports several different types of DNS records, listed in [Table 14.2, “DNS Record Types”](#).

Table 14.2. DNS Record Types

A	CERT	KX	NS	SIG
AAAA	CNAME	LOC	NSEC	SRV
A6	DNAME	MX	PTR	SSHFP (RFC 4255 and RFC 6594)
AFSDB	DS	NAPTR	RRSIG	TXT

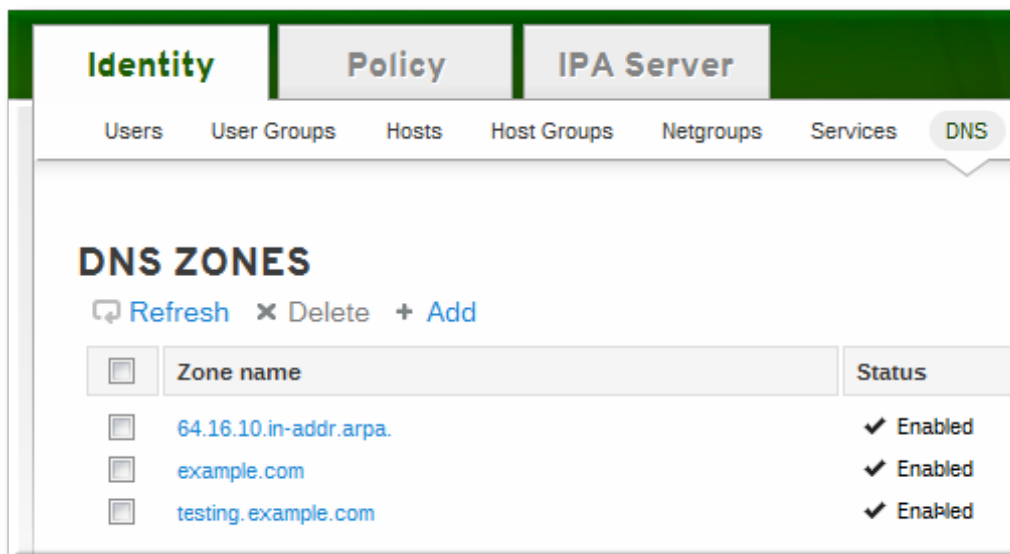
14.8.1.1. Adding DNS Resource Records from the Web UI



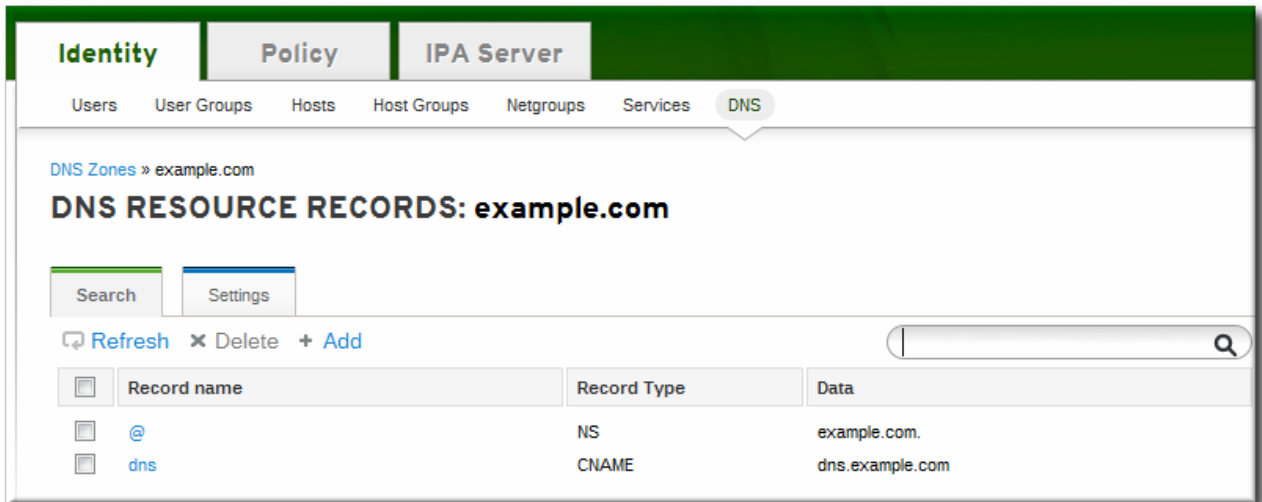
TIP

To make new resource records immediately resolvable without restarting the name service, enable persistent searches with the **named** service or configure the BIND service to poll the Directory Server automatically for zone changes. See [Section 14.9.2, “Disabling Persistent Searches”](#).

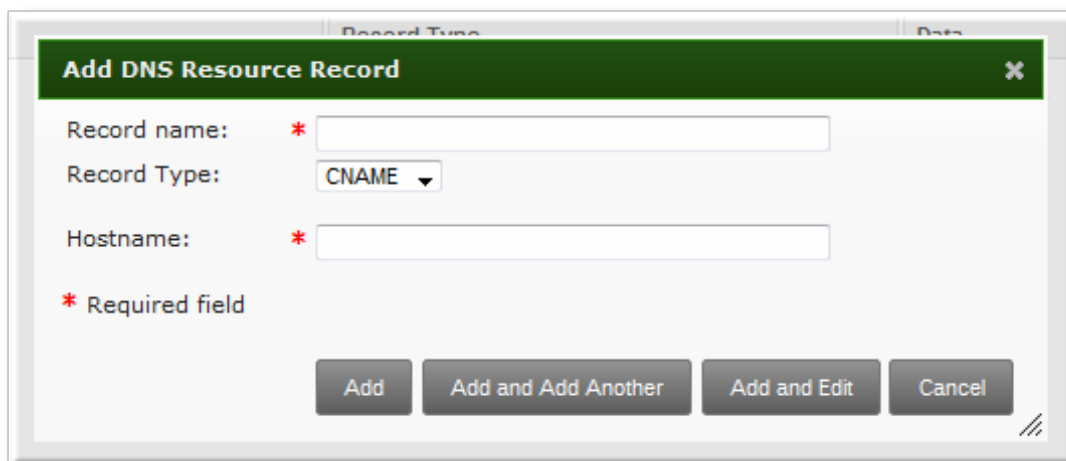
1. Open the **Identity** tab, and select the **DNS** subtab.
2. Click the name of the DNS zone to which to add records.



3. In the **DNS Resource Records** tab, click the **Add** link.



4. Select the type of record to create in the **Record Type** drop-down menu. The required data is different, depending on the record type. For example, a CNAME record requires a hostname. The data field name updates automatically to indicate what kind of information to supply.



Although IdM supports many different record types, there are four frequent record types that are used:

- ▶ **A**. This is a basic map for a hostname and an ordinary IPv4 address. The **Record Name** is a hostname, such as **www**. The **IP Address** value is a standard IPv4 address, such as **192.168.1.2**.

More information about A records is in [RFC 1035](#).

- ▶ **AAAA**. This is a basic map for a hostname and an IPv6 address. The **Record Name** is a hostname, such as **www**. The **IP Address** value is a standard hexadecimal IPv6 address, such as **fe80::20c:29ff:fe02:a1b3**.

More information about AAAA records is in [RFC 3596](#).

- ▶ **SRV**. *Service (SRV) resource records* map service names to the DNS name of the server that is providing that particular service. The **Record Name** has the format **_service._protocol**, such as **_ldap._tcp**. There are individual fields to set the priority, weight, port number, and hostname for the target service.

More information about SRV records is in [RFC 2782](#).

- ▶ **PTR.** A pointer record type (PTR) record adds a *reverse* DNS record, which maps an IP address to a domain name. In this case, the **Record Name** is the record ID number for the DNS entry of the resource and the **Hostname** value is the hostname with a terminal period, such as **server.example.com.**

More information about PTR records is in [RFC 1035](#).

5. Click the **Add** button to save the new resource record.

14.8.1.2. Adding DNS Resource Records from the Command Line

The same script, **ipa dnsrecord-add**, is used to add resource records of any type, but the options for the script and the required data are different, based on the resource record type.

14.8.1.2.1. About the Commands to Add DNS Records

The **ipa dnsrecord-add** command adds records to DNS zones, based on the type. Adding a record has the same basic command format:

```
$ ipa dnsrecord-add zoneName recordName --recordType-option=data
```

The *zoneName* is the name of the DNS zone to which the record is being added. The *recordName* is an identifier for the new DNS resource record.

[Table 14.3, “Common dnsrecord-add Options”](#) lists options for the most common resource record types: A (IPv4), AAAA (IPv6), SRV, and PTR. Options for other supported record types are listed in the **ipa dnsrecord-add** help and manpages.



NOTE

The **ipa dnsrecord-add** command only creates forward entries, not reverse entries.

Table 14.3. Common dnsrecord-add Options

General Record Options	
Option	Description
--ttl= <i>number</i>	Sets the time to live for the record.
--class=IN CS CH HS	Sets the class of the record. This is usually IN, for Internet protocol.
--structured	Parses the raw DNS records and returns them in a structured format.
"A" Record Options	
Option	Description
--a-rec= <i>ARECORD</i>	Passes a list of A records. Lists of entries can be set by using the option multiple times with the same command invocation or by listing the options in a comma-separated list inside curly braces, such as <code>--option={val1,val2,val3}</code> .
--a-ip-address= <i>string</i>	Gives the IP address for the record.
"AAAA" Record Options	
Option	Description

"AAAA" Record Options

<code>--aaaa-rec=AAAARECORD</code>	Passes a list of AAAA (IPv6) records. Lists of entries can be set by using the option multiple times with the same command invocation or by listing the options in a comma-separated list inside curly braces, such as <code>--option={val1,val2,val3}</code> .
<code>--aaaa-ip-address=string</code>	Gives the IPv6 address for the record.

"PTR" Record Options

Option	Description
<code>--ptr-rec=PTRRECORD</code>	Passes a list of PTR records. Lists of entries can be set by using the option multiple times with the same command invocation or by listing the options in a comma-separated list inside curly braces, such as <code>--option={val1,val2,val3}</code> .
<code>--ptr-hostname=string</code>	Gives the hostname for the record.

"SRV" Record Options

Option	Description
<code>--srv-rec=SRVRECORD</code>	Passes a list of SRV records. Lists of entries can be set by using the option multiple times with the same command invocation or by listing the options in a comma-separated list inside curly braces, such as <code>--option={val1,val2,val3}</code> .
<code>--srv-priority=number</code>	Sets the priority of the record. There can be multiple SRV records for a service type. The priority (0 - 65535) sets the rank of the record; the lower the number, the higher the priority. A service has to use the record with the highest priority first.
<code>--srv-weight=number</code>	Sets the weight of the record. This helps determine the order of SRV records with the same priority. The set weights should add up to 100, representing the probability (in percentages) that a particular record is used.
<code>--srv-port=number</code>	Gives the port for the service on the target host.
<code>--srv-target=string</code>	Gives the domain name of the target host. This can be a single period (.) if the service is not available in the domain.

14.8.1.2.2. Examples of Adding DNS Resource Records**TIP**

To make new resource records immediately resolvable without restarting the name service, enable persistent searches with the **named** service or configure the BIND service to poll the Directory Server automatically for zone changes. See [Section 14.9.2, “Disabling Persistent Searches”](#).

Example 14.6. IPv4 Record

Type A resource records map hostnames to IPv4 addresses. The *record* value for these commands, then, is a standard IPv4 address. The URL label is usually `www`.

```
$ ipa dnsrecord-add example.com www --a-rec 10.64.14.165
```

This creates the record `www.example.com` with the IP address 10.64.14.165.

More information about A records is in [RFC 1035](#).

Example 14.7. Modifying IPv4 Record

There are two options that specify an A record value. When creating a record, the option is `--a-record`. However, when modifying an A record, the `--a-record` option shows the *old* value for the A record. The new value is set with the `--ip-address` option.

```
$ ipa dnsrecord-mod example.com www --a-rec 10.1.1.1 --ip-address 10.1.1.2
```

Example 14.8. IPv6 Record

Type AAAA resource records (*quad-A records*) map hostnames to IPv6 addresses. The *record* value for these commands is an IPv6 address. As with Type A records, the URL label is usually `www`.

```
$ ipa dnsrecord-add example.com www --aaaa-rec fe80::20c:29ff:fe02:a1b3
```

This creates the record `www.example.com` with the IP address `fe80::20c:29ff:fe02:a1b3`. More information about AAAA records is in [RFC 3596](#).

Example 14.9. SRV Record

Service (SRV) resource records map service names to the DNS name of the server that is providing that particular service. For example, this record type can map a service like an LDAP directory to the server which manages it.

As with Type A and Type AAAA records, SRV records specify a way to connect to and identify the service, but the record format is different.

The *recordName* identifies the service type and the connection protocol, in the format `_service._protocol`.

The *record* information has the format "*priority weight port target*".

```
[root@server ~]# ipa dnsrecord-add server.example.com _ldap._tcp --srv-rec="0 51 389 server1.example.com."
[root@server ~]# ipa dnsrecord-add server.example.com _ldap._tcp --srv-rec="1 49 389 server2.example.com."
```

The set weights should add up to 100, representing the probability (in percentages) that a particular record is used.

More information about SRV records is in [RFC 2782](#).

Example 14.10. PTR Record

A pointer record type (PTR) record adds a *reverse* DNS record, which maps an IP address to a domain name, rather than the other way around.

All reverse DNS lookups for IPv4 addresses use reverse entries that are defined in the **in-addr.arpa.** domain. The reverse address, in human-readable form, is the exact reverse of the regular IP address, with the **in-addr.arpa.** domain appended to it. For example, for the IP address **192.0.1.2**, the reverse address is **2.1.0.192.in-addr.arpa.**

When adding the reverse DNS record, the format of the **dnsrecord-add** command is also reverse, compared to the usage for adding regular DNS entries:

```
$ ipa dnsrecord-add reverseIpAddress recordId --ptr-rec FQDN
```

The *recordId* is the numeric identifier to use for the entry in the zone.

For example, this adds a record with an ID of 4 for **server2.example.com**:

```
$ ipa dnsrecord-add 2.1.0.192.in-addr.arpa 4 --ptr-rec server2.example.com.
```

More information about PTR records is in [RFC 1035](#).



NOTE

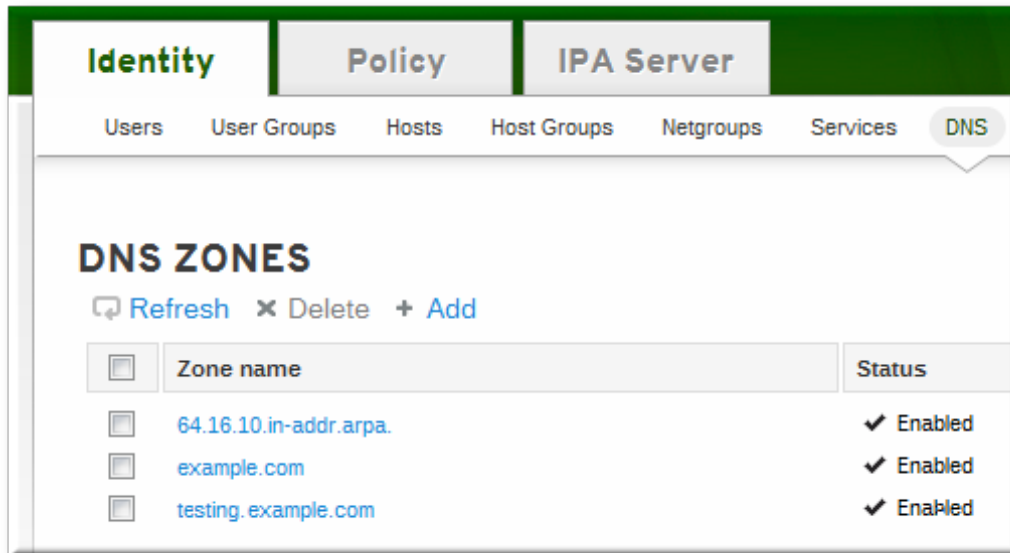
Reverse zones can also be configured for IPv6 addresses, with zones in the **.ip6.arpa.** domain. For more information about IPv6 reverse zones, see [RFC 3596](#).

14.8.2. Deleting Records from DNS Zones

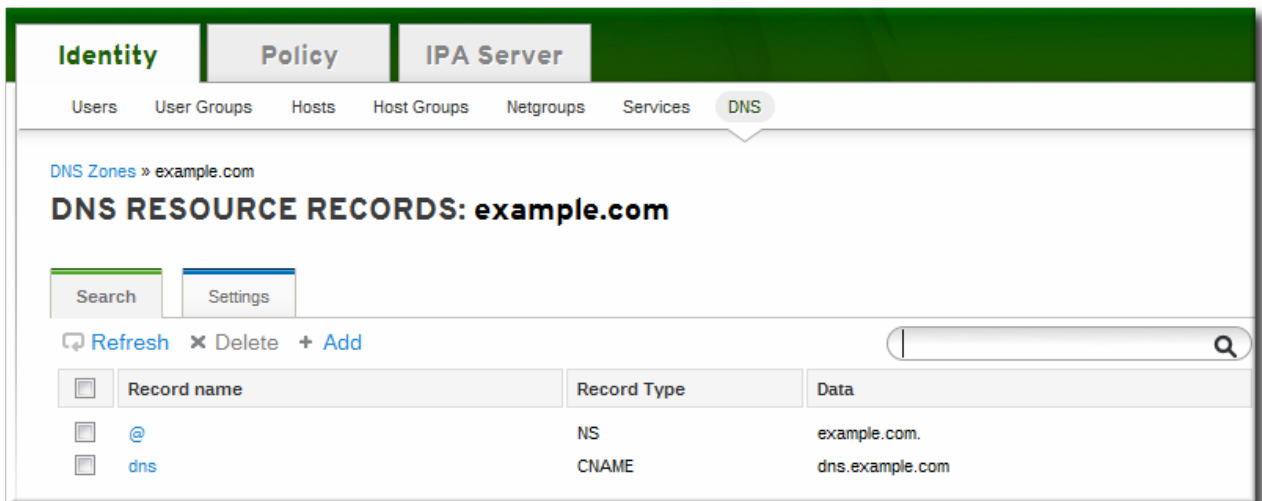
14.8.2.1. Deleting Records with the Web UI

To delete only a specific record type from the resource record:

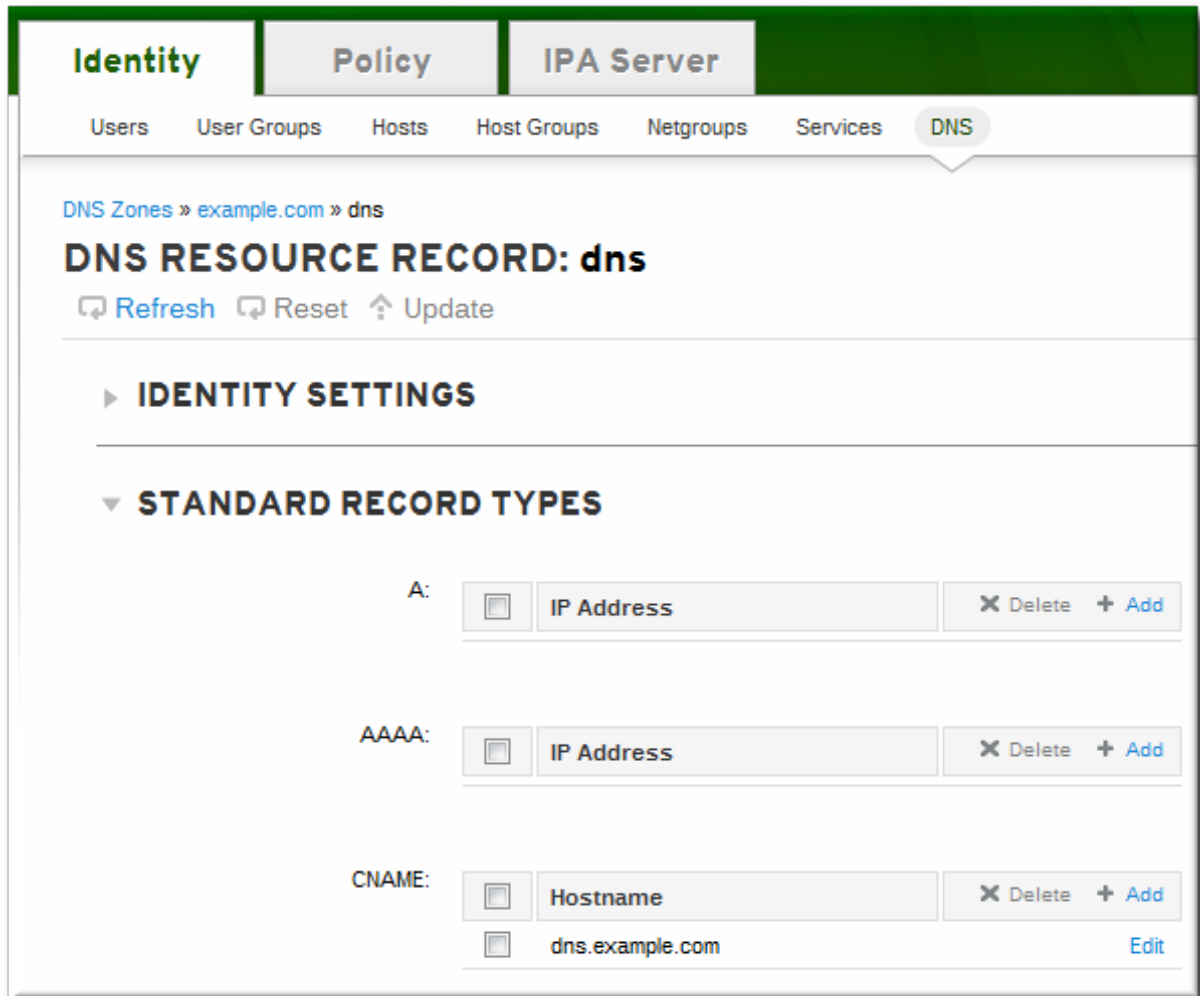
1. Open the **Identity** tab, and select the **DNS** subtab.
2. Click the name of the DNS zone.



- In the **DNS Resource Records** tab, click the name of the resource record.



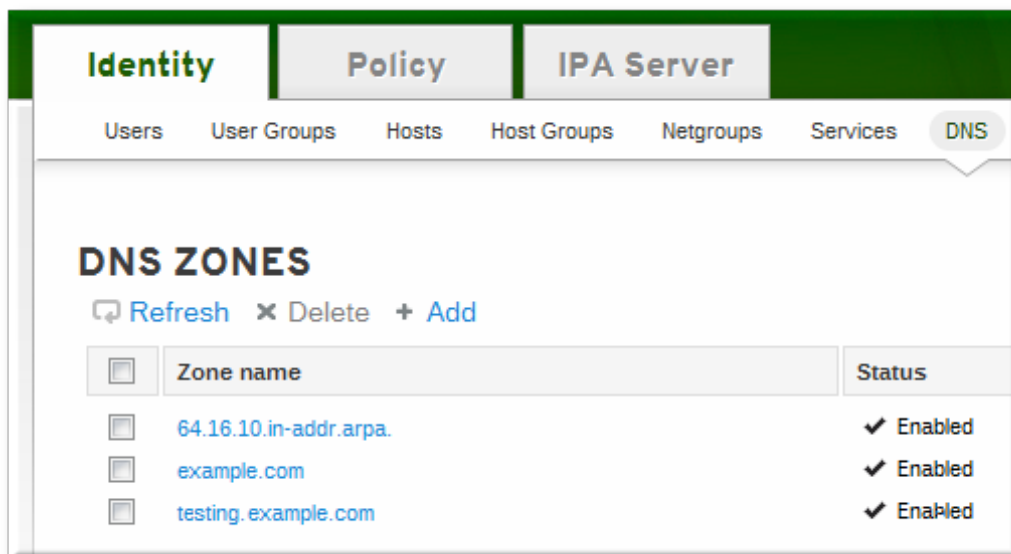
- Click the checkbox by the name of the record type to delete, and then click the active **Delete** link at the top of the list.



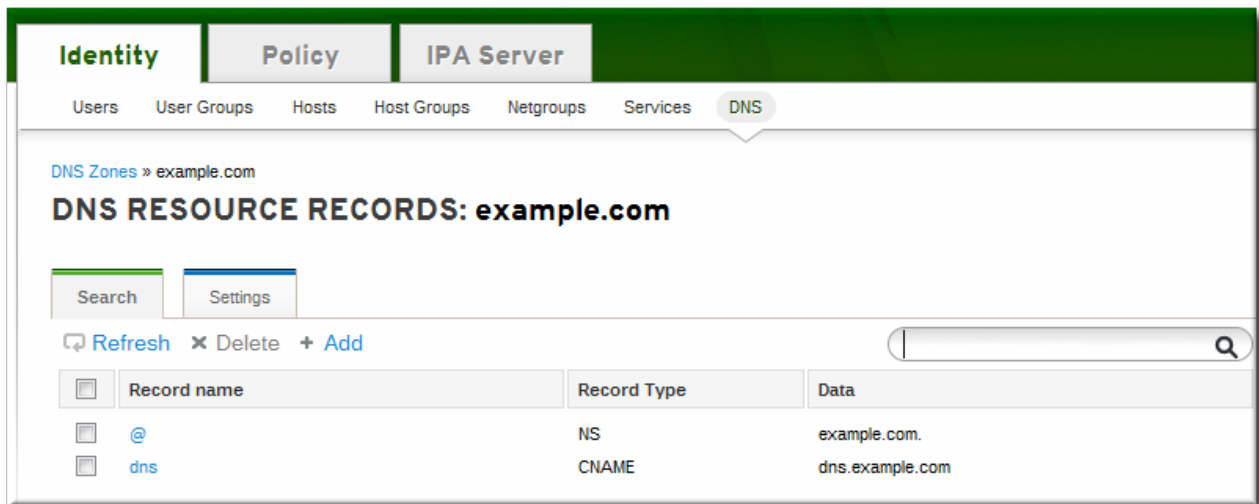
This deletes only that record type while leaving the other configuration intact.

Alternatively, delete all of the records for the resource in the zone:

1. Open the **Identity** tab, and select the **DNS** subtab.
2. Click the name of the DNS zone.



3. In the **DNS Resource Records** tab, select the checkbox by the name of the resource record to delete. This deletes the entire record.



4. Click the **Delete** link at the top of the zone records page.

14.8.2.2. Deleting Records with the Command Line

Records are removed from the zone using the `ipa dnsrecord-del` command. As with adding records, records are deleted using an option that specifies the type of record (`--recordType-rec`) and the record value.

For example, to remove the A type record:

```
$ ipa dnsrecord-del example.com www --a-rec 10.64.14.213
```

If you run the `ipa dnsrecord-del` command without any options, the command prompts for information about the record to delete.

Alternatively, using the `--del-all` option removes all associated records for the zone.

14.9. Configuring the bind-dyndb-ldap Plug-in

The `bind-dyndb-ldap` system plug-in contains a DNS record cache for zones and a history of successful DNS resolutions. Maintaining the cache improves lookup performance in the Directory Server because it is not necessary to query the directory services every time there is a new DNS request.

When this plug-in is installed and IdM is configured to manage DNS, then a new configuration section is added to the plug-in configuration.

Example 14.11. Default dynamic-db Configuration

```
dynamic-db "ipa" {
    library "ldap.so";
    arg "uri ldapi://%2fvar%2frun%2fslapd-EXAMPLE.socket";
    arg "base cn=dns,dc=example,dc=com";
    arg "fake_mname server.example.com.";
    arg "auth_method sasl";
    arg "sasl_mech GSSAPI";
    arg "sasl_user DNS/server.example.com";
    arg "zone_refresh 0";
    arg "psearch yes";
    arg "serial_autoincrement 1";
};
```

This configuration uses implied default values for *other* plug-in behaviors, like how long it maintains the cache. The assumed, default configuration can be changed by adding arguments to the **dynamic-db "ipa"** entry.

```
arg "argument value";
```

The additional parameters are listed in [Table 14.4, “Additional bind-dyndb-ldap Configuration Parameters”](#).

**NOTE**

Both cache updates and new zone detection can be forced by reloading the name server:

```
# rndc reload
```

Table 14.4. Additional bind-dyndb-ldap Configuration Parameters

Parameter	Description	Default Value
cache_ttl	Checks the DNS configuration in the Directory Server for new zones.	120 (seconds); this is defined in the <i>bind-dyndb-ldap</i> plug-in.
zone_refresh	Checks frequency, in seconds, that the server checks the DNS configuration in the Directory Server for new zones.	0 (disabled)
psearch	Enables persistent searches for the Directory Server so the BIND service immediately receives an update notification when a new DNS zone is added.	yes

14.9.1. Changing the DNS Cache Setting

To improve DNS performance, it may be necessary to change the cache setting. By default, DNS records are kept in cache and considered valid for 120 seconds. This means that if a DNS record changes, it will not (necessarily) be propagated to the name server for up to 120 seconds. If the Directory Server has a high traffic volume or if records do not change frequently, then the cache time can be increased to improve

performance by adding the `cache_ttl` parameter.

```
dynamic-db "ipa" {
...
    arg "cache_ttl 1800";
};
```

14.9.2. Disabling Persistent Searches

The DNS service receives its information through the `bind-dyndb-ldap` plug-in. The plug-in resolves only zones which were configured and enabled in the Directory Server when the name server started. When the name service restarts, the plug-in reloads its configuration and identifies any new zones or any new resource records.

However, the `bind-dyndb-ldap` plug-in pulls zone and resource record information from the IdM LDAP directory, and it is possible to pull information from that directory apart from simply restarting the plug-in. The `bind-dyndb-ldap` plug-in searches for zone changes actively by keeping a persistent connection open to the Directory Server and immediately catching any changes.

Persistent searches provide immediate notification of changes and maintain a local cache of the configuration data.



NOTE

A persistent search catches updates both to zones and to zone resource records.

Because persistent searches leave an ongoing, open connection with the Directory Server, there can be some performance issues. Performance implications are covered in the [Red Hat Directory Server Administrator's Guide](#).

Persistent searches are enabled by default but can be disabled in the `psearch` argument:

```
dynamic-db "ipa" {
...
    arg "psearch no";
};
```

14.10. Changing Recursive Queries Against Forwarders

The `ipa-client-install` script sets a configuration statement in the `/etc/named.conf` file that allows name resolution against hosts that are outside the IdM DNS domain. (This requires that the IdM server be set up with DNS configured and with forwarders configured.) What this means is that any host is permitted to issue recursive queries against configured forwarders.

By default, any host is permitted to issue recursive queries against configured forwarders. The IdM installation script automatically adds a line to the `/etc/named.conf` file to allow these recursive queries.

```
forward first;
forwarders { 10.16.36.29; };
allow-recursion { any; };
```

This behavior can be changed in the `allow-recursion` statement.

1. Open the `/etc/named.conf` file.
2. Reset the **allow-recursion** statement. This is set to **any** by default, which allows all hosts to resolve names against all forwarders.

```
forward first;
forwarders { 10.16.36.29; };
allow-recursion { any; };
```

3. Restart the **named** service.

```
service named restart
```

The name server documentation has more details on editing configuration statements.

14.11. Resolving Hostnames in the IdM Domain

It is possible to check the DNS entries for IdM domain members using the **dns-resolve** command. If the record exists and is properly formatted in the DNS configuration, then the command returns the DNS record. If not, the command returns an error, that the hostname is not recognized within the DNS service.

```
$ipa dns-resolve server1.example.com
```

This can be helpful with troubleshooting connection problems between servers, clients, and services.

[5] Any updated schema files, included updated DNS schema elements, are located in the `/usr/share/ipa/updates` directory.

Part IV. Defining Domain-wide System Policies

Chapter 15. Using Automount

Automount is a way of making directories on different servers available, automatically, when requested by a user. This works exceptionally well within an IdM domain since it allows directories on clients within the domain to be shared easily. This is especially important with user home directories ([Section 9.1, “Setting up User Home Directories”](#)).

In IdM, automount works with the internal LDAP directory and, if it is configured, DNS services.

15.1. About Automount and IdM

Automount is a way to manage, organize, and access directories across multiple systems. Automount automatically mounts a directory whenever that resource is requested. Automount also provides a coherent structure to the way that these directories are organized. Every single directory, or *mount point* is called a *key*. Multiple keys that are grouped together are a *map*, and maps are associated according to their physical or conceptual *location*.

The base configuration file for automount is the **auto.master** file in the **/etc/** directory. There can be multiple **auto.master** configuration files in separate server locations, if necessary.

When **autofs** is configured on a server and that server is a client in an IdM domain, then all of the configuration information for automount is stored in the IdM directory. Rather than being stored in separate text files, the autofs configuration — maps, locations, and keys — are stored as LDAP entries. For example, the default map file, **auto.master**, is stored as:

```
dn: automountmapname=auto.master, cn=default, cn=automount, dc=example, dc=com
objectClass: automountMap
objectClass: top
automountMapName: auto.master
```



IMPORTANT

Identity Management does not set up or configure autofs. That must be done separately. Identity Management works with an existing autofs deployment.

Each new location is added as a container entry under **cn=automount, dc=example, dc=com**, and each map and each key are stored beneath that location.

As with other IdM domain services, automount works with IdM natively. The automount configuration can be managed by IdM tools:

- ▶ *Locations*, using **ipa automountlocation*** commands
- ▶ Both direct and indirect *maps*, using **ipa automountmap*** commands
- ▶ *Keys*, using **ipa automountkey*** commands

For automount to work within the IdM domain, the NFS server must be configured as an IdM client. Configuring NFS itself is covered in the [Red Hat Enterprise Linux Storage Administration Guide](#).

15.2. Configuring Automount

Configuring automount entries, like locations and maps, in Identity Management requires an existing autofs/NFS server. Creating automount entries does not create the underlying autofs configuration.

Autofs can be configured manually using LDAP or SSSD as a data store, or it can be configured automatically.



TIP

Test that the `/home` directory can be mounted from the command line successfully before changing the automount configuration. Making sure that NFS is already working properly makes it easier to troubleshoot any potential IdM automount configuration errors later.

15.2.1. Configuring NFS Automatically

After a system is configured as an IdM client (including IdM servers and replicas, which are configured as domain clients as part of their configuration), autofs can be configured to use the IdM domain as its NFS domain and have autofs services enabled.

By default, the `ipa-client-automount` command automatically configures the NFS configuration files (`/etc/sysconfig/nfs` and `/etc/idmapd.conf`). It also configures SSSD to manage the credentials for NFS.

If the `ipa-client-automount` command is run without any options, then it runs a DNS discovery scan to identify an available IdM server and creates a default location called `default`.

```
[root@server ~]# ipa-client-automount
Searching for IPA server...
IPA server: DNS discovery
Location: default
Continue to configure the system with these values? [no]: yes
Configured /etc/nsswitch.conf
Configured /etc/sysconfig/nfs
Configured /etc/idmapd.conf
Started rpcidmapd
Started rpcgssd
Restarting sssd, waiting for it to become available.
Started autofs
```

It is possible to specify an IdM server to use and to create an automount location other than default.

```
[root@server ~]# ipa-client-automount --server=ipaserver.example.com --
location=raleigh
```

Along with setting up NFS, the `ipa-client-automount` command configures SSSD to cache automount maps, in case the external IdM store is ever inaccessible. Configuring SSSD does two things:

- It adds service configuration information to the SSSD configuration. The IdM domain entry is given settings for the autofs provider and the mount location.

```
autofs_provider = ipa
ipa_automount_location = default
```

And NFS is added to the list of supported services (`services = nss,pam,autofs...`) and given a blank configuration entry (`[autofs]`).

- ▶ The Name Service Switch (NSS) service information is updated to check SSSD first for automount information, and then the local files.

```
automount: sss files
```

There may be some instances, such as highly secure environments, where it is not appropriate for a client to cache automount maps. In that case, the `ipa-client-automount` command can be run with the `--no-sssd` option, which changes all of the required NFS configuration files, but does not change the SSSD configuration.

```
[root@server ~]# ipa-client-automount --no-sssd
```

All of the required NFS configuration files — but the list of files is slightly different without SSSD:

- ▶ The command updates `/etc/sysconfig/autofs` instead of `/etc/sysconfig/nfs`.
- ▶ The command configures `/etc/autofs_ldap_auth.conf` with the IdM LDAP configuration.
- ▶ The command configures `/etc/nsswitch.conf` to use the LDAP services for automount maps.

NOTE

The `ipa-client-automount` command can only be run once. If there is an error in the configuration, then the configuration files need to be edited manually.

15.2.2. Configuring autofs Manually to Use SSSD and Identity Management

1. Edit the `/etc/sysconfig/autofs` file to specify the schema attributes that autofs searches for:

```
#
# Other common LDAP naming
#
MAP_OBJECT_CLASS="automountMap"
ENTRY_OBJECT_CLASS="automount"
MAP_ATTRIBUTE="automountMapName"
ENTRY_ATTRIBUTE="automountKey"
VALUE_ATTRIBUTE="automountInformation"
```

2. Specify the LDAP configuration. There are two ways to do this. The simplest is to let the automount service discover the LDAP server and locations on its own:

```
LDAP_URI="ldap:///dc=example,dc=com"
```

Alternatively, explicitly set which LDAP server to use and the base DN for LDAP searches:

```
LDAP_URI="ldap://ipa.example.com"
SEARCH_BASE="cn=location,cn=automount,dc=example,dc=com"
```

Note

The default value for `location` is `default`. If additional locations are added ([Section 15.4, “Configuring Locations”](#)), then the client can be pointed to use those locations, instead.

3. Edit the `/etc/autofs_ldap_auth.conf` file so that autofs allows client authentication with the IdM LDAP server.
 - ▶ Change ***authrequired*** to `yes`.
 - ▶ Set the principal to the Kerberos host principal for the NFS client server, `host/fqdn@REALM`. The principal name is used to connect to the IdM directory as part of GSS client authentication.

```
<autofs_ldap_sasl_conf
  usetls="no"
  tlsrequired="no"
  authrequired="yes"
  authtype="GSSAPI"
  clientprinc="host/server.example.com@EXAMPLE.COM"
/>
```

If necessary, run `klist -k` to get the exact host principal information.

4. Configure autofs as one of the services which SSSD manages.

- a. Open the SSSD configuration file.

```
[root@server ~]# vim /etc/sss/sss.conf
```

- b. Add the autofs service to the list of services handled by SSSD.

```
[sss]
services = nss,pam,autofs
```

- c. Create a new **[autofs]** section. This can be left blank; the default settings for an autofs service work with most infrastructures.

```
[nss]

[pam]

[sudo]

[autofs]

[ssh]

[pac]
```

- d. Optionally, set a search base for the autofs entries. By default, this is the LDAP search base, but a subtree can be specified in the ***ldap_autofs_search_base*** parameter.

```
[domain/EXAMPLE]
...
ldap_search_base = "dc=example,dc=com"
ldap_autofs_search_base = "ou=automount,dc=example,dc=com"
```

5. Restart SSSD:

```
[root@server ~]# systemctl restart sssd.service
```

6. Check the `/etc/nsswitch.conf` file, so that SSSD is listed as a source for automount configuration:

```
automount: sss files
```

7. Restart autofs:

```
[root@server ~]# systemctl restart autofs.service
```

8. Test the configuration by listing a user's `/home` directory:

```
[root@server ~]# ls /home/userName
```

If this does not mount the remote file system, check the `/var/log/messages` file for errors. If necessary, increase the debug level in the `/etc/sysconfig/autofs` file by setting the **LOGGING** parameter to **debug**.



TIP

If there are problems with automount, then cross-reference the automount attempts with the 389 Directory Server access logs for the IdM instance, which will show the attempted access, user, and search base.

It is also simple to run automount in the foreground with debug logging on.

```
automount -f -d
```

This prints the debug log information directly, without having to cross-check the LDAP access log with automount's log.

15.2.3. Configuring Automount on Solaris



NOTE

Solaris uses a different schema for autofs configuration than the schema used by Identity Management. Identity Management uses the 2307bis-style automount schema which is defined for 389 Directory Server (and used in IdM's internal Directory Server instance).

1. If the NFS server is running on Red Hat Enterprise Linux, specify on the Solaris machine that NFSv3 is the maximum supported version. Edit the `/etc/default/nfs` file and set the following parameter:

```
NFS_CLIENT_VERSMAX=3
```

2. Use the `ldapclient` command to configure the host to use LDAP:

```
ldapclient -v manual -a authenticationMethod=none
-a defaultSearchBase=dc=example,dc=com
-a defaultServerList=ipa.example.com
-a serviceSearchDescriptor=passwd:cn=users,cn=accounts,dc=example,dc=com
-a serviceSearchDescriptor=group:cn=groups,cn=compat,dc=example,dc=com
```

```
-a
serviceSearchDescriptor=auto_master:automountMapName=auto.master,cn=location,cn=
=automount,dc=example,dc=com?one
-a
serviceSearchDescriptor=auto_home:automountMapName=auto_home,cn=location,cn=aut
omount,dc=example,dc=com?one
-a objectClassMap=shadow:shadowAccount=posixAccount
-a searchTimeLimit=15
-a bindTimeLimit=5
```

3. Enable **automount**:

```
# svcadm enable svc:/system/filesystem/autofs
```

4. Test the configuration.

a. Check the LDAP configuration:

```
# ldapclient -l auto_master

dn:
automountkey=/home,automountmapname=auto.master,cn=location,cn=automount,d
c=example,dc=com
objectClass: automount
objectClass: top
automountKey: /home
automountInformation: auto.home
```

b. List a user's **/home** directory:

```
# ls /home/userName
```

15.3. Setting up a Kerberized NFS Server

Identity Management can be used to set up a Kerberized NFS server.



NOTE

The NFS server does not need to be running on Red Hat Enterprise Linux.

15.3.1. Setting up a Kerberized NFS Server

1. Obtain a Kerberos ticket before running IdM tools.

```
[jsmith@server ~]$ kinit admin
```

2. If the NFS host machine has not been added as a client to the IdM domain, then create the host entry. See [Section 5.4.2, “Other Examples of Adding a Host Entry”](#).

3. Create the NFS service entry in the IdM domain. For example:

```
[jsmith@server ~]$ ipa service-add nfs/nfs-server.example.com
```

For more information, see [Section 11.1, “Adding and Editing Service Entries and Keytabs”](#).

4. Generate an NFS service keytab for the NFS server using the **ipa-getkeytab** command, and save the keys directly to the host keytab. For example:

```
[jsmith@server ~]$ ipa-getkeytab -s ipaserver.example.com -p nfs/nfs-server.example.com -k /etc/krb5.keytab
```



TIP

Verify that the NFS service has been properly configured in IdM, with its keytab, by checking the service entry:

```
[jsmith@server ~]$ ipa service-show nfs/ipaclient2.example.com
Principal: NFS/ipaclient2.example.com@EXAMPLE.COM
Keytab: True
```



NOTE

This procedure assumes that the NFS server is running on a Red Hat Enterprise Linux system or a UNIX system which can run **ipa-getkeytab**.

If the NFS server is running on a system which cannot run **ipa-getkeytab**, then create the keytab using system tools. Two things must be done:

- ▶ The key must be created in the **/root** (or equivalent) directory.
- ▶ The **ktutil** command can merge the keys into the system **/etc/krb5.keytab** file. The [ktutil man page](#) describes how to use the tool.

5. Install the NFS packages. For example:

```
[root@nfs-server ~]# yum install nfs-utils
```

6. Configure weak crypto support. This is required for every NFS client if *any* client (such as a Red Hat Enterprise Linux 5 client) in the domain will use older encryption options like DES.

- a. Edit the **krb5.conf** file to allow weak crypto.

```
[root@nfs-server ~]# vim /etc/krb5.conf

allow_weak_crypto = true
```

- b. Update the IdM server Kerberos configuration to support the DES encryption type.

```
[jsmith@ipaserver ~]$ ldapmodify -x -D "cn=directory manager" -w
password -h ipaserver.example.com -p 389

dn: cn=EXAMPLEREALM,cn=kerberos,dc=example,dc=com
changetype: modify
add: krbSupportedEncSaltTypes
krbSupportedEncSaltTypes: des-cbc-crc:normal
-
add: krbSupportedEncSaltTypes
```

```
krbSupportedEncSaltTypes: des-cbc-crc:special
-
add: krbDefaultEncSaltTypes
krbDefaultEncSaltTypes: des-cbc-crc:special
```

7. Run the **ipa-client-automount** command to configure the NFS settings.

By default, this enables secure NFS in the `/etc/sysconfig/nfs` file and sets the IdM DNS domain in the **Domain** parameter in the `/etc/idmapd.conf` file.

8. Edit the `/etc/exports` file and add the Kerberos information:

```
/export *(rw,sec=sys:krb5:krb5i:krb5p)
```

9. Restart the NFS server and related services.

```
[root@nfs-server ~]# systemctl restart nfs.service
[root@nfs-server ~]# systemctl restart nfs-server.service
[root@nfs-server ~]# systemctl restart nfs-secure.service
[root@nfs-server ~]# systemctl restart nfs-secure-server.service
[root@nfs-server ~]# systemctl restart rpcsvcgssd.service
```

10. Configure the NFS server as an NFS client, following the directions in [Section 15.3.2, “Setting up a Kerberized NFS Client”](#).

15.3.2. Setting up a Kerberized NFS Client

1. Obtain a Kerberos ticket before running IdM tools.

```
[jsmith@server ~]$ kinit admin
```

2. If the NFS client is not enrolled as a client in the IdM domain, then set up the required host entries, as described in [Section 5.4.2, “Other Examples of Adding a Host Entry”](#).

3. Generate an NFS service keytab for the NFS client using the **ipa-getkeytab** command, and save the keys directly to the host keytab. For example:

```
[jsmith@server ~]$ ipa-getkeytab -k /etc/krb5.keytab -p host/nfs-client-server.example.com@EXAMPLE.COM
```



NOTE

This procedure assumes that the NFS server is running on a Red Hat Enterprise Linux system or a UNIX system which can run **ipa-getkeytab**.

If the NFS server is running on a system which cannot run **ipa-getkeytab**, then create the keytab using system tools. Two things must be done:

- ▶ The key must be created in the `/root` (or equivalent) directory.
- ▶ The **ktutil** command can merge the keys into the system `/etc/krb5.keytab` file. The [ktutil man page](#) describes how to use the tool.

4. Run the **ipa-client-automount** command to configure the NFS settings.

By default, this enables secure NFS in the `/etc/sysconfig/nfs` file and sets the IdM DNS domain in the `Domain` parameter in the `/etc/idmapd.conf` file.

5. Start the GSS daemon.

```
[root@nfs-client-server ~]# systemctl start rpcgssd.service
[root@nfs-client-server ~]# systemctl start rpcbind.service
[root@nfs-client-server ~]# systemctl start rpcidmapd.service
```

6. Mount the directory.

```
[root@nfs-client-server ~]# echo "$NFSSERVER:/this /mnt/this nfs4
sec=krb5i,rw,proto=tcp,port=2049" >>/etc/fstab
[root@nfs-client-server ~]# mount -av
```

7. Configure SSSD on the client system to manage home directories and renew Kerberos tickets.

- a. Enable SSSD with the `--enablemkhomedir` option.

```
[root@nfs-client-server ~]# authconfig --update --enablesssd --
enablesssdauth --enablemkhomedir
```

- b. Restart the OpenSSH client.

```
[root@nfs-client-server ~]# systemctl start ssh.service
```

- c. Edit the IdM domain section in the SSSD configuration file to set the keytab renewal options.

```
[root@nfs-client-server ~]# vim /etc/sss/sss.conf

[domain/EXAMPLE.COM]
cache_credentials = True
krb5_store_password_if_offline = True
ipa_domain = example.com
id_provider = ipa
auth_provider = ipa
...
krb5_renewable_lifetime = 50d
krb5_renew_interval = 3600
```

- d. Restart SSSD.

```
[root@nfs-client-server ~]# systemctl restart sssd.service
```

15.4. Configuring Locations

A location is a set of maps, which are all stored in `auto.master`, and a location can store multiple maps. The location entry only works as a container for map entries; it is not an automount configuration in and of itself.

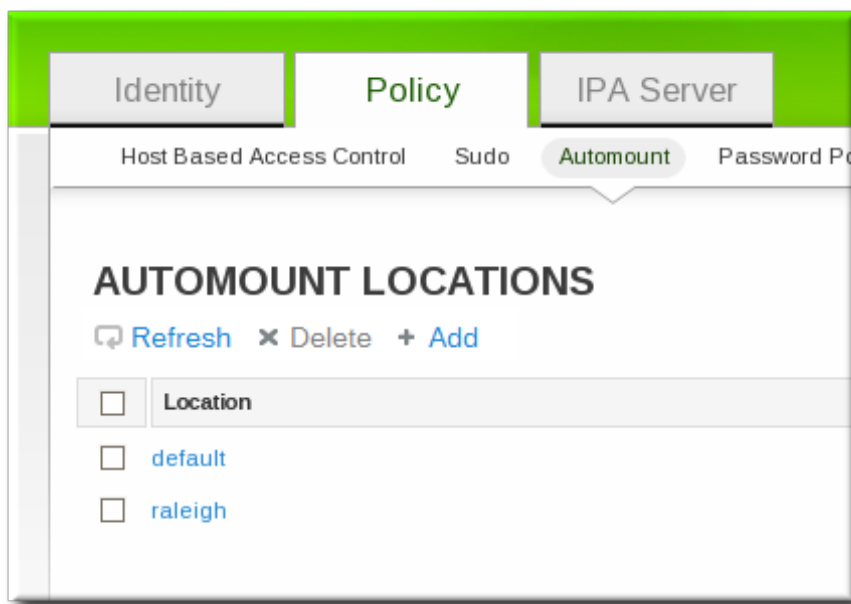


IMPORTANT

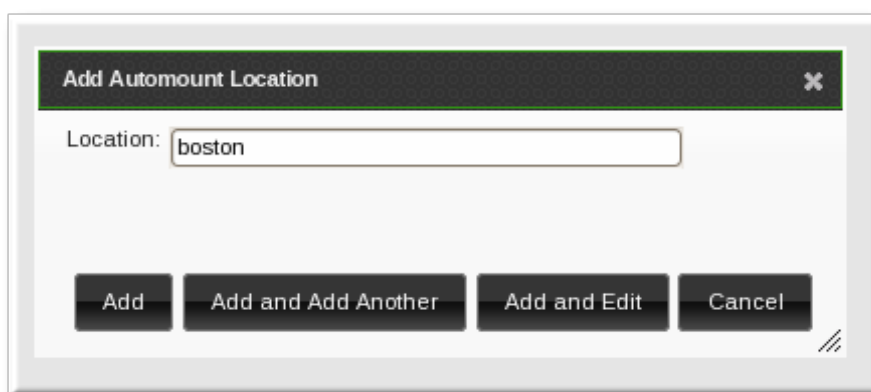
Identity Management does not set up or configure autofs. That must be done separately. Identity Management works with an existing autofs deployment.

15.4.1. Configuring Locations through the Web UI

1. Click the **Policy** tab.
2. Click the **Automount** subtab.
3. Click the **Add** link at the top of the list of automount locations.



4. Enter the name for the new location.



5. Click the **Add and Edit** button to go to the map configuration for the new location. Create maps, as described in [Section 15.5.1.1, “Configuring Direct Maps from the Web UI”](#) and [Section 15.5.2.1, “Configuring Indirect Maps from the Web UI”](#).

15.4.2. Configuring Locations through the Command Line

To create a map, using the `automountlocation-add` and give the location name.

```
$ ipa automountlocation-add location
```

For example:

```
$ ipa automountlocation-add raleigh
-----
Added automount location "raleigh"
-----
Location: raleigh
```

When a new location is created, two maps are automatically created for it, **auto.master** and **auto.direct**. **auto.master** is the root map for all automount maps for the location. **auto.direct** is the default map for direct mounts and is mounted on `/-`.

To view all of the maps configured for a location as if they were deployed on a filesystem, use the **automountlocation-tofiles** command:

```
$ ipa automountlocation-tofiles raleigh
/etc/auto.master:
/-      /etc/auto.direct
-----
/etc/auto.direct:
```

15.5. Configuring Maps

Configuring maps not only creates the maps, it associates mount points through the keys and it assigns mount options that should be used when the directory is accessed. IdM supports both direct and indirect maps.



NOTE

Different clients can use different map sets. Map sets use a tree structure, so maps *cannot* be shared between locations.



IMPORTANT

Identity Management does not set up or configure autofs. That must be done separately. Identity Management works with an existing autofs deployment.

15.5.1. Configuring Direct Maps

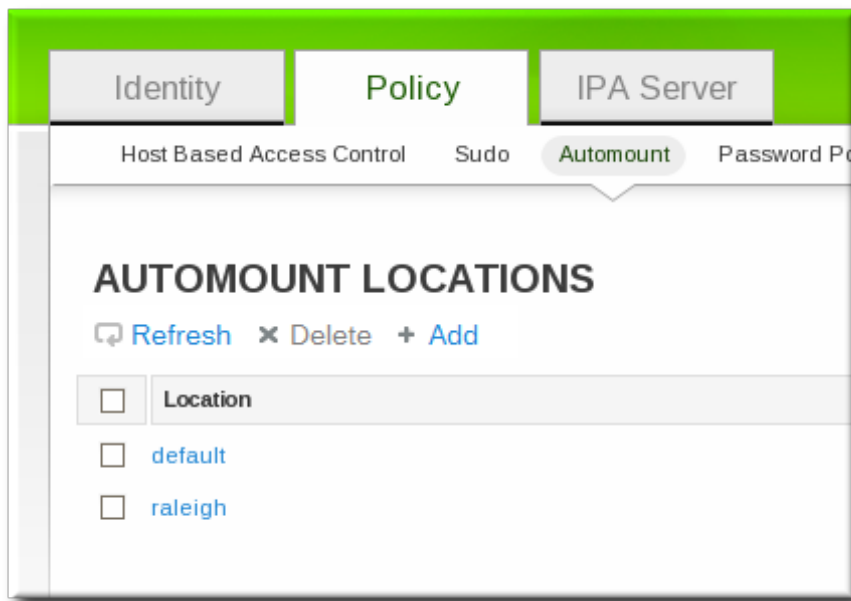
Direct maps define exact locations, meaning absolute paths, to the file mount. In the location entry, a direct map is identified by the preceding forward slash:

```
-----
/etc/auto.direct:
/shared/man server.example.com:/shared/man
```

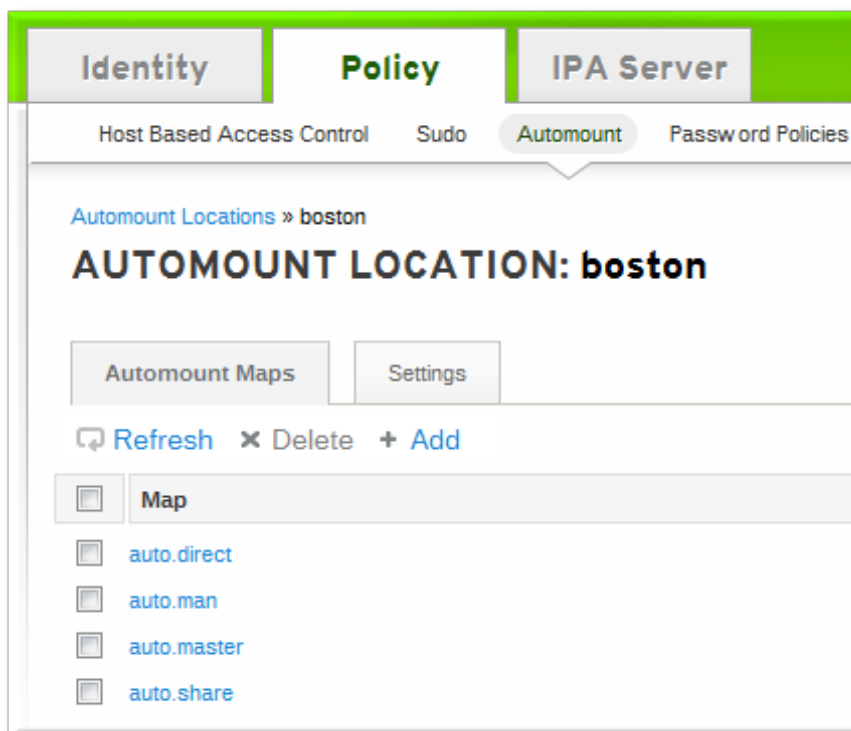
15.5.1.1. Configuring Direct Maps from the Web UI

1. Click the **Policy** tab.

2. Click the **Automount** subtab.
3. Click name of the automount location to which to add the map.



4. In the **Automount Maps** tab, click the + **Add** link to create a new map.



5. In pop-up window, select the **Direct** radio button and enter the name of the new map.

Add Automount Map

Map Type: Direct Indirect

Map:

Description:

Add **Add and Add Another** **Add and Edit** **Cancel**

6. In the **Automount Keys** tab, click the **+ Add** link to create a new key for the map.

Host Based Access Control Sudo **Automount** Password Policies Kerberos Ticket Policy

Automount Locations » boston » auto.man

AUTOMOUNT MAP: auto.man

Automount Keys Settings

Refresh Delete + Add

Key	Mount information
<input type="checkbox"/> /manpages	-ro,soft, ipaserver.example.com:/home/manpages

7. Enter the mount point. The key defines the actual mount point in the key name. The **Info** field sets the network location of the directory, as well as any **mount** options to use.

Add Automount Key

Key:

Mount information:

Add **Add and Add Another** **Add and Edit** **Cancel**

8. Click the **Add** button to save the new key.

15.5.1.2. Configuring Direct Maps from the Command Line

The key defines the actual mount point (in the key name) and any options. A map is a direct or indirect map based on the format of its key.

Each location is created with an **auto.direct** item. The simplest configuration is to define a direct mapping by adding an automount key the existing direct map entry. It is also possible to create different

direct map entries.

Add the key for the direct map to the location's **auto.direct** file. The **--key** option identifies the mount point, and **--info** gives the network location of the directory, as well as any **mount** options to use. For example:

```
$ ipa automountkey-add raleigh auto.direct --key=/share --info="-ro,soft,
ipaserver.example.com:/home/share"
Key: /share
Mount information: -ro,soft, ipaserver.example.com:/home/share
```

Mount options are described in the mount manpage, <http://linux.die.net/man/8/mount>.

On Solaris, add the direct map and key using the **ldapclient** command to add the LDAP entry directly:

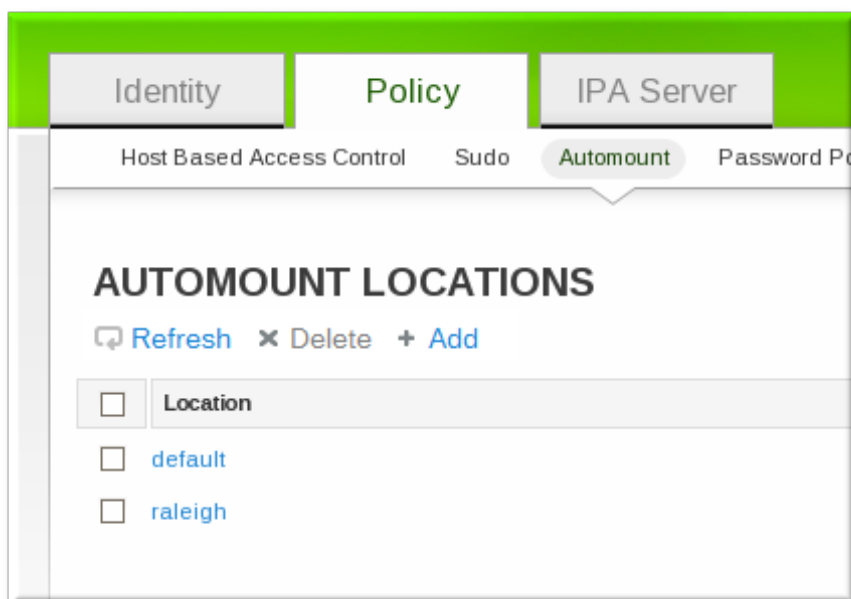
```
ldapclient -a
serviceSearchDescriptor=auto_direct:automountMapName=auto.direct,cn=location,cn=auto
mount,dc=example,dc=com?one
```

15.5.2. Configuring Indirect Maps

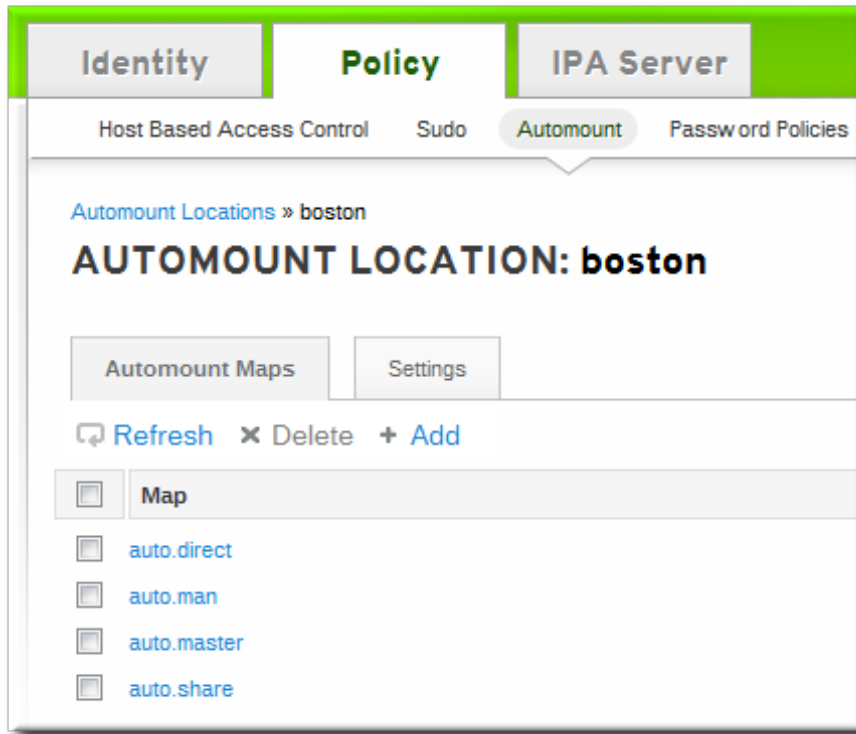
An indirect map essentially specifies a relative path for maps. A parent entry sets the base directory for all of the indirect maps. The indirect map key sets a sub directory; whenever the indirect map location is loaded, the key is appended to that base directory. For example, if the base directory is **/docs** and the key is **man**, then the map is **/docs/man**.

15.5.2.1. Configuring Indirect Maps from the Web UI

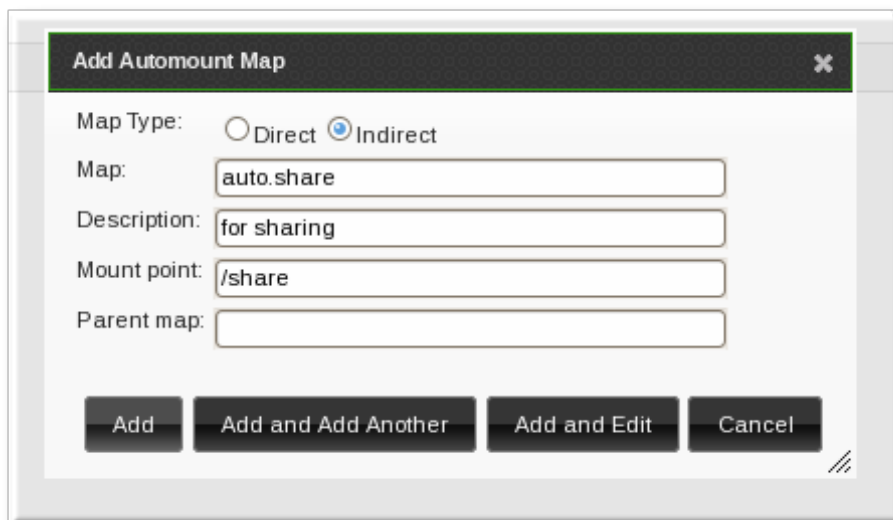
1. Click the **Policy** tab.
2. Click the **Automount** subtab.
3. Click name of the automount location to which to add the map.



4. In the **Automount Maps** tab, click the **+ Add** link to create a new map.



- In pop-up window, select the **Indirect** radio button and enter the required information for the indirect map:



- › The name of the new map
- › The mount point. The **Mount** field sets the base directory to use for all the indirect map keys.
- › Optionally, a parent map. The default parent is **auto.master**, but if another map exists which should be used, that can be specified in the **Parent Map** field.

- Click the **Add** button to save the new key.

15.5.2.2. Configuring Indirect Maps from the Command Line

The primary difference between a direct map and an indirect map is that there is no forward slash in front of an indirect key.

```

-----
/etc/auto.share:
man      ipa.example.com:/docs/man
-----

```

1. Create an indirect map to set the base entry using the **automountmap-add-indirect** command. The **--mount** option sets the base directory to use for all the indirect map keys. The default parent entry is **auto.master**, but if another map exists which should be used, that can be specified using the **--parentmap** option.

```
$ ipa automountmap-add-indirect location mapName --mount=directory [--parentmap=mapName]
```

For example:

```
$ ipa automountmap-add-indirect raleigh auto.share --mount=/share
-----
Added automount map "auto.share"
-----
```

2. Add the indirect key for the mount location:

```
$ ipa automountkey-add raleigh auto.share --key=docs --info="ipa.example.com:/export/docs"
-----
Added automount key "docs"
-----
Key: docs
Mount information: ipa.example.com:/export/docs
```

3. To verify the configuration, check the location file list using **automountlocation-tofiles**:

```
$ ipa automountlocation-tofiles raleigh
/etc/auto.master:
/-      /etc/auto.direct
/share  /etc/auto.share
-----
/etc/auto.direct:
-----
/etc/auto.share:
man      ipa.example.com:/export/docs
```

On Solaris, add the indirect map using the **ldapclient** command to add the LDAP entry directly:

```
ldapclient -a
serviceSearchDescriptor=auto_share:automountMapName=auto.share,cn=location,cn=automount,dc=example,dc=com?one
```

15.5.3. Importing Automount Maps

If there are existing automount maps, these can be imported into the IdM automount configuration.

```
ipa automountlocation-import location map_file [--continuous]
```

The only required information is the IdM automount location and the full path and name of the map file. The **--continuous** option tells the **automountlocation-import** command to continue through the map file, even if the command encounters errors.

For example:

```
$ ipa automountlocation-import raleigh /etc/custom.map
```

Chapter 16. Defining Password Policies

All users must have a password which they use to authenticate to the Kerberos domain. Identity Management defines and enforces rules about password complexity, password histories, and account lockouts in order to maintain security.



NOTE

IdM, by default, does not expose passwords to clients, even hashed passwords, for system security.

16.1. About Password Policies and Policy Attributes

A *password policy* sets certain standards for passwords, such as the password complexity and the rules for changing passwords. A password policy minimizes the inherent risk of using passwords by ensuring that they meet adequate complexity standards to thwart brute force attacks and they are changed frequently enough to mitigate the risk of someone revealing or discovering a password.

There are three main configuration areas that are defined within the password policy:

- ▶ Strength or complexity requirements
- ▶ History
- ▶ Account lockout

The IdM password policy is enforced jointly by the KDC and the LDAP server. While the password policy is set in the LDAP directory and is based on 389 Directory Server password policy attributes, the policy is ultimately constrained by the KDC password policy framework. The KDC policy is less flexible than the 389 Directory Server policy framework, so the IdM password policy can only implement password policy elements supported in the KDC. Any other policy settings made within the 389 Directory Server are not visible or enforced in Identity Management.


Password policies are assigned either globally or to groups in IdM, not to individual users. The password policy is assigned a priority, so that if a user belongs to multiple groups with different password policies, the policy with the highest priority will take precedence.

The different policy attributes that can be set are listed in [Table 16.1, “Password Policy Settings”](#).

Table 16.1. Password Policy Settings

Configuration Property	Command-Line Option	Description
Options for both the UI and CLI		
Minimum Password Lifetime	--minlife	Sets the minimum period of time, in hours, that a user's password must be in effect before the user can change it. This can prevent a user from changing a password and then immediately changing it to the original value. The default value is one hour.

Configuration Property	Command-Line Option	Description
Maximum Password Lifetime	--maxlife	Sets the maximum period of time, in days, that a user's password can be in effect before it must be changed. The default value is 90 days.
Minimum Number of Character Classes	--minclasses	<p>Sets the minimum number of different classes, or types, of character that must exist in a password before it is considered valid. For example, setting this value to 3 requires that any password must have characters from at least three categories in order to be approved. The default value is zero (0), meaning there are no required classes. There are six character classes:</p> <ul style="list-style-type: none"> » Upper-case characters » Lower-case characters » Digits » Special characters (for example, punctuation) » 8-bit characters (characters whose decimal code starts at 128 or below) » Number of repeated characters <p>This weights in the opposite direction, so that too many repeated characters does meet the quorum to satisfy the "level" expressed by <code>krbPwMinDiffChars</code>.</p>
Minimum Length of Password	--minlength	Sets the minimum number of characters for a password. The default value is eight characters.

Configuration Property	Command-Line Option	Description
Password History	--history	Sets the number of previous passwords that are stored and which a user is prevented from using. For example, if this is set to ten, IdM prevents a user from reusing any of their previous ten passwords. The default value is zero (0), which disables password history.
<div style="border: 1px solid gray; padding: 5px;">  <p>NOTE</p> <p>Even with the password history set to zero, users cannot reuse a <i>current</i> password.</p> </div>		
Options for the CLI only		
Priority	--priority	Sets the priority which determines which policy is in effect. The lower the number, the higher priority. Although this priority is required when the policy is first created in the UI, it cannot be reset in the UI. It can only be reset using the CLI.
Maximum Consecutive Failures	--maxfail	Specifies the maximum number of consecutive failures to input the correct password before the user's account is locked.
Fail Interval	--failinterval	Specifies the period (in seconds) after which the failure count will be reset.
Lockout Time	--lockouttime	Specifies the period (in seconds) for which a lockout is enforced.

16.2. Viewing Password Policies

There can be multiple password policies configured in IdM. There is always a global policy, which is set when the server is created. Additional policies can be created for groups in IdM.

The UI lists all of the group password policies and the global policy on the **Password Policies** page.

Using the CLI, both global and group-level password policies can be viewed using the **pwpolicy-show** command. The CLI can also display the password policy in effect for a user.

16.2.1. Viewing the Global Password Policy

The global password policy is created as part of the initial IdM server setup. This policy applies to every user until a group-level password policy supersedes it.

The default settings for the global password policy are listed in [Table 16.2, “Default Global Password Policy”](#).

Table 16.2. Default Global Password Policy

Attribute	Value
Max lifetime	90 (days)
Min lifetime	1 (hour)
History size	0 (unset)
Character classes	0 (unset)
Min length	8
Max failures	6
Failure reset interval	60
Lockout duration	600

16.2.1.1. With the Web UI

1. Click the **Policy** tab, and then click the **Password Policies** subtab.
2. All of the policies in the UI are listed by group. The global password policy is defined by the **global_policy** group. Click the group link.



3. The global policy is displayed.

The screenshot shows the IPA web interface with the 'Policy' tab selected. The 'Password Policies' sub-tab is active, displaying the configuration for the 'global_policy' group. The settings are as follows:

Setting	Value
Group	global_policy
Max lifetime (days)	90
Min lifetime (hours)	1
History size	0
Character classes	0
Min length	8
Max failures	3
Failure reset interval	60
Lockout duration	10
Priority	

16.2.1.2. With the Command Line

To view the global policy, simply run the `pwpolicy-show` command with no arguments:

```
[root@server ~]# kinit admin
[root@server ~]# ipa pwpolicy-show
```

```
Group: global_policy
Max lifetime (days): 90
Min lifetime (hours): 1
History size: 0
Character classes: 0
Min length: 8
Max failures: 6
Failure reset interval: 60
Lockout duration: 600
```

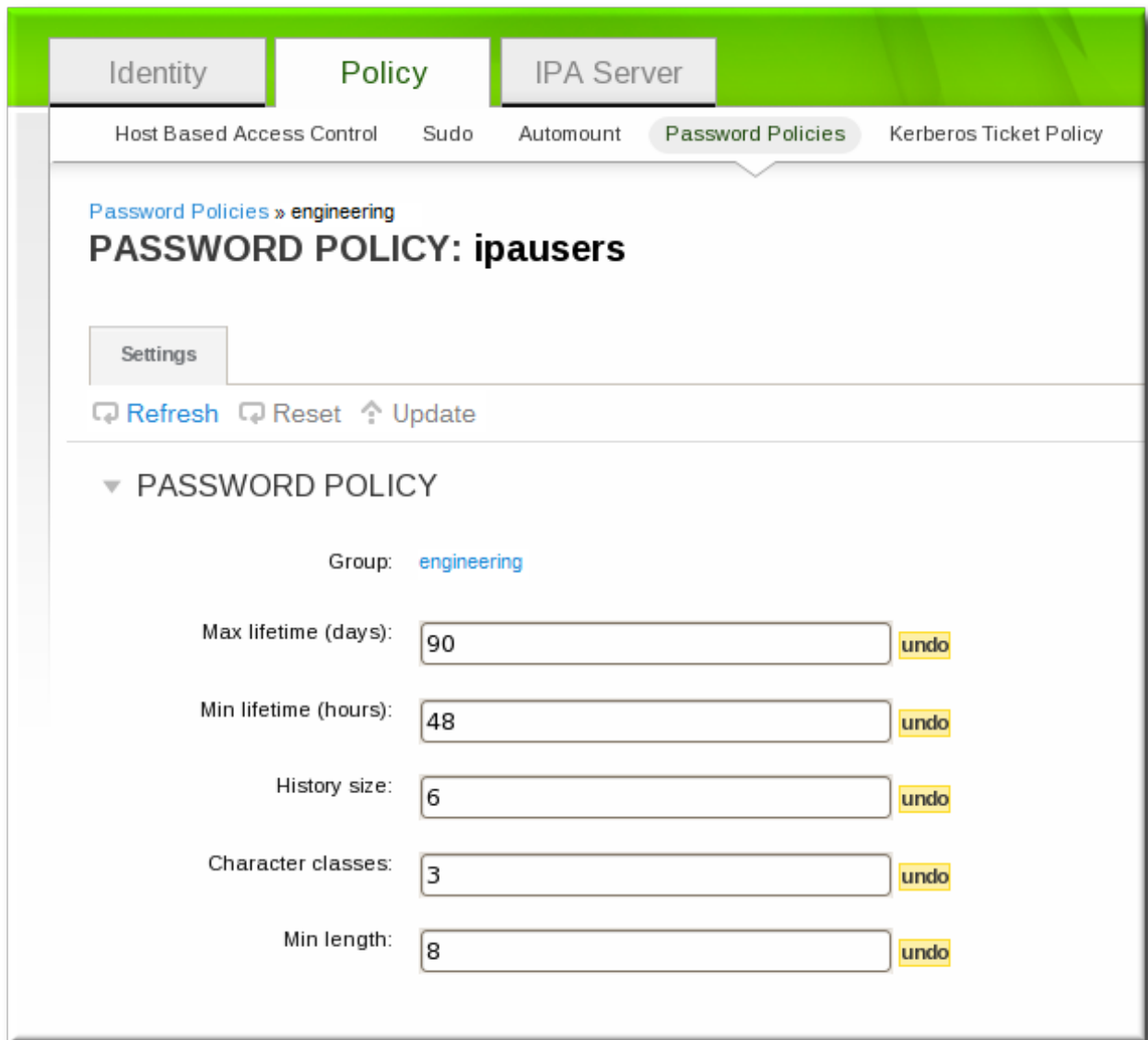
16.2.2. Viewing Group-Level Password Policies

16.2.2.1. With the Web UI

1. Click the **Policy** tab, and then click the **Password Policies** subtab.
2. All of the policies in the UI are listed by group. Click the name of the group which is assigned the policy.



3. The group policy is displayed.



16.2.2.2. With the Command Line

For a group-level password policy, specify the group name with the command:

```
[root@server ~]# kinit admin
[root@server ~]# ipa pwpolicy-show ipausers
Group: ipausers
Max lifetime (days): 120
Min lifetime (hours): 10
Min length: 10
Priority: 50
```

16.2.3. Viewing the Password Policy in Effect for a User

A user may belong to multiple groups, each with their own separate password policies. These policies are not additive. Only one policy is in effect at a time and it applies to all password policy attributes. To see which policy is in effect for a specific user, the **pwpolicy-show** command can be run for a specific user. The results also show *which* group policy is in effect for that user.

```
[root@server ~]# kinit admin
[root@server ~]# ipa pwpolicy-show --user=jsmith
Group: global_policy
Max lifetime (days): 90
```

```

Min lifetime (hours): 1
History size: 0
Character classes: 0
Min length: 8
Max failures: 6
Failure reset interval: 60
Lockout duration: 600

```

16.3. Creating and Editing Password Policies

A password policy can be selective; it may only define certain elements. A *global* password policy sets defaults that are used for every user entry, unless a group policy takes priority.



NOTE

A global policy always exists, so there is no reason to add a global password policy.

Group-level policies override the global policies and offer specific policies that only apply to group members. Password policies are not cumulative. Either a group policy or the global policy is in effect for a user or group, but not both simultaneously.

Group-level policies do not exist by default, so they must be created manually.

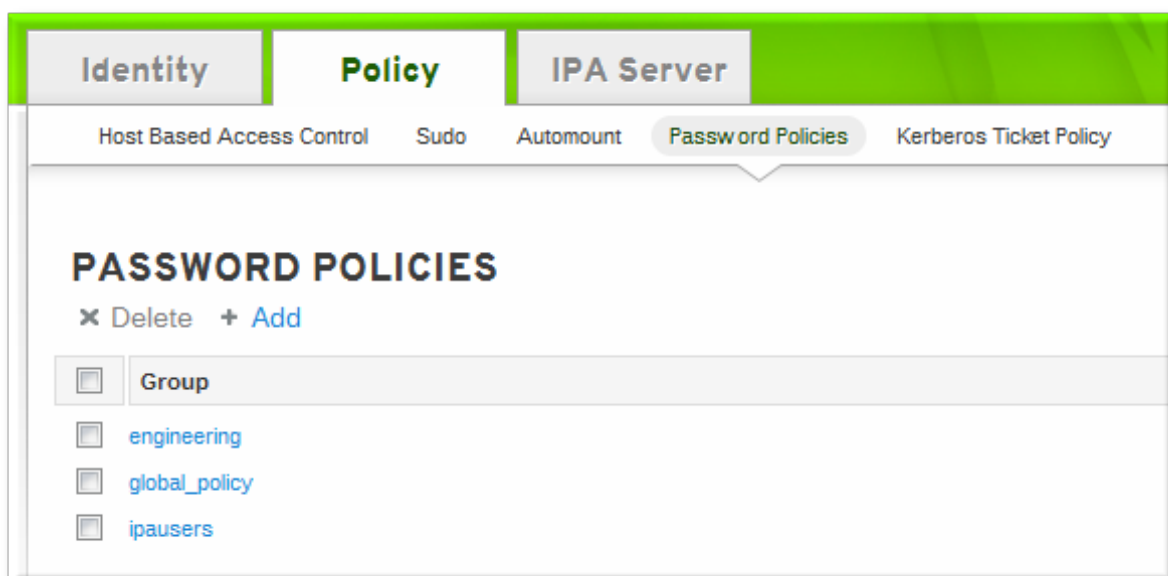


NOTE

It is not possible to set a password policy for a non-existent group.

16.3.1. Creating Password Policies in the Web UI

1. Click the **Policy** tab, and then click the **Password Policies** subtab.
2. All of the policies in the UI are listed by group. The global password policy is defined by the **global_policy** group. Click the group link.



3. Click the **Add** link at the top.

4. In the pop-up box, select the group for which to create the password policy.

The screenshot shows the 'Add Password Policy' dialog box. The 'Group' field is a dropdown menu currently showing 'engineering'. Below it, the 'Priority' field is a search-enabled dropdown menu that is open, displaying a list of groups: 'admins', 'editors', 'engineering' (which is highlighted in blue), and 'engineering_managers'. At the bottom of the dialog, there are four buttons: 'Add', 'Add and Add Another', 'Add and Edit', and 'Cancel'.

5. Set the priority of the policy. The higher the number, the lower the priority. Conversely, the highest priority policy has the lowest number.

Only one password policy is in effect for a user, and that is the highest priority policy.

This screenshot shows the 'Add Password Policy' dialog box after the priority has been set. The 'Group' dropdown remains set to 'engineering'. The 'Priority' field is now a text input box containing the number '50'. The same four buttons ('Add', 'Add and Add Another', 'Add and Edit', and 'Cancel') are visible at the bottom.



NOTE

The priority cannot be changed in the UI once the policy is created.

6. Click the **Add and Edit** button so that the policy form immediately opens.
7. Set the policy fields. Leaving a field blank means that attribute is not added the password policy configuration.
- » *Max lifetime* sets the maximum amount of time, in days, that a password is valid before a user must reset it.

- ▶ *Min lifetime* sets the minimum amount of time, in hours, that a password must remain in effect before a user is permitted to change it. This prevents a user from attempting to change a password back immediately to an older password or from cycling through the password history.
- ▶ *History size* sets how many previous passwords are stored. A user cannot re-use a password that is still in the password history.
- ▶ *Character classes* sets the *number* of different categories of character that must be used in the password. This does not set which classes must be used; it sets the number of different (unspecified) classes which must be used in a password. For example, a character class can be a number, special character, or capital; the complete list of categories is in [Table 16.1, “Password Policy Settings”](#). This is part of setting the complexity requirements.
- ▶ *Min length* sets how many characters must be in a password. This is part of setting the complexity requirements.

16.3.2. Creating Password Policies with the Command Line

Password policies are added with the **pwpolicy-add** command.

```
[root@server ~]# kinit admin
[root@server ~]# ipa pwpolicy-add groupName --attribute-value
```

For example:

```
[root@server ~]# kinit admin
[root@server ~]# ipa pwpolicy-add exampleGroup --minlife=7 --maxlife=49 --history=
--priority=1
Group: exampleGroup
Max lifetime (days): 49
Min lifetime (hours): 7
Priority: 1
```



TIP

Setting an attribute to a blank value effectively removes that attribute from the password policy.

16.3.3. Editing Password Policies with the Command Line

As with most IdM entries, a password policy is edited by using a *** -mod** command, **pwpolicy-mod**, and then the policy name. However, there is one difference with editing password policies: there is a global policy which always exists. Editing a group-level password policy is slightly different than editing the global password policy.

Editing a group-level password policy follows the standard syntax of *** -mod** commands. It uses the **pwpolicy-mod** command, the name of the policy entry, and the attributes to change. For example:

```
[jsmith@ipaserver ~]$ ipa pwpolicy-mod exampleGroup --lockouttime=300 --history=5
--minlength=8
```

To edit the global password policy, use the **pwpolicy-mod** command with the attributes to change, *but without specifying a password policy name*. For example:

```
[jsmith@ipaserver ~]$ ipa pwpolicy-mod --lockouttime=300 --history=5 --minlength=8
```


16.4. Managing Password Expiration Limits

Password policies are applied **at the time a password is changed**. So, when a password is set, it conforms to the password policy in effect at that time. If the password policy is changed later, that change is not applied, retroactively, to the password.

Setting password expiration periods is configured as part of the group password policy. Creating and editing password policies (including the expiration attribute in the policy) is covered in [Section 16.3, “Creating and Editing Password Policies”](#).

With password expiration periods, there are two attributes that are related:

- ▶ The maximum lifetime setting given in the password policy (**--maxlife**)
- ▶ The actual date that the password for a given user expires (**krbPasswordExpiration**)

Changing the password expiration time in the password policy does not affect the expiration date for a user, until the user password is changed. If the password expiration date needs to be changed immediately, it can be changed by editing the user entry.

To force the expiration date to change, reset the **krbPasswordExpiration** attribute value for the user. **This can only be done using `ldapmodify`**. For example, for a single user:

```
[bjensen@ipaserver ~]$ ldapmodify -D "cn=Directory Manager" -w secret -h
ipaserver.example.com -p 389 -vv

dn: uid=jsmith,cn=users,cn=accounts,dc=example,dc=com
changetype: modify
replace: krbpasswordexpiration
krbpasswordexpiration: 20140202203734Z
-
```

Multiple entries can be edited simultaneously by referencing an LDIF file in the **-f** option with the **ldapmodify** command.



TIP

If an administrator resets a password, it expires the previous password and forces the user to update the password. When the user updates the password, it automatically uses the new password policies, including a new expiration date.

16.5. Changing the Priority of Group Password Policies

A user may belong to multiple groups, each with different password policies. Since only one policy can be in effect for a user, there has to be a method to assign precedence to policies. That is done through *priority*.

The highest priority is zero (0). The lower the number, the higher the priority.

This is set initially when the password policy is created. It can be modified after the policy is created by resetting the **--priority** option.

```
[root@server ~]# kinit admin
[root@server ~]# ipa pwpolicy-mod examplegroup --priority=10
```

When a user belongs to multiple groups, the group password policy with the lowest priority *number* has the highest priority.

16.6. Setting Account Lockout Policies

A brute force attack occurs when a malefactor attempts to guess a password by simply slamming the server with multiple login attempts. An account lockout policy prevents brute force attacks by blocking an account from logging into the system after a certain number of login failures — even if the correct password is subsequently entered.



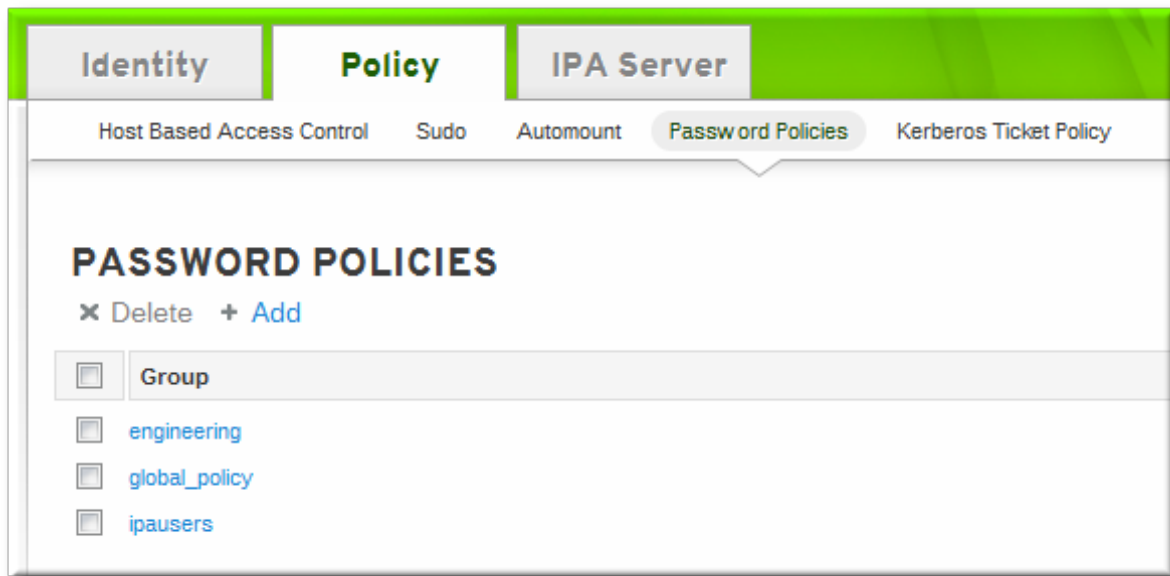
NOTE

A user account can be manually unlocked by an administrator using the `ipa user-unlock`. Refer to [Section 9.6, “Unlocking User Accounts After Password Failures”](#).

16.6.1. In the UI

These attributes are available in the password policy form when a group-level password policy is created or when any password policy (including the global password policy) is edited.

1. Click the **Policy** tab, and then click the **Password Policies** subtab.
2. Click the name of the policy to edit.



3. Set the account lockout attribute values.

▼ **PASSWORD POLICY**

Group: [global_policy](#)

Max lifetime (days):

Min lifetime (hours):

History size:

Character classes:

Min length:

Max failures:

Failure reset interval:

Lockout duration:

Priority:

There are three parts to the account lockout policy:

- ▶ The number of failed login attempts before the account is locked (**Max Failures**).
- ▶ The time after a failed login attempt before the counter resets (**Failure reset interval**). Since mistakes do happen honestly, the count of failed attempts is not kept forever; it naturally lapses after a certain amount of time. This is in seconds.
- ▶ How long an account is locked after the max number of failures is reached (**Lockout duration**). This is in seconds.

16.6.2. In the CLI

There are three parts to the account lockout policy:

- ▶ The number of failed login attempts before the account is locked (**--maxfail**).
- ▶ How long an account is locked after the max number of failures is reached (**--lockouttime**). This is in seconds.
- ▶ The time after a failed login attempt before the counter resets (**--failinterval**). Since mistakes do happen honestly, the count of failed attempts is not kept forever; it naturally lapses after a certain amount of time. This is in seconds.

These account lockout attributes can all be set when a password policy is created with **pwpolicy-add** or added later using **pwpolicy-mod**. For example:

```
[jsmith@ipaserver ~]$ kinit admin
[jsmith@ipaserver ~]$ ipa pwpolicy-mod examplegroup --maxfail=4 --lockouttime=600
--failinterval=30
```

16.7. Enabling a Password Change Dialog

There may be situations when a user exists in Identity Management but does not have a valid Kerberos ticket, meaning he cannot authenticate to the IdM domain. This is possible for new users or for users whose domain passwords have expired. Much like enabling password authentication in the web UI, it is possible to enable password-based authentication to the client. This opens up a password change dialog box to allow the user to reset the expired password.

The password change dialog is enabled by using OpenSSH's *challenge-response* authentication.

The challenge-response dialog is optional. In many environments, it is not necessary because SSSD can handle changing expired passwords by invoking the required PAM modules. However, using the challenge-response option in OpenSSH makes it possible to do password changes directly in PAM and to support full PAM conversations.

This is not enabled by default, but it can be enabled by editing the OpenSSH configuration.

1. Open the `/etc/ssh/sshd_config` file.
2. Set ***ChallengeResponseAuthentication*** to **yes**.

Chapter 17. Managing the Kerberos Domain

Kerberos authentication is the core of authentication within the IdM domain. The IdM server actually runs a Kerberos server within it, and this Kerberos server can be configured for custom policies for managing tickets and keytabs.

For more information on Kerberos concepts, see the MIT Kerberos documentation, <http://web.mit.edu/kerberos/www/>.



IMPORTANT

Identity Management has its own command-line tools to use to manage Kerberos policies. **Do not** use `kadmin` or `kadmin.local` to manage IdM Kerberos settings.

17.1. About Kerberos

Kerberos provides an authentication layer between services and users. Kerberos centralizes authentication into a single location; a user authenticates to the Kerberos server, and then when that user attempts to access any resource on the network, that resource can check the *key distribution center* (KDC) for the stored user credentials. This allows users to access multiple resources without having to supply credentials separately to each and every one.

All of the users and services, combined, and all of the KDCs and Kerberos servers that are aware of each other constitute a *realm*. Each user, machine, and service within the realm is identified by a unique name called the *principal*. The user or service uses the principal and a verifying credential (usually a password) to authenticate to the KDC. The credential that is shared with the KDC is a *key* and it is stored in a file called a *key table* or *keytab*.

When the KDC verifies the user's identity, it issues a *ticket*. The ticket is a long-term pass to any service and machine on the realm. The KDC issues the user a special kind of ticket called a *ticket-granting ticket* (TGT). Whenever the user tries to access a resource within the Kerberos realm, the resource sends a request for a ticket specifically for it. The TGT is used to issue a resource-specific ticket that the resource then uses to authenticate the user and grant access.



NOTE

When an IdM client is first configured, the host principal is automatically retrieved by the setup script and stored in the `/etc/krb5.keytab` file. This host principal is stored within the host record so that local service commands cannot be used with this principal. This prepares the client to function in the IdM realm.

17.1.1. About Principal Names

The principal identifies not only the user or service, but also the realm that that entity belongs to. A principal name has two parts, the identifier and the realm:

```
identifier@REALM
```

For a user, the *identifier* is only the Kerberos username. For a service, the *identifier* is a combination of the service name and the hostname of the machine it runs on:

```
service/FQDN@REALM
```

The *service* name is a case-sensitive string that is specific to the service type, like **host**, **ldap**, **http**, and **dns**. Not all services have obvious principal identifiers; the **sshd** daemon, for example, uses the host service principal.

The host principal is usually stored in **/etc/krb5.keytab**.

When Kerberos requests a ticket, it always resolves the domain name aliases (DNS CNAME records) to the corresponding DNS address (A or AAAA records). The hostname from the address record is then used when service or host principals are created.

For example:

```
www.example.com CNAME web-01.example.com
web-01.example.com A 192.0.2.145
```

A service attempts to connect to the host using its CNAME alias:

```
$ ssh www.example.com
```

The Kerberos server requests a ticket for the resolved hostname, **web-01.example.com@EXAMPLE.COM**, so the host principal must be **host/web-01.example.com@EXAMPLE.COM**.

17.1.2. About Protecting Keytabs

To protect keytab files, reset the permissions and ownership to restrict access to the files to only the keytab owner. For example, set the owner of the Apache keytab (**/etc/httpd/conf/ipa.keytab**) to **apache** and the mode to **0600**.

17.2. Setting Kerberos Ticket Policies

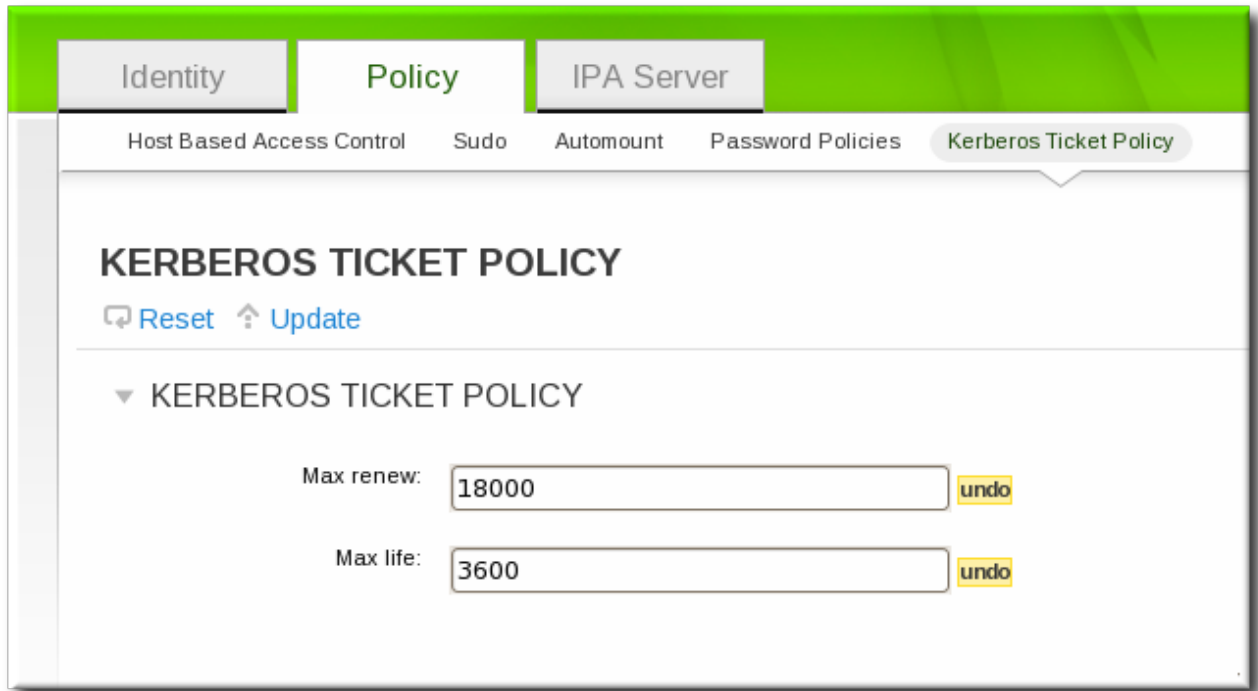
The Kerberos *ticket policy* sets basic restrictions on managing tickets within the Kerberos realm, such as the maximum ticket lifetime and the maximum renewal age (the period during which the ticket is renewable).

The Kerberos ticket policy is set globally so that it applies to every ticket issued within the realm. IdM also has the ability to set user-level ticket policies which override the global policies. This can be used, for example, to set extended expiration times for administrators or to set shorter expiration times for some employees.

17.2.1. Setting Global Ticket Policies

17.2.1.1. From the Web UI

1. Click the **Policy** tab, and then click the **Kerberos Ticket Policy** subtab.
2. Change the ticket lifetime policies.



- *Max renew* sets the period after a ticket expires that it can be renewed.
- *Max life* sets the active period (lifetime) of a Kerberos ticket.

3. Click the **Update** link at the top of the policy page.

4. Restart the KDC.

```
[root@server ~]# systemctl start krb5kdc.service
```



IMPORTANT

Any change to the global Kerberos ticket policy requires a restart of the KDC for the changes to take effect.

17.2.1.2. From the Command Line

The **ipa krbtpolicy-mod** command modifies the policy, while the **ipa krbtpolicy-reset** command resets the policy to the default values.

For example:

```
# ipa krbtpolicy-mod --maxlife=3600 --maxrenew=18000
Max life: 3600
Max renew: 18000
```

**IMPORTANT**

Any change to the global Kerberos ticket policy requires a restart of the KDC for the changes to take effect. Restart the KDC:

```
[root@server ~]# systemctl restart krb5kdc.service
```

17.2.2. Setting User-Level Ticket Policies

User-level Kerberos ticket policies are set using the same commands as global policies, but the user is specified in the command.

For example:

```
# ipa krbtpolicy-mod jsmith --maxlife=3600
Max life: 3600
```

**IMPORTANT**

User-level policies take effect immediately on the next requested ticket (such as running **init**), without having to restart the KDC service.

17.3. Refreshing Kerberos Tickets

Kerberos keys are analogous to passwords. As with password policies, Kerberos tickets come under security policies which require them to be manually refreshed after a specified interval.

The version of the key is shown in its *key version number* (KVNO). Refreshing (also called rotating) the principal's key increments the KVNO in the keytab entry. When a key is refreshed, a new entry is added to the keytab with a higher KVNO. The original key remains in the keytab but is no longer used to issue tickets.

Each keytab for the IdM realm has an entry in the IdM LDAP server, which includes its last change time. The principals which need to be refreshed can be regenerated using the **ipa-getkeytab** command.

**NOTE**

The **ipa-getkeytab** command does not delete the old keytab in case it already exists in the file.

1. Find all keytabs issued before the requisite date. For example, this looks for any principals created between midnight on January 1, 2010, and 11:59 PM on December 31, 2010:

```
[root@server ~]# ldapsearch -x -b "cn=computers,cn=accounts,dc=example,dc=com"
"(&(krblastpwdchange>=20100101000000)(krblastpwdchange<=20101231235959))" dn
krbprincipalname
...
[root@server ~]# ldapsearch -x -b "cn=services,cn=accounts,dc=example,dc=com"
"(&(krblastpwdchange>=20100101000000)(krblastpwdchange<=20101231235959))" dn
krbprincipalname
```


- Host (machine) principals are stored under the **cn=computers,cn=accounts,dc=example,dc=com** subtree.
- Service principals are stored under the **cn=services,cn=accounts,dc=example,dc=com** subtree.
- Filter by the last change date (*krblastpwdchange*).
- Limit the search result information to only the entry name and principal by specifying the **dn** *krbprincipalname* attributes.

Dates are expressed in YYYYMMDD format, and times in HHMMSS format (GMT).

2. Retrieve a new keytab for the principal using the **ipa-getkeytab** command. This requires the location of the original keytab for the service or host (**-k**), the principal (**-p**), and the IdM server hostname (**-s**).

For example, this refreshes the host principal with a keytab in the default location of **/etc/krb5.keytab**:

```
# ipa-getkeytab -p host/client.example.com@EXAMPLE.COM -s ipa.example.com -k
/etc/krb5.keytab
```

This refreshes the keytab for the Apache service, with a keytab in the default location of **/etc/httpd/conf/ipa.keytab**:

```
# ipa-getkeytab -p HTTP/client.example.com@EXAMPLE.COM -s ipa.example.com -k
/etc/httpd/conf/ipa.keytab
```

3. Regenerate the keytab using **ipa-getkeytab** for every service.

The **klist** command displays the new key version number for the refreshed keytab. The original keytab still exists in the database, and it is listed with the previous KVNO.

```
# klist -kt /etc/krb5.keytab
Keytab: WRFILE:/etc/krb5.keytab
KVNO Timestamp          Principal
-----
  1 06/09/10 11:23:01 host/client.example.com@EXAMPLE.COM(aes256-cts-hmac-sha1-96)
  2 06/09/11 05:58:47 host/client.example.com@EXAMPLE.COM(aes256-cts-hmac-sha1-96)
  1 03/09/11 13:57:16 krbtgt/EXAMPLE.COM@EXAMPLE.COM(aes256-cts-hmac-sha1-96)
  1 03/09/11 13:57:16 HTTP/ipa.example.com@EXAMPLE.COM(aes256-cts-hmac-sha1-96)
  1 03/09/11 13:57:16 ldap/ipa.example.com@EXAMPLE.COM(aes256-cts-hmac-sha1-96)
```

Tickets issued against the old keytab continue to work, while new tickets are issued using the key with the highest KVNO. This avoids any disruption to system operations.



IMPORTANT

Some services, such as NFSv4, only support a limited set of encryption types. Pass the appropriate arguments to the **ipa-getkeytab** command to configure the keytab properly.

17.4. Caching Kerberos Passwords

A machine may not always be on the same network as the IdM domain; for example, a machine may need to be logged into a VPN before it can access the IdM domain. If a user logs into a system when it is offline and then later attempts to connect to IdM services, then the user is blocked because there is no IdM Kerberos ticket for that user. IdM works around that limitation by using SSSD to store the Kerberos passwords in the SSSD cache.

This is configured by default by the `ipa-client-install` script. A configuration parameter is added to the `/etc/sss/sss.conf` file which specifically instructs SSSD to store those Kerberos passwords for the IdM domain:

```
[domain/example.com]
cache_credentials = True
ipa_domain = example.com
id_provider = ipa
auth_provider = ipa
access_provider = ipa
chpass_provider = ipa
ipa_server = _srv_, server.example.com
krb5_store_password_if_offline = true
```

This default behavior can be disabled during the client installation by using the `--no-krb5-offline-passwords` option.

This behavior can also be disabled by editing the `/etc/sss/sss.conf` file and removing the `krb5_store_password_if_offline` line or changing its value to false.

```
[domain/example.com]
...
krb5_store_password_if_offline = false
```

The SSSD configuration options for Kerberos authentication is covered in [the "Configuring Domains" section of the SSSD chapter in the Red Hat Enterprise Linux Deployment Guide](#).

17.5. Removing Keytabs

Refreshing Kerberos tickets adds a new key to the keytab, but it does not clear the keytab. If a host is being unenrolled and re-added to the IdM domain or if there are Kerberos connection errors, then it may be necessary to remove the keytab and create a new keytab.

This is done using the `ipa-rmkeytab` command. To remove all principals on the host, specify the realm with the `-r` option:

```
# ipa-rmkeytab -r EXAMPLE.COM -k /etc/krb5.keytab
```

To remove the keytab for a specific service, use the `-p` option to specify the service principal:

```
# ipa-rmkeytab -p ldap/client.example.com -k /etc/krb5.keytab
```

Chapter 18. Using sudo

Identity Management provides a mechanism for predictably and consistently applying **sudo** policies across the IdM domain. The **sudo** policies apply to domain users and domain hosts.

18.1. About sudo and IPA

The **sudo** command allows a system administrator to delegate authority to specific users to run specific commands as root or another specified user. **sudo** provides an audit trail of the commands and their arguments, so access can be tracked.

18.1.1. General sudo Configuration in Identity Management

sudo uses a local configuration file, `/etc/sudoers`, which defines the commands and users with sudo access. While this file can be shared among machines, there's no native way to distribute **sudo** configuration files among machines.

Identity Management uses its centralized LDAP database to contain the **sudo** configuration, which makes it globally available to all domain hosts. Identity Management also has a specialized LDAP schema for **sudo** entries that allows a lot more flexible and simpler configuration. This schema adds two key features:

- ▶ The Identity Management schema supports host groups in addition to netgroups for **sudo**, while **sudo** only supports netgroups.

For every host group, Identity Management also creates a corresponding shadow netgroup. This allows IdM administrators to create **sudo** rules that reference host groups, while the local **sudo** command uses the corresponding netgroup.

- ▶ Identity Management introduces the concept of a *sudo command group*. The group contains multiple commands, and the command group can be referenced in the **sudo** configuration.

Because **sudo** does not support host groups and command groups, Identity Management translates the IdM **sudo** configuration into native **sudo** configuration when the **sudo** rules are created.

Because the **sudo** information is not available anonymously over LDAP by default, Identity Management defines a default **sudo** user, `uid=sudo,cn=sysaccounts,cn=etc,$SUFFIX`, which can be set in the LDAP/**sudo** configuration file, `/etc/ldap.conf`.

Because the **sudo** information is not available anonymously over LDAP by default, Identity Management defines a default **sudo** user, `uid=sudo,cn=sysaccounts,cn=etc,$SUFFIX`, which can be set in the LDAP/**sudo** configuration file, `/etc/sud-ldap.conf`.

Both **sudo** and Identity Management support user groups as part of the **sudo** configuration. User groups can be either Unix or non-POSIX groups. Creating non-POSIX groups can create some access issues because any users in the group inherit non-POSIX rights from the group. Having the choice between Unix and non-POSIX groups allows administrators the choice in group formatting and to avoid problems with inherited permissions or GID information.

18.1.2. sudo and Netgroups

As [Section 18.1.1, "General sudo Configuration in Identity Management"](#) mentions, the LDAP schema used for sudo entries in Identity Management supports host group-style groups in addition to netgroups. Really, Identity Management creates two groups, a visible host group and a shadow netgroup. **sudo** itself only supports NIS-style netgroups for group formats.

One important thing to consider is that even though **sudo** uses NIS netgroups, *it is not necessary to have a NIS server installed or a NIS client configured*. When any group is created for **sudo**, the NIS object is created in the Directory Server instance, and then the information is retrieved by NSS_LDAP or by SSSD. The client (in this case, **sudo**) then extracts the required NIS information from the information provided by Identity Management's Directory Server.

In short, **sudo** configuration requires NIS-formatted netgroups. It does not require NIS.

The Identity Management Directory Server instance uses the standard LDAP schema for NIS objects, defined in [RFC 2307](#).

18.1.3. Supported sudo Clients

Any system which is supported as an IdM client system can be configured as a **sudo** client in IdM.

18.2. Setting up sudo Commands and Command Groups

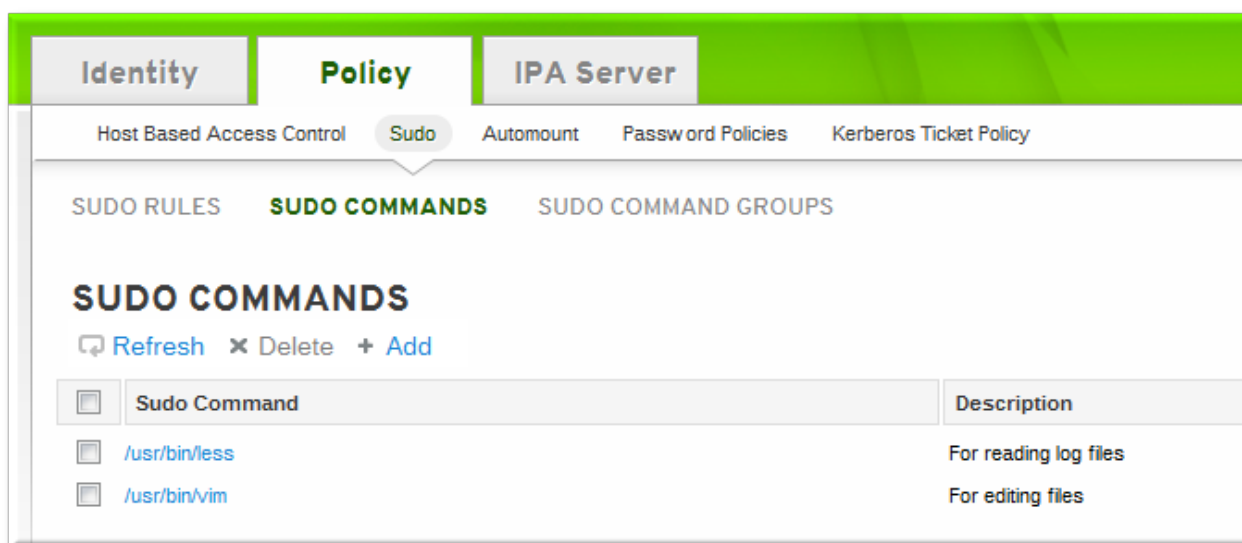
Just as in regular **sudo** configuration, any command which will be governed by **sudo** access must be listed in the configuration. Identity Management adds an extra control measure with *sudo command groups*, which allow a group of commands to be defined and then applied to the **sudo** configuration as one.

Adding a command or a command group makes it available to IdM to be defined in a **sudo** rule; simply adding a command does not automatically include it in a **sudo** rule.

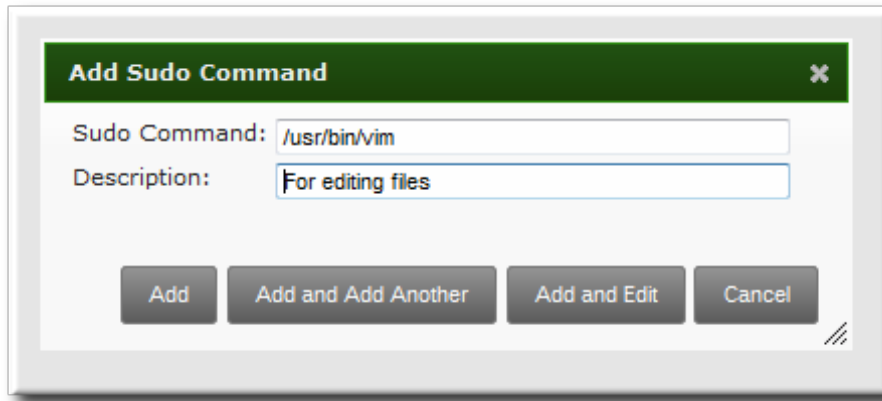
18.2.1. Adding sudo Commands

18.2.1.1. Adding sudo Commands with the Web UI

1. Click the **Policy** tab.
2. Click the **Sudo** subtab, and then select the **Sudo Commands** link.
3. Click the **Add** link at the top of the list of commands.



4. Enter the full system path and name of the command and, optionally, a description.



5. Click the **Add and Edit** button to go immediately to the settings pages for the command.
6. In the **Sudo Command Groups** tab, click the **Add** button to add the sudo command to a command group.
7. Click the checkbox by the groups for the command to join, and click the right arrows button, **>>**, to move the group to the selection box.
8. Click the **Add** button.

18.2.1.2. Adding sudo Commands with the Command Line

To add a single command, use the **sudocmd-add** command. This requires the full, local path to the command executable and a description of the command:

```
$ ipa sudocmd-add --desc "description" /local/path/to/command
```

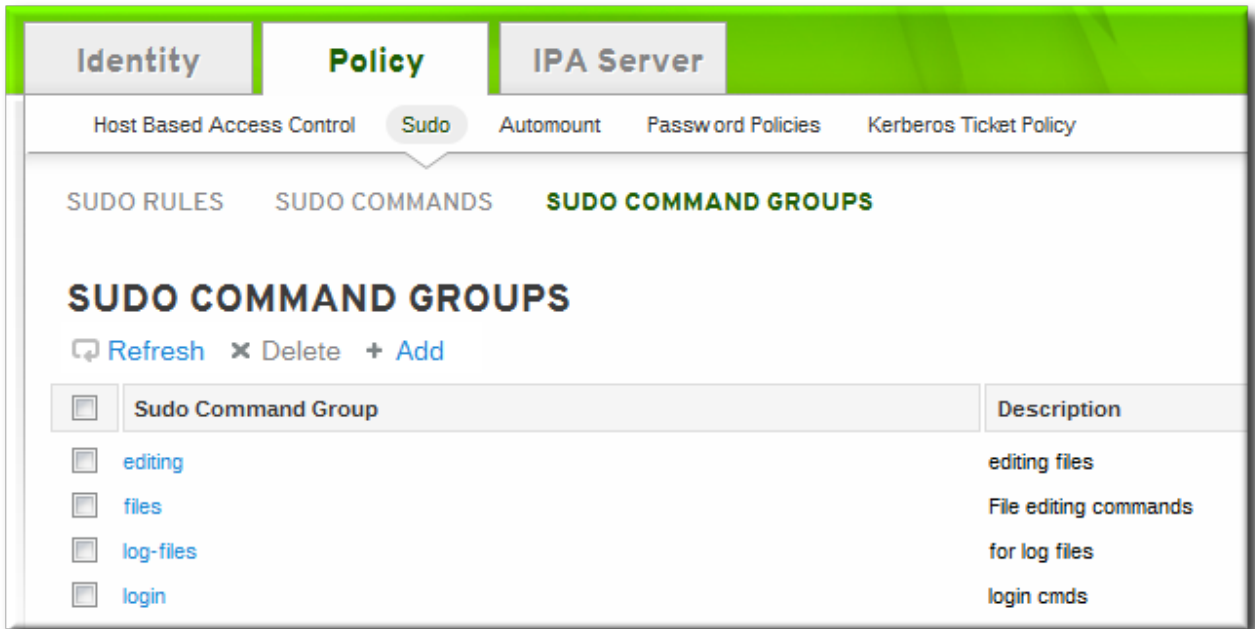
For example:

```
$ ipa sudocmd-add --desc 'For reading log files' '/usr/bin/less'
-----
Added sudo command "/usr/bin/less"
-----
sudo Command: /usr/bin/less
Description: For reading log files
```

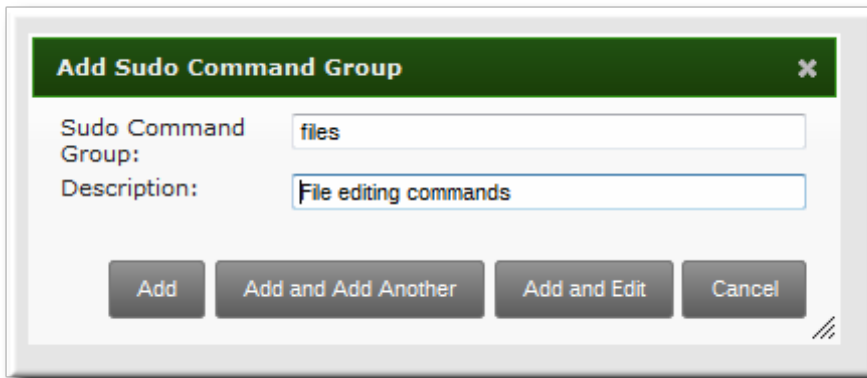
18.2.2. Adding sudo Command Groups

18.2.2.1. Adding sudo Command Groups with the Web UI

1. Click the **Policy** tab.
2. Click the **Sudo** subtab, and then select the **Sudo Command Groups** link.
3. Click the **Add** link at the top of the list of command groups.

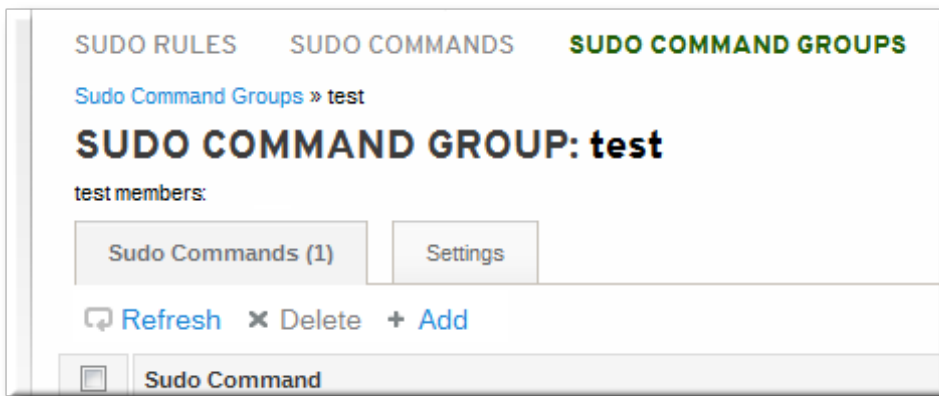


4. Enter the name and description for the new command group.

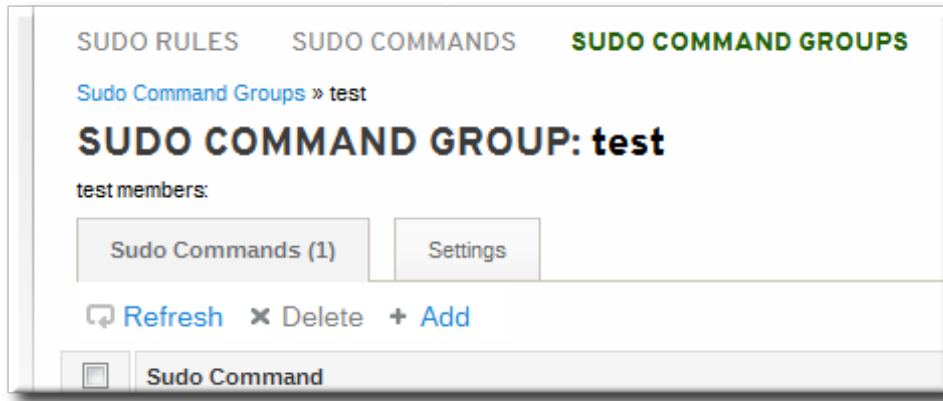


5. Click the **Add and Edit** button to go immediately to the settings pages for the group.

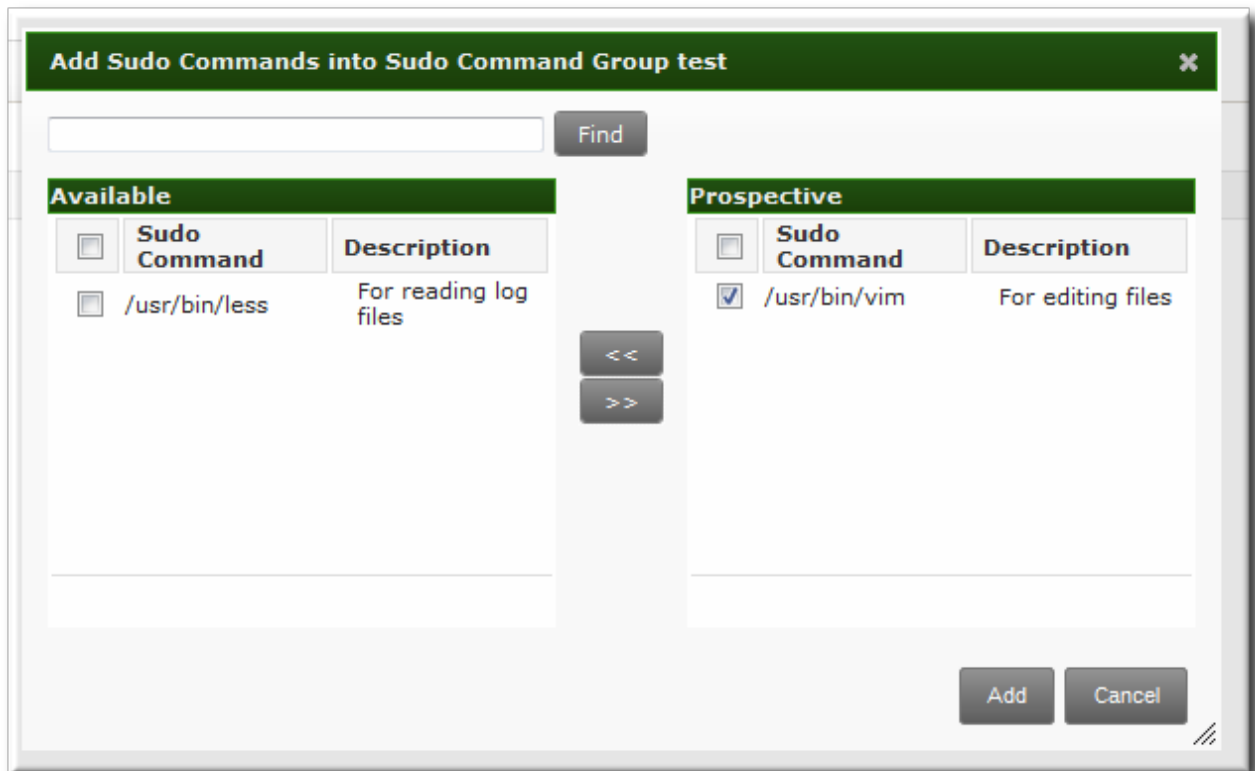
6. In the **Sudo Commands** tab, click the **Add** button to add a sudo command to the group.



7. In the **Sudo Commands** tab, click the **Add** button to add a sudo command to the group.



- Click the checkbox by the names of the commands to add, and click the right arrows button, >>, to move the command to the selection box.



- Click the **Add** button.

18.2.2.2. Adding sudo Command Groups with the Command Line

Creating a command group requires creating two entries, one for the group and one for the command itself:

- Create the command group using the **sudo cmdgroup-add** command:

```
$ ipa sudo cmdgroup-add --desc 'File editing commands' files
-----
Added sudo command group "files"
-----
sudo Command Group: files
Description: File editing commands
```

- Create a command entry using the **sudo cmd-add** command:

```
$ ipa sudocmd-add --desc 'For editing files' '/usr/bin/vim'
-----
Added sudo command "/usr/bin/vim"
-----
sudo Command: /usr/bin/vim
Description: For editing files
```

3. Add the command, using its full directory location as its name, to the command group using the **sudocmdgroup-add-member** command:

```
$ ipa sudocmdgroup-add-member --sudocmds '/usr/bin/vim' files
sudo Command Group: files
Description: File editing commands
Member sudo commands: /usr/bin/vim
-----
Number of members added 1
-----
```

18.3. Defining sudo Rules

sudo rules are in a sense similar to access control rules: they define users who are granted access, the commands which are within the scope of the rule, and then the target hosts to which the rule applies. In IdM, additional information can be configured in the rule, such as **sudoeers** options and run-as settings, but the basic elements always define who, what (services), and where (hosts).

18.3.1. About External Users

sudo rules define four elements: *who* can do *what*, *where*, and as *whom*. The *who* is the regular user, and the *as whom* is the system or other user identity which the user uses to perform tasks. Those tasks are system commands that can be run (or specifically not run) on a target machine.

Three of those elements — *who*, *as whom*, and *where* — are identities. They are users. Most of the time, those identities are going to be entities within the IdM domain because there will be overlap between the system users in the environment and the users and hosts belonging to the IdM domain.

However, that is not necessarily the case with all identities that a **sudo** policy may realistically cover. For example, **sudo** rules could be used to grant root access to a member of the IT group in IdM, and that root user is not a user in IdM. Or, for another example, administrators may want to block access to certain hosts that are on a network but are not part of the IdM domain.

The **sudo** rules in Identity Management support the concept of *external* users — meaning, users which are stored and exist outside of the IdM configuration.

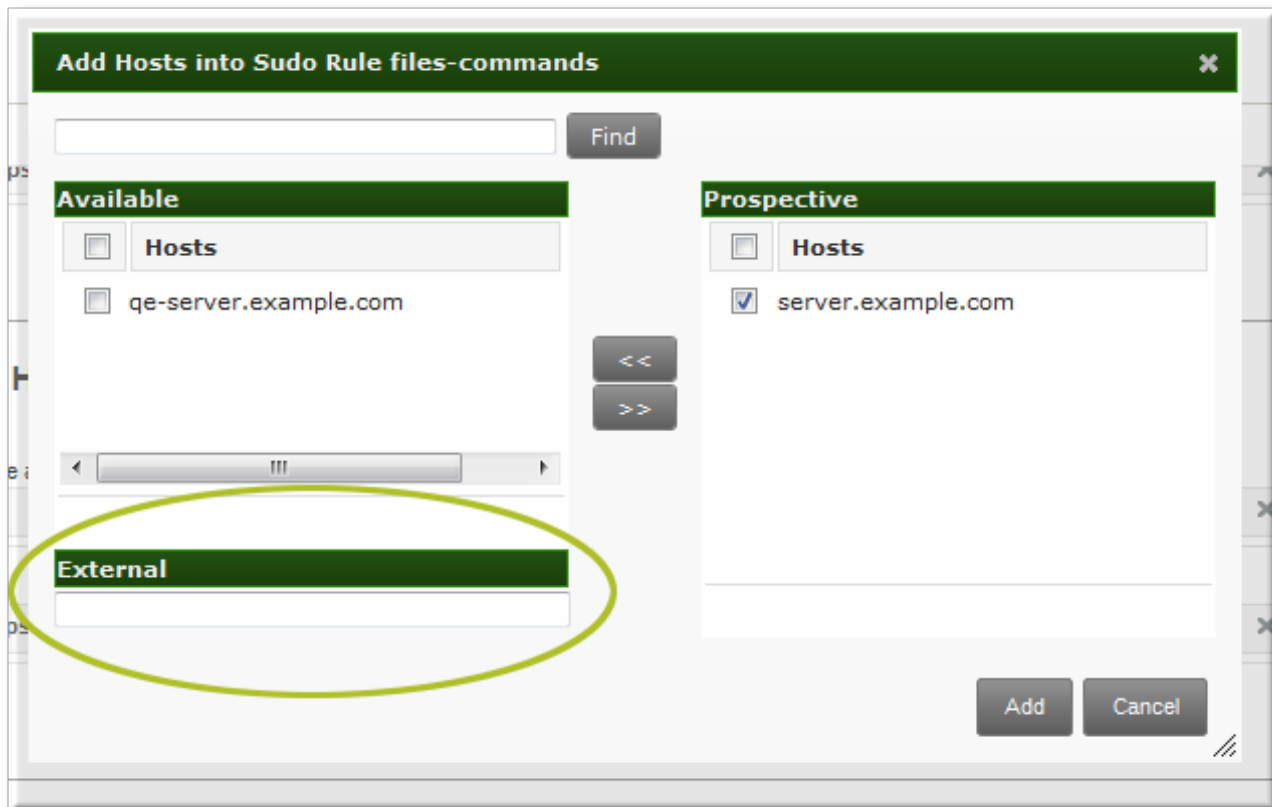


Figure 18.1. External Entities

When configuring a **sudo** rule, the user and run-as settings can point to an external identity to be included and evaluated in the **sudo** rule.

18.3.2. About sudo Options Format

The **sudo** rule can be configured to use any supported **sudoers** options. (The complete list of options is in the **sudoers** manpage and at http://www.gratisoft.us/sudo/sudoers.man.html#sudoers_options.)

However, the **sudo** rule configuration in Identity Management *does not* allow the same formatting as the configuration in the `/etc/sudoers` file. Specifically, Identity Management does not allow whitespaces in the options parameter, whether it is set in the UI or the CLI.

For example, in the `/etc/sudoers` file, it is permissible to list options in a comma-separated list with spaces between:

```
mail_badpass, mail_no_host, mail_no_perms, syslog = local2
```

However, in Identity Management, that same configuration would be interpreted as different arguments — including the equals sign (=) since it has spaces around it. Instead, each option must be added individually, either through the UI or the command-line tools.

```
[jsmith@server ~]$ ipa sudorule-add-option readfiles
Sudo Option: mail_badpass
-----
Added option "mail_badpass" to Sudo rule "readfiles"
-----
[jsmith@server ~]$ ipa sudorule-add-option readfiles
Sudo Option: syslog=local2
```

```
-----
Added option "syslog=local2" to Sudo rule "readfiles"
-----
...
```

Likewise, linebreaks that are ignored in the `/etc/sudoers` file are not allowed in the Identity Management configuration.

```
env_keep = "COLORS DISPLAY EDITOR HOSTNAME HISTSIZE INPUTRC
           KDEDIR LESSECURE LS_COLORS MAIL_PATH PS1 PS2
           QTDIR USERNAME LANG LC_ADDRESS LC_CTYPE LC_COLLATE
           LC_IDENTIFICATION LC_MEASUREMENT LC_MESSAGES
           LC_MONETARY LC_NAME LC_NUMERIC LC_PAPER LC_TELEPHONE
           LC_TIME LC_ALL LANGUAGE LINGUAS _XKB_CHARSET
           XAUTHORITY"
```

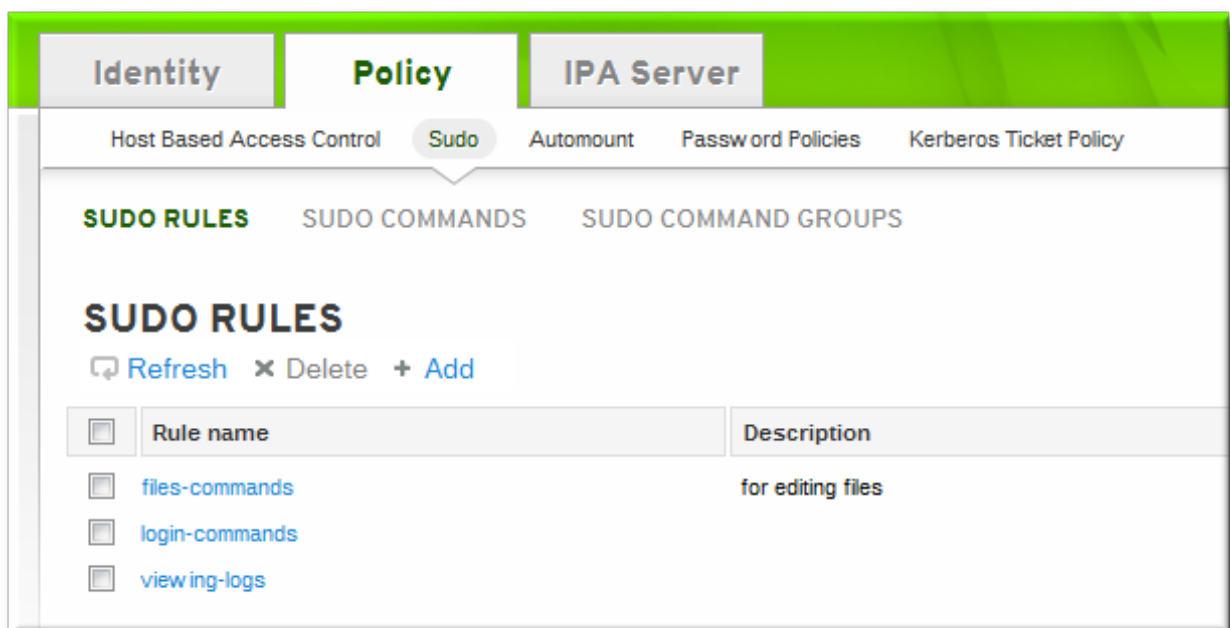
For example, the same command in the IdM command line has all of the variables on one line and no spaces around the equals sign.

```
[jsmith@server ~]$ ipa sudorule-add-option readfiles
Sudo Option: env_keep="COLORS DISPLAY EDITOR HOSTNAME HISTSIZE INPUTRC KDEDIR
LESSECURE LS_COLORS MAIL_PATH PS1 PS2 ... XAUTHORITY"
```

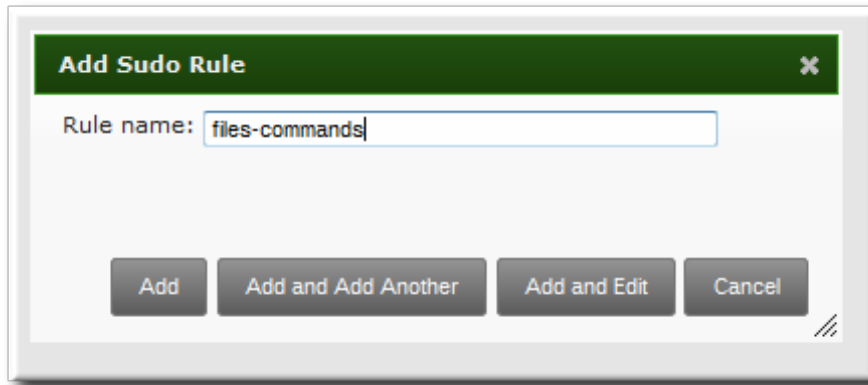
To use multiple `sudoers` options in Identity Management, configure each one as a separate option setting, rather than all on one line.

18.3.3. Defining sudo Rules in the Web UI

1. Click the **Policy** tab.
2. Click the **Sudo** subtab, and then select the **Sudo Rules** link.
3. Click the **Add** link at the top of the list of sudo rules.



4. Enter the name for the rule.



5. Click the **Add and Edit** button to go immediately to set the configuration for the rule.

There are a number of configuration areas for the rule. The most basic elements are set in the **Who**, **Access This Host**, and **Run Commands** areas; the others are optional and are used to refine the rule.

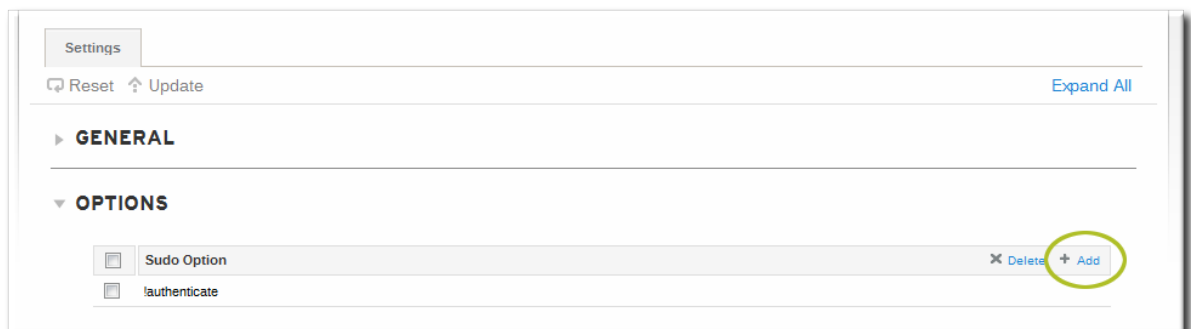
6. *Optional.* In the **Options** area, add any **sudoers** options. The complete list of options is in the **sudoers** manpage and at http://www.gratisoft.us/sudo/sudoers.man.html#sudoers_options.



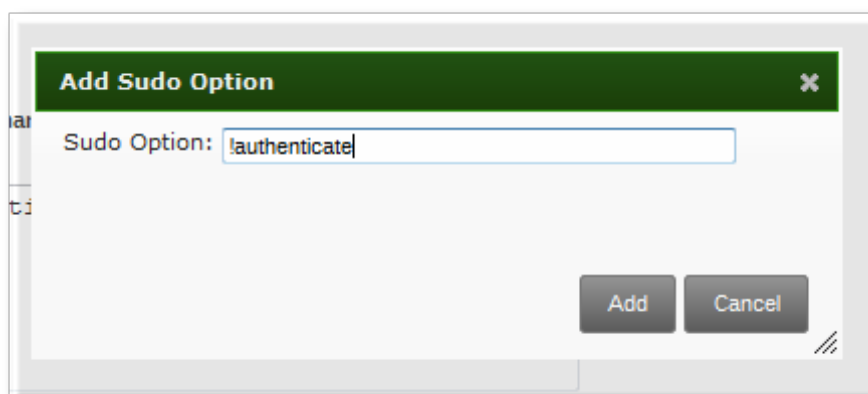
NOTE

As described in [Section 18.3.2, "About sudo Options Format"](#), do not use options with whitespace in the values. Rather than adding a list of options in one line, add a single option setting for each desired option.

- a. Click the **+ Add** link at the right of the options list.



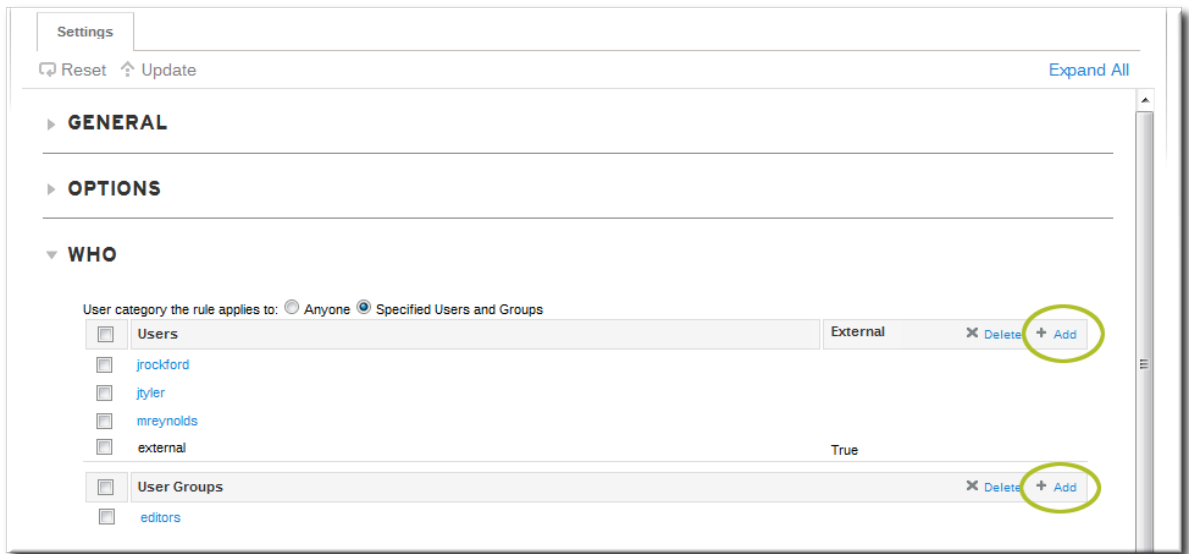
- b. Enter the **sudoers** option.



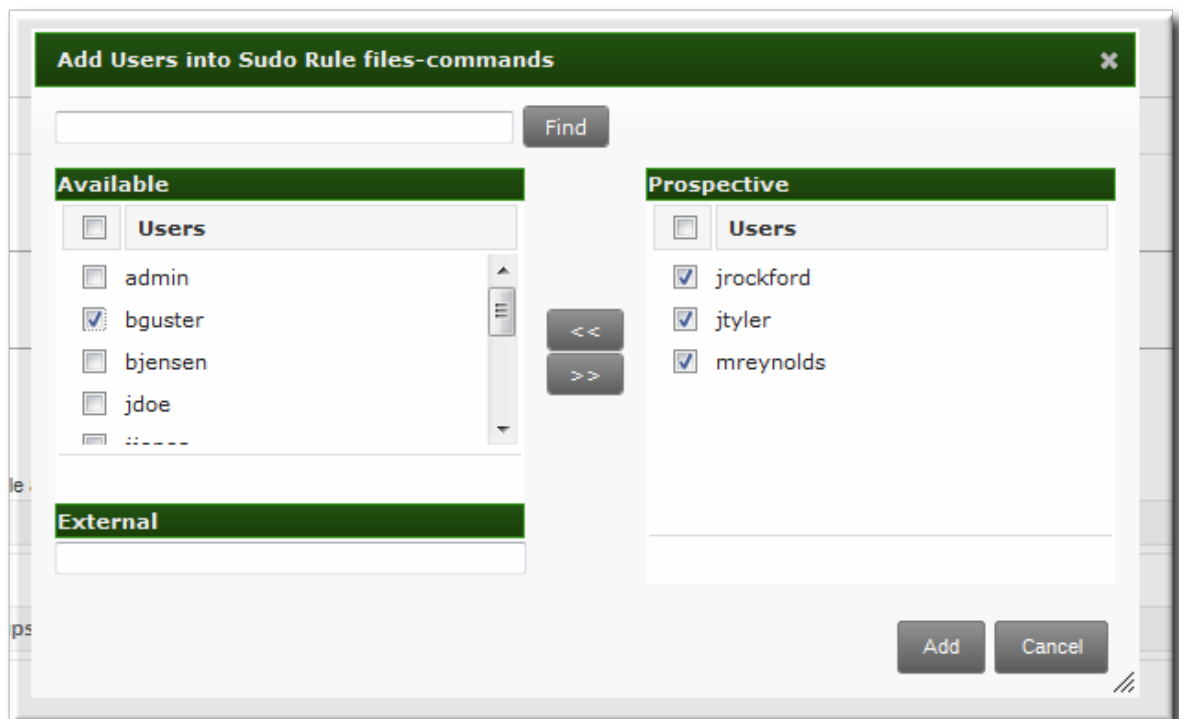
c. Click **Add**.

7. In the **who** area, select the users or user groups to which the sudo rule is applied.

a. Click the + **Add** link at the right of the users list.



b. Click the checkbox by the users to add to the rule, and click the right arrows button, >>, to move the users to the selection box.

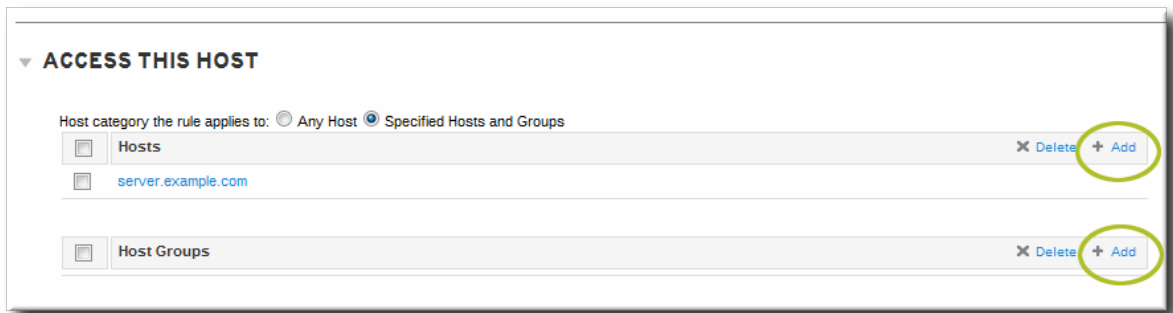


c. Click **Add**.

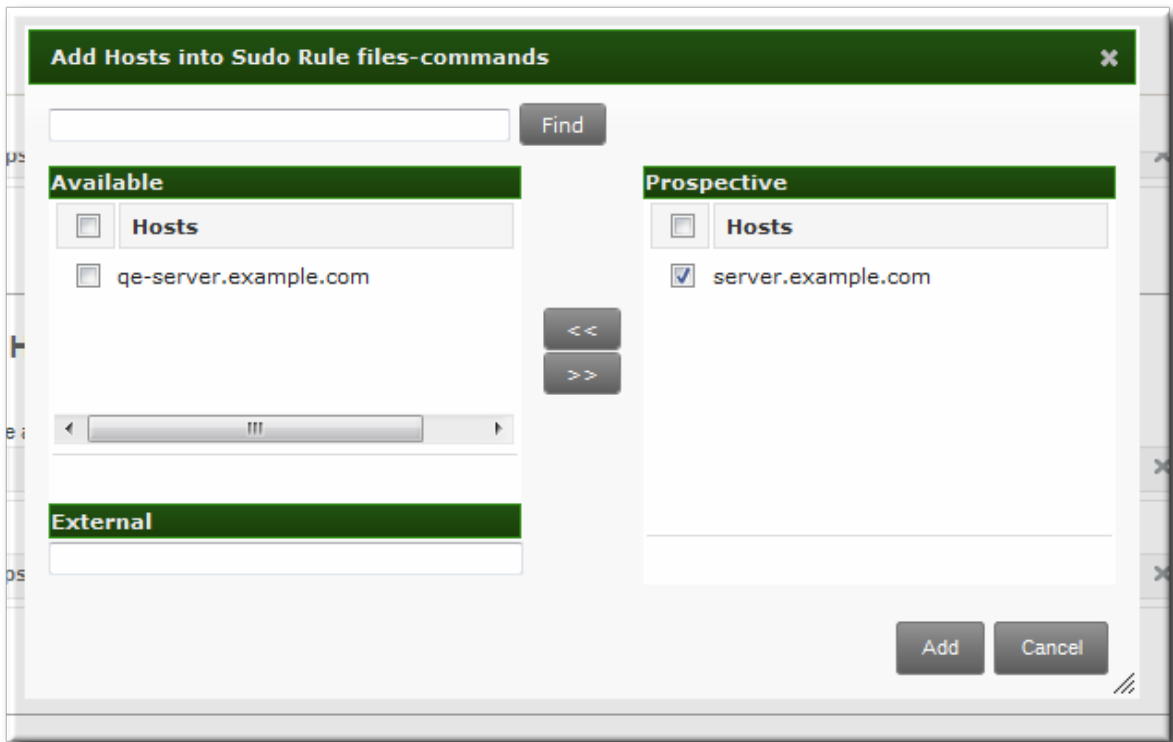
It is possible to configure both IdM users and external system users ([Section 18.3.1, “About External Users”](#)).

8. In the **Access This Host** area, select the hosts on which the sudo rule is in effect.

a. Click the + **Add** link at the right of the hosts list.



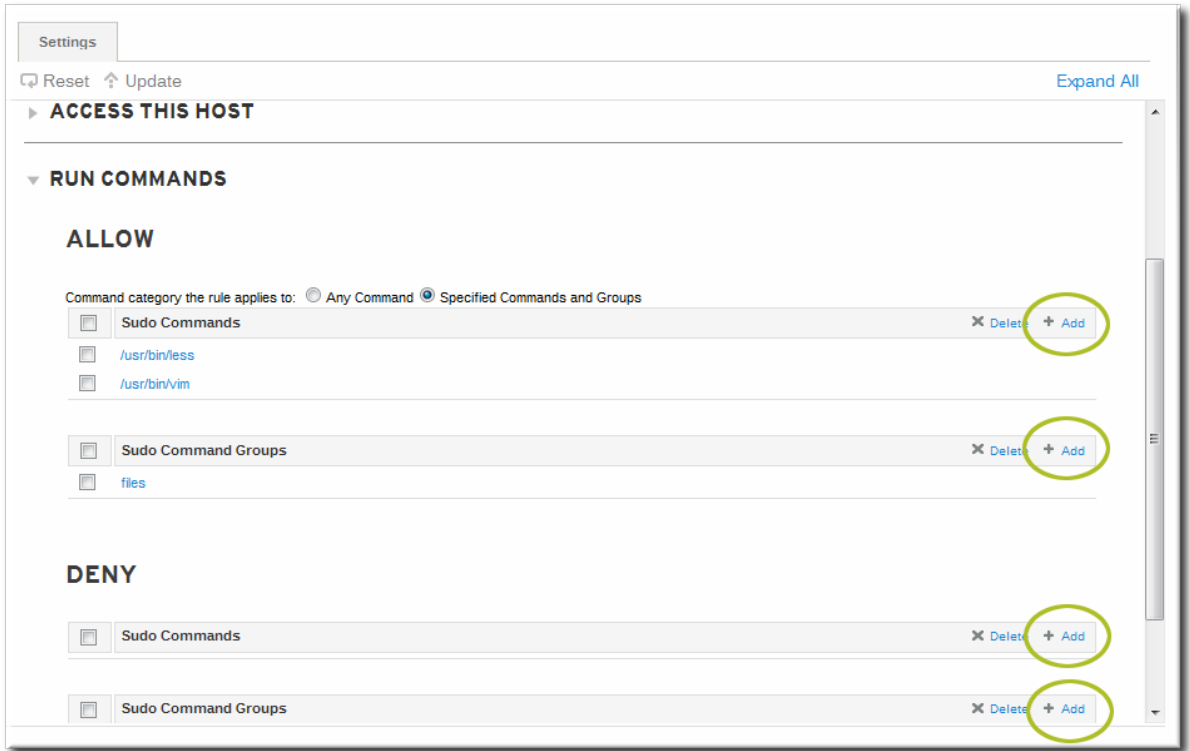
- b. Click the checkbox by the hosts to include with the rule, and click the right arrows button, >>, to move the hosts to the selection box.



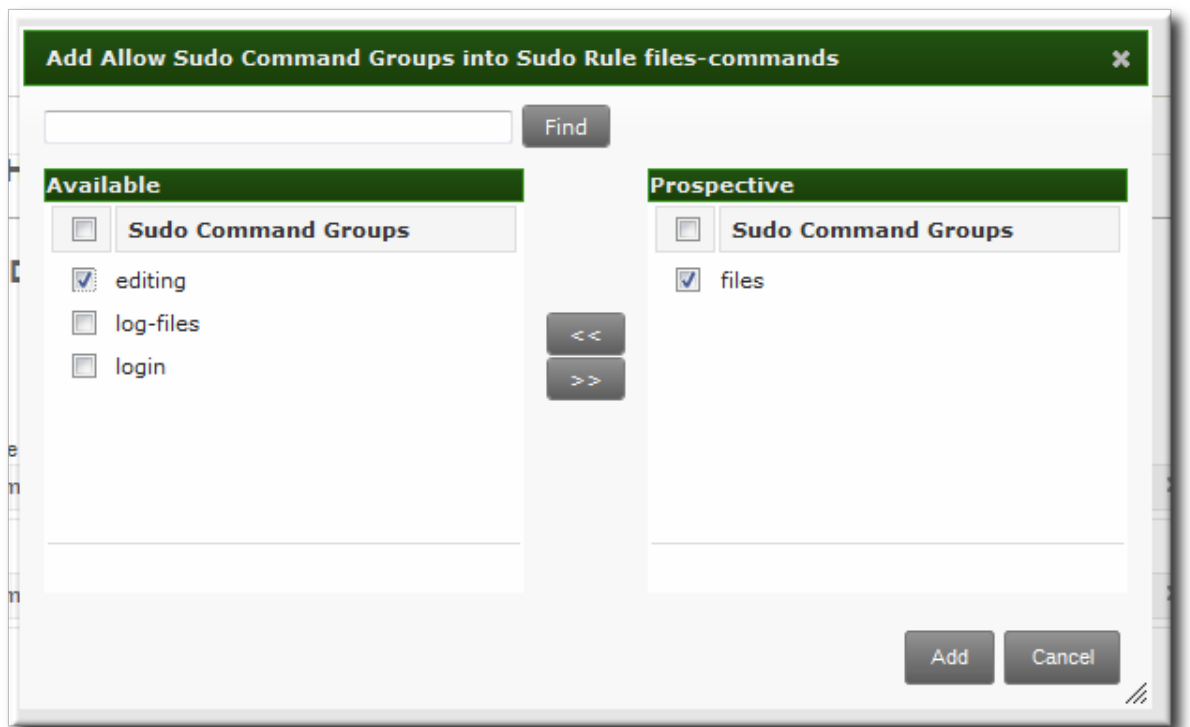
- c. Click **Add**.

9. In the **Run Commands** area, select the commands which are included in the sudo rule. The **sudo** rule can grant access or deny access to commands, and it can grant allow access to one command and also deny access to another.

- a. In the **Allow/Deny** area, click the + **Add** link at the right of the commands list.



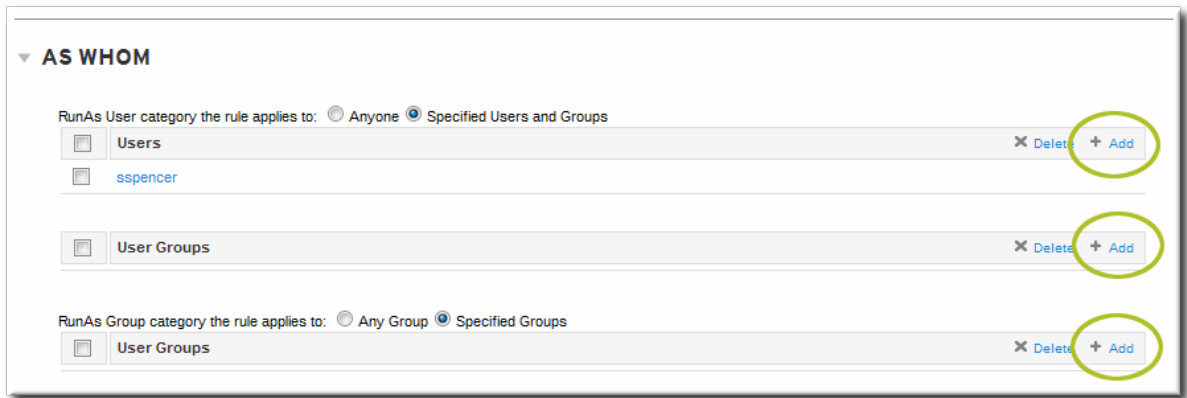
- b. Click the checkbox by the commands or command groups to include with the rule, and click the right arrows button, >>, to move the commands to the selection box.



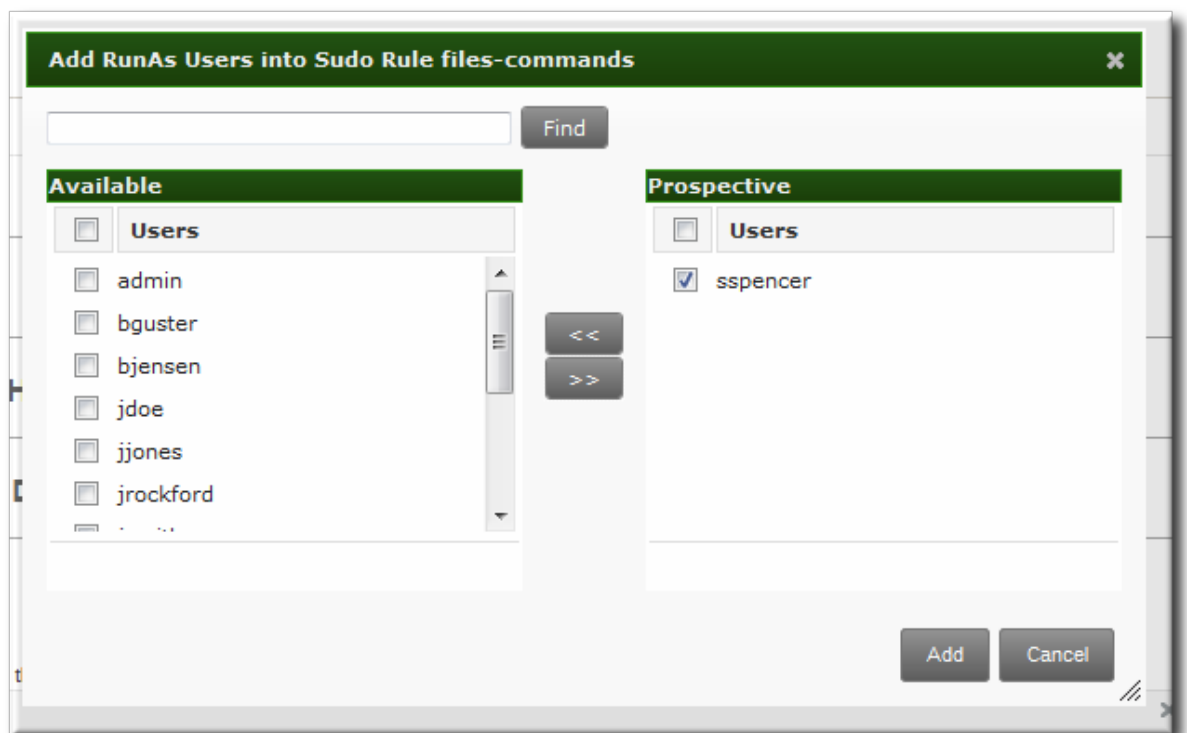
- c. Click **Add**.

10. *Optional.* The sudo rule can be configured to run the given commands as a specific, non-root user.

- a. In the **As whom** area, click the + **Add** link at the right of the users list.



- b. Click the checkbox by the users to run the command as, and click the right arrows button, >>, to move the users to the selection box.



- c. Click **Add**.

18.3.4. Defining sudo Rules in the Command Line

Each element is added to the rule command using a different command (listed in [Table 18.1, “sudo Commands”](#)).

The basic outline of a **sudo** rule command is:

```
$ ipa sudorule-add* options ruleName
```

Example 18.1. Creating Basic sudo Rules

In the most basic case, the **sudo** configuration is going to grant the right to one user for one command on one host.

The first step is to add the initial rule entry.

```
[jsmith@server ~]$ kinit admin
[jsmith@server ~]$ ipa sudorule-add files-commands
-----
Added sudo rule "files-commands"
-----
Rule name: files-commands
Enabled: TRUE
```

Next, add the commands to *grant* access to. This can be a single command, using **--sudocmd**, or a group of commands, using **--sudocmdgroups**.

```
[jsmith@server ~]$ ipa sudorule-add-allow-command --sudocmd "/usr/bin/vim"
files-commands
Rule name: files-commands
Enabled: TRUE
sudo Commands: /usr/bin/vim
-----
Number of members added 1
-----
```

Add a host or a host group to the rule.

```
[jsmith@server ~]$ ipa sudorule-add-host --host server.example.com files-commands
Rule name: files-commands
Enabled: TRUE
Hosts: server.example.com
sudo Commands: /usr/bin/vim
-----
Number of members added 1
-----
```

Last, add the user or group to the rule. This is the user who is allowed to use **sudo** as defined in the rule; if no "run-as" user is given, then this user will run the **sudo** commands as root.

```
[jsmith@server ~]$ ipa sudorule-add-user --user jsmith files-commands
Rule name: files-commands
Enabled: TRUE
Users: jsmith
Hosts: server.example.com
sudo Commands: /usr/bin/vim"
-----
Number of members added 1
-----
```


Example 18.2. Allowing and Denying Commands

The **sudo** rule can grant access or deny access to commands. For example, this rule would allow read access to files but prevent editing:

```
[jsmith@server ~]$ kinit admin
[jsmith@server ~]$ ipa sudorule-add-allow-command --sudocmd "/usr/bin/less"
readfiles
[jsmith@server ~]$ ipa sudorule-add-allow-command --sudocmd "/usr/bin/tail"
readfiles
[jsmith@server ~]$ ipa sudorule-add-deny-command --sudocmd "/usr/bin/vim"
readfiles
```

Example 18.3. Using sudoers Options

The **sudoers** file has a lot of potential flags that can be set to control the behavior of **sudo** users, like requiring (or not requiring) passwords to offer a user to authenticate to **sudo** or using fully-qualified domain names in the **sudoers** file. The complete list of options is in the **sudoers** manpage and at http://www.gratisoft.us/sudo/sudoers.man.html#sudoers_options.

Any of these options can be set for the IdM **sudo** rule using the **sudorule-add-option** command. When the command is run, it prompts for the option to add:

```
[jsmith@server ~]$ kinit admin
[jsmith@server ~]$ ipa sudorule-add-option readfiles
Sudo Option: !authenticate
-----
Added option "!authenticate" to Sudo rule "readfiles"
-----
```

NOTE

As described in [Section 18.3.2, "About sudo Options Format"](#), do not use options with whitespace in the values. Rather than adding a list of options in one line, add a single option setting for each desired option.

Example 18.4. Running as Other Users

The **sudo** rule also has the option of specifying a non-root user or group to run the commands as. The initial rule has the user or group specified using the **--sudorule-add-runasuser** or **--sudorule-add-runasgroup** command, respectively.

```
$ ipa sudorule-add-runasuser --users=jsmith readfiles
$ ipa sudorule-add-runasgroup --groups=ITadmins readfiles
```

When creating a rule, the **sudorule-add-runasuser** or **sudorule-add-runasgroup** command can only set *specific* users or groups. However, when editing a rule, it is possible to run **sudo** as all users or all groups by using the **--runasusercat** or **--runasgroupcat** option. For example:

```
$ ipa sudorule-mod --runasgroupcat=all ruleName
```

**NOTE**

The `--sudorule-add-runasuser` and `--sudorule-add-runasgroup` commands do not support an `all` option, only specific user or group names. Specifying all users or all groups can only be used with options with the `sudorule-mod` command.

Example 18.5. Referencing External Users

The "who" in a `sudo` rule can be an IdM user, but there are many logical and useful rules where one of the referents is a system user. Similarly, a rule may need to grant or deny access to a host machine on the network which is not an IdM client.

In those cases, the `sudo` policy can refer to an *external* user — an identity created and stored outside of IdM ([Section 18.3.1, "About External Users"](#)).

The options to add an external identity to a `sudo` rule are:

- ▶ `--externaluser`
- ▶ `--runasexternaluser`

For example:

```
$ ipa sudorule-add-user --externaluser=ITAdmin readfiles
$ ipa sudorule-add-runasuser --runasexternaluser=root readfiles
```

Table 18.1. sudo Commands

Command	Description
<code>sudorule-add</code>	Adds a sudo rule entry.
<code>sudorule-add-user</code>	Adds a user or a user group to the sudo rule. This user (or every member of the group) is then entitled to sudo any of the commands in the rule.
<code>sudorule-add-host</code>	Adds a target host for the rule. These are the hosts where the users are granted sudo permissions.
<code>sudorule-add-runasgroup</code>	Sets a group to run the sudo commands as. This must be a specific user; to specify all users, modify the rule using <code>sudo -rule</code> .
<code>sudorule-add-runasuser</code>	Sets a user to run the sudo commands as. This must be a specific user; to specify all users, modify the rule using <code>sudo -rule</code> .
<code>sudorule-add-allow-command</code>	Adds a command that users in the rule have sudo permission to run.
<code>sudorule-add-deny-command</code>	Adds a command that users in the rule are explicitly <i>denied</i> sudo permission to run.
<code>sudorule-add-option</code>	Adds a sudoers flag to the sudo rule.

18.3.5. Suspending and Removing sudo Rules

`sudo` rules that are defined through Identity Management must be deleted. Local rules can be enabled or

disabled so that they are temporarily suspended, but this is not possible in Identity Management because of how the rules are stored and applied.

The only way to suspend a **sudo** rule is to (permanently) delete it. For example:

```
$ ipa sudorule-remove files-commands
```



NOTE

It is not possible to enable or disable a **sudo** rule in Identity Management **even though there are enable/disable buttons in the IdM web UI**. These buttons do not work and no modifications to enable or disable a **sudo** rule are saved.

18.4. Configuring Hosts to Use IdM sudo Policies

Actually implementing **sudo** policies is more complicated than simply creating the rules in IdM. Those rules need to be applied to every local machine, which means that each system in the IdM domain has to be configured to refer to IdM (as an LDAP server) for its policies.

18.4.1. Applying the sudo Policies to Hosts Using LDAP

This example specifically configures a Red Hat Enterprise Linux 7 client for sudo rules. The NSLCD configuration is different, depending on the platform.

1. **Set up the host and sudo entries in IdM.**
 - a. *Optional.* Set up a host group, as described in [Section 10.7, “Managing Host Groups”](#).
 - b. *Optional.* Create a user group and add the users, as described in [Section 9.10.2.1, “Creating User Groups”](#).
 - c. Set up the sudo commands and command groups, as described in [Section 18.2, “Setting up sudo Commands and Command Groups”](#).
 - d. Set up the sudo rules, as described in [Section 18.3, “Defining sudo Rules”](#).
2. Set up a bind (authenticated) user by setting a password for the default IdM **sudo** user. The user must be able to authenticate to the server; anonymous access is not supported for **sudo** policies.

Using LDAP tools, set the password for the **sudo** user, **uid=sudo, cn=sysaccounts, cn=etc, dc=example, dc=com**. For example:

```
[jsmith@server ~]$ ldappasswd -Y GSSAPI -S -h ipaserver.example.com
uid=sudo, cn=sysaccounts, cn=etc, dc=example, dc=com
New password:
Re-enter new password:
Enter LDAP Password:
```

3. **Configure every system in the IdM domain to use SSSD for sudo rules.**
 - a. Configure **sudo** to look to LDAP for the **sudoeers** file.

```
vim /etc/nsswitch.conf

sudoers: files ldap
```

Leaving the **files** option in place allows **sudo** to check its local configuration before checking the LDAP-based IdM configuration.

- b. Enable debug logging for **sudo** operations in the `/etc/ldap.conf` file. If this file does not exist, it can be created.

```
vim /etc/ldap.conf

sudoers_debug: 1
```



TIP

Adding the **`sudoers_debug`** parameter helps with troubleshooting. Valid values for this parameter are 0, 1, and 2. The **sudo** documentation at http://www.gratisoft.us/sudo/readme_ldap.html has more information on debugging the process.

- c. Edit the NSS/LDAP configuration file and add the following **sudo**-related lines to the `/etc/sudo-ldap.conf` file:

```
binddn uid=sudo,cn=sysaccounts,cn=etc,dc=example,dc=com
bindpw sudo_password

ssl start_tls
tls_cacertfile /etc/ipa/ca.crt
tls_checkpeer yes

bind_timelimit 5
timelimit 15

uri ldap://ipaserver.example.com ldap://backup.example.com:3890
sudoers_base ou=SUDOers,dc=example,dc=com
```

Multiple LDAP servers can be configured in a space-separated list, and other options (like SSL and non-standard ports) can be used with the LDAP URL. The **sudo** LDAP configuration is covered in the **sudo** manpages, <http://www.sudo.ws/sudo/man/1.8.2/sudoers.ldap.man.html>.



IMPORTANT

The **`uri`** directive must give the fully-qualified domain name of the LDAP server, not an IP address. Otherwise, **sudo** fails to connect to the LDAP server.

- d. Optionally, enable debugging in SSSD to show what LDAP settings it is using.

```
[root@server ~]# vim /etc/sss/sss.conf

[domain/LDAPDOMAIN]
debug_level = 6
....
```

The LDAP search base used by SSSD for operations is recorded in the `sssd_DOMAINNAME.log` log.

- e. Set a name for the NIS domain in the `sudo` configuration. `sudo` uses NIS-style netgroups, so the NIS domain name must be set in the system configuration for `sudo` to be able to find the host groups used in the IdM `sudo` configuration.
 - a. Set the NIS domain name to use with the `sudo` rules.

```
[root@server ~]# nisdomainname example.com
```

- b. Configure the system authentication settings to persist the NIS domain name. For example:

```
[root@server ~]# echo "NISDOMAIN=example.com.com" >>
/etc/sysconfig/network
```

This updates the `/etc/sysconfig/network` and `/etc/yp.conf` files with the NIS domain.



IMPORTANT

Even though `sudo` uses NIS-style netgroups, **it is not necessary to have a NIS server installed**. Netgroups require that a NIS domain be named in their configuration, so `sudo` requires that a NIS domain be named for netgroups. However, that NIS domain does not actually need to exist.

18.4.2. Applying the Configured sudo Policies to Hosts Using SSSD

1. Set up the host and sudo entries in IdM.

- a. *Optional.* Set up a host group, as described in [Section 10.7, “Managing Host Groups”](#).
- b. *Optional.* Create a user group and add the users, as described in [Section 9.10.2.1, “Creating User Groups”](#).
- c. Set up the sudo commands and command groups, as described in [Section 18.2, “Setting up sudo Commands and Command Groups”](#).
- d. Set up the sudo rules, as described in [Section 18.3, “Defining sudo Rules”](#).

2. Configure every system in the IdM domain to use SSSD for sudo rules.

- a. Configure `sudo` to look to SSSD for the `sudors` file.

```
vim /etc/nsswitch.conf

sudoers: files sss
```

Leaving the `files` option in place allows `sudo` to check its local configuration before checking SSSD for the IdM configuration.

- b. Add `sudo` to the list of services managed by the local SSSD client.

```
[root@server ~]# vim /etc/sss/sss.conf
```

```
[sssd]
config_file_version = 2
services = nss, pam, sudo
domains = IPADOMAIN
```

- c. Optionally, enable debugging in SSSD to show what LDAP settings it is using.

```
[domain/IPADOMAIN]
debug_level = 6
....
```

The LDAP search base used by SSSD for operations is recorded in the `sssd_DOMAINNAME.log` log.

- d. Set a name for the NIS domain in the `sudo` configuration. `sudo` uses NIS-style netgroups, so the NIS domain name must be set in the system configuration for `sudo` to be able to find the host groups used in the IdM `sudo` configuration.

- a. Set the NIS domain name to use with the `sudo` rules.

```
[root@server ~]# nisdomainname example.com
```

- b. Configure the system authentication settings to persist the NIS domain name. For example:

```
[root@server ~]# echo "NISDOMAIN=example.com.com" >>
/etc/sysconfig/network
```

This updates the `/etc/sysconfig/network` and `/etc/yp.conf` files with the NIS domain.



IMPORTANT

Even though `sudo` uses NIS-style netgroups, **it is not necessary to have a NIS server installed**. Netgroups require that a NIS domain be named in their configuration, so `sudo` requires that a NIS domain be named for netgroups. However, that NIS domain does not actually need to exist.

Chapter 19. Configuring Host-Based Access Control

IdM can control access to both machines and the services on those machines within the IdM domain. The rules define who can access what within the domain, not the level of access (which are defined by system or application settings). These access control rules grant access, with all other users and hosts implicitly denied.

This is called *host-based access control* because the rule defines what hosts (*targets*) within the domain a user is allowed to access. This access can be further broken down to users and services on those hosts.



NOTE

Using host-based access control requires SSSD to be installed and configured on the IdM client machine.

19.1. About Host-Based Access Control

Host-based access control rules (which are described in [Chapter 19, Configuring Host-Based Access Control](#)) can be applied to individual hosts. However, using host groups allows centralized, and potentially simplified, access control management because an access control rule only needs to be defined once and then it is applied immediately and consistently to all the hosts within the group.

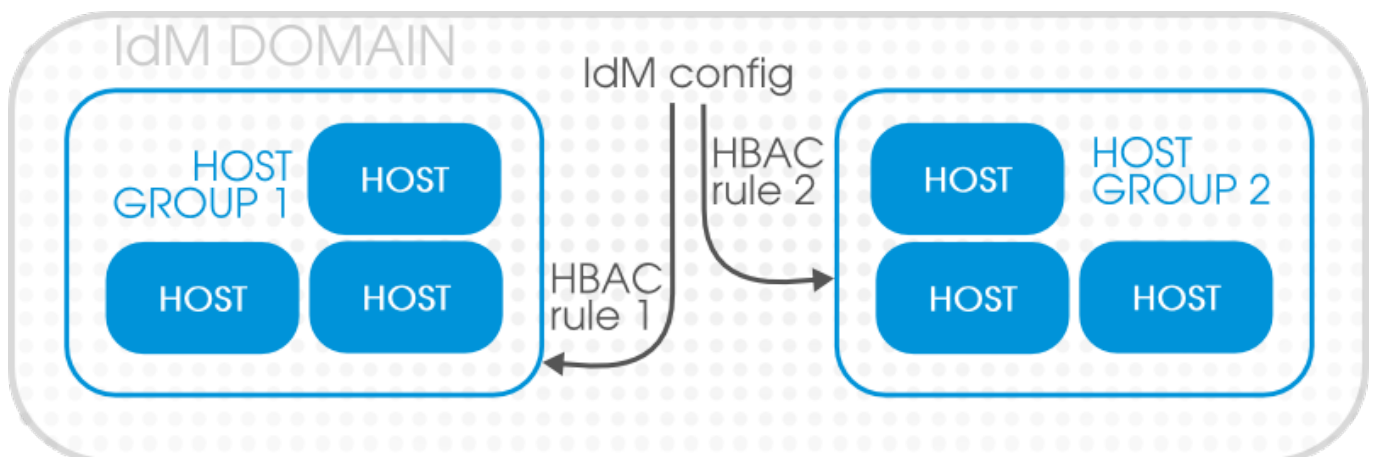


Figure 19.1. Host Groups and Host-Based Access Control



NOTE

While access must be explicitly granted to users and hosts within the IdM domain, IdM servers are configured by default with an **allow all** access control rule which allows access for every host within the domain to every host within the domain.

To create an IdM server without the default **allow all** rule, run `ipa-server-install` with the `--no_hbac_allow` option.

The *rule* first defines things that can be accessed, and there are two types of entities:

- *Hosts*, or target hosts, within the IdM domain.

- *Services* on the target hosts. Multiple services can be combined into *service groups*. The service group can be modified without having to edit the access control rule itself.

The rule also sets *who can have access* (the IdM domain user).



TIP

It is possible to use categories for users and target hosts instead of adding each one individually to the access control rule. The only supported category is **all**.

The entities in host-based access control rules follow the Kerberos principal entries: users, hosts (machines), and services. Users and target hosts can be added directly to host-based access control rules. However, services must be added to the host-based access control configuration first to make it available to rules, and then added to the access control rules.

19.2. Creating Host-Based Access Control Entries for Services and Service Groups

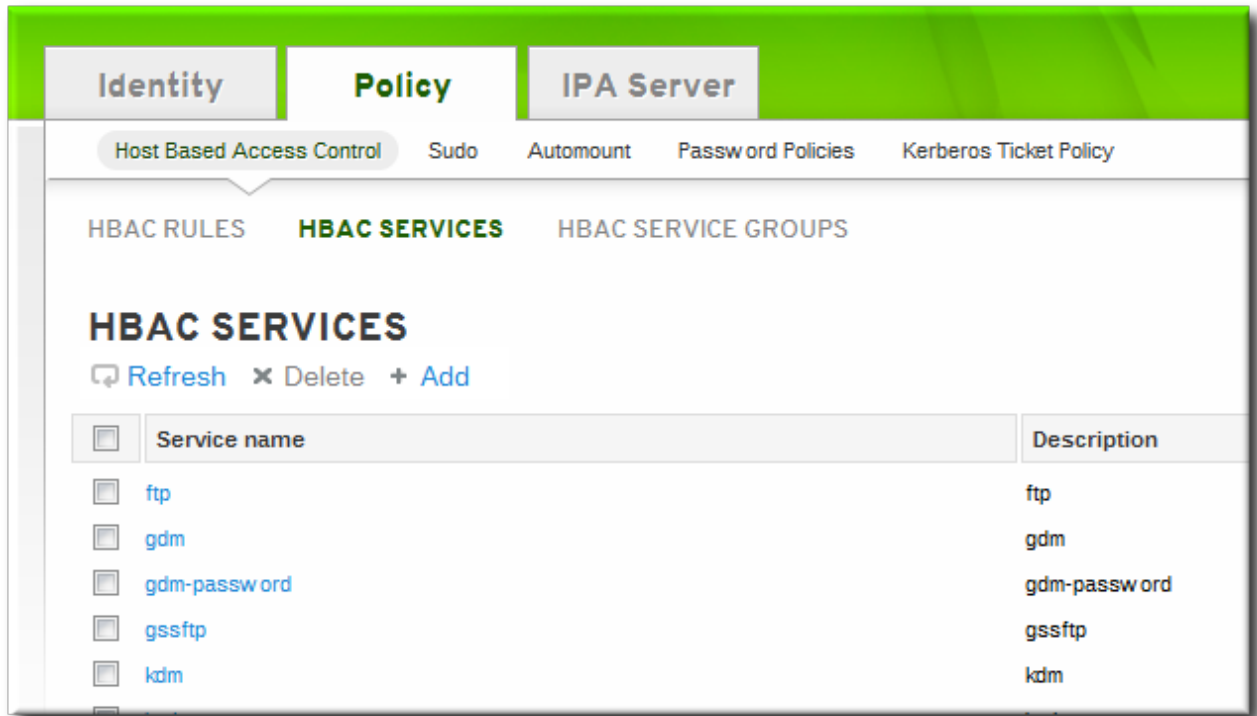
Any PAM service can be identified as to the host-based access control (HBAC) system in IdM. The service entries used in host-based access control are separate from adding a service to the IdM domain. Adding a service to the domain makes it a recognized resource which is available to other resources. Adding a domain resource to the host-based access control configuration allows administrators to exert defined control over what domain users and what domain clients can access that service.

Some common services are already configured as HBAC services, so they can be used in host-based access control rules. Additional services can be added, and services can be added into service groups for simpler management.

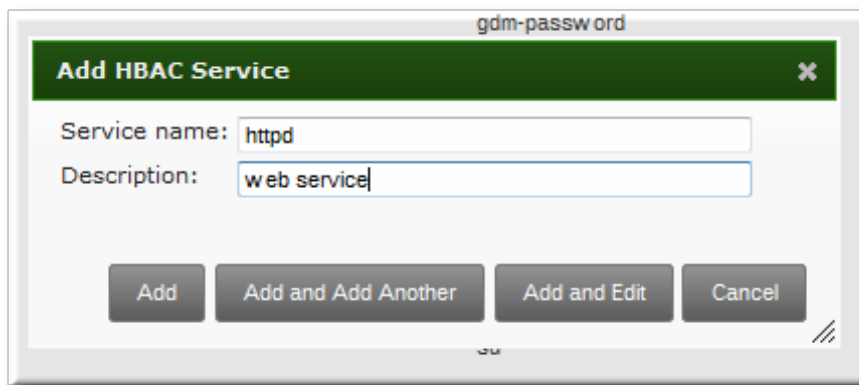
19.2.1. Adding HBAC Services

19.2.1.1. Adding HBAC Services in the Web UI

1. Click the **Policy** tab.
2. Click the **Host-Based Access Control** subtab, and then select the **HBAC Services** link.
3. Click the **Add** link at the top of the list of services.



4. Enter the service name and a description.



5. Click the **Add** button to save the new service.
6. If a service group already exists, then add the service to the desired group, as described in [Section 19.2.2.1, “Adding Service Groups in the Web UI”](#).

19.2.1.2. Adding Services in the Command Line

The service is added to the access control system using the **hbacsvc-add** command, specifying the service by the name that PAM uses to evaluate the service.

For example, this adds the **tftp** service:

```
# ipa hbacsvc-add --desc="TFTP service" tftp
-----
Added HBAC service "tftp"
-----
Service name: tftp
Description: TFTP service
```

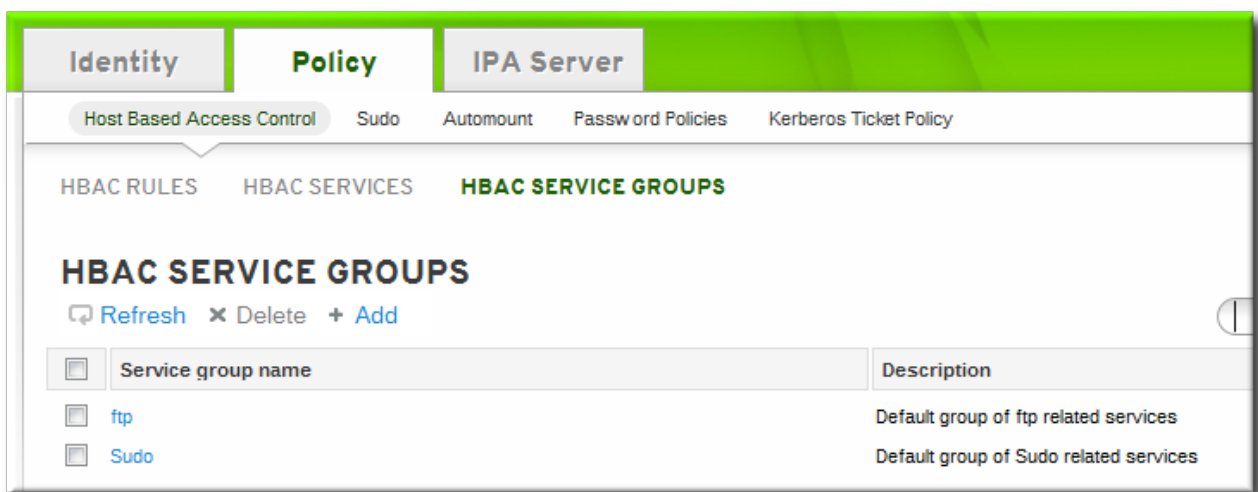
If a service group already exists, then the service can be added to the group using the **hbacsvcgroup-add-member** command, as in [Section 19.2.2.2, “Adding Service Groups in the Command Line”](#).

19.2.2. Adding Service Groups

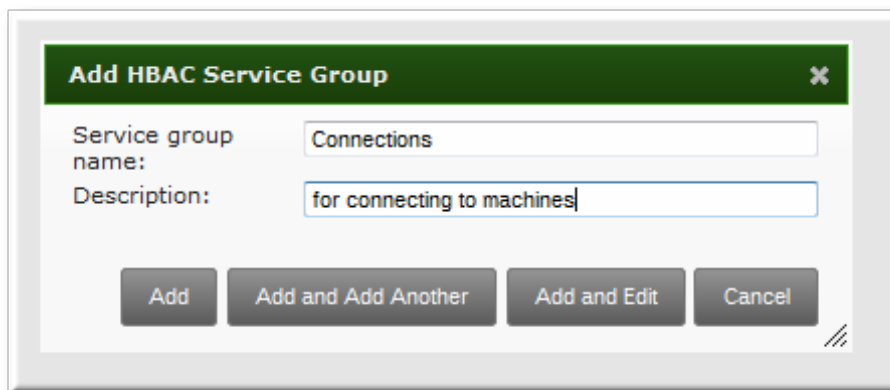
Once the individual service is added, it can be added to the access control rule. However, if there is a large number of services, then it can require frequent updates to the access control rules as services change. Identity Management also allows groups of services to be added to access control rules. This makes it much easier to manage access control, because the members of the service group can be changed without having to edit the rule itself.

19.2.2.1. Adding Service Groups in the Web UI

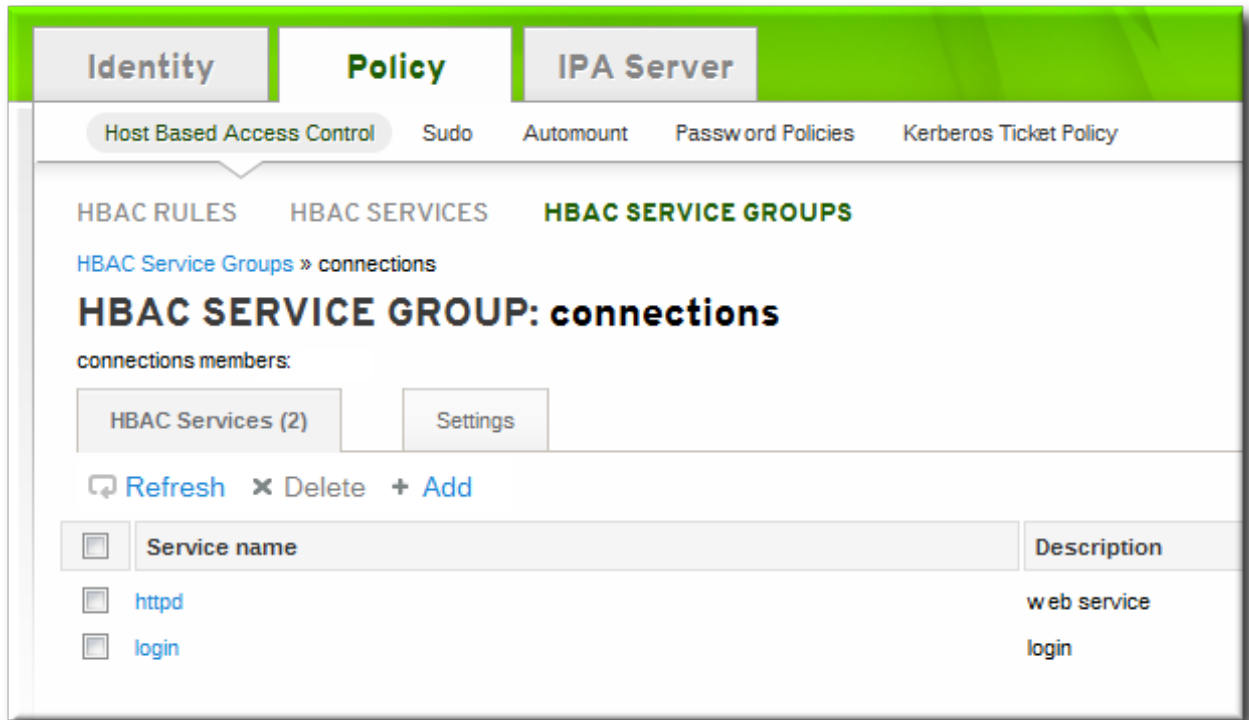
1. Click the **Policy** tab.
2. Click the **Host-Based Access Control** subtab, and then select the **HBAC Service Groups** link.
3. Click the **Add** link at the top of the list of service groups.



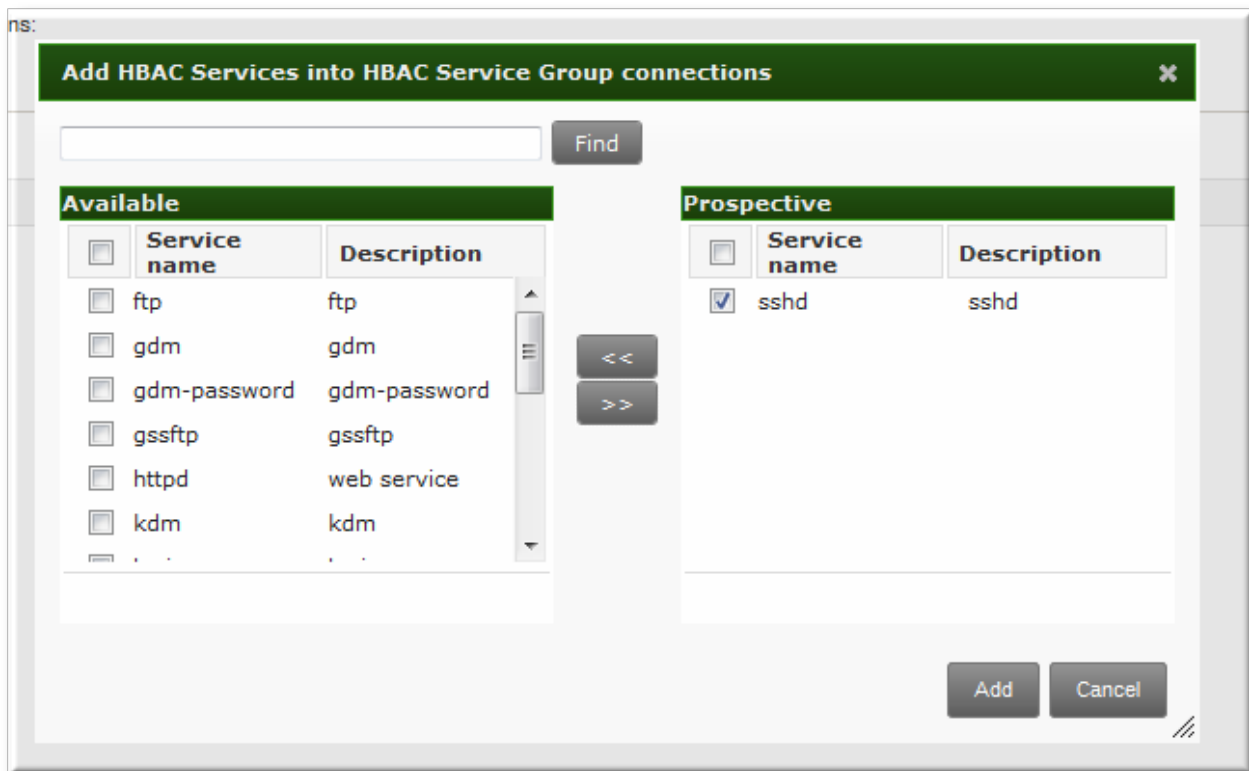
4. Enter the service group name and a description.



5. Click the **Add and Edit** button to go immediately to the service group configuration page.
6. At the top of the **HBAC Services** tab, click the **Add** link.



- Click the checkbox by the names of the services to add, and click the right arrows button, >>, to move the command to the selection box.



- Click the **Add** button to save the group membership.

19.2.2.2. Adding Service Groups in the Command Line

First create the service group entry, then create the service, and then add that service to the service group as a member. For example:

```
[jsmith@server ~]$ kinit admin
[jsmith@server ~]$ ipa hbacsvgroup-add --desc="login services" login
-----
Added HBAC service group "login"
-----
Service group name: login
Description: login services

[jsmith@server ~]$ ipa hbacsvc-add --desc="SSHD service" sshd
-----
Added HBAC service "sshd"
-----
Service name: sshd
Description: SSHD service

[jsmith@server ~]$ ipa hbacsvgroup-add-member --hbacsvcs=sshd login
Service group name: login
Description: login services
-----
Number of members added 1
-----
```



NOTE

IdM defines two default service groups: **SUDO** for sudo services and **FTP** for services which provide FTP access.

19.3. Defining Host-Based Access Control Rules

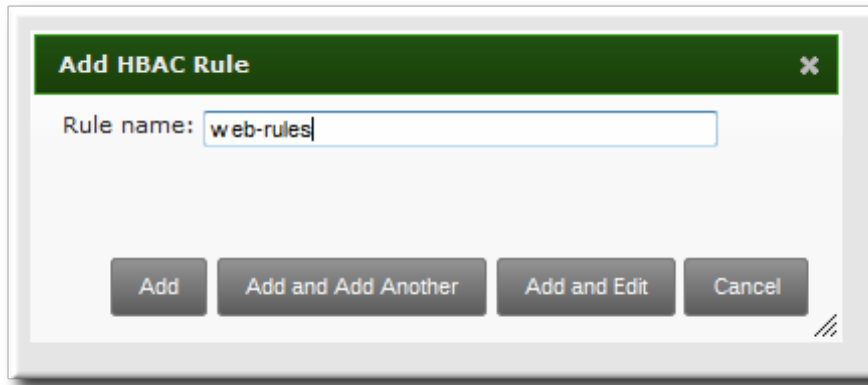
Access controls, at a high level, define *who* has access to *what*. The *who* is an IdM user, and the *what* can be either a host (target host), service, or service group, or a combination of the three.

19.3.1. Setting Host-Based Access Control Rules in the Web UI

1. Click the **Policy** tab.
2. Click the **Host-Based Access Control** subtab, and then select the **HBAC Rules** link.
3. Click the **Add** link at the top of the list of host-based access control rules.

Rule name	Status	Description
allow_all	✓ Enabled	Allow all users to access any host from any host
rule01	✓ Enabled	Test HBAC Rule 01
rule02	✓ Enabled	Test HBAC Rule 02

4. Enter the name for the rule.



5. Click the **Add and Edit** button to go immediately to set the configuration for the rule.

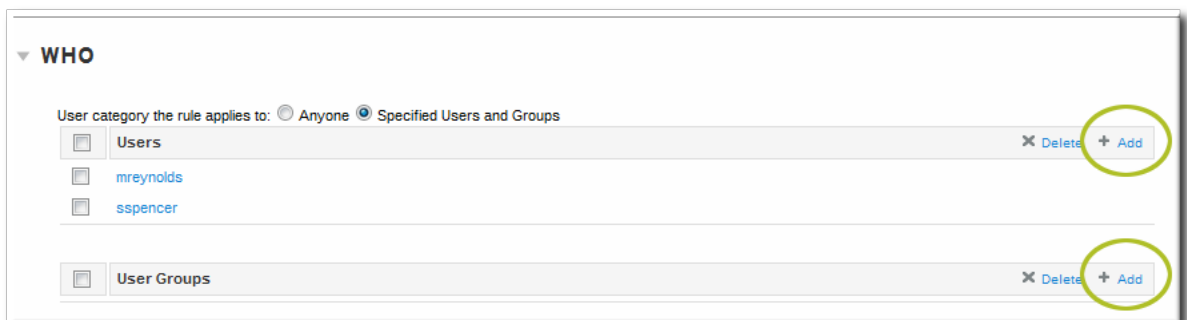
There are a number of configuration areas for the rule. The four basic elements are *who* the rule applies to, what hosts allow access (the target), and, optionally, what services can be accessed.

6. In the **who** area, select the users or user groups to which the access control rule is applied.

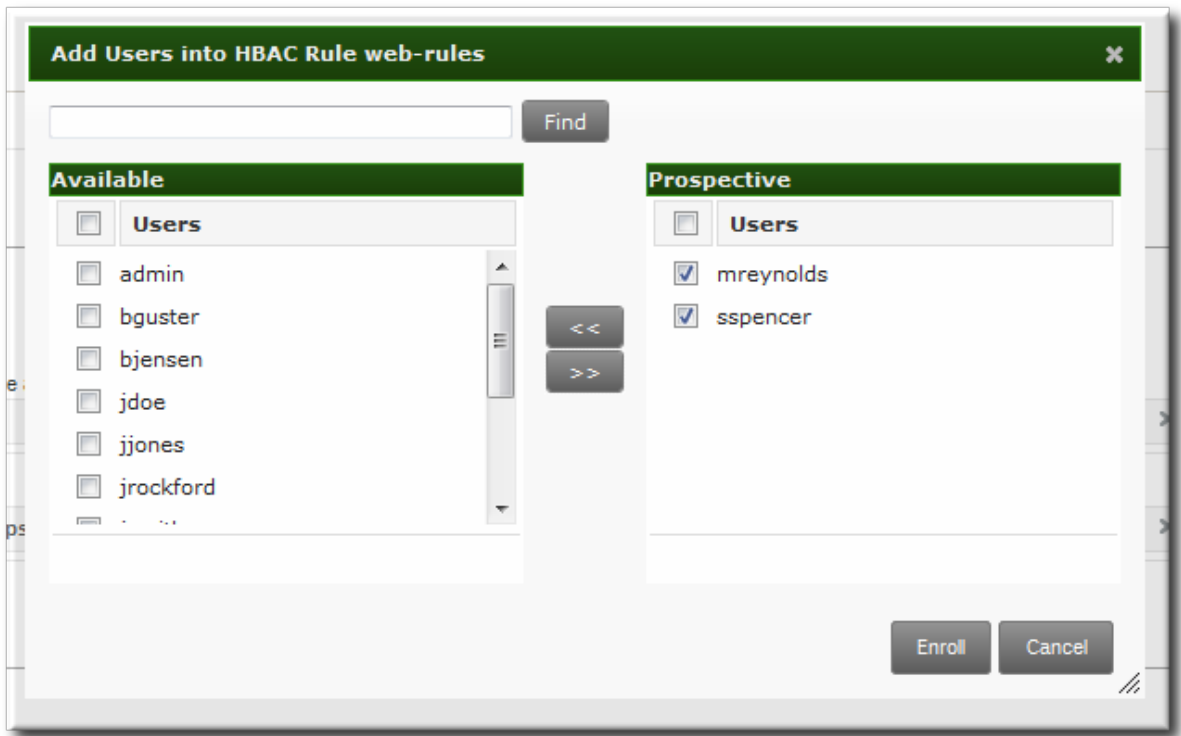
To apply the rule to all IdM users, select the **Anyone** radio button.

To apply the rule to a specific set of users or user groups:

- a. Select the **Specified Users and Groups** radio button.
- b. Click the **+ Add** link at the right of the users list.



- c. Click the checkbox by the users to add to the rule, and click the right arrows button, **>>**, to move the users to the selection box.



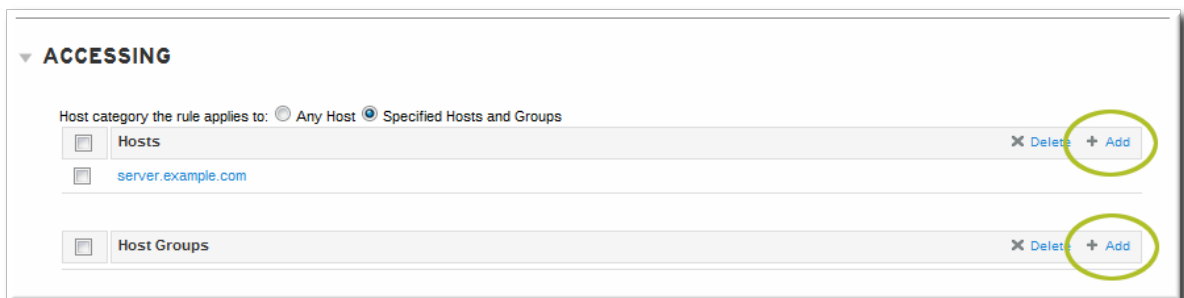
d. Click **Add**.

7. In the **Accessing** area, select the target hosts which can be accessed through this access control rule.

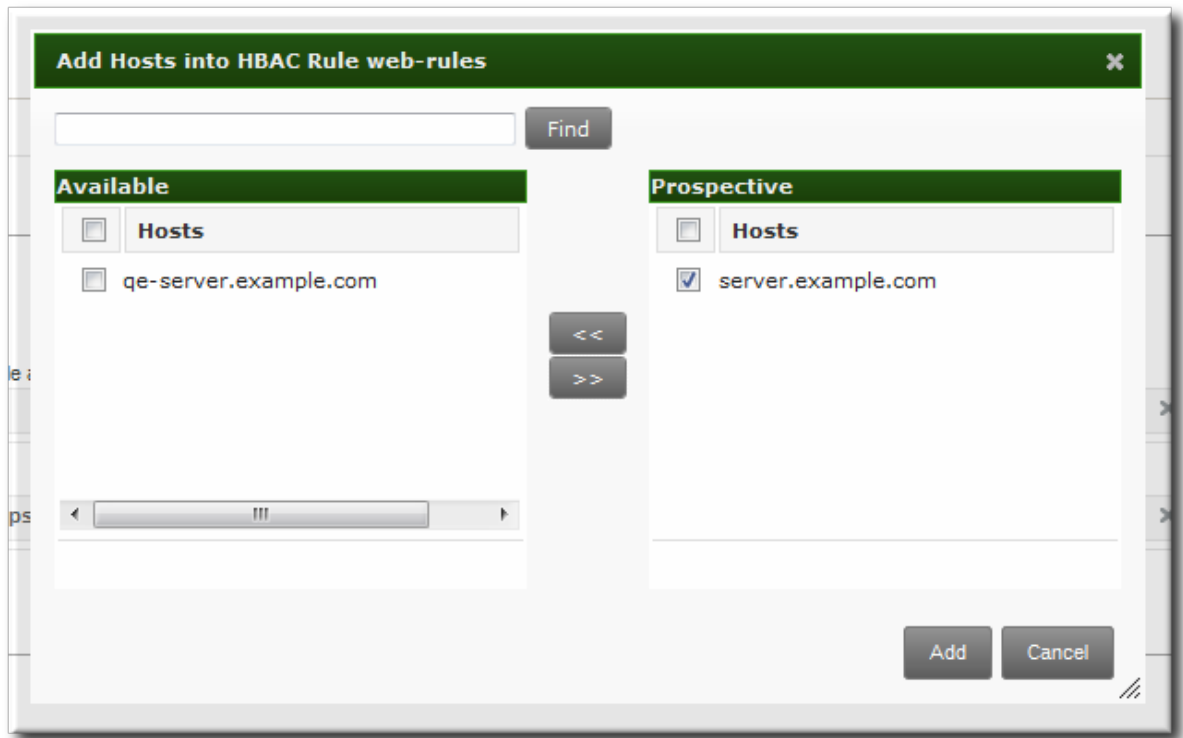
To apply the rule to all IdM hosts, select the **Any Host** radio button.

To apply the rule to a specific set of hosts or host groups:

- a. Select the **Specified Hosts and Groups** radio button.
- b. Click the **+ Add** link at the right of the hosts list.



- c. Click the checkbox by the hosts to include with the rule, and click the right arrows button, **>>**, to move the hosts to the selection box.



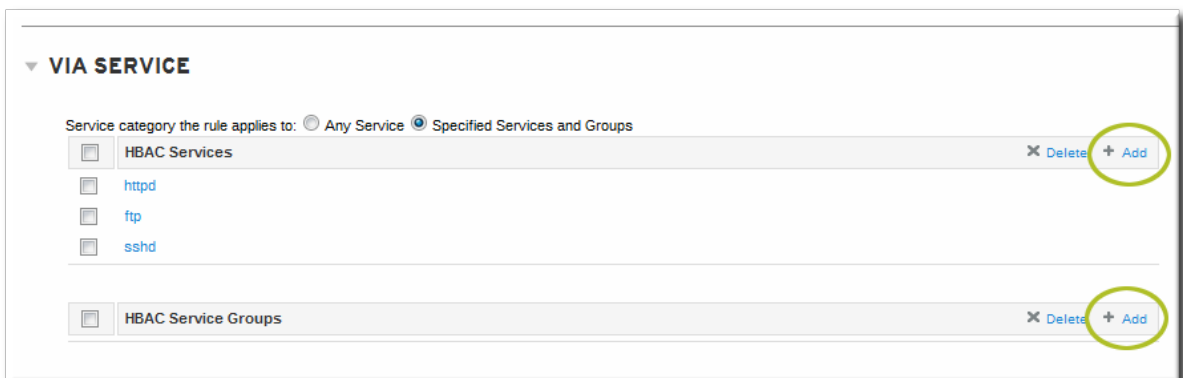
d. Click **Add**.

8. In the **Via Service** area, select specific services on the target hosts which the users are allowed to use to access target machines.

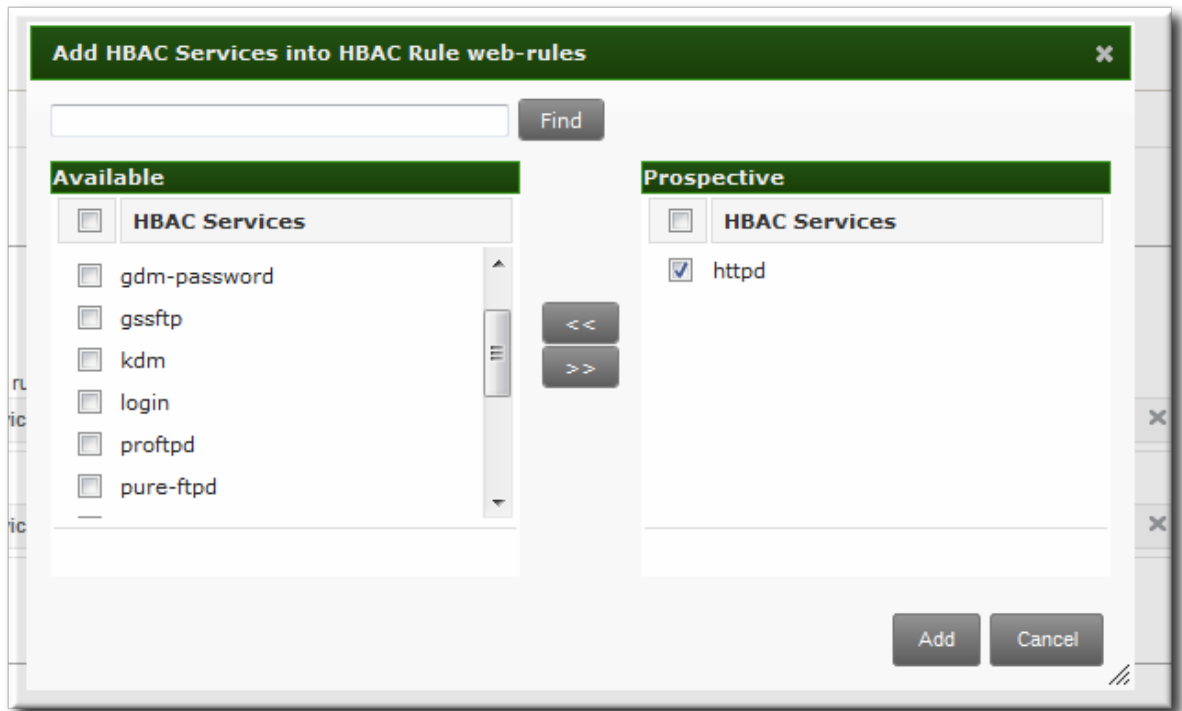
To apply the rule to all IdM hosts, select the **Any Service** radio button.

To apply the rule to a specific set of hosts or host groups:

- a. Select the **Specified Services and Groups** radio button.
- b. Click the **+ Add** link at the right of the commands list.



- c. Click the checkbox by the services or groups to include with the rule, and click the right arrows button, **>>**, to move the services to the selection box.



d. Click **Add**.

19.3.2. Setting Host-Based Access Control Rules in the Command Line

Access control rules are created using the **hbacrule-*** commands (listed in [Table 19.1, “Host-Based Access Control Command and Options”](#)). The first step is to create a container entry; from there, users, hosts, and services can be added to the access control entry.

The basic outline of all the access control commands is:

```
$ ipa hbacrule-add* options ruleName
```



TIP

To set every user or every host as a target, use the category options, such as **--usercat=all**.

Example 19.1. Granting All Access to One Host

One simple rule is to grant every user access to a single server. The first command creates the entry and uses the category options to apply every user.

```
$ ipa hbacrule-add --usercat=all allGroup
-----
Added HBAC rule "allGroup"
-----
Rule name: allGroup
User category: all
Enabled: TRUE
```

The second rule adds the target host, using the **hbacrule-add-host** command:

```
$ ipa hbacrule-add-host --hosts=server.example.com allGroup
Rule name: allGroup
User category: all
Enabled: TRUE
Successful hosts/hostgroups:
  member host: server.example.com
-----
Number of members added 1
-----
```

Example 19.2. Adding Control for a Single User to a Service

Another access control method is to specify which services users are allowed to use to access the target hosts.

First, for the user to have access to every machine, every host must be added as both a host and target. This can be done using the category options:

```
$ ipa hbacrule-add --hostcat=all sshd-jsmith
```

Since the access control rule applies to a specific user, the user is added to the rule using the **hbacrule-add-user** command:

```
$ ipa hbacrule-add-user --users=jsmith sshd-jsmith
```

Then, the service is added to the access control rule. (The service should have already been added to the access control system using the **hbacsvc-add** command.) This is the service that the user can use to connect to the machine.

```
$ ipa hbacrule-add-service --hbacsvcs=sshd sshd-jsmith
```

Example 19.3. Adding a Service Group to the Rule

While a single service can be added to a rule, it is also possible to add an entire service group. Like a single service, this uses the **hbacrule-add-service** command, only with the **--hbacsvcgroups** option that specifies the group name.

```
$ ipa hbacrule-add-service --hbacsvcgroups=login loginRule
```

Table 19.1. Host-Based Access Control Command and Options

Command	Description	Arguments	Source or Target Entry
hbacrule-add	Adds a new host-based access control rule.	<ul style="list-style-type: none"> ▶ --usercat=all, which applies the rule to every user ▶ --hostcat=all, which sets every host as an allowed target server ▶ --servicecat=all, which sets every configured service as an allowed target service ▶ <i>ruleName</i>, which is the required unique identifier for the new rule 	
hbacrule-add-host	Adds a target host to the access control rule. A target host can be accessed <i>by</i> other servers and users in the domain.	<ul style="list-style-type: none"> ▶ --hosts, which adds an individual server or command-separated list of servers as an allowed target server ▶ --hostgroups, which adds a host group to the rule and every host within the host group is an allowed target server ▶ <i>ruleName</i>, which is the rule to which to add the target server 	Target

Command	Description	Arguments	Source or Target Entry
hbacrule-add-service	Adds a service type to the rule.	<ul style="list-style-type: none"> <li data-bbox="826 230 1114 439">▶ <code>--hbacsvcs</code>, which adds an individual service type or a list of service types as an allowed target service <p data-bbox="850 477 1114 864">Lists of entries can be set by using the option multiple times with the same command invocation or by listing the options in a comma-separated list inside curly braces, such as <code>--option={val1,val2,val3}</code>.</p> <li data-bbox="826 902 1114 1178">▶ <code>--hbacsvcgroups</code>, which adds a service group to the rule and every service within the service group is an allowed target service <p data-bbox="850 1216 1114 1603">Lists of entries can be set by using the option multiple times with the same command or by listing the options in a comma-separated list inside curly braces, such as <code>--option={val1,val2,val3}</code>.</p> <li data-bbox="826 1641 1114 1776">▶ <code>ruleName</code>, which is the rule to which to add the target service 	Target

Command	Description	Arguments	Source or Target Entry
hbacrule-add-user	Adds a user to the access control rule. The user is then able to access any allowed target host or service within the domain.	<ul style="list-style-type: none"> ▶ <code>--users</code>, which adds an individual user or command-separated list of users to the rule ▶ <code>--groups</code>, which adds a user group to the rule and, thus, every user within the group ▶ <code>ruleName</code>, which is the rule to which to add the user 	Source
hbacrule-disable hbacrule-enable	Disables or enables a host-based access control rule. Rules can be disabled if their behavior needs to be evaluated (for troubleshooting or to test a new rule).	<code>ruleName</code> , which is the rule to disable or enable	

19.4. Testing Host-Based Access Control Rules

Implementing host-based access controls effectively can be tricky because it requires that all of the hosts be properly configured and the access is properly applied to users and services.

The **hbactest** command can test different host-based access control scenarios to make sure that the rules are working as expected.



NOTE

The **hbactest** command does not work with trusted Active Directory users. Active Directory user/group associations are determined dynamically, as a user logs in, and those data are not stored in the IdM LDAP directory. The **hbactest** command, then, is unable to resolve the group memberships to check how access control rules will be applied.

19.4.1. The Limits of Host-Based Access Control Configuration

The access control configuration should always be tested before it is implemented to prevent authorization failures.

Host-based access control rules depend on a lot of interactions — between hosts, services, DNS lookups, and users. If any element is misconfigured, then the rule can behave in unexpected ways.

Identity Management includes a testing tool to verify that access control rules are behaving in the expected way by testing the access in a defined scenario. There are several situations where this testing is useful:

- ▶ A new rule needs to be tested before it is implemented.
- ▶ There are problems with the existing rules, and the testing tool can identify what rule is behaving badly.
- ▶ A subset of existing rules can be tested to see how they are performing.

19.4.2. Test Scenarios for Host-Based Access Control (CLI-Based)



NOTE

The **hbactest** command does not work with trusted Active Directory users. Active Directory user/group associations are determined dynamically, as a user logs in, and those data are not stored in the IdM LDAP directory. The **hbactest** command, then, is unable to resolve the group memberships to check how access control rules will be applied.

The **hbactest** command tests configured host-based access control rules in very specific situations. A test run defines:

- ▶ The user to run the operation as to test the rule performance for that user (**--user**).
- ▶ Using the login client Y (**--service**).
- ▶ To target host Z (**--host**).
- ▶ The rule to test (**--rules**); if this is not used, then all enabled rules are tested.
- ▶ *Optional* The **hbactest** returns detailed information about which rules were matched, not matched, or invalid. This detailed rule output can be disabled using **--nodetail**, so the test simply runs and returns whether access was granted.



NOTE

The **hbactest** script does not actually connect to the target host. Instead, it uses the rules within the IdM database to simulate how those rules would be applied in a specific situation as if an SSSD client were connecting to the IdM server.

More briefly, it performs a simulated test run based on the given information and configuration, but it does not actually attempt a service request against the target host.

Example 19.4. Testing All Active Rules

The most basic command checks all active rules. It requires a specific connection scenario, so the user, login service and target host have to be given, and the testing tool checks the connection.

```
[jsmith@server ~]$ kinit admin
[jsmith@server ~]$ ipa hbactest --user=jsmith --host=target.example.com --
service=ssh
-----
Access granted: True
-----
Matched rules: allow_all
Matched rules: sshd-jsmith
Matched rules: web-rules
Not matched rules: allGroup
```

Example 19.5. Testing a Specific Rule

It is possible to check a specific rule (or several rules).

```
[jsmith@server ~]$ kinit admin
[jsmith@server ~]$ ipa hbactest --user=jsmith --host=target.example.com --
service=ssh --rules=myrule
-----
Access granted: True
-----
notmatched: myrule
```

Example 19.6. Testing Specific Rules Plus All Enabled

The **--rules** option lists specific rules to test, but it may be useful to test the specified rules against all of the enabled rules in the domain. This can be done by adding the **--enabled** option, which includes the (unspecified) enabled rules along with the specified rules.

```
[jsmith@server ~]$ kinit admin
[jsmith@server ~]$ ipa hbactest --user=jsmith --host=target.example.com --
service=ssh --rules=myrule --enabled
-----
Access granted: True
-----
matched: my-second-rule
notmatched: my-third-rule
matched: myrule
matched: allow_all
```

It is possible to run a similar comparison against *disabled* rules by using the **--disabled** option. With the **--rules** option, the specified rule plus all of the disabled rules are checked. With the **--disabled** option, all disabled rules are checked.

19.4.3. Testing Host-Based Access Control Rules in the UI

As [Section 19.4.1, “The Limits of Host-Based Access Control Configuration”](#) details, misconfiguring a host-based access-control rule can result in unpredictable behavior when users or services attempt to connect to a remote host.

Testing host-based access control can help confirm that the rule performs as expected before it is deployed or to troubleshoot a rule once it is already active.



NOTE

The **hbactest** command does not work with trusted Active Directory users. Active Directory user/group associations are determined dynamically, as a user logs in, and those data are not stored in the IdM LDAP directory. The **hbactest** command, then, is unable to resolve the group memberships to check how access control rules will be applied.

By the nature of host-based access control rules, a test must define and verify a very specific set of criteria. A test run defines:

- ▶ The user to run the operation as to test the rule performance for that user (**Who**).
- ▶ To target host Z (**Accessing**).
- ▶ Using the login client Y (**Via Service**).
- ▶ The rule to test; if this is not used, then all enabled rules are tested (**Rules**).

The test environment is defined on the **HBAC TEST** page in the **Host Based Access Control** tab under **Policy**. A series of tabs is set up for each configuration step.

Figure 19.2. The From Tab to Set up an HBAC Test

Once the environment is defined, then the test is run simply by clicking a button on the **Run Test** page. The results show clearly whether access was granted or denied to the users, and then runs through the rules which matched the given parameters.

Identity | **Policy** | **IPA Server**

Host Based Access Control | Sudo | Automount | Password Policies | Kerberos Ticket Policy | SELinux User Maps | Automember

HBAC RULES | HBAC SERVICES | HBAC SERVICE GROUPS | **HBAC TEST**

RUN TEST

Who | Accessing | Via Service | From | Rules | Run Test

Run Test | **ACCESS GRANTED**

RULES

Matched Unmatched

Rule name	Matched	Status	Description
allow_all	True	✓ Enabled	Allow all users to access any host from any host
rule01	True	✓ Enabled	Test HBAC Rule 01
rule02	True	✓ Enabled	Test HBAC Rule 02
rule03	True	✓ Enabled	Test HBAC Rule 03
rule04	True	— Disabled	Test HBAC Rule 04
rule05	True	✓ Enabled	Test HBAC Rule 05
rule06	True	✓ Enabled	
rule07	True	✓ Enabled	
rule08	True	✓ Enabled	
rule09	True	✓ Enabled	
rule10	True	✓ Enabled	
rule11	True	✓ Enabled	
rule12	True	✓ Enabled	
rule13	True	✓ Enabled	
rule14	True	✓ Enabled	
rule15	True	✓ Enabled	

Showing 1 to 20 of 21 entries.

Prev Next Page: / 2

← Prev | **New Test**

Figure 19.3. HBAC Test Results

NOTE

To change some of the parameters and check for other results, click the **New Test** button at the bottom of the test results page. If that button is not selected, the form is not reset, so a new test will not run, even if test settings are changed.

Chapter 20. Defining SELinux User Maps

Security-enhanced Linux (SELinux) sets rules over what system users can access processes, files, directories, and system settings. Both the system administrator and system applications can define *security contexts* that restrict or allow user access and even access from other applications.

As part of defining centralized security policies in the Identity Management domain, Identity Management provides a way to map IdM users to (existing) SELinux user contexts and grant or restrict access to clients and services within the IdM domain, per host, based on the defined SELinux policies.

20.1. About Identity Management, SELinux, and Mapping Users



NOTE

Identity Management does not create or modify the SELinux contexts on a system. Rather, it uses existing contexts as the basis to map IdM users (in the domain) to SELinux users (on a system).

Security-enhanced Linux defines kernel-level, mandatory access controls for how users, processes, and applications can interact with other resources on a system. These rules for interactions, called *contexts*, look at the data and behavior characteristics of different objects on the system and then set rules, called *policies*, based on the security implications of each specific object. This is in contrast to higher-level discretionary access controls which are concerned primarily with file ownership and user identity, without accounting for data criticality or application behavior. Every resource on a system (users, applications, files, processes) is assigned a context.

System users are associated with an SELinux *role*. The role is assigned both a multi-layer security context (MLS) a multi-category security context (MCS). The MLS/MCS contexts *confine* users to what processes, files, and operations they can access on the system.

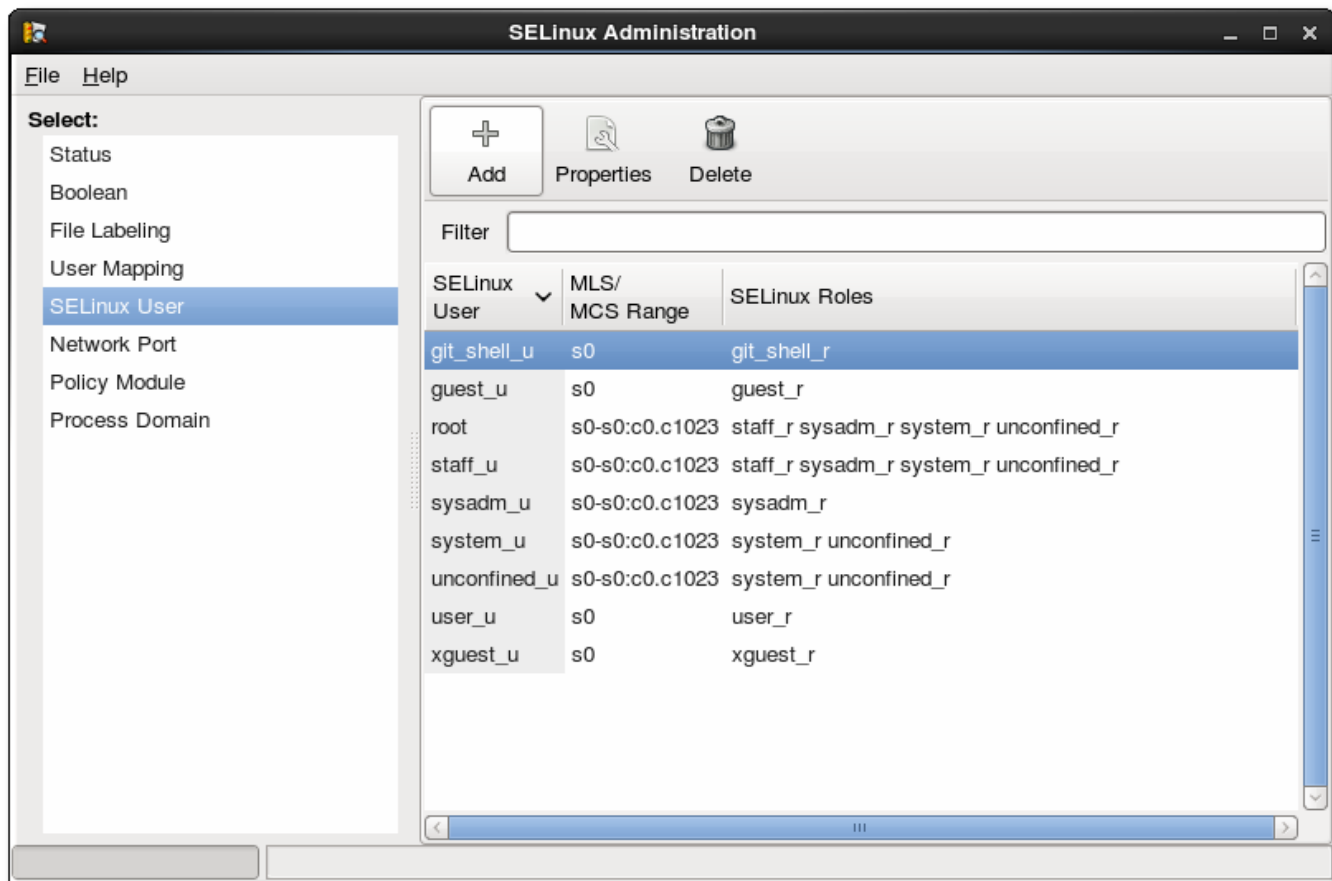


Figure 20.1. SELinux Users in the SELinux Manager

This is all described in detail in [Red Hat Enterprise Linux 6 Security-Enhanced Linux](#).

SELinux users and policies function at the system level, not the network level. This means that SELinux users are configured independently on each system. While this is acceptable in many situations — SELinux has common defined system users and SELinux-aware services define their own policies — it has some issues when dealing with remote users and systems that access local resources. Remote users and services can get shuffled into a default guest context without a lot of intelligence about what their actual SELinux user and role should be.

This is how Identity Management can cleanly integrate an identity domain with local SELinux services. Identity Management can map IdM users to configured SELinux roles *per host*. Mapping SELinux and IdM users improves user administration:

- ▶ Remote users can be granted appropriate SELinux user contexts based on their IdM group assignments. This also allows administrators to consistently apply the same policies to the same users without having to create local accounts or reconfigure SELinux.
- ▶ SELinux users are automatically updated as hosts are added to the IT environment or as users are added, removed, or changed, without having to edit local systems.
- ▶ SELinux policies can be planned and related to domain-wide security policies through settings like IdM host-based access control rules.
- ▶ Administrators gain environment-wide visibility and control over how users and systems are assigned in SELinux.

SELinux user maps are comprised of three parts: the SELinux user for the system, an IdM user, and an IdM host. These define two separate relationships. First, it defines a map for the SELinux user on a specific host (the local or target system). Second, it defines a map for the SELinux user and the IdM user.

This arrangement allows administrators to set different SELinux users for the same IdM users, depending on which host they are accessing.

SELinux user maps work with the System Security Services Daemon (SSSD) and the `pam_selinux` module. When a remote user attempts to log into a machine, SSSD checks its IdM identity provider to collect the user information, including any SELinux maps. The PAM module then processes the user and assigns it the appropriate SELinux user context.

The core of an SELinux mapping rule is the SELinux system user. Each map is associated with the SELinux user first. The SELinux users which are available for mapping are configured in the IdM server, so there is a central and universal list. These are SELinux users which are configured on every host in the IdM domain. By default, there are five common SELinux users defined:

- ▶ `unconfined_u` (also used as a default for IdM users)
- ▶ `guest_u`
- ▶ `xguest_u`
- ▶ `user_u`
- ▶ `staff_u`

In the IdM server configuration, each SELinux user is configured with both its username and its MLS/MCS range, `SELinux_username:MLS[:MCS]`, and this format is used to identify the SELinux user when configuring maps.

The IdM user and host configuration is very flexible. Users and hosts can be explicitly and individually assigned to an SELinux user map individually, or user groups or host groups can be explicitly assigned to the map.

An extra layer of security is possible by using host-based access control rules. As long as the host-based access control rule defines a user and a host, it can be used for an SELinux user map. Host-based access control rules (described in [Chapter 19, Configuring Host-Based Access Control](#)) help integrate SELinux user maps with other access controls in IdM and can help limit or allow host-based user access for remote users, as well as defining local security contexts.



NOTE

If a host-based access control rule is associated with an SELinux user map, the host-based access control rule cannot be deleted until it is removed from the SELinux user map configuration.

20.2. Configuring SELinux User Map Order and Defaults

SELinux user maps, as the name implies, creates an association between an SELinux user and an IdM user. Before that association can be established, the IdM server has to be aware of the underlying SELinux users configuration on the systems it manages.

The available *system* SELinux user maps are part of the IdM server configuration. This is a list, in order from most to least confined, of the SELinux users. The SELinux user entry itself has this format:

```
SELinux_username:MLS[:MCS]
```

The individual user entries are separated with a dollar sign (\$).

Since there is no requirement on user entries to have an SELinux map, many entries may be unmapped. The IdM server configuration sets a default SELinux user (one of the users from the total SELinux map list) to use for unmapped IdM user entries. This way, even unmapped IdM users have a functional SELinux context.



NOTE

This configuration defines the map order of available system SELinux users. This does not define any IdM user SELinux policies. The IdM user - SELinux user map must be defined and then users are added to the map, as in [Section 20.3, “Mapping SELinux Users and IdM Users”](#).

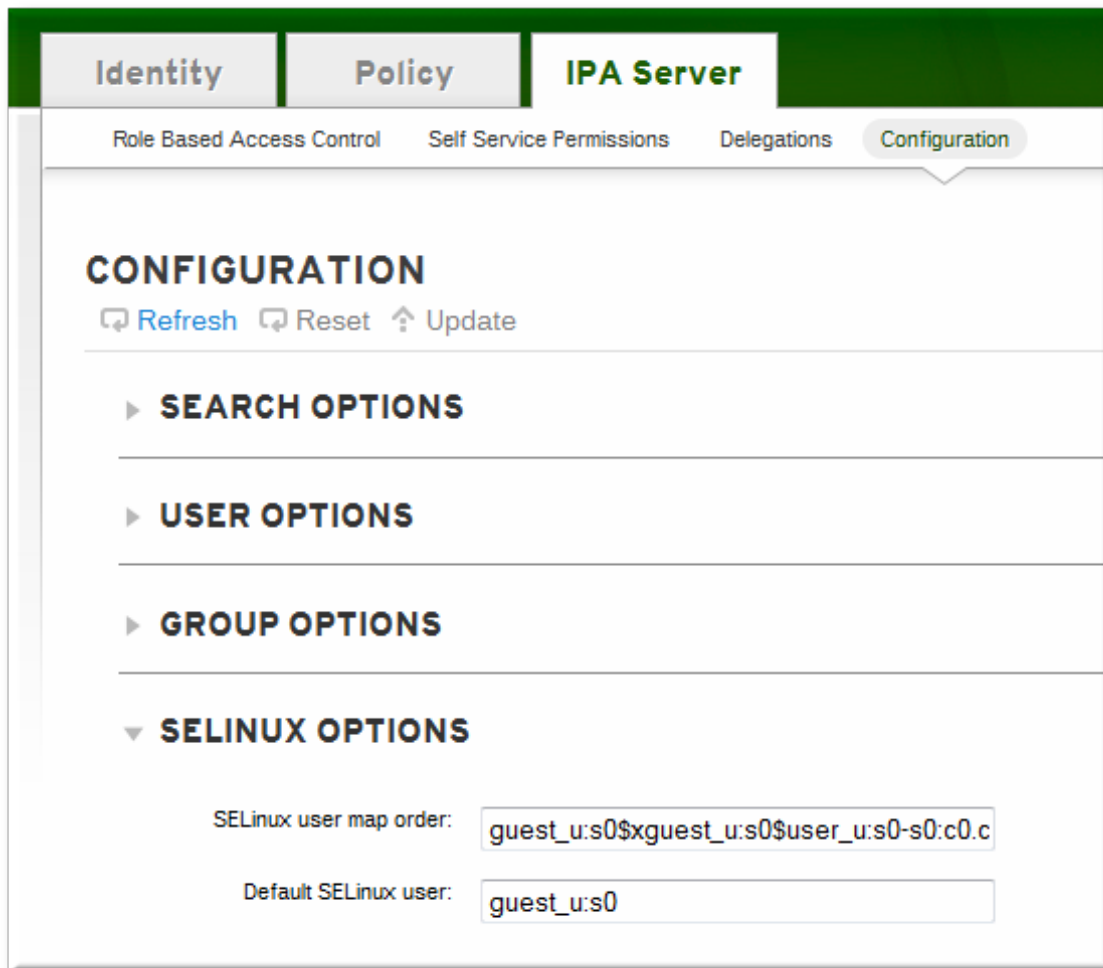
20.2.1. In the Web UI

1. In the top menu, click the **IPA Server** main tab and the **Configuration** subtab.
2. Scroll to the bottom of the list of server configuration areas, to **SELINUX OPTIONS**.
3. Set the SELinux user configuration.

There are two areas that can be edited: the prioritized list of SELinux users and the default SELinux user to use for unmapped IdM users.

The **SELinux user map order** gives the list of SELinux users, defined on the local Linux system, which are available for configuring mapping rules. This is a prioritized list, from most to least confined. Each SELinux user has the format *SELinux_user:MLS*.

The **Default SELinux user** field sets the SELinux user to use for *unmapped* IdM users.



4. Click the **Update** link at the top of the page to save the changes.

20.2.2. In the CLI

Before SELinux mapping rules can be created, there has to be a defined and universal list of SELinux users which are available to be mapped. This is set in the IdM server configuration:

```
[jsmith@server ~]$ ipa config-show
...
SELinux user map order: guest_u:s0$guest_u:s0$user_u:s0$staff_u:s0-
s0:c0.c1023$unconfined_u:s0-s0:c0.c1023
Default SELinux user: unconfined_u:s0-s0:c0.c1023
```

The SELinux user settings can be edited using the **config-mod** command.

Example 20.1. List of SELinux Users

The complete list of SELinux users is passed in the `--ipaselinuxusermaporder` option. This list sets a priority order, from most to least confined users.

The SELinux user entry itself has this format:

```
SELinux_user:MLS:MCS
```

The individual user entries are separated with a dollar sign (\$).

For example:

```
[jsmith@server ~]$ ipa config-mod --ipaselinuxusermaporder="unconfined_u:s0-s0:c0.c1023$guest_u:s0$guest_u:s0$user_u:s0-s0:c0.c1023$staff_u:s0-s0:c0.c1023"
```



NOTE

The default SELinux user, used for unmapped entries, must be included in the user map list or the edit operation fails. Likewise, if the default is edited, it must be changed to a user in the SELinux map list or the map list must be updated first.

Example 20.2. Default SELinux User

IdM users are not required to have a specific SELinux user mapped to their account. However, the local system still checks the IdM entry for an SELinux user to use for the IdM user account. The default SELinux user sets the fallback user to use for unmapped IdM user entries; this is, by default, the default SELinux user for system users on Red Hat Enterprise Linux, **unconfined_u**.

This default user can be changed with the `--ipaselinuxusermapdefault`. For example:

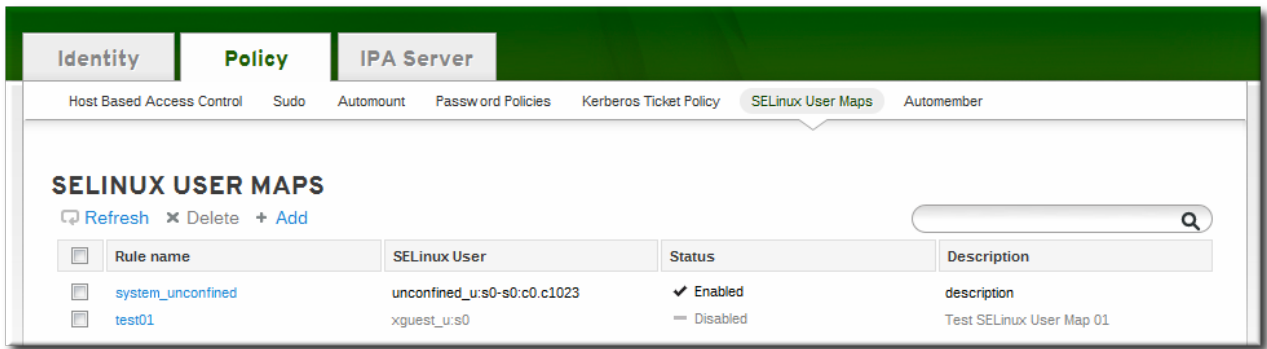
```
[jsmith@server ~]$ ipa config-mod --ipaselinuxusermapdefault="guest_u:s0"
```

20.3. Mapping SELinux Users and IdM Users

An SELinux map associates an SELinux user context on a local system with an IdM user (or users) within the domain. An SELinux map has three parts: the SELinux user context and an IdM user/host pairing. That IdM user/host pair can be defined in one of two ways: it can be set for explicit users on explicit hosts (or user and host groups), or it can be defined using a host-based access control rule.

20.3.1. In the Web UI

1. In the top menu, click the **Policy** main tab and the **SELinux User Mappings** subtab.
2. In the list of mappings, click the **Add** button to create a new map.



3. Enter the name for the map and the SELinux user *exactly as it appears in the IdM server configuration*. SELinux users have the format `SELinux_username:MLS[:MCS]`.

Add SELinux User Map ✕

Rule name: * example-map

SELinux User: * sysadmin_u:s0

* Required field

Add Add and Add Another Add and Edit Cancel

4. Click **Add and Edit** to add the IdM user information.
5. To set a host-based access control rule, select the rule from the drop-down menu in the **General** area of the configuration. Using a host-based access control rule also introduces access controls on what hosts a remote user can use to access a target machine. **Only one host-based access control rule can be assigned.**



NOTE

The host-based access control rule must contain users and hosts, not just services.

SELinux User Maps » user

SELINUX USER MAP: user

Settings

Refresh Reset Update

GENERAL

Rule name: **user**

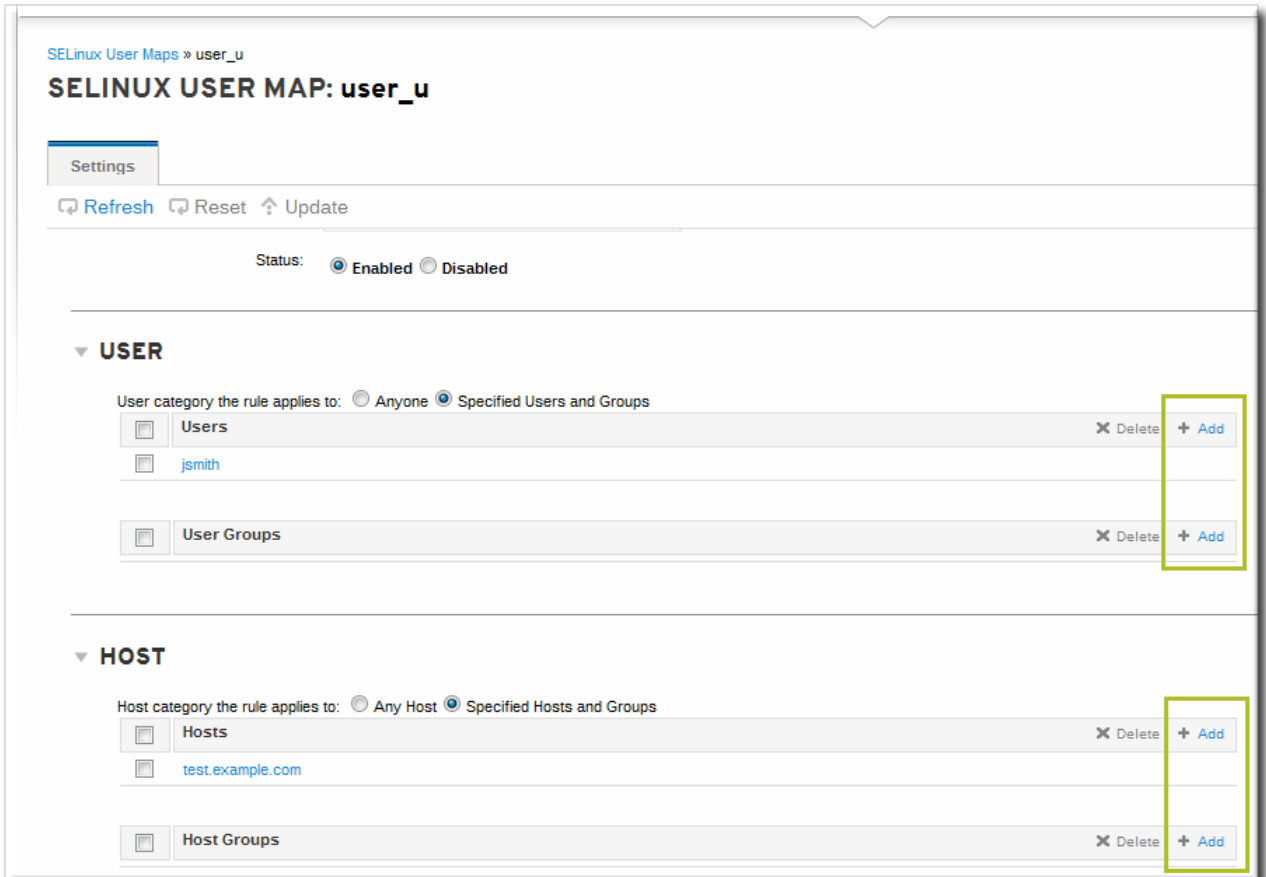
Description:

SELinux User: *

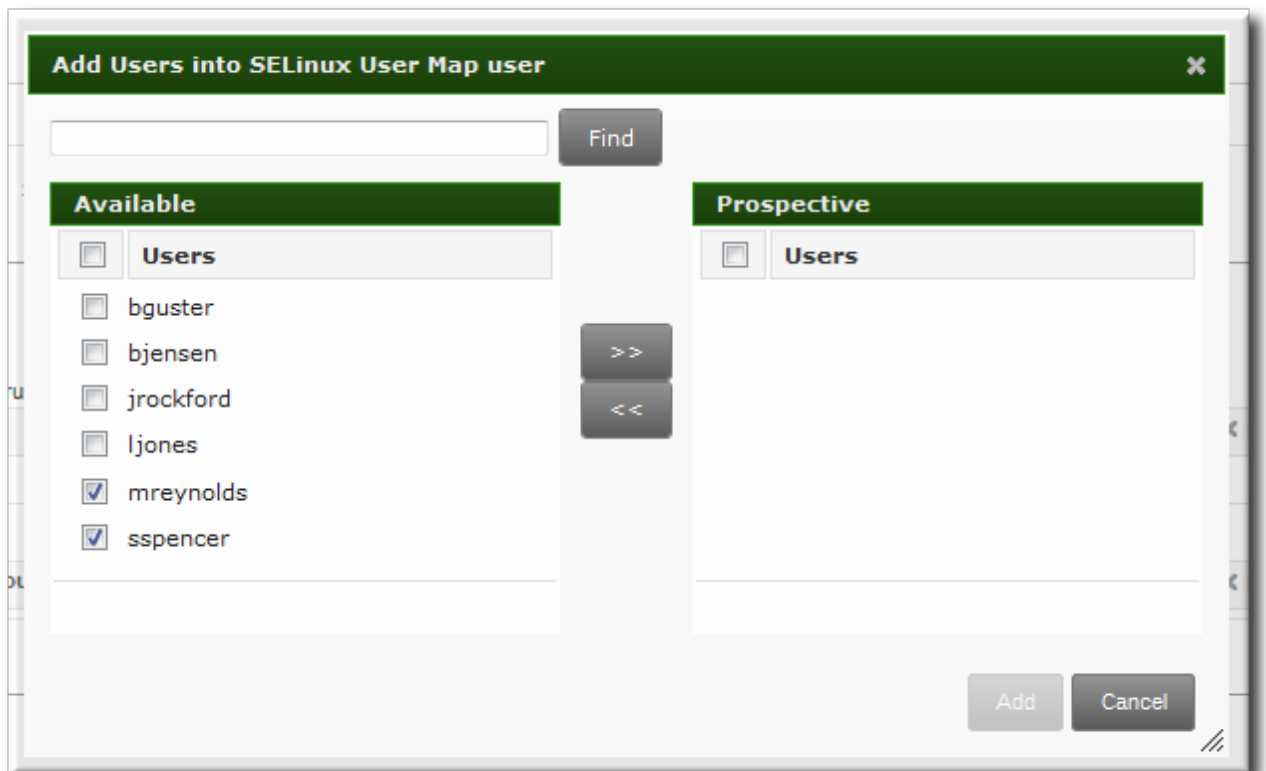
HBAC Rule:

Status: Enabled Disabled

Alternatively, scroll down the **Users** and **Hosts** areas, and click the **Add** link to assign users, user groups, hosts, or host groups to the SELinux map.



Select the users (or hosts or groups) on the left, click the right arrows button (>>) to move them to the **Prospective** column, and click the **Add** button to add them to the rule.



**NOTE**

Either a host-based access control rule can be given or the users and hosts can be set manually. Both options cannot be used at the same time.

6. Click the **Update** link at the top to save the changes to the SELinux user map.

20.3.2. In the CLI

An SELinux map rule has three fundamental parts:

- ▶ The SELinux user (**--selinuxuser**)
- ▶ The user or user groups which are associated with the SELinux user (**--users** or **--groups**)
- ▶ The host or host groups which are associated with the SELinux user (**--hosts** or **--hostgroups**)
- ▶ Alternatively, a host-based access control rule which specifies both hosts and users in it (**--hbacrule**)

A rule can be created with all information at once using the **selinuxusermap-add** command. Users and hosts can be added to a rule after it is created by using the **selinuxusermap-add-user** and **selinuxusermap-add-host** commands, respectively.

Example 20.3. Creating a New SELinux Map

The **--selinuxuser** value must be the SELinux user name exactly as it appears in the IdM server configuration. SELinux users have the format *SELinux_username:MLS[:MCS]*.

Both a user and a host (or appropriate groups) must be specified for the SELinux mapping to be valid. The user, host, and group options can be used multiple times or can be used once with a comma-separated listed inside curly braces, such as *--option={val1,val2,val3}*.

```
[jsmith@server ~]$ ipa selinuxusermap-add --users=jsmith --users=bjensen --
users=jrockford --hosts=server.example.com --hosts=test.example.com --
selinuxuser="xguest_u:s0" selinux1
```

Example 20.4. Creating an SELinux Map with a Host-Based Access Control Rule

The **--hbacrule** value identifies the host-based access control rule to use for mapping. Using a host-based access control rule introduces access controls on what hosts a remote user can use to access a target machine, along with applying SELinux contexts after the remote user has logged into the target machine.

The access control rule must specify both users and hosts appropriately so that the SELinux map can construct the SELinux user, IdM user, and host triple.

Only one host-based access control rule can be specified.

```
[jsmith@server ~]$ ipa selinuxusermap-add --hbacrule=webserver --
selinuxuser="xguest_u:s0" selinux1
```

Host-based access control rules are described in [Chapter 19, Configuring Host-Based Access Control](#).

Example 20.5. Adding a User to an SELinux Map

While all of the users and hosts can be added to a map when it is created, users and hosts can also be added after the rule is created. This is done using a specific command, either **selinuxusermap-add-user** or **selinuxusermap-add-host**.

```
[jsmith@server ~]$ ipa selinuxusermap-add-user --users=jsmith selinux1
```

It is not necessary to use a separate command to add a host-based access control rule after the rule is configured because there can only be one. If the **selinuxusermap-mod** command is used with the **--hbacrule** option, it adds the host-based access control rule or overwrites the previous one.

Example 20.6. Removing a User from an SELinux Map

A specific user or host can be removed from an SELinux map by using either the **selinuxusermap-remove-host** or **selinuxusermap-remove-user** command. For example:

```
[jsmith@server ~]$ ipa selinuxusermap-remove-user --users=jsmith selinux1
```

Chapter 21. Defining Automatic Group Membership for Users and Hosts

Most of the policies and configuration within the Identity Management domain are based on *groups*. Settings from sudo rules to automount to access control are defined for groups, and then those settings are applied to group members.

Managing group membership is an important factor in managing users and hosts. Creating *automember groups* defines rules to add users and hosts to specified groups automatically, as soon as a new entry is added.

21.1. About Automembership

One of the most critical tasks for managing policies, identities, and security is managing group membership in Identity Management. Groups are the core of most policy configuration.

By default, hosts do not belong to any group when they are created; users are added to the catchall **ipausers** group. Even if custom groups are configured and all policy configuration is in place, users and hosts cannot take advantage of those policies until they are joined to groups. Of course, this can be done manually, but it is both more efficient and more consistent if group membership can be assigned automatically.

This is done with *automembership groups*.

Automembership is essentially an automatic, global entry filter that organizes entries, at least in part, based on specific criteria. An automember rule, then, is the way that that filter is specified.

For example, there can be a lot of different, repeatable ways to categorize identities within the IT and organizational environment:

- ▶ Adding all hosts or all users to a single global group.
- ▶ Adding employees to specific groups based on their employee type, ID number, manager, or physical location.
- ▶ Dividing hosts based on their IP address or subnet.

Automembers provide a way to pre-sort those entries. That makes it easier to configure the actual behavior that you want to configure — like granting different sudo rules to different user types or machines on different subnets or have different automount settings for different users.



NOTE

Automembership only applies to *new* users or hosts. Changing the configuration for an existing user or group does not trigger a change group membership.

Automembership is a target set on an existing user group or host group. An *automembership rule* is created as a policy. This is a sister entry to the actual group entry and it signals that the given group is used for automatic group membership.

Once the rule is created — once the group is identified as being a target — then the next step is to define *automember conditions*. Conditions are regular expression filters that are used to identify group members. Conditions can be inclusive or exclusive, meaning that matching entries can be added or ignored based on those conditions.

There can be multiple conditions in a single rule. A user or host entry can match multiple rules and be added to multiple groups.

Automembership is a way of imposing reliable order on user and host entries by adding them to groups as they are created.

The key to using automember groups effectively is to plan your overall Identity Management structure — the access control policies, sudo rules, host/service management rules, host groups, and user groups.

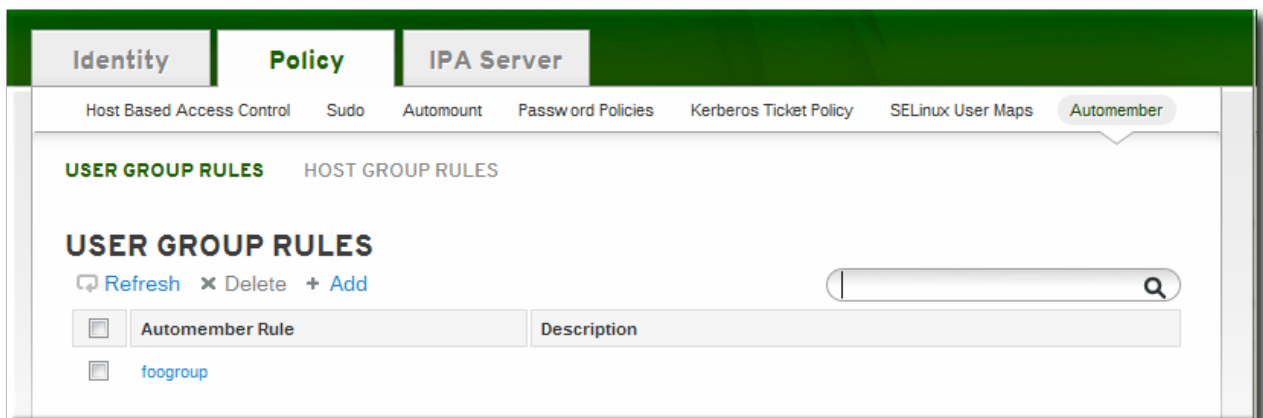
Once the structure is in place, then several things are clear:

- ▶ What groups will be used in the Identity Management
- ▶ What specific groups different types of users and hosts need to belong to to perform their designated functions
- ▶ What delineating attributes can be used to filter users and hosts into the appropriate groups

21.2. Defining Automembership Rules (Basic Procedure)

21.2.1. From the Web UI

1. Create the user group ([Section 9.10.2.1, “Creating User Groups”](#)) or host group ([Section 10.7.1.1, “Creating Host Groups from the Web UI”](#)).
2. Open the **Policy** tab, and select the **Automembers** subtab.
3. In the top of the **Automembers** area, select the type of autogroup to create, either **USER GROUP RULES** or **HOST GROUP RULES**.



4. In the drop-down menu, select the group for which to create the automember rule.

5. Click the **Add and Edit** button.
6. In the edit page for the rule, click the **+ Add** by the type of condition to create to identify entries.

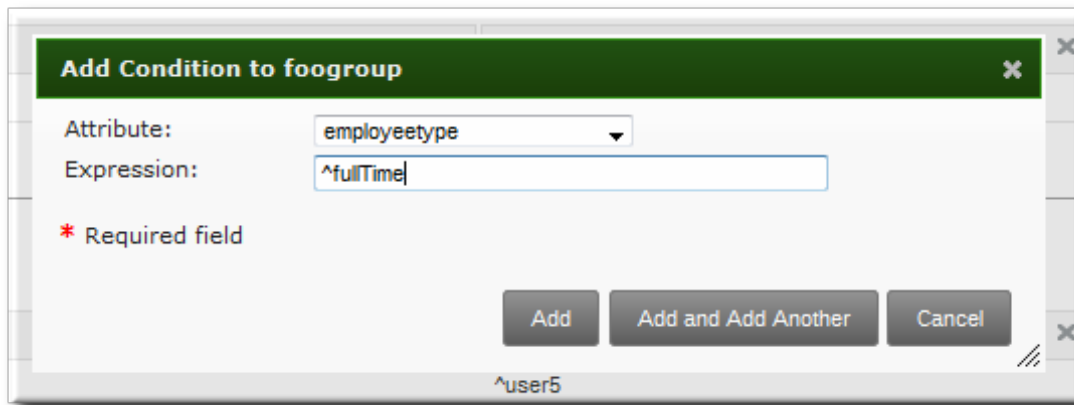
7. Select the attribute to use as the basis for the search and then set the regular expression to use to match the attribute value.

Conditions can look for entries either to *include* in the group or to explicitly *exclude* from the group. The format of a condition is a Perl-compatible regular expression (PCRE). For more information on PCRE patterns, see [the `pcresyntax\(3\)` man page](#).



NOTE

Exclude conditions are evaluated first and take precedence over include conditions.



8. Click **Add and Add Another** to add another condition. A single rule can have multiple include and exclude conditions. When all conditions have been configured, click the **Add** button to save the last condition and close the dialog window.

21.2.2. From the CLI

There are two commands used to define an automember rule:

- ▶ A command to target the group as an automember group, **automember-add**
- ▶ A command to add regular expression conditions to identify group members, **automember-add-condition**

For example:

1. Create the user group ([Section 9.10.2.1.2, “With the Command Line”](#)) or host group ([Section 10.7.1.2, “Creating Host Groups from the Command Line”](#)).
2. Create the automember rule entry for the group. Use the **--type** to identify whether the target group is a user group (**group**) or a host group (**hostgroup**). This command has the format:

```
ipa automember-add --type=group|hostgroup groupName
```

For example:

```
[jsmith@server ~]$ ipa automember-add --type=group exampleGroup
```

3. Create the conditions for the rule. To set multiple patterns, either give a comma-separated list of patterns inside a set of curly braces with the **--inclusive-regex|--exclusive-regex** options (**--option={pattern1,pattern2}**) or run the command multiple times.

This command has the format:

```
ipa automember-add-condition --type=group|hostgroup --key=attribute --inclusive-regex=regex | --exclusive-regex=regex groupName
```

As with the automember rule, the condition must specify the type of group (**--type**) and the name of the target group (*groupName*).

The condition must also specify the attribute (the key) and any patterns for the attribute value. The **--key** is the attribute name that is the focus of the condition. Then, there is a regular expression pattern to identify matching values; matching entries can either be included (**--inclusive-regex**) or excluded (**--exclusive-regex**) from the group. Exclusion rules take precedence.

For example, to include all employees with Barbara Jensen as a manager, but excluding the temporary employees:

```
[jsmith@server ~]$ ipa automember-add-condition --type=group --key=manager --
inclusive-regex=^uid=bjensen$ exampleGroup
[jsmith@server ~]$ ipa automember-add-condition --type=group --
key=employee --exclusive-regex=^temp exampleGroup
```



TIP

The regular expression can match any part of the string. Using a caret (^) means that it must match at the beginning, and using a dollar sign (\$) means that it must match at the end. Wrapping the pattern in ^ and \$ means that the string as a whole must match.

For more information on Perl-compatible regular expression (PCRE) patterns, see [the pcreyntax\(3\) man page](#).

To remove a condition for a rule, pass the full condition information, both the key and the regular expression:

```
[jsmith@server ~]$ ipa automember-remove-condition --key=fqdn --type=hostgroup --
inclusive-regex=^web[1-9]+\.\example\.\com webservers
```

To remove the entire rule, simply run the **automember -del** command.

21.3. Examples of Using Automember Groups



NOTE

These examples are shown using the CLI; the same configuration can be performed in the web UI.

A Note on Creating Default Groups

One common environment requirement is to have some sort of default group that users or hosts are added to. There are a couple of different ways to approach that.

- ▶ All entries can be added to a single, global group regardless of what other groups they are also added to.
- ▶ Entries can be added to specific automember groups. If the new entry does not match any autogroup, then it is added to a default or fallback group.

These strategies are mutually exclusive. If an entry matches a global group, then it does match an automember group and would, therefore, not be added to the fallback group.

21.3.1. Setting an All Users/Hosts Rule

To add all users or all hosts to a single group, use an inclusive regular expression for some attribute (such as **cn** or **fqdn**) which all entries will contain.

A regular expression to match all entries is simply **.***. For example, to add all hosts to the same host group:


```
[jsmith@server ~]$ ipa automember-add-condition --type=hostgroup allhosts --
inclusive-regex=. * --key=fqdn
-----
Added condition(s) to "allhosts"
-----
Automember Rule: allhosts
Inclusive Regex: fqdn=. *
-----
Number of conditions added 1
-----
```

Every host added after that is automatically added to the **allhosts** group:

```
[jsmith@server ~]$ ipa host-add test.example.com
-----
Added host "test.example.com"
-----
Host name: test.example.com
Principal name: host/test.example.com@EXAMPLE.COM
Password: False
Keytab: False
Managed by: test.example.com

[jsmith@server ~]$ ipa hostgroup-show allhosts
Host-group: allhosts
Description: Default hostgroup
Member hosts: test.example.com
```

For more information on PCRE patterns, see [the pcreyntax\(3\) man page](#).

21.3.2. Defining Default Automembership Groups

There is a special command to set a default group, **automember-default-group-set**. This sets the group name (**--default-group**) and group type (**--type**), similar to an automember rule, but there is no condition to match. By definition, default group members are unmatched entries.

For example:

```
[jsmith@server ~]$ ipa automember-default-group-set --default-group=ipaclients --
type=hostgroup
[jsmith@server ~]$ ipa automember-default-group-set --default-group=ipausers --
type=group
```

A default group rule can be removed using the **automember-default-group-remove** command. Since there is only one default group for a group type, it is only necessary to give the group type, not the group name:

```
[jsmith@server ~]$ ipa automember-default-group-remove --type=hostgroup
```

21.3.3. Using Automembership Groups with Windows Users

When a user is created in IdM, that user is automatically added as a member to the **ipausers** group (which is the default group for all new users, apart from any automember group). However, when a Windows user is synced over from Active Directory, that user is not automatically added to the **ipausers** group.

New Windows users can be added to the **ipausers** group, as with users created in Identity Management, by using an automember group. Every Windows user is added with the **ntUser** object class; that object class can be used as an inclusive filter to identify new Windows users to add to the automember group.

First, define the **ipausers** group as an automember group:

```
[jsmith@server ~]$ ipa automember-add --type=group ipausers
```

Then, use the **ntUser** object class as a condition to add users:

```
[jsmith@server ~]$ ipa automember-add-condition ipausers --key=objectclass --  
type=group --inclusive-regex=ntUser
```

Part V. Configuring the Identity Management Server

Chapter 22. Defining Access Control for IdM Users

Access control is a security system which defines who can access certain resources — from machines to services to entries — and what kinds of operations they are allowed to perform. Identity Management provides several access control areas to make it very clear what kind of access is being granted and to whom it is granted. As part of this, Identity Management draws a distinction between access controls to resources within the domain and access control to the IdM configuration itself.

This chapter details the different internal access control mechanisms that are available for users within IdM to the IdM server and other IdM users.

22.1. About Access Controls for IdM Entries

Access control defines the rights or permissions users have been granted to perform operations on other users or objects.

22.1.1. A Brief Look at Access Control Concepts

The Identity Management access control structure is based on standard LDAP access controls. Access within the IdM server is based on the IdM users (who are stored in the backend Directory Server instance) who are allowed to access other IdM entities (which are also stored as LDAP entries in the Directory Server instance).

An access control instruction (ACI) has three parts:

- ▶ *Who can perform the operation.* This is the entity who is being granted permission to do something; this is the actor. In LDAP access control models, this is called the *bind rule* because it defines who the user is (based on their bind information) and can optionally require other limits on the bind attempt, such as restricting attempts to a certain time of day or a certain machine.
- ▶ *What can be accessed.* This defines the entry which the actor is allowed to perform operations on. This is the *target* of the access control rule.
- ▶ *What type of operation can be performed.* The last part is determining what kinds of actions the user is allowed to perform. The most common operations are add, delete, write, read, and search. In Identity Management, all users are implicitly granted read and search rights to all entries in the IdM domain, with restrictions only for sensitive attributes like passwords and Kerberos keys. (Anonymous users are restricted from seeing security-related configuration, like **sudo** rules and host-based access control.)

The only rights which can be granted are add, delete, and write — the permissions required to *modify* an entry.

When any operation is attempted, the first thing that the IdM client does is send user credentials as part of the bind operation. The backend Directory Server checks those user credentials and then checks the user account to see if the user has permission to perform the requested operation.

22.1.2. Access Control Methods in Identity Management

To make access control rules simple and clear to implement, Identity Management divides access control definitions into three categories:

- ▶ *Self-service rules*, which define what operations a user can perform on his own personal entry. The access control type only allows write permissions to attributes within the entry; it does not allow add or delete operations for the entry itself.

- ▶ *Delegation rules*, which allow a specific user group to perform write (edit) operations on specific attributes for users in another user group. Like self-service rules, this form of access control rule is limited to editing the values of specific attributes; it does not grant the ability to add or remove whole entries or control over unspecified attributes.
- ▶ *Role-based access control*, which creates special access control groups which are then granted much broader authority over all types of entities in the IdM domain. Roles can be granted edit, add, and delete rights, meaning they can be granted complete control over entire entries, not just selected attributes.

Some roles are already created and available within Identity Management. Special roles can be created to manage any type of entry in specific ways, such as hosts, automount configuration, netgroups, DNS settings, and IdM configuration.

22.2. Defining Self-Service Settings

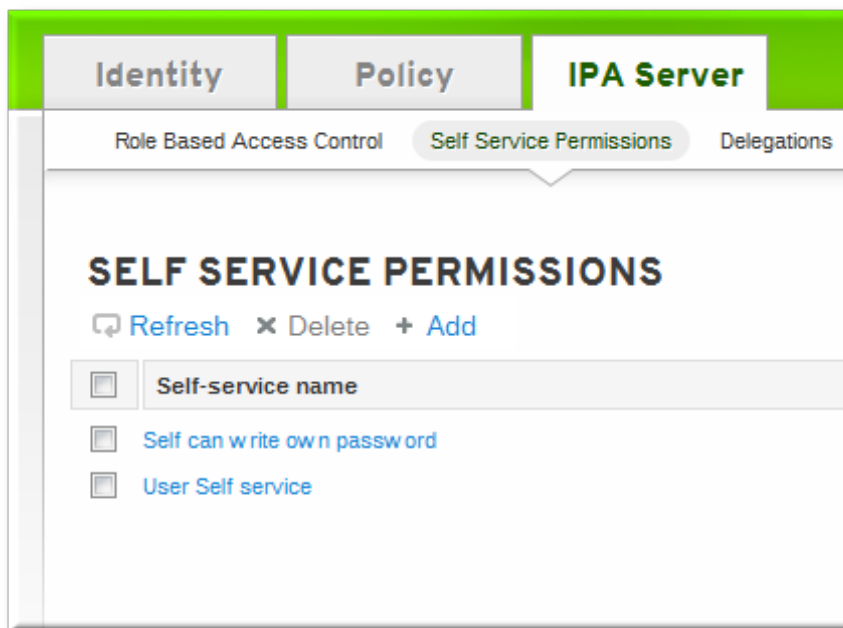
Self-service access control rules define the operations that an entity can perform on itself. These rules define only what attributes a user (or other IdM entity) can edit on their personal entries.

Three self-service rules exist by default:

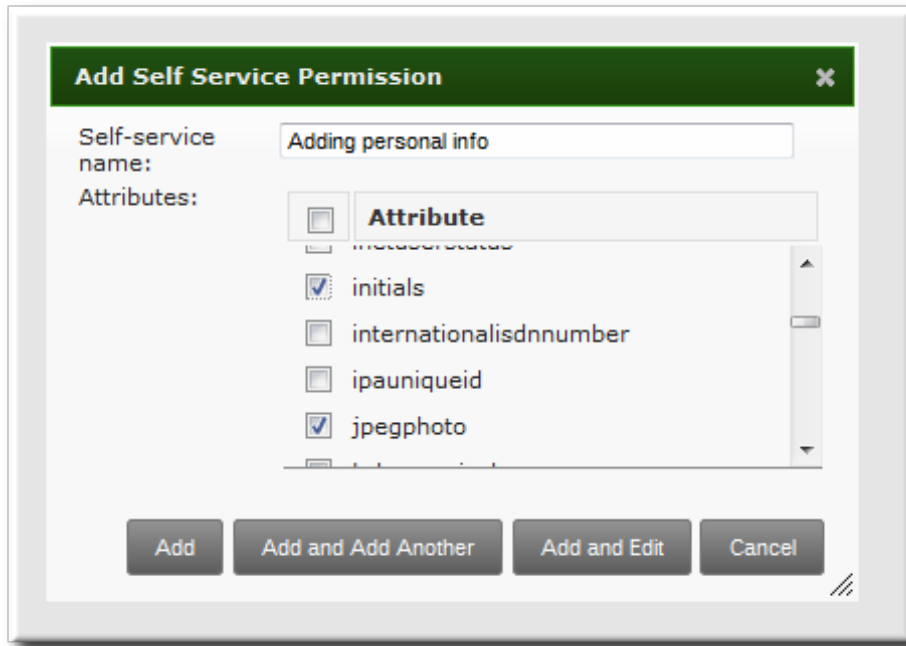
- ▶ A rule for editing some general attributes in the personal entry, including given name and surname, phone numbers, and addresses.
- ▶ A rule to edit personal passwords, including two Samba passwords, the Kerberos password, and the general user password.
- ▶ A rule to manage personal SSH keys.

22.2.1. Creating Self-Service Rules from the Web UI

1. Open the **IPA Server** tab in the top menu, and select the **Self Service Permissions** subtab.
2. Click the **Add** link at the top of the list of self-service ACIs.



3. Enter the name of the rule in the pop-up window. Spaces are allowed.



4. Select the checkboxes by the attributes which this ACI will permit users to edit.
5. Click the **Add** button to save the new self-service ACI.

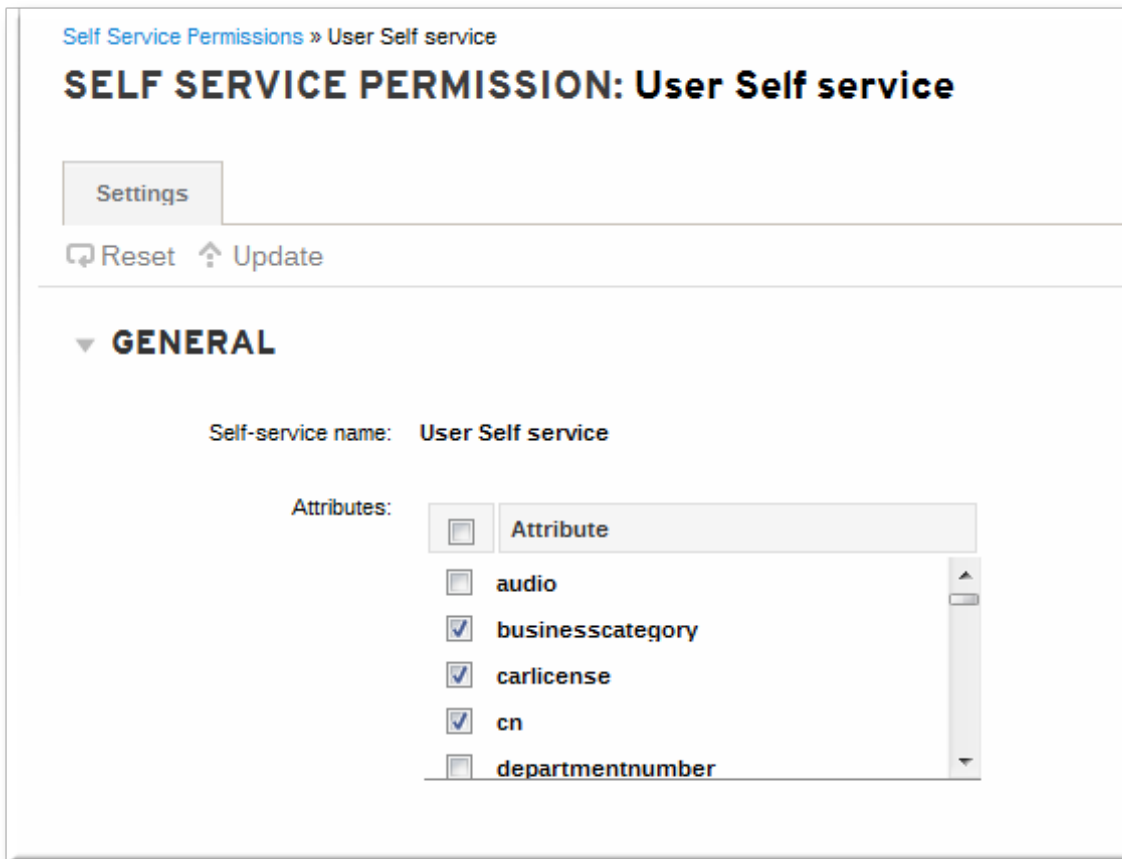
22.2.2. Creating Self-Service Rules from the Command Line

A new self-service rule can be added using the **selfservice-add** command. There are two required options, **--permissions** to set whether the ACI grants write, add, or delete permission and **--attrs** to give the full list of attributes which this ACI grants permission to.

```
[jsmith@server ~]$ ipa selfservice-add "Users can manage their own name details" --
permissions=write --attrs=givenname --attrs=displayname --attrs=title --
attrs=initials
-----
Added selfservice "Users can manage their own name details"
-----
Self-service name: Users can manage their own name details
Permissions: write
Attributes: givenname, displayname, title, initials
```

22.2.3. Editing Self-Service Rules

In the self-service entry in the web UI, the only element that can be edited is the list of attributes that are included in the ACI. The checkboxes can be selected or deselected.



Self Service Permissions » User Self service

SELF SERVICE PERMISSION: User Self service

Settings

Reset Update

▼ GENERAL

Self-service name: User Self service

Attributes:

- Attribute
- audio
- businesscategory
- carlicense
- cn
- departmentnumber

Figure 22.1. Self-Service Edit Page

With the command line, self-service rules are edited using the `ipa selfservice-mod` command. The `--attrs` option overwrites whatever the previous list of supported attributes was, so always include the complete list of attributes along with any new attributes.

```
[jsmith@server ~]$ ipa selfservice-mod "Users can manage their own name details" --
attrs=givenname --attrs=displayname --attrs=title --attrs=initials --attrs=surname
-----
Modified selfservice "Users can manage their own name details"
-----
Self-service name: Users can manage their own name details
Permissions: write
Attributes: givenname, displayname, title, initials
```



IMPORTANT

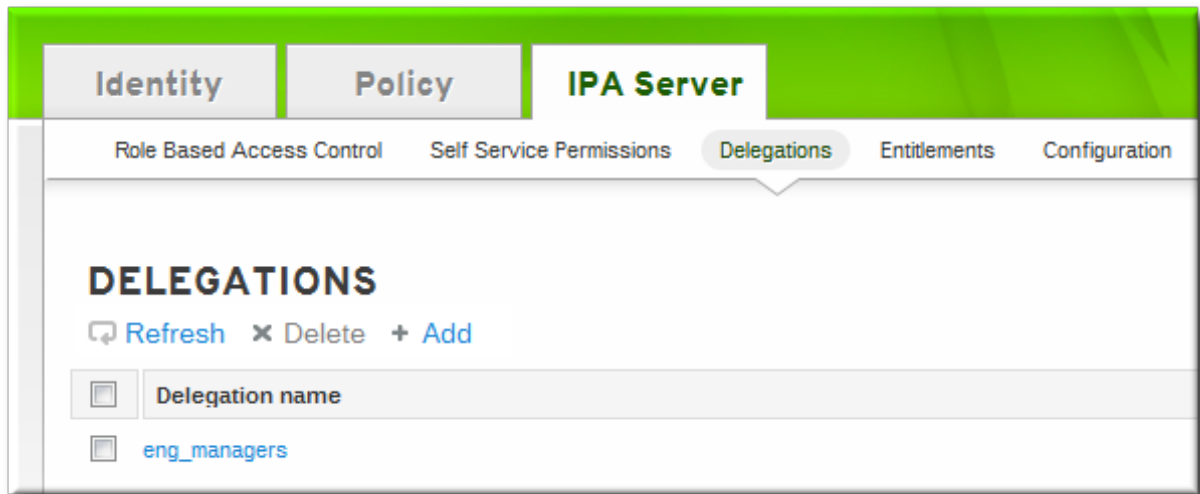
Include all of the attributes when modifying a self-service rule, including existing ones.

22.3. Delegating Permissions over Users

Delegation is very similar to roles in that one group of users is assigned permission to manage the entries for another group of users. However, the delegated authority is much more similar to self-service rules in that complete access is granted but only to specific user attributes, not to the entire entry. Also, the groups in delegated authority are existing IdM user groups instead of roles specifically created for access controls.

22.3.1. Delegating Access to User Groups in the Web UI

1. Open the **IPA Server** tab in the top menu, and select the **Delegations** subtab.
2. Click the **Add** link at the top of the list of delegation ACIs.



3. Name the new delegation ACI.
4. Set the permissions by selecting the checkboxes whether users will have the right to view the given attributes (read) and add or change the given attributes (write).

Some users may have a need to see information, but should not be able to edit it.

5. In the **User group** drop-down menu, select the group *who is being granted permissions to the entries of users in the user group*.

The 'Add Delegation' dialog box is shown. It has a title bar with 'Add Delegation' and a close button. The form contains the following fields:

- Delegation name:** * eng_managers
- Permissions:**
 - read
 - write
- User group:** * engineering_managers
- Member user group:** * engineers
- Attributes:** *

Attribute
<input type="checkbox"/> audio
<input type="checkbox"/> businesscategory
<input type="checkbox"/> carlicense
<input type="checkbox"/> cn
<input type="checkbox"/> departmentnumber
<input type="checkbox"/> description

At the bottom, there is a legend: * Required field. Below the legend are four buttons: 'Add', 'Add and Add Another', 'Add and Edit', and 'Cancel'.

6. In the **Member user group** drop-down menu, select the group *whose entries can be edited by members of the delegation group*.

7. In the attributes box, select the checkboxes by the attributes to which the member user group is being granted permission.
8. Click the **Add** button to save the new delegation ACI.

22.3.2. Delegating Access to User Groups in the Command Line

A new delegation access control rule is added using the **delegation-add** command. There are three required arguments:

- ▶ **--group**, the group *who is being granted permissions* to the entries of users in the user group.
- ▶ **--memberof**, the group *whose entries can be edited* by members of the delegation group.
- ▶ **--attrs**, the attributes which users in the member group are allowed to edit.

For example:

```
$ ipa delegation-add "basic manager attrs" --attrs=manager --attrs=title --
attrs=employeetype --attrs=employeenumber --group=engineering_managers --
memberof=engineering
-----
Added delegation "basic manager attrs"
-----
Delegation name: basic manager attrs
Permissions: write
Attributes: manager, title, employeetype, employeenumber
Member user group: engineering
User group: engineering_managers
```

Delegation rules are edited using the **delegation-mod** command. The **--attrs** option overwrites whatever the previous list of supported attributes was, so always include the complete list of attributes along with any new attributes.

```
[jsmith@server ~]$ ipa delegation-mod "basic manager attrs" --attrs=manager --
attrs=title --attrs=employeetype --attrs=employeenumber --attrs=displayname
-----
Modified delegation "basic manager attrs"
-----
Delegation name: basic manager attrs
Permissions: write
Attributes: manager, title, employeetype, employeenumber, displayname
Member user group: engineering
User group: engineering_managers
```



IMPORTANT

Include all of the attributes when modifying a delegation rule, including existing ones.

22.4. Defining Role-Based Access Controls

Role-based access control grants a very different kind of authority to users compared to self-service and delegation access controls. Role-based access controls are fundamentally administrative, with the potential to add, delete, and significantly modify entries.

There are three parts to role-based access controls:

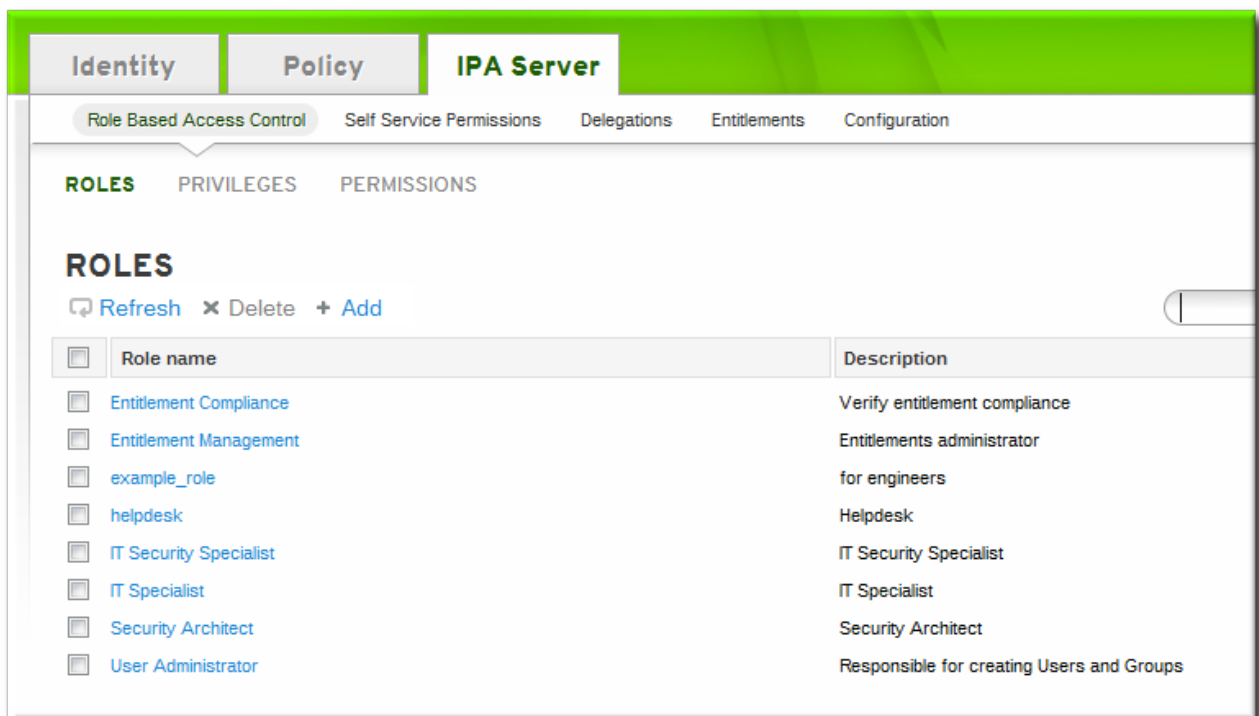
- ▶ The *permission*. The permission defines a specific operation or set of operations (write, add, or delete) and the target entries within the IdM LDAP directory to which those operations apply. Permissions are building blocks; they can be assigned to multiple privileges as needed.
- ▶ The *privileges* available to a role. A privilege is essentially a group of permissions. Permissions are not applied directly to a role. Permissions are added to a privilege so that the privilege creates a coherent and complete picture of a set of access control rules. For example, a permission can be created to add, edit, and delete automount locations. Then that permission can be combined with another permission relating to managing FTP services, and they can be used to create a single privilege that relates to managing filesystems.
- ▶ The *role*. This is the list of IdM users who are able to perform the actions defined in the privileges.

It is possible to create entirely new permissions, as well as to create new privileges based on existing permissions or new permissions.

22.4.1. Creating Roles

22.4.1.1. Creating Roles in the Web UI

1. Open the **IPA Server** tab in the top menu, and select the **Role Based Access Control** subtab.
2. Click the **Add** link at the top of the list of role-based ACIs.



3. Enter the role name and a description.

Helpdesk

Add Role [X]

Role name:

Description:

[Add] [Add and Add Another] [Add and Edit] [Cancel]

4. Click the **Add and Edit** button to save the new role and go to the configuration page.
5. At the top of the **Users** tab, or in the **Users Groups** tab when adding groups, click the **Add** link.

Identity | Policy | **IPA Server**

Role Based Access Control | Self Service Permissions | Delegations | ID Ranges | Trusts | Configuration

ROLES | PRIVILEGES | PERMISSIONS

Roles > example_role

ROLE: example_role

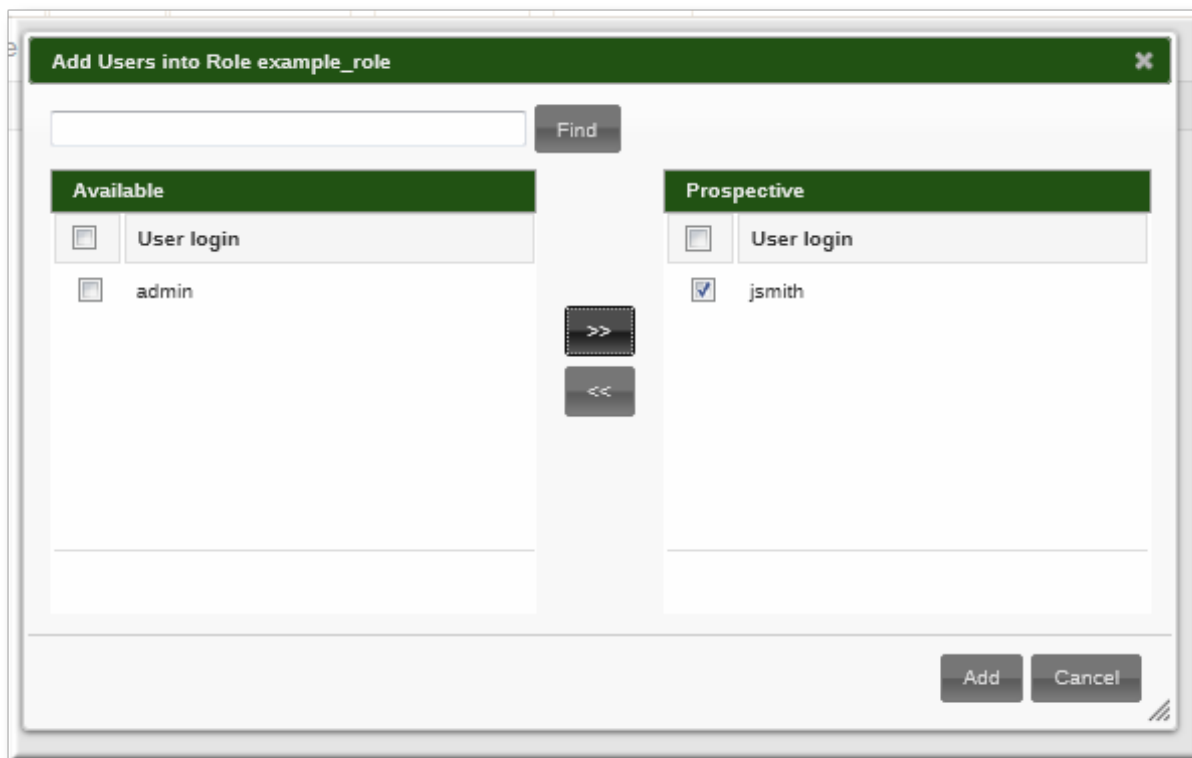
example_role members:

Users (1) | User Groups | Hosts | Host Groups | Privileges | Settings

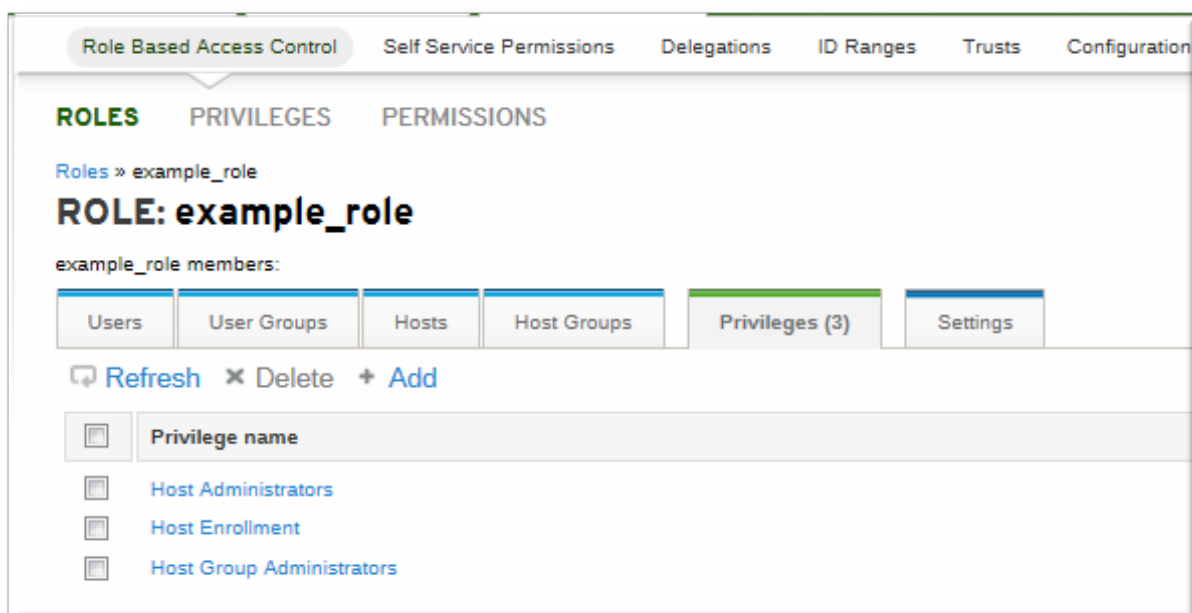
Refresh | Delete | Add

<input type="checkbox"/>	User login
<input type="checkbox"/>	jsmith

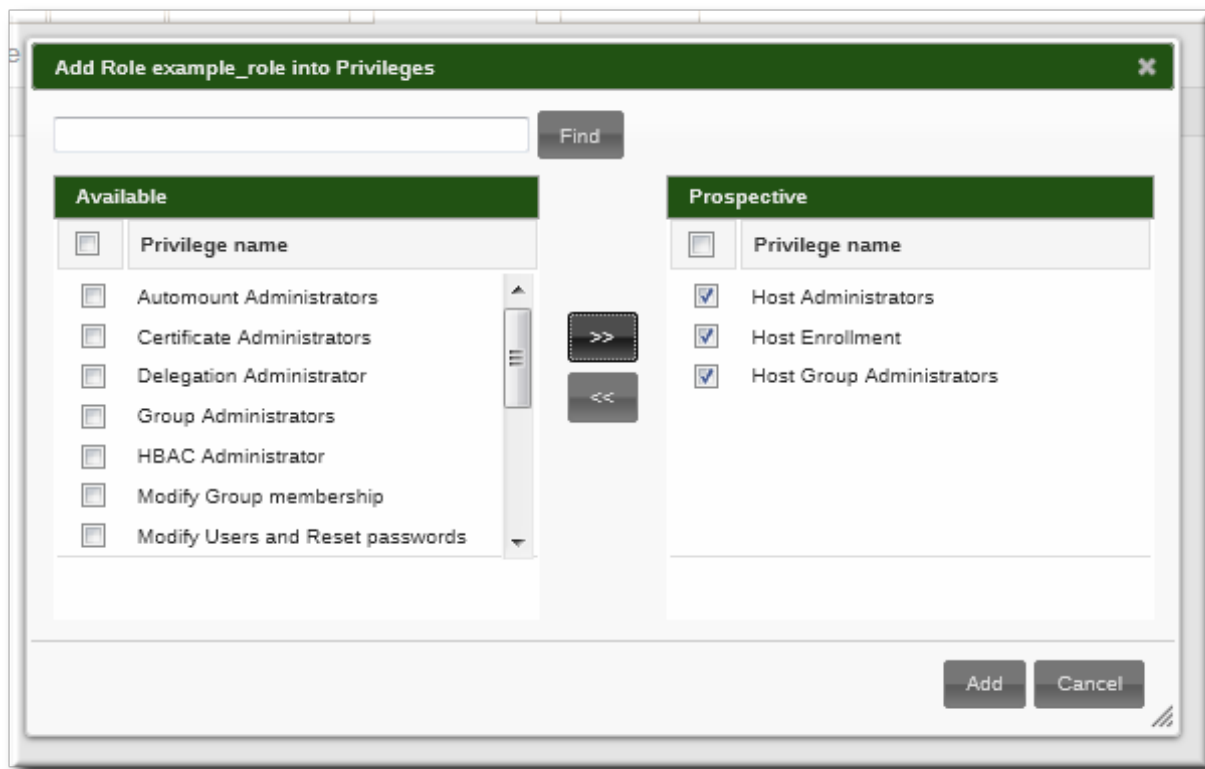
6. Select the users on the left and use the >> button to move them to the assigned box.



7. Open the **Privileges** tab in the role configuration page.
8. Click the **Add** link at the top of the list of privileges to add a new privilege.



9. Select the privileges on the left and use the >> button to move them to the assigned box.



10. Click the **Add** button to save.

22.4.1.2. Creating Roles in the Command Line

1. Add the new role:

```
[root@server ~]# kinit admin
[root@server ~]# ipa role-add --desc="User Administrator" useradmin
-----
Added role "useradmin"
-----
Role name: useradmin
Description: User Administrator
```

2. Add the required privileges to the role:

```
[root@server ~]# ipa role-add-privilege --privileges="User Administrators"
useradmin
Role name: useradmin
Description: User Administrator
Privileges: user administrators
-----
Number of privileges added 1
-----
```

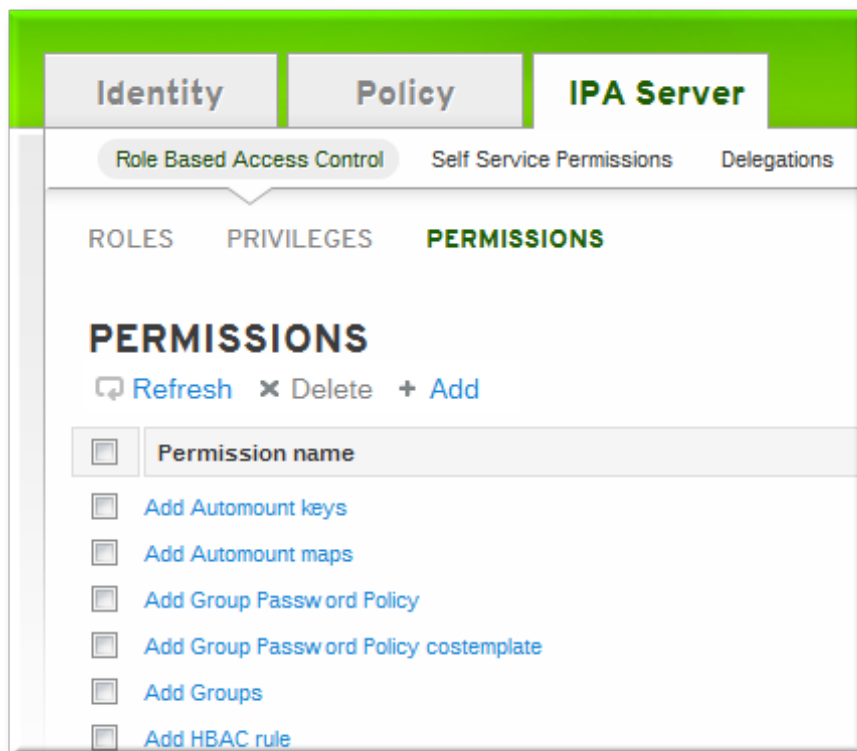
3. Add the required groups to the role. In this case, we are adding only a single group, **useradmin**, which already exists.

```
[root@server ~]# ipa role-add-member --groups=useradmins useradmin
Role name: useradmin
Description: User Administrator
Member groups: useradmins
Privileges: user administrators
-----
Number of members added 1
```

22.4.2. Creating New Permissions

22.4.2.1. Creating New Permissions from the Web UI

1. Open the **IPA Server** tab in the top menu, and select the **Role Based Access Control** subtab.
2. Select the **Permissions** task link.
3. Click the **Add** link at the top of the list of permissions.



4. Enter the name of the new permission.
5. Select the checkboxes next to the allowed operations for this permission.

6. Select the method to use to identify the target entries from the **Target** drop-down menu. There are four different methods:

- ▶ *Type* looks for an entry type like user, host, or service and then provides a list of all possible attributes for that entry type. The attributes which will be accessible through this ACI are selected from the list.
- ▶ *Filter* uses an LDAP filter to identify which entries the permission applies to.
- ▶ *Subtree* targets every entry beneath the specified subtree entry. All attributes within the matching entries can be modified.
- ▶ *Target group* specifies a user group, and all the user entries within that group are available through the ACI. All attributes within the matching entries can be modified.

7. Fill in the required information to identify the target entries, depending on the selected type.

8. For *Filter*, *Subtree*, and *Target group* targets, click the **Add** link to add attributes that are included in the permission. A single attribute is added at a time; to add multiple attributes, click the **Add** again to add another field.

If no attributes are set for the permission then, by default, all attributes are excluded.

9. Click the **Add** button to save the permission.

22.4.2.2. Creating New Permissions from the Command Line

A new permission is added using the **permission-add** command. All permissions require a list of attributes over which permission is granted (**--attr**), a list of allowed actions (**--permissions**), and the target entries for the ACI. There are four methods to identify the target entries:

- ▶ `--type` looks for an entry type like user, host, or service and then provides a list of all possible attributes for that entry type.
- ▶ `--filter` uses an LDAP filter to identify which entries the permission applies to.
- ▶ `--subtree` targets every entry beneath the specified subtree entry.
- ▶ `--targetgroup` specifies a user group, and all the user entries within that group are available through the ACL.

Example 22.1. Adding a Permission with a Filter

A filter can be any valid LDAP filter.

```
$ ipa permission-add "manage Windows groups" --filter="(!(objectclass=posixgroup))" --permissions=write --attrs=description
```

NOTE

The **permission-add** command does not validate the given LDAP filter. Verify that the filter returns the expected results before configuring the permission.

Example 22.2. Adding a Permission for a Subtree

All a subtree filter requires is a DN within the directory. Since IdM uses a simplified, flat directory tree structure, this can be used to target some types of entries, like automount locations, which are containers or parent entries for other configuration.

```
[jsmith@server ~]$ ipa permission-add "manage automount locations" --  
subtree="ldap://ldap.example.com:389/cn=automount,dc=example,dc=com" --  
permissions=write --attrs=automountmapname --attrs=automountkey --  
attrs=automountInformation
```


Example 22.3. Adding a Permission Based on Object Type

There seven object types that can be used to form a permission:

- ▶ user
- ▶ group
- ▶ host
- ▶ service
- ▶ hostgroup
- ▶ netgroup
- ▶ dnsrecord

Each type has its own set of allowed attributes. These can be set by using multiple `--attrs` options or by listing the options in a comma-separated list inside curly braces, such as `--option={val1,val2,val3}`.

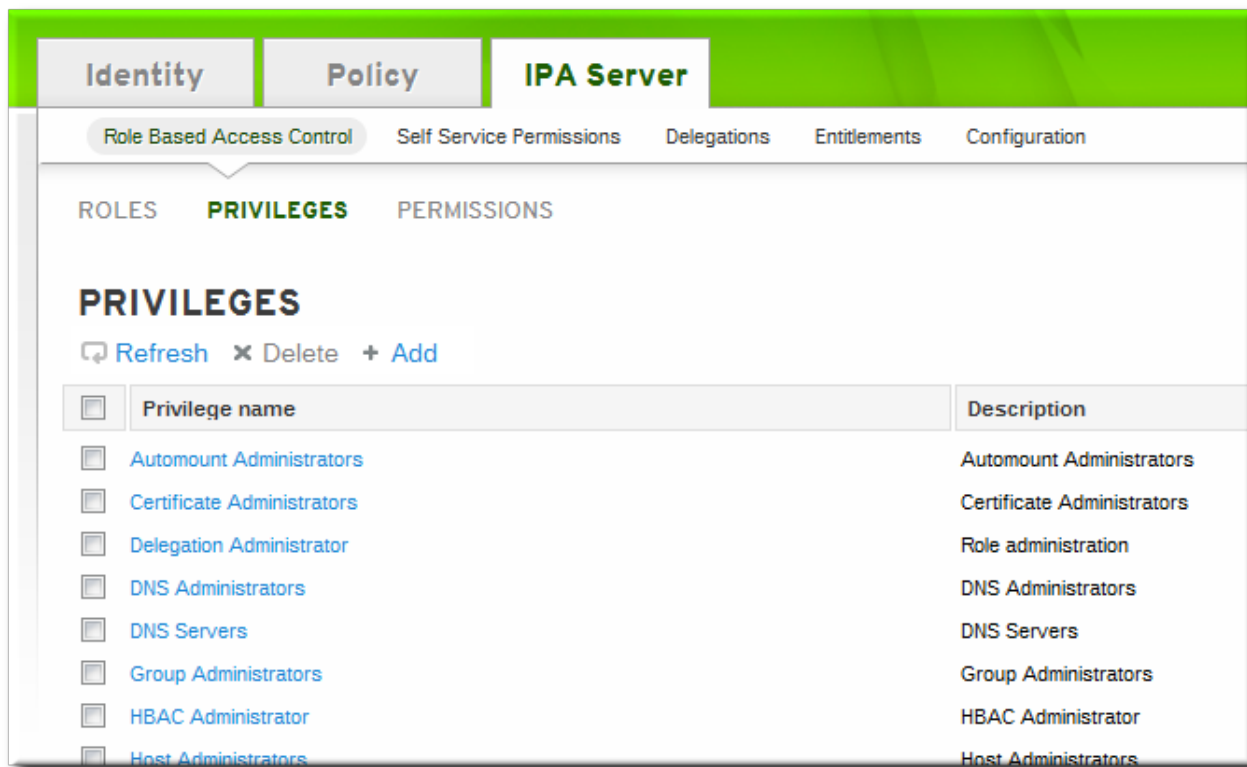
```
[jsmith@server ~]$ ipa permission-add "manage service" --permissions=all --  
type=service --attrs=krbprincipalkey --attrs=krbprincipalname --attrs=managedby
```

The attributes (`--attrs`) must exist and be allowed attributes for the given object type, or the permission operation fails with schema syntax errors.

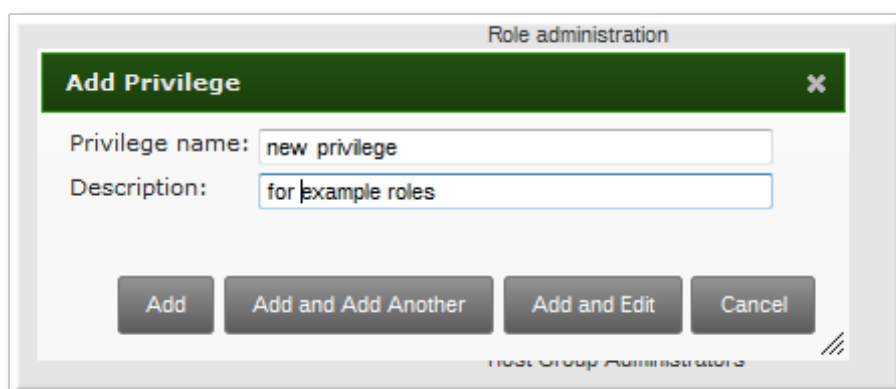
22.4.3. Creating New Privileges

22.4.3.1. Creating New Privileges from the Web UI

1. Open the **IPA Server** tab in the top menu, and select the **Role Based Access Control** subtab.
2. Select the **Privileges** task link.
3. Click the **Add** link at the top of the list of privileges.



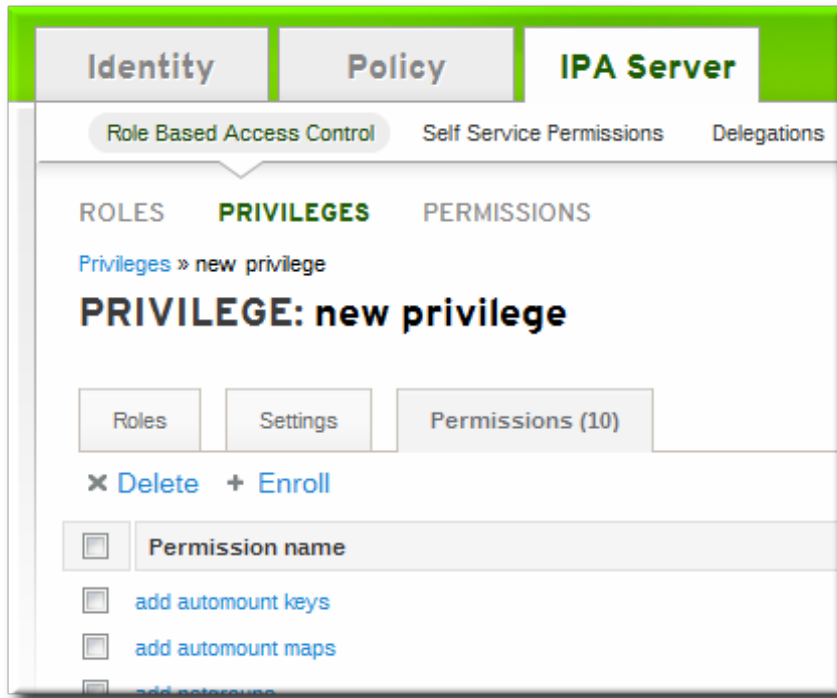
4. Enter the name and a description of the privilege.



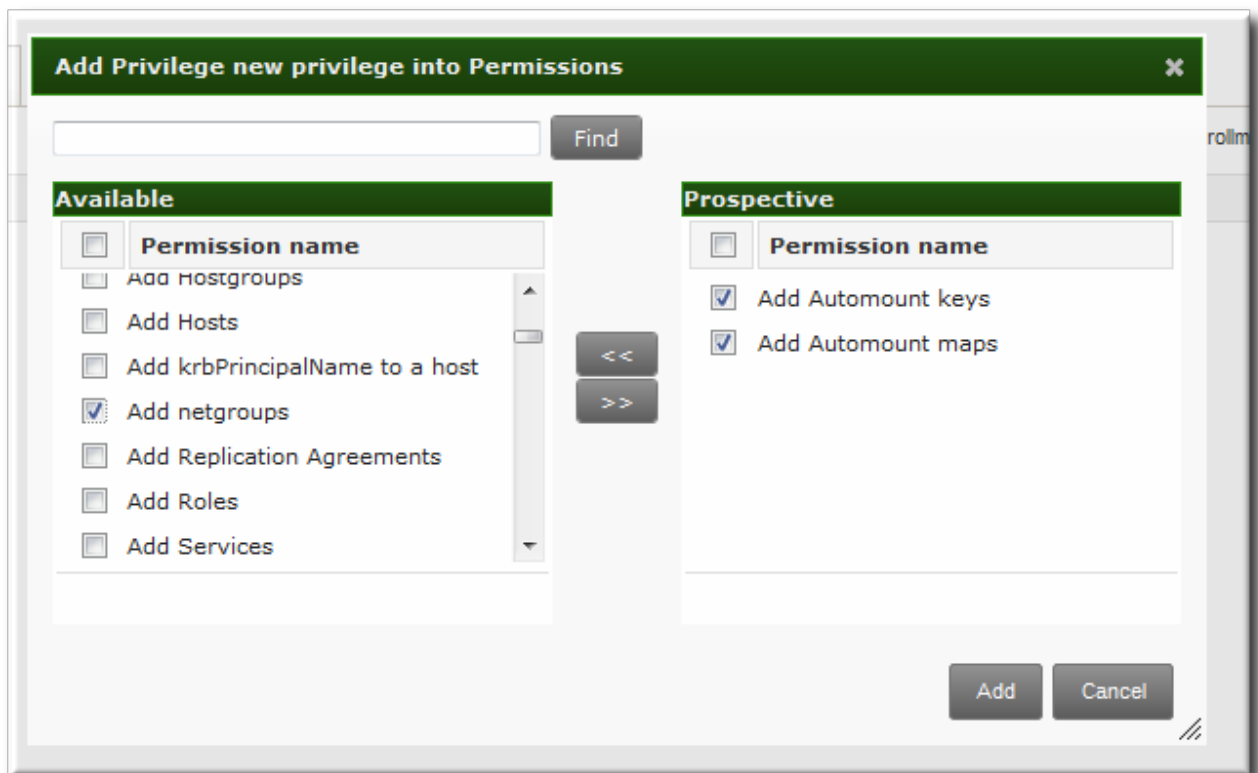
5. Click the **Add and Edit** button to go to the privilege configuration page to add permissions.

6. Select the **Permissions** tab.

7. Click the **Add** link at the top of the list of permissions to add permission to the privilege.



8. Click the checkbox by the names of the permissions to add, and click the right arrows button, >>, to move the permissions to the selection box.



9. Click the **Add** button.

22.4.3.2. Creating New Privileges from the Command Line

Privilege entries are created using the **privilege-add** command, and then permissions are added to the privilege group using the **privilege-add-permission** command.

1. Create the privilege entry.

```
[jsmith@server ~]$ ipa privilege-add "managing filesystems" --desc="for filesystems"
```

2. Assign the desired permissions. For example:

```
[jsmith@server ~]$ ipa privilege-add-permission "managing filesystems" --permissions="managing automount" --permissions="managing ftp services"
```

Chapter 23. Configuring IdM Servers

The IdM servers and backend services are configured with default settings that are applicable in most environments.

There are some configuration areas where the IdM server configuration can be tweaked to improve security or performance in certain situations.

This chapter covers information about the IdM configuration, including files and logs used by the IdM server, and procedures for updating the IdM server configuration itself.

23.1. Identity Management Files and Logs

Identity Management is a unifying framework that combines disparate Linux services into a single management context. However, the underlying technologies — such as Kerberos, DNS, 389 Directory Server, and Dogtag Certificate System — retain their own configuration files and log files. Identity Management directly manages each of these elements through their own configuration files and tools.

This section covers the directories, files, and logs used specifically by IdM. For more information about the configuration files or logs for a specific server used within IdM, see the product documentation.

23.1.1. A Reference of IdM Server Configuration Files and Directories

Table 23.1. IdM Server Configuration Files and Directories

Directory or File	Description
Server Configuration	
/etc/ipa/	The main IdM configuration directory.
/etc/ipa/default.conf	The primary configuration file for IdM.
/etc/ipa/server.conf	An optional configuration file for IdM. This does not exist by default, but can be created to load custom configuration when the IdM server is started.
/etc/ipa/cli.conf	An optional configuration file for IdM command-line tools. This does not exist by default, but can be created to apply custom configuration when the ipa is used.
/etc/ipa/ca.crt	The CA certificate issued by the IdM server's CA.
~/.ipa/	A user-specific IdM directory that is created on the local system in the system user's home directory the first time the user runs an IdM command.
IdM Logs	
~/.ipa/log/cli.log	The log file for errors returned by XML-RPC calls and responses by the IdM command-line tools. This is created in the home directory for the <i>system user</i> who runs the tools, who may have a different name than the IdM user.
/var/log/ipaclient-install.log	The installation log for the client service.
/var/log/ipaserver-install.log	The installation log for the IdM server.
/etc/logrotate.d/	The log rotation policies for DNS, SSSD, Apache, Tomcat, and Kerberos.
System Services	
/etc/rc.d/init.d/ipa/	The IdM server init script.

Directory or File	Description
Web UI	
/etc/ipa/html/	A symlink directory in the main configuration directory for the HTML files used by the IdM web UI.
/etc/httpd/conf.d/ipa.conf	The configuration files used by the Apache host for the web UI application.
/etc/httpd/conf.d/ipa-rewrite.conf	
/etc/httpd/conf/ipa.keytab	The keytab file used by the web UI service.
/usr/share/ipa/	The main directory for all of the HTML files, scripts, and stylesheets used by the web UI.
/usr/share/ipa/ipa-rewrite.conf	The configuration files used by the Apache host for the web UI application.
/usr/share/ipa/ipa.conf	
/usr/share/ipa/updates/	Contains any updated files, schema, and other elements for Identity Management.
/usr/share/ipa/html/	Contains the HTML files, JavaScript files, and stylesheets used by the web UI.
/usr/share/ipa/ipaclient/	Contains the JavaScript files used to access Firefox's autoconfiguration feature and set up the Firefox browser to work in the IdM Kerberos realm.
/usr/share/ipa/migration/	Contains HTML pages, stylesheets, and Python scripts used for running the IdM server in migration mode.
/usr/share/ipa/ui/	Contains all of the scripts used by the UI to perform IdM operations.
/var/log/httpd/	The log files for the Apache web server.
Kerberos	
/etc/krb5.conf	The Kerberos service configuration file.
SSSD	
/usr/share/sss/api.d/sss-ipa.conf	The configuration file used to identify the IdM server, IdM Directory Server, and other IdM services used by SSSD.
/var/log/sss/	The log files for SSSD.
389 Directory Server	
/var/lib/dirsrv/slapd- <i>REALM_NAME</i> /	All of the database associated with the Directory Server instance used by the IdM server.
/etc/dirsrv/slapd- <i>REALM_NAME</i> /	All of the configuration and schema files associated with the Directory Server instance used by the IdM server.
/var/log/dirsrv/slapd- <i>REALM_NAME</i> /	Log files associated with the Directory Server instance used by the IdM server.
Dogtag Certificate System	
/etc/pki-ca/	The main directory for the IdM CA instance.
/var/lib/pki/pki-tomcat/conf/ca/CS.cfg	The main configuration file for the IdM CA instance.
/var/log/dirsrv/slapd- <i>REALM</i> /	Log files associated with the Directory Server instance used by the IdM CA.
Cache Files	

Directory or File	Description
/var/cache/ipa/	Cache files for the IdM server and the IdM Kerberos password daemon.
System Backups	
/var/lib/ipa/sysrestore/	Contains backups of all of the system files and scripts that were reconfigured when the IdM server was installed. These include the original .conf files for NSS, Kerberos (both krb5.conf and kdc.conf), and NTP.
/var/lib/ipa-client/sysrestore/	Contains backups of all of the system files and scripts that were reconfigured when the IdM client was installed. Commonly, this is the sssd.conf file for SSSD authentication services.

23.1.2. IdM Domain Services and Log Rotation

The 389 Directory Server instances used by IdM as a backend and by the Dogtag Certificate System have their own internal log rotation policies. Log rotation settings such as the size of the file, the period between log rotation, and how long log files are preserved can all be configured by editing the 389 Directory Server configuration. This is covered in the [Red Hat Directory Server Administrator's Guide](#).

Several IdM domain services use the system **logrotate** service to handle log rotation and compression:

- ▶ named (DNS)
- ▶ httpd (Apache)
- ▶ tomcat6
- ▶ sssd
- ▶ krb5kdc (Kerberos domain controller)

Most of these policies use the **logrotate** defaults for the rotation schedule (weekly) and the archive of logs (four, for four weeks' worth of logs).

The individual policies set post-rotation commands to restart the service after log rotation, that a missing log file is acceptable, and compression settings.

Example 23.1. Default httpd Log Rotation File

```
[root@server ~]# cat /etc/logrotate.d/httpd
/var/log/httpd/*log {
    missingok
    notifempty
    sharedscripts
    delaycompress
    postrotate
        /sbin/service httpd reload > /dev/null 2>/dev/null || true
    endscript
}
```

There are other potential log settings, like compress settings and the size of the log file, which can be edited in either the global **logrotate** configuration or in the individual policies. The **logrotate** settings are covered in the [logrotate](#) manpage.

**WARNING**

Two policies set special **create** rules. All of the services create a new log file with the same name, default owner, and default permissions as the previous log. For the **named** and **tomcat6** logs, the **create** is set with explicit permissions and user/group ownership.

```
[root@server ~]# cat /etc/logrotate.d/named
/var/named/data/named.run {
    missingok
    create 0644 named named
    postrotate
        /sbin/service named reload 2> /dev/null > /dev/null || true
    endscrip
}
```

Do not change the permissions or the user and group which own the log files. This is required for both IdM operations and SELinux settings. Changing the ownership of the log rotation policy or of the files can cause the IdM domains services to fail or to be unable to start.

23.1.3. About default.conf and Context Configuration Files

Certain global defaults — like the realm information, the LDAP configuration, and the CA settings — are stored in the **default.conf** file. This configuration file is referenced when the IdM client and servers start and every time the **ipa** command is run to supply information as operations are performed.

The parameters in the **default.conf** file are simple *attribute=value* pairs. The attributes are case-insensitive and order-insensitive.

```
[global]
basedn=dc=example,dc=com
realm=EXAMPLE.COM
domain=example.com
xmlrpc_uri=https://server.example.com/ipa/xml
ldap_uri=ldapi://%2fvar%2frun%2fslapd-EXAMPLE-COM.socket
enable_ra=True
ra_plugin=dogtag
mode=production
```

When adding more configuration attributes or overriding the global values, users can create additional *context* configuration files. A **server.conf** and **cli.conf** file can be created to create different options when the IdM server is started or when the **ipa** command is run, respectively. The IdM server checks the **server.conf** and **cli.conf** files first, and then checks the **default.conf** file.

Any configuration files in the **/etc/ipa** directory apply to all users for the system. Users can set individual overrides by creating **default.conf**, **server.conf**, or **cli.conf** files in their local IdM directory, **~/.ipa/**. This optional file is merged with **default.conf** and used by the local IdM services.

23.1.4. Checking IdM Server Logs

Identity Management unifies several different Linux services, so it relies on those services' native logs for tracking and debugging those services.

The other services (Apache, 389 Directory Server, and Dogtag Certificate System) all have detailed logs and log levels. See the specific server documentation for more information on return codes, log formats,

and log levels.

Table 23.2. IdM Log Files

Service	Log File	Description	Additional Information
IdM server	/var/log/ipaserver-install.log	Server installation log	
IdM server	~/ipa/log/cli.log	Command-line tool log	
IdM client	/var/log/ipaclient-install.log	Client installation log	
Apache server	/var/log/httpd/access_log /var/log/httpd/error_log	These are standard access and error logs for Apache servers. Both the web UI and the XML-RPC command-line interface use Apache, so some IdM-specific messages will be recorded in the error log along with the Apache messages.	Apache log chapter
Dogtag Certificate System	/var/log/pki-ca-install.log	The installation log for the IdM CA.	
Dogtag Certificate System	/var/log/pki-ca/debug /var/log/pki-ca/system /var/log/pki-ca/transactions /var/log/pki-ca/signedAudit	These logs mainly relate to certificate operations. In IdM, this is used for service principals, hosts, and other entities which use certificates.	Logging chapter
389 Directory Server	/var/log/dirsrv/slapd-REALM/access /var/log/dirsrv/slapd-REALM/audit /var/log/dirsrv/slapd-REALM/errors	The access and error logs both contain detailed information about attempted access and operations for the domain Directory Server instance. The error log setting can be changed to provide very detailed output.	The access log is buffered, so the server only writes to the log every 30 seconds, by default. <ul style="list-style-type: none"> ▶ Monitoring servers and databases ▶ Log entries explained

Service	Log File	Description	Additional Information
389 Directory Server	<pre>/var/log/dirsrv/slapd-RE ALM/access /var/log/dirsrv/slapd-RE ALM/audit /var/log/dirsrv/slapd-RE ALM/errors</pre>	This directory server instance is used by the IdM CA to store certificate information. Most operational data here will be related to server-replica interactions.	<p>The access log is buffered, so the server only writes to the log every 30 seconds, by default.</p> <ul style="list-style-type: none"> ▶ Monitoring servers and databases ▶ Log entries explained
Kerberos	<pre>/var/log/krb5libs.log</pre>	This is the primary log file for Kerberos connections.	This location is configured in the krb5.conf file, so it could be different on some systems.
Kerberos	<pre>/var/log/krb5kdc.log</pre>	This is the primary log file for the Kerberos KDC server.	This location is configured in the krb5.conf file, so it could be different on some systems.
Kerberos	<pre>/var/log/kadmind.log</pre>	This is the primary log file for the Kerberos administration server.	This location is configured in the krb5.conf file, so it could be different on some systems.
DNS	<pre>/var/log/messages</pre>	DNS error messages are included with other system messages.	<p>DNS logging is <i>not</i> enabled by default. DNS logging is enabled by running the querylog command:</p> <pre style="border: 1px solid #ccc; border-radius: 10px; padding: 5px; display: inline-block;">/usr/sbin/rndc querylog</pre> <p>This begins writing log messages to the system's /var/log/messages file. To turn off logging, run the querylog command again.</p>

23.1.4.1. Enabling Server Debug Logging

Debug logging for the IdM server is set in the **server.conf** file.



NOTE

Editing the **default.conf** configuration file affects all IdM components, not only the IdM server.

1. Edit or create the `server.conf` file.

```
vim server.conf
```

2. Add the `debug` line and set its value to true.

```
[global]
debug=True
```

3. Restart the Apache daemon to load the changes.

```
service httpd restart
```

23.1.4.2. Debugging Command-Line Operations

Any command-line operation with the `ipa` command can return debug information by using the `-v` option. For example:

```
$ ipa -v user-show admin
ipa: INFO: trying https://ipaserver.example.com/ipa/xml
First name: John
Last name: Smythe
User login [jsmythe]:
ipa: INFO: Forwarding 'user_add' to server u'https://ipaserver.example.com/ipa/xml'
-----
Added user "jsmythe"
-----
  User login: jsmythe
  First name: John
  Last name: Smythe
  Full name: John Smythe
  Display name: John Smythe
  Initials: JS
  Home directory: /home/jsmythe
  GECOS field: John Smythe
  Login shell: /bin/sh
  Kerberos principal: jsmythe@EXAMPLE.COM
  UID: 1966800003
  GID: 1966800003
  Keytab: False
  Password: False
```

Using the option twice, `-vv`, displays the XML-RPC exchange:

```
$ ipa -vv user-add

ipa: INFO: trying https://ipaserver.example.com/ipa/xml
First name: Jane
Last name: Russell
User login [jrussell]:
ipa: INFO: Forwarding 'user_add' to server u'https://ipaserver.example.com/ipa/xml'
send: u'POST /ipa/xml HTTP/1.0\r\nHost: ipaserver.example.com\r\nAccept-Language:
en-us\r\nAuthorization: negotiate
YIIFgQYJKoZIHvcSAQICAQBugVvMIIIFbKADAgEFoQMCAQ6iBwMFACAAAACjggGHYYIBgzCCAX+gAwIBBaEZ
GxdSSFRTLkVORy5CT1MuUkVESEFULkNPTaI5MDegAwIBA6EwMC4bBEhUVFABJmRlbGwtcGUxODUwLTxLnJ
odHMuZW5nLmJvcy5yZWRoYXQyY29to4IBIDCCARygAwIBEqEDAgECooIBDgSCAQpV2YEWv03X+SENdUBf0h
MFGc3Fvnd51nELV0rIB1tfGVjpn1kuQxXKSfFKVD3vyAUqkii255T0mnXyTwayE93W1U4s0shetmG50zeU4
KDMhuupzQZSCb5xB0KPU4HMDvP1UnDFJUGck9tcqDJiYE+1JrEcZ8H+Vxvvl+nP6yIdUQKqoEuNhJaLWiiT
```

```

8ieAzk8zvmd1DzpfYtInGWe9D5ko1Bb7Npu0SEpdVJB2gnB5vszCIdLlZHM4JUqX8p21AZV0UYA6QZOWX90
XhqHdElKcuHCN2s9FBRoFYK83gf1voS7xSflZzAFsEGHNmdA0qXbzREKqUr8fmWmNvBGpDiR2ILQep091
L56JqSCA8owggPGoAMCARKigg09BIIDuarbB67zjmBu9Ax2K+0k1SD99pNv97h9yxo18c6NGLB4CmE8Mo3
9rL4MMXHe0S00Cbn+TD97XVGLu+cgkfvCuIG4PMMBoajuSnPmIf7qDvfa8IYDF1DDnRB7I//IXtCc/Z4rBba
xk0SMIRLrSkf5wha7awtN1JbizBMQw+J0Uln8JjsWxu0Ls75hbtIDbPf3fva3vWbF7kTBChBsheewSAlck9q
UglyNxA0DgFVvRrXbfbk51Uo++9qhnhh+zFSwepfv7US7RYK0Kx0KfD+uauY1ES+xlnMvK18ap2pcy0odBkk
u1kwJDND0JXUdSY08MxK2zb/UGWrVEf6GIsBgu122UGiHp6C+0fEu+nRrvt0RY65BgI8E1vm55fbb/9dQWN
cQhel9m6QJWPw0rgc+E5S0990N6x3Vv2+Zk17EmbZXinPd2tDe7fJ9cS9o/z7Qjw8z8vvSzHL4GX7FKi2H
JdBST3nEgOC8Pq046UnAJcA8pf1ZkwCK9xDWH+5PSph6WnvpRquqf/6cq+3jk3MEjCrX+JBJ8QL6AgN3oE
B4kvjZpAC+FFtkdX59VLDwfl/r0gMw3ZNk0nLLCLkiiYUMTEHZBzJw9kFbsX3LmS8qQA6rQ2L782DYisEly
wfZ/0Sax8JO/G62Zvy7BHy7SQSGIvcdA0afeNyfxaWM1vTpvSh0Grnllyfs3FhZAKnVcLYr1PTapR23uLgR
Mv+0c9wAbwuUDfKg0015vAd1j55VUYapgDEzi/URsLdVdcF4zigt4KrTByCwU2/pI6FmEPqB2tsjM2A8Jmq
A+9Nt8bjandNwCOWE0dF50zeL9P8oodWGkbRZLk4DLiurpCW1d6IyTBhPQ5qZqHJweoGiFa5y94zBpp27go
MPmE0BskXT0JQmveYfl0eKEMSzyiWPL2mwi7KEMtfGcpwTIGP2LRE/QxNvPGkwFF0+PDjZGVw+APkMKqc1
VXxhtJA/2NmBr01pZIIJ9R+41sR/QoACCXIUXJnhrTwwR1viKCB5Tec87gN+e0Cf0g+fmZuXNRscwJfhyQJ
YwJqdYzGtZW+h8jdWqa2EPCdWIQwyFagXNQ/aMvh1yNTECPLEgrMhYmFAUDLQzI2BDnfbDftIs0rXjSC0oZn
/Uaoqdr4F5syOrYAxH47bS6MW8CxyylreH8nT2qQXjenakLFHcNjt4M1n0c/igzNSeZ28qW9WSr4bCdkH+r
a3BVpT/AF0WHWkxGF4vwr/iNHCjq8fLF+DsAEx0Zs696Rg0fWZy079A\r\nUser-Agent:
xmlrpc.lib.py/1.0.1 (by www.pythonware.com)\r\nContent-Type: text/xml\r\nContent-
Length: 1240\r\n\r\n"
send: "<?xml version='1.0' encoding='UTF-8'?
>\n<methodCall>\n<methodName>user_add</methodName>\n<params>\n<param>\n<value>
<array><data>\n<value><string>jrussell</string></value>\n</data></array>
</value>\n</param>\n<param>\n<value><struct>\n<member>\n<name>all</name>\n<value>
<boolean>0</boolean>
</value>\n</member>\n<member>\n<name>displayname</name>\n<value><string>Jane
Russell</string></value>\n</member>\n<member>\n<name>cn</name>\n<value><string>Jane
Russell</string></value>\n</member>\n<member>\n<name>noprivate</name>\n<value>
<boolean>0</boolean></value>\n</member>\n<member>\n<name>uidnumber</name>\n<value>
<int>999</int></value>\n</member>\n<member>\n<name>raw</name>\n<value>
<boolean>0</boolean></value>\n</member>\n<member>\n<name>version</name>\n<value>
<string>2.11</string></value>\n</member>\n<member>\n<name>gecos</name>\n<value>
<string>Jane Russell</string>
</value>\n</member>\n<member>\n<name>sn</name>\n<value><string>Russell</string>
</value>\n</member>\n<member>\n<name>krbprincipalname</name>\n<value>
<string>jrussell@EXAMPLE.COM</string>
</value>\n</member>\n<member>\n<name>givenname</name>\n<value><string>Jane</string>
</value>\n</member>\n<member>\n<name>initials</name>\n<value><string>JR</string>
</value>\n</member>\n</struct></value>\n</param>\n</params>\n</methodCall>\n"
reply: 'HTTP/1.1 200 OK\r\n'
header: Date: Thu, 15 Sep 2011 00:50:39 GMT
header: Server: Apache/2.2.15 (Red Hat)
header: WWW-Authenticate: Negotiate
YIGZBqkqhkiG9xIBAgICAg+BiTCBhqADAgEFoQMCAQ+iejB4oAMCARKicQRvV15x6Zt9PbWNzvPEWkdu+3P
TCq/ZVKjGHM+1zDBz81GL/f+/Pr75zTuveLYn9de0C3k27vz96fn2HQsy9qVH7sfqn0RWGQWz1+kDKu6bJ/
Dp/mpJvicW5gSkCSH6/UCNuE4I0xqwabLIz8MM/5o
header: Connection: close
header: Content-Type: text/xml; charset=utf-8
body: "<?xml version='1.0' encoding='UTF-8'?
>\n<methodResponse>\n<params>\n<param>\n<value>
<struct>\n<member>\n<name>result</name>\n<value>
<struct>\n<member>\n<name>dn</name>\n<value>
<string>uid=jrussell,cn=users,cn=accounts,dc=example,dc=com</string>
</value>\n</member>\n<member>\n<name>has_keytab</name>\n<value><boolean>0</boolean>
</value>\n</member>\n<member>\n<name>displayname</name>\n<value><array>
<data>\n<value><string>Jane Russell</string></value>\n</data></array>
</value>\n</member>\n<member>\n<name>uid</name>\n<value><array><data>\n<value>
<string>jrussell</string></value>\n</data></array>
</value>\n</member>\n<member>\n<name>objectclass</name>\n<value><array>
<data>\n<value><string>top</string></value>\n<value><string>person</string>
</value>\n<value><string>organizationalperson</string></value>\n<value>
<string>inetorgperson</string></value>\n<value><string>inetuser</string>
</value>\n<value><string>posixaccount</string></value>\n<value>

```

```

<string>krbprincipalaux</string></value>\n<value><string>krbticketpolicyaux</string>
</value>\n<"
body: 'value><string>ipaobject</string></value>\n</data></array>
</value>\n</member>\n<member>\n<name>loginshell</name>\n<value><array>
<data>\n<value><string>/bin/sh</string></value>\n</data></array>
</value>\n</member>\n<member>\n<name>uidnumber</name>\n<value><array>
<data>\n<value><string>1966800004</string></value>\n</data></array>
</value>\n</member>\n<member>\n<name>initials</name>\n<value><array><data>\n<value>
<string>JR</string></value>\n</data></array>
</value>\n</member>\n<member>\n<name>gidnumber</name>\n<value><array>
<data>\n<value><string>1966800004</string></value>\n</data></array>
</value>\n</member>\n<member>\n<name>gecos</name>\n<value><array><data>\n<value>
<string>Jane Russell</string></value>\n</data></array>
</value>\n</member>\n<member>\n<name>sn</name>\n<value><array><data>\n<value>
<string>Russell</string></value>\n</data></array>
</value>\n</member>\n<member>\n<name>homedirectory</name>\n<value><array>
<data>\n<value><string>/home/jrussell</string></value>\n</data></array>
</value>\n</member>\n<member>\n<name>has_password</name>\n<value><boolean>0</'
body: 'boolean>
</value>\n</member>\n<member>\n<name>krbprincipalname</name>\n<value><array>
<data>\n<value><string>jrussell@EXAMPLE.COM</string></value>\n</data></array>
</value>\n</member>\n<member>\n<name>givenname</name>\n<value><array>
<data>\n<value><string>Jane</string></value>\n</data></array>
</value>\n</member>\n<member>\n<name>cn</name>\n<value><array><data>\n<value>
<string>Jane Russell</string></value>\n</data></array>
</value>\n</member>\n<member>\n<name>ipauniqueid</name>\n<value><array>
<data>\n<value><string>bba27e6e-df34-11e0-a5f4-001143d2c060</string>
</value>\n</data></array></value>\n</member>\n</struct>
</value>\n</member>\n<member>\n<name>value</name>\n<value><string>jrussell</string>
</value>\n</member>\n<member>\n<name>summary</name>\n<value><string>Added user
"jrussell"</string></value>\n</member>\n</struct>
</value>\n</param>\n</params>\n</methodResponse>\n'
-----
Added user "jrussell"
-----
  User login: jrussell
  First name: Jane
  Last name: Russell
  Full name: Jane Russell
  Display name: Jane Russell
  Initials: JR
  Home directory: /home/jrussell
  GECOS field: Jane Russell
  Login shell: /bin/sh
  Kerberos principal: jrussell@EXAMPLE.COM
  UID: 1966800004
  GID: 1966800004
  Keytab: False
  Password: False

```



IMPORTANT

The `-v` and `-vv` options are *global* options and must be used before the subcommand when running `ipa`.

23.2. Managing Certificates and Certificate Authorities

Almost every IdM topology will include an integrated Dogtag Certificate System to manage certificates for servers/replicas, hosts, users, and services within the IdM domain.

The Dogtag Certificate System configuration itself may require changes as the domain and the physical machines change.

23.2.1. Viewing Renewal Messages

All certificates issued by the IdM servers, such as host and user certificates (including subsystem and server certificates used by internal IdM services), are tracked by **certmonger** and automatically renewed as they near expiration.

As a certificate nears its expiration, **certmonger** logs messages in `/var/log/message`:

```
certmonger: Certificate named "NSS Certificate DB" in token "auditSigningCert cert-pki-ca" in database "/var/lib/pki-ca/alias" will not be valid after 20160204065136.
```

Once a certificate is renewed, then **certmonger** records another message to indicate that the renewal operation has occurred (or, possibly, that it failed).

```
Certificate named "NSS Certificate DB" in token "auditSigningCert cert-pki-ca" in database "/var/lib/pki-ca/alias" renew success
```

23.2.2. Renewing CA Certificates Issued by External CAs

All certificates issued by the IdM servers, such as host and user certificates (including subsystem and server certificates used by internal IdM services), are tracked by **certmonger** and automatically renewed as they near expiration.

There is one exception: the CA certificate itself. This certificate is not automatically renewed when it expires.

The CA certificate must be renewed through the external CA which issued it, and then manually updated in the certificate databases (also called *NSS databases*). This is done using the **certutil** NSS security tool, which is described in detail in the [Mozilla NSS developer documentation](#).



NOTE

There is no way to renew the CA certificate using the IdM web UI or IdM command-line tools.

There are some requirements for renewing the certificate:

- ▶ The CA's private key must not change.
- ▶ The new certificate should have the same subject name as the original certificate.



NOTE

The external CA which issued the certificate must allow renewals.

To renew a CA certificate issued by an external CA:

1. On the IdM server machine, get the password for the security database. This is the **internal** parameter in the password file.

```
[root@server ~]# cat /var/lib/pki-ca/conf/password.conf

internal=818724830794
internaldb=secret12
replicationdb=-673050111
```

2. List the key and nickname for the certificate being renewed. In order to renew a certificate, the key pairs used to generate and the subject name given to the new certificate must be the same as the one in the old certificate.

```
[root@server ~]# certutil -K -d /var/lib/pki-ca/alias

certutil: Checking token "NSS Certificate DB" in slot "NSS User Private Key and
Certificate Services"
Enter Password or Pin for "NSS Certificate DB":
< 0> rsa      42aaefe9bb68c4bbb32a71417af750623cfc167c   ocspsigningCert cert-
pki-ca
< 1> rsa      71e2ef0f481f7b916cc637b3e029468e1b008a3e   subsystemCert cert-
pki-ca
< 2> rsa      78adf578e36361d75e29b1a371196d1a079f5106   auditSigningCert
cert-pki-ca
< 3> rsa      4d16745ea6026964e503448c6ee958f4ceed479a   caSigningCert cert-
pki-ca
< 4> rsa      88106bb292d293d0955a4d9e67d39f034f04b521   Server-Cert cert-
pki-ca
```

3. Copy the alias directory as a backup.
4. Delete the original certificate from the certificate database. For example:

```
[root@server ~]# certutil -D -n "caSigningCert cert-pki-ca" -d /var/lib/pki-
ca/alias
```

5. Run the certutil command with the options set to the values in the existing certificate.

```
[root@server ~]# certutil -d /var/lib/pki-ca/alias -R -k "caSigningCert cert-
pki-ca" -s "cn=CA Authority,o=Example Domain" -a -o example-req2.csr
```

The difference between generating a new certificate and key pair and renewing the certificate is the value of the **-k** option. To generate an entirely new request and key pair, then **-k** sets the key type and is used with **-g**, which sets the bit length. For a renewal request, the **-k** option uses the certificate nickname to access the existing key pair stored in the security database.

6. Submit the generated request for approval *with the CA which originally issued the certificate*. The submission and retrieval process is different, depending on the CA being used.
7. Once the CA certificate is retrieved, add the new certificate into the certificate database for the CA. Set the trust for the CA certificate to *CT,C,C*.

```
[root@server ~]# certutil -d /var/lib/pki-ca/alias -A -n "caSigningCert cert-
pki-ca" -t "CT,C,C" -i /tmp/CAcert.crt -a
```

8. To verify that the certificate was properly installed, list the certificates in the database.

```
[root@server ~]# certutil -L -d /var/lib/pki-ca/alias
```

23.2.3. Starting IdM with Expired Certificates

If IdM administrative server certificates expire, then most IdM services will be inaccessible, including administrative services. The underlying Apache and 389 Directory Server services can be configured to allow SSL access to those services, even if the certificates are expired.



NOTE

Allowing limited access with expired certificates permits Apache, Kerberos, DNS, and 389 Directory Server services to continue working. With those services active, users are able to log into the domain.

Client services such as **sudo** that require SSL for access will still fail because of the expired server certificates.

1. Change the **mod_nss** configuration for the Apache server to not enforce valid certificates, in the **NSSEnforceValidCerts** parameter. If this parameter is not already in the file, then add it.

Set the value to **off**.

```
[root@ipaserver ~]# vim /etc/httpd/conf.d/nss.conf
NSSEnforceValidCerts off
```

2. Restart Apache.

```
[root@ipaserver ~]# systemctl restart httpd.service
```

3. Change the **nsslapd-validate-cert** attribute in the 389 Directory Server configuration to **warn** instead of **true** to disable validity checks.

```
[root@ipaserver ~]# ldapmodify -D "cn=directory manager" -w secret -p 389 -h
ipaserver.example.com

dn: cn=config
changetype: modify
replace: nsslapd-validate-cert
nsslapd-validate-cert: warn
```

4. Restart 389 Directory Server.

```
[root@ipaserver ~]# systemctl restart dirsrv.service
```

23.2.4. Configuring Alternate Certificate Authorities

IdM creates a Dogtag Certificate System certificate authority (CA) during the server installation process. To use an external CA, it is possible to create the required server certificates and then import them into the 389 Directory Server and the HTTP server, which require IdM server certificates.

 TIP

Save an ASCII copy of the CA certificate as `/usr/share/ipa/html/ca.crt`. This allows users to download the correct certificate when they configure their browsers.

1. Use the `ipa-server-certinstall` command to install the certificate.

```
# /usr/sbin/ipa-server-certinstall -d /path/to/pkcs12.p12
```

2. To keep using browser autoconfiguration in Firefox, regenerate the `/usr/share/ipa/html/configure.jar` file.
 - a. Create a directory, and then create the new security databases in that directory.

```
# mkdir /tmp/signdb
# certutil -N -d /tmp/signdb
```

- b. Import the PKCS #12 file for the signing certificate into that directory.

```
# pk12util -i /path/to/pkcs12.p12 -d /tmp/signdb
```

- c. Make a temporary signing directory, and copy the IdM JavaScript file to that directory.

```
# mkdir /tmp/sign
# cp /usr/share/ipa/html/preferences.html /tmp/sign
```

- d. Use the object signing certificate to sign the JavaScript file and to regenerate the `configure.jar` file.

```
# signtool -d /tmp/signdb -k Signing_cert_nickname -Z
/usr/share/ipa/html/configure.jar -e .html /tmp/sign
```

23.2.5. Changing Which Server Generates CRLs

The master CA is the authoritative CA; it has the root CA signing key and generates CRLs which are distributed among the other servers and replicas in the topology. In general, the first IdM server installed owns the master CA in the PKI hierarchy. All subsequent replica databases are cloned (or copied) directly from that master database as part of running `ipa-replica-install`.

 NOTE

The only reason to replace the master server is if the master server is being taken offline. There has to be a root CA which can issue CRLs and ultimately validate certificate checks.

As explained in [Section 1.3.1, “About IdM Servers and Replicas”](#), all servers and replicas work together to share data. This arrangement is the *server topology*.

Servers (created with `ipa-server-install`) is almost always created to host certificate authority services ^[6]. These are the *original* CA services. When a replica is created (with `ipa-replica-install`), it is based on the configuration of an existing server. A replica *can* host CA services, but this is not required.

After they are created, servers and replicas are equal peers in the server topology. They are all read-write data masters and replicate information to each other through multi-master replication. Servers and replicas which host a CA are also equal peers in the topology. They can all issue certificates and keys to IdM clients, and they all replicate information amongst themselves.

The only difference between a server and a replica is which IdM instance issues the CRL.

When the first server is installed, it is configured to issue CRLs. In its CA configuration file (`/var/lib/pki-ca/conf/CS.cfg`), it has CRL generation enabled:

```
ca.crl.issuingPointId.enableCRLCache=true
ca.crl.issuingPointId.enableCRLUpdates=true
ca.certStatusUpdateInterval=600
ca.listenToCloneModifications=false
```

All replicas point to that master CA as the source for CRL information and disable the CRL settings:

```
master.ca.agent.host=hostname
master.ca.agent.port=port number
ca.certStatusUpdateInterval=0
ca.crl.issuingPointId.enableCRLUpdates=false
```

There must be one instance somewhere in the IdM topology which issues CRLs. If the original server is going to be taken offline or decommissioned, a replica needs to be configured to take its place. *Promoting* a replica to a master server changes its configuration and enables it to issue CRLs and function as the root CA.

To move CRL generation from a server to a replica, **first decommission the original master CA**.

1. Identify which server instance is the master CA server. Both CRL generation *and* renewal operations are handled by the same CA server. So, the master CA can be identified by having the **renew_ca_cert** certificate being tracked by **certmonger**.

```
[root@server ~]# getcert list -d /var/lib/pki-ca/alias -n "subsystemCert cert-pki-ca" | grep post-save
post-save command: /usr/lib64/ipa/certmonger/renew_ca_cert "subsystemCert cert-pki-ca"
```

2. **On the original master CA**, disable tracking for all of the original CA certificates.

```
[root@server ~]# getcert stop-tracking -d /etc/pki/pki-tomcat/alias -n "auditSigningCert cert-pki-ca"
Request "20141127184547" removed.
[root@server ~]# getcert stop-tracking -d /etc/pki/pki-tomcat/alias -n "ocspSigningCert cert-pki-ca"
Request "20141127184548" removed.
[root@server ~]# getcert stop-tracking -d /etc/pki/pki-tomcat/alias -n "subsystemCert cert-pki-ca"
Request "20141127184549" removed.
[root@server ~]# getcert stop-tracking -d /etc/httpd/alias -n ipaCert
Request "20141127184550" removed.
```

3. Reconfigure the original master CA to retrieve renewed certificates from a new master CA.
 - a. Copy the renewal helper into the **certmonger** directory, and set the appropriate permissions.

```
[root@server ~]# cp /usr/share/ipa/ca_renewal
/var/lib/certmonger/cas/ca_renewal
[root@server ~]# chmod 0600 /var/lib/certmonger/cas/ca_renewal
```

- b. Update the SELinux configuration.

```
[root@server ~]# /sbin/restorecon /var/lib/certmonger/cas/ca_renewal
```

- c. Restart **certmonger**.

```
[root@server ~]# systemctl restart certmonger.service
```

- d. Check that the CA is listed to *retrieve* certificates. This is printed in the CA configuration.

```
[root@server ~]# getcert list-cas
...
CA 'dogtag-ipa-retrieve-agent-submit':
    is-default: no
    ca-type: EXTERNAL
    helper-location: /usr/libexec/certmonger/dogtag-ipa-retrieve-agent-
submit
```

- e. Get the CA certificate database PIN.

```
[root@server ~]# grep internal= /var/lib/pki/pki-
tomcat/conf/password.conf
```

- f. Configure **certmonger** track the certificates for external renewal. This requires the database PIN.

```
[root@server ~]# getcert start-tracking -c dogtag-ipa-retrieve-agent-
submit -d /var/lib/pki-ca/alias -n "auditSigningCert cert-pki-ca" -B
/usr/lib64/ipa/certmonger/stop_pkicad -C
'/usr/lib64/ipa/certmonger/restart_pkicad "auditSigningCert cert-pki-ca"'
-T "auditSigningCert cert-pki-ca" -P database_pin
New tracking request "20141127184743" added.
[root@server ~]# getcert start-tracking -c dogtag-ipa-retrieve-agent-
submit -d /var/lib/pki-ca/alias -n "ocspSigningCert cert-pki-ca" -B
/usr/lib64/ipa/certmonger/stop_pkicad -C
'/usr/lib64/ipa/certmonger/restart_pkicad "ocspSigningCert cert-pki-ca"'
-T "ocspSigningCert cert-pki-ca" -P database_pin
New tracking request "20141127184744" added.
[root@server ~]# getcert start-tracking -c dogtag-ipa-retrieve-agent-
submit -d /var/lib/pki-ca/alias -n "subsystemCert cert-pki-ca" -B
/usr/lib64/ipa/certmonger/stop_pkicad -C
'/usr/lib64/ipa/certmonger/restart_pkicad "subsystemCert cert-pki-ca"' -T
"subsystemCert cert-pki-ca" -P database_pin
New tracking request "20141127184745" added.
[root@server ~]# getcert start-tracking -c dogtag-ipa-retrieve-agent-
submit -d /etc/httpd/alias -n ipaCert -C
/usr/lib64/ipa/certmonger/restart_httpd -T ipaCert -p
/etc/httpd/alias/pwdfile.txt
New tracking request "20141127184746" added.
```

4. Stop CRL generation on the original master CA.

- a. Stop CA service:

```
[root@server ~]# systemctl stop pki-tomcatd@pki-tomcat.service
```

- b. Open the CA configuration file.

```
[root@server ~]# vim /etc/pki/pki-tomcat/ca/CS.cfg
```

- c. Change the values of the **ca.cr1.MasterCRL.enableCRLCache** and **ca.cr1.MasterCRL.enableCRLUpdates** parameters to **false** to disable CRL generation.

```
ca.cr1.MasterCRL.enableCRLCache=false
ca.cr1.MasterCRL.enableCRLUpdates=false
```

- d. Start the CA service:

```
[root@server ~]# systemctl start pki-tomcatd@pki-tomcat.service
```

5. Configure Apache to redirect CRL requests to the new master.

- a. Open the CA proxy configuration.

```
[root@server ~]# vim /etc/httpd/conf.d/ipa-pki-proxy.conf
```

- b. Uncomment the **RewriteRule** on the last line:

```
RewriteRule ^/ipa/crl/MasterCRL.bin
https://server.example.com/ca/ee/ca/getCRL?
op=getCRL&crlIssuingPoint=MasterCRL [L,R=301,NC]
```

- c. Restart Apache:

```
[root@server ~]# systemctl restart httpd.service
```

Then, set up a replica as a new master:

1. Stop tracking the CA's certificates to change the renewal settings. As a clone, the CA was configured to retrieve its renewed certificates from the master; as the master CA, it will issue the renewed certificates.

```
[root@server ~]# getcert stop-tracking -d /etc/pki/pki-tomcat/alias -n
"auditSigningCert cert-pki-ca"
Request "20141127163822" removed.
[root@server ~]# getcert stop-tracking -d /etc/pki/pki-tomcat/alias -n
"ocspSigningCert cert-pki-ca"
Request "20141127163823" removed.
[root@server ~]# getcert stop-tracking -d /etc/pki/pki-tomcat/alias -n
"subsystemCert cert-pki-ca"
Request "20141127163824" removed.
[root@server ~]# getcert stop-tracking -d /etc/httpd/alias -n ipaCert
Request "20141127164042" removed.
```

2. Get the PIN for the CA certificate database.

```
[root@server ~]# grep internal= /var/lib/pki/pki-tomcat/conf/password.conf
```

3. Set up the certificates to be tracked in **certmonger** using the renewal agent profile.

```
[root@server ~]# getcert start-tracking -c dogtag-ipa-renew-agent -d
/etc/pki/pki-tomcat/alias -n "auditSigningCert cert-pki-ca" -B
/usr/lib64/ipa/certmonger/stop_pkicad -C
'/usr/lib64/ipa/certmonger/renew_ca_cert "auditSigningCert cert-pki-ca"' -P
database_pin
New tracking request "20141127185430" added.
[root@server ~]# getcert start-tracking -c dogtag-ipa-renew-agent -d
/etc/pki/pki-tomcat/alias -n "ocspSigningCert cert-pki-ca" -B
/usr/lib64/ipa/certmonger/stop_pkicad -C
'/usr/lib64/ipa/certmonger/renew_ca_cert "ocspSigningCert cert-pki-ca"' -P
database_pin
New tracking request "20141127185431" added.
[root@server ~]# getcert start-tracking -c dogtag-ipa-renew-agent -d
/etc/pki/pki-tomcat/alias -n "subsystemCert cert-pki-ca" -B
/usr/lib64/ipa/certmonger/stop_pkicad -C
'/usr/lib64/ipa/certmonger/renew_ca_cert "subsystemCert cert-pki-ca"' -P
database_pin
New tracking request "20141127185432" added.
[root@server ~]# getcert start-tracking -c dogtag-ipa-renew-agent -d
/etc/httpd/alias -n ipaCert -C /usr/lib64/ipa/certmonger/renew_ra_cert -p
/etc/httpd/alias/pwdfilename.txt
New tracking request "20141127185433" added.
```

4. Configure the new master CA to generate CRLs.

a. Stop CA service:

```
[root@server ~]# systemctl stop pki-tomcatd@pki-tomcat.service
```

b. Open the CA configuration file.

```
[root@server ~]# vim /etc/pki/pki-tomcat/ca/CS.cfg
```

c. Change the values of the *ca.cr1.MasterCRL.enableCRLCache* and *ca.cr1.MasterCRL.enableCRLUpdates* parameters to **true** to enable CRL generation.

```
ca.cr1.MasterCRL.enableCRLCache=true
ca.cr1.MasterCRL.enableCRLUpdates=true
```

d. Start CA service:

```
[root@server ~]# systemctl start pki-tomcatd@pki-tomcat.service
```

5. Configure Apache to disable redirect CRL requests. As a clone, all CRL requests were routed to the original master. As the new master, this instance will respond to CRL requests.

a. Open the CA proxy configuration.

```
[root@server ~]# vim /etc/httpd/conf.d/ipa-pki-proxy.conf
```

b. Comment out the **RewriteRule** argument on the last line:

```
#RewriteRule ^/ipa/crl/MasterCRL.bin
https://server.example.com/ca/ee/ca/getCRL?
op=getCRL&crlIssuingPoint=MasterCRL [L,R=301,NC]
```

c. Restart Apache:

```
[root@server ~]# systemctl start httpd.service
```

23.2.6. Configuring OCSP Responders

A certificate is created with a validity period, meaning it has a point where it expires and is no longer valid. The expiration date is contained in the certificate itself, so a client always checks the validity period in the certificate to see if the certificate is still valid.

However, a certificate can also be revoked before its validity period is up, but this information is not contained in the certificate. A CA publishes a *certificate revocation list* (CRL), which contains a complete list of every certificate that was issued by that CA and subsequently revoked. A client can check the CRL to see if a certificate within its validity period has been revoked and is, therefore, invalid.

Validity checks are performed using the online certificate status protocol (OCSP), which sends a request to an *OCSP responder*. Each CA integrated with the IdM server uses an internal OCSP responder, and any client which runs a validity check can check the IdM CA's internal OCSP responder.

Every certificate issued by the IdM CA puts its OCSP responder service URL in the certificate. For example:

```
http://ipaserver.example.com:9180/ca/ocsp
```



NOTE

For the IdM OCSP responder to be available, port 9180 needs to be open in the firewall.

23.2.6.1. Using an OSCP Responder with SELinux

Clients can use the Identity Management OCSP responder to check certificate validity or to retrieve CRLs. A client can be a number of different services, but is most frequently an Apache server and the `mod_revocator` module (which handles CRL and OCSP operations).

The Identity Management CA has an OCSP responder listening over port 9180, which is also the port available for CRL retrieval. This port is protected by default SELinux policies to prevent unauthorized access. If an Apache server attempts to connect to the OCSP port, then it may be denied access by SELinux.

The Apache server, on the local machine, must be granted access to port 9180 for it to be able to connect to the Identity Management OCSP responder. There are two ways to work around this by changing the SELinux policies:

- ▶ Edit the SELinux policy to allow Apache servers using the `mod_revocator` module to connect to port 9180:

```
semodule -i revoker.pp
```

- ▶ Generate a new SELinux policy to allow access based on the SELinux error logs for the `mod_revocator` connection attempt.

```
audit2allow -a -M revoker
```

23.2.6.2. Changing the CRL Update Interval

The CRL file is automatically generated by the Dogtag Certificate System CA every four hours. This interval can be changed by editing the Dogtag Certificate System configuration.

1. Stop the CA server.

```
[root@server ~]# systemctl stop pki-tomcatd@pki-tomcat.service
```

2. Open the **CS.cfg** file.

```
[root@server ~]# vim /var/lib/pki/pki-tomcat/conf/ca/CS.cfg
```

3. Change the **ca.cr1.MasterCRL.autoUpdateInterval** to the new interval setting.
4. Restart the CA server.

```
[root@server ~]# systemctl start pki-tomcatd@pki-tomcat.service
```

23.2.6.3. Changing the OCSP Responder Location

Each IdM server generates its own CRL. Likewise, each IdM server uses its own OCSP responder, with its own OCSP responder URL in the certificates it issues.

A DNS CNAME can be used by IdM clients, and then from there be redirected to the appropriate IdM server OCSP responder.

1. Open the certificate profile.

```
[root@server ~]# vim /var/lib/pki-ca/profiles/ca/caIPAserviceCert.cfg
```

2. Change the **policyset.serverCertSet.9.default.params.cr1DistPointsPointName_0** parameter to the DNS CNAME hostname.
3. Restart the CA server.

```
service pki-ca restart
```

That change must be made on every IdM server, with the **cr1DistPointsPointName_0** parameter set to the same hostname.

23.3. Disabling Anonymous Binds

Accessing domain resources and running client tools always require Kerberos authentication. However, the backend LDAP directory used by the IdM server allows anonymous binds by default. This potentially opens up all of the domain configuration to unauthorized users, including information about users, machines, groups, services, netgroups, and DNS configuration.

It is possible to disable anonymous binds on the 389 Directory Server instance by using LDAP tools to reset the **nsslapd-allow-anonymous-access** attribute.

1. Change the **nsslapd-allow-anonymous-access** attribute to **rootdse**.

```
ldapmodify -x -D "cn=Directory Manager" -w secret -h server.example.com -p 389
```

```
Enter LDAP Password:
```

```
dn: cn=config
changetype: modify
replace: nsslapd-allow-anonymous-access
nsslapd-allow-anonymous-access: rootdse
```



IMPORTANT

Anonymous access can be completely allowed (on) or completely blocked (off). However, completely blocking anonymous access also blocks external clients from checking the server configuration. LDAP and web clients are not necessarily domain clients, so they connect anonymously to read the root DSE file to get connection information.

The **rootdse** allows access to the root DSE and server configuration *without* any access to the directory data.

- Restart the 389 Directory Server instance to load the new setting.

```
service dirsrv restart
```

23.4. Changing Domain DNS Configuration

23.4.1. Setting DNS Entries for Multi-Homed Servers

Some server machines may support multiple network interface cards (NICs). Multi-homed machines typically have multiple IPs, all assigned to the same hostname. This works fine in IdM most of the time because it listens on all available interfaces, except localhost. For a server to be available through any NIC, edit the DNS zone file and add entries for each IP address. For example:

```
ipaserver IN A 192.168.1.100
ipaserver IN A 192.168.1.101
ipaserver IN A 192.168.1.102
```

23.4.2. Setting up Additional Name Servers

The list of configured nameservers in `/etc/resolv.conf` only contains the IdM server itself when configuration is finished. If the local **named** service ever crashes, then the IdM server is unable to run and DNS services for the entire domain are no longer available.

Other DNS servers should be added manually to the IdM server's `/etc/resolv.conf` file.

```
[root@server ~]# vim /etc/resolv.conf

search example.com

; the IdM server
nameserver 127.0.0.1

; backup DNS servers
nameserver 198.51.100.0
nameserver 192.0.2.0
```


**NOTE**

A default limit of three servers is set for the `/etc/resolv.conf` file.

Other information about configuring the `/etc/resolv.conf` file is given in the `resolv.conf` manpage.

23.4.3. Changing Load Balancing for IdM Servers and Replicas

As [Section 1.3.1, “About IdM Servers and Replicas”](#) touches on, IdM servers and replicas in the domain automatically share the load among instances to maintain performance. The load balancing is defined first by the *priority* set for the server or replica in its SRV entry, and then by the *weight* of that instance for servers/replicas with the same priority. Clients contact servers/replicas with the highest priority and then work their way down.

Load balancing is done automatically by servers, replicas, and clients. The configuration used for load balancing can be altered by changing the priority and the weight given to a server or replica.

(All replicas are initially created with the same priority.)

For example, this gives server1 a higher priority than server 2, meaning it will be contacted first:

```
$ ipa dnsrecord-add server.example.com _ldap._tcp --srv-rec="0 100 389
server1.example.com."

$ ipa dnsrecord-add server.example.com _ldap._tcp --srv-rec="1 100 389
server2.example.com."
```

More information about SRV records is in [RFC 2782](#).

[6] The only exception to this is if system certificates are manually loaded during the installation for a CA-less installation. Otherwise, a Dogtag Certificate System instance is installed and configured.

Chapter 24. Managing the Server-Replica Relationships

[Section 1.3.1, “About IdM Servers and Replicas”](#) describes the relationship between servers (original instances) and replicas (copied instances) in Identity Management. This network of related servers and replicas is the **topology** of the Identity Management domain.

The topology is defined by a series of agreements set between IdM servers and replicas that copy data between instances. These replication agreements identify what servers and replicas are active in the topology (meaning, recognized by other servers and sending and updating information).

Changing the IdM topology by adding or removing replicas and servers is done by managing the replication agreements between instances. These replication agreements are created between the master server and the replicas automatically by the `ipa-replica-install` command as replicas are created. When replicas are removed or when two new replicas need to communicate with each other, those replication agreements must be managed manually.

24.1. Managing Replication Agreements Between IdM Servers

Information is shared between the IdM servers and replicas using *multi-master replication*. What this means is that servers and replicas all receive updates and, therefore, are data masters. The domain information is copied between the servers and replicas using *replication*.

24.1.1. The Topology of Replication Agreements

As replicas are added to the domain, mutual replication agreements are automatically created between the replica and the server it is based on. Additional replication agreements can be created between other replicas and servers or the configuration of the replication agreement can be changed using the `ipa-replica-manage` command.

When a replica is created, the replica install script creates two replication agreements: one going from the master server to the replica and one going from the replica to the master server.

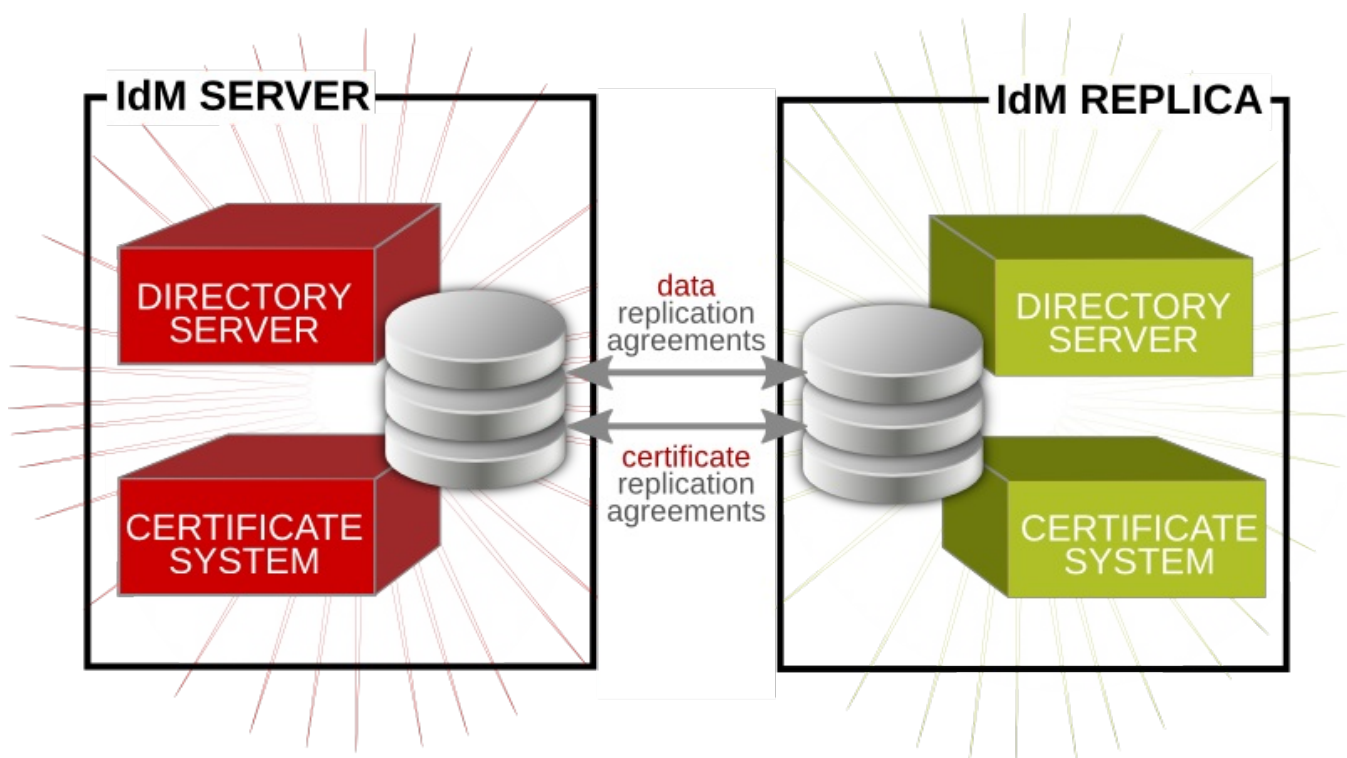


Figure 24.1. Server and Replica Agreements

As more replicas and servers are added to the domain, there can be replicas and servers that have replication agreements to other servers and replicas but not between each other. For example, the first IdM server is Server A. Then, the admin creates Replica B, and the install script creates a Server A => Replica B replication agreement and a Replica B => Server A replication agreement. Next, the admin creates Replica C based on Server A. The install script creates a Server A => Replica C replication agreement and a Replica C => Server A replication agreement. Replica B and Replica C both have replication agreements with Server A — but they do not have agreements with each other. For data availability, consistency, failover tolerance, and performance, it can be beneficial to create a pair of replication agreements between Replica B and Replica C, even though their data will eventually be replicated over to each other through replication with Server A.

24.1.2. Types of Replication Agreements

There are three types of replication agreements for IdM servers:

- ▶ Ones to replicate directory data (such as users, groups, and policies)
- ▶ Ones to replicate user information with an Active Directory server (a synchronization agreement)
- ▶ Ones to replicate certificate and key data

24.1.3. Commands to Manage Replication Agreements

Agreements for both the directory data and the synchronized user data are managed using the **ipa-replica-manage** command. Agreements for the certificate and key data are managed using the **ipa-csreplica-manage** command.

These tools have the same commands, arguments, and format. The differences relate to which subtree within the IdM directory is being replicated.

Table 24.1. Replica Management Commands

Command	Description
connect	Create a new replication agreement between the two specified servers.
disconnect	Removes a replication agreement between the two specified servers.
del	Removes all replication agreements for the given server and removes it entirely from the replication topology. This is used to decommission a server/replica, not simply to change the replication agreements for it.
list	Lists the replication agreements. If no server is given, then it lists all servers involved in the replication topology. If a server is specified, then it lists all of the servers with which it has a replication agreement.
re-initialize	Essentially restarts replication for the given server. It retrieves all of the replicated data from the original source.
force-sync	Forces an immediate, incremental update (replication event) for the specified server.

Command	Description
list-ruv	Lists the replication ID (a backend identifier) for each server within the replication topology. <i>For the ipa-replica-manage command only.</i>
clean-ruv	Runs a special task to remove all outstanding updates associated with a given replication ID. <i>For the ipa-replica-manage command only.</i>

24.1.4. Listing Replication Agreements

The **ipa-replica-manage** command can list all of the servers and replicas in the replication topology, using the **list** command:

```
[root@server ~]# ipa-replica-manage list
srv1.example.com: master
srv2.example.com
srv3.example.com
srv4.example.com
```

After getting the server/replica list, then it is possible to list the replication agreements for the server. These are the other servers/replicas to which the specified server sends updates.

```
[root@server ~]# ipa-replica-manage list srv1.example.com
srv2.example.com
srv3.example.com
```

The same thing can be done for certificate replication agreements by using the **ipa-csreplica-manage** command.

24.1.5. Creating Replication Agreements

Replication agreements are created by *connecting* one server to another server. When a replica is created from a master server, those two servers have a replication agreement between them. However, other servers within the topology do not have a replication agreement with the new replica. While data will most likely be replicated across the topology eventually, adding additional replication agreements can improve performance and provide additional failover. (In some topologies, and depending on how replicas are cloned from a master, some changes could still be missed without additional replication agreements.)

A new replication agreement is created using the **connect** command.

```
ipa-replica-manage connect server1 server2
```

If only one server is given, the replication agreements are created between the local host and the specified server.

For example:

```
[root@server ~]# ipa-replica-manage connect srv2.example.com srv4.example.com
```

Replication occurs over standard LDAP; to enable SSL, then include the CA certificate for the local host (or the specified *server1*). The CA certificate is then installed in the remote server's certificate database to enable TLS/SSL connections. For example:

```
[root@server ~]# ipa-replica-manage connect --cacert=/etc/ipa/ca.crt
srv2.example.com srv4.example.com
```

The same thing can be done for certificate replication agreements by using the **ipa-csreplica-manage** command.

24.1.6. Removing Replication Agreements

To remove a replication agreement between specific servers/replicas, use the **disconnect** command:

```
[root@server ~]# ipa-replica-manage disconnect srv2.example.com srv4.example.com
```

Using the **disconnect** command removes that one replication agreement but leaves both the server/replica instances in the overall replication topology. To remove a server entirely from the IdM replication topology, with all its data, (and, functionally, removing it from the IdM domain as a server), use the **del** command:

```
[root@server ~]# ipa-replica-manage del srv2.example.com
```

The same thing can be done for certificate replication agreements by using the **ipa-csreplica-manage** command.

24.1.7. Forcing Replication

Replication between servers and replicas occurs on a schedule. Although replication is frequent, there can be times when it is necessary to initiate the replication operation manually. For example, if a server is being taken offline for maintenance, it is necessary to flush all of the queued replication changes out of its changelog before taking it down.

To initiate a replication update manually, use the **force-sync** command. The server which receives the update is the local server; the server which sends the updates is specified in the **--from** option.

```
[root@server ~]# ipa-replica-manage force-sync --from srv1.example.com
```

The same thing can be done for certificate replication agreements by using the **ipa-csreplica-manage** command.

24.1.8. Reinitializing IdM Servers

When a replica is first created, the database of the master server is copied, completely, over to the replica database. This process is called *initialization*. If a server/replica is offline for a long period of time or there is some kind of corruption in its database, then the server can be re-initialized, with a fresh and updated set of data.

This is done using the **re-initialize** command. The target server being initialized is the local host. The server or replica from which to pull the data to initialize the local database is specified in the **--from** option:

```
[root@server ~]# ipa-replica-manage re-initialize --from srv1.example.com
```

The same thing can be done for certificate replication agreements by using the **ipa-csreplica-manage** command.

24.1.9. Resolving Replication Problems

24.1.9.1. Serial Numbers Not Found Errors

The 389 Directory Server and Dogtag Certificate System instances share a single directory database for data. Replication agreements are set up for different suffixes within that directory.

The directory and certificate replication agreements are managed through different tools and are created and removed independently. If a certificate replication agreement is removed, but a data replication agreement is not, there can be problems with using certificates with some directory entries.

For example, both data and certificate replication agreements exist between Server A and Server B. If the certificate agreement is removed, both Server A and Server B still have certificate authorities and are still issuing certificates, but that information is no longer being replicated. If Server A issues a certificate to Host 1, and then someone attempts to use Server B to manage Host 1, Server B returns an error that it cannot verify Host 1's certificate serial number.

```
Certificate operation cannot be completed: EXCEPTION (Certificate serial number 0x2d not found)
```

This is because Server B has information about Host 1 in its data directory, but it does not have the host certificate in its certificate directory.

To work around this, enable replication between the two IdM servers.

24.1.9.2. Resolving Replication Conflicts

Changes — both for IdM domain data and for certificate and key data — are replicated between IdM servers and replicas (and, in similar paths, between IdM and Active Directory servers).

Even though replication operations are run continuously, there is a chance that changes can be made on one IdM server at the same time different changes are made to the same entry on a different IdM server. When replication begins to process those entries, the changes collide — this is a *replication conflict*.

Every single directory modify operation is assigned a server-specific *change state number* (CSN) to track how those modifications are propagated during replication. The CSN also contains a modify timestamp. When there is a replication conflict, the timestamp is checked and the last change wins.

Simply accepting the most recent change is effective for resolving conflicts with attribute values. That method is too blunt for some types of operations, however, which affect the directory tree. Some operations, like `modrdn`, DN changes, or adding or removing parent and child entries, require administrator review before the conflict is resolved.



NOTE

Replication conflicts are resolved by editing the entries directory in the LDAP database.

When there is a replication conflict, both entries are added to the directory and are assigned a ***nsds5ReplConflict*** attribute. This makes it easy to search for entries with a conflict:

```
[jsmith@ server ~]$ ldapsearch -x -D "cn=directory manager" -w password -b "dc=example,dc=com" "nsds5ReplConflict=*" \* nsds5ReplConflict
```

24.1.9.2.1. Solving Naming Conflicts

When two entries are added to the IdM domain with the same DN, both entries are added to the directory, but they are renamed to use the *nsuniqueid* attribute as a naming attribute. For example:

```
nsuniqueid=0a950601-435311e0-86a2f5bd-
3cd26022+uid=jsmith,cn=users,cn=accounts,dc=example,dc=com
```

Those entries can be searched for and displayed in the IdM CLI, but they cannot be edited or deleted until the conflict is resolved and the DN is updated.

To resolve the conflict:

1. Rename the entry using a different naming attribute, and keep the old RDN. For example:

```
ldapmodify -x -D "cn=directory manager" -w secret -h ipaserver.example.com -p
389
dn: nsuniqueid=66446001-
1dd211b2+uid=jsmith,cn=users,cn=accounts,dc=example,dc=com
changetype: modrdn
newrdn: cn=TempValue
deleteoldrdn: 0
```

2. Remove the old RDN value of the naming attribute and the conflict marker attribute. For example:

```
ldapmodify -x -D "cn=directory manager" -w secret -h ipaserver.example.com -p
389
dn: cn=TempValue,cn=users,cn=accounts,dc=example,dc=com
changetype: modify
delete: uid
dc: jsmith
-
delete: nsds5ReplConflict
-
```



NOTE

The unique identifier attribute *nsuniqueid* cannot be deleted.

3. Rename the entry with the intended attribute-value pair. For example:

```
ldapmodify -x -D "cn=directory manager" -w secret -h ipaserver.example.com -p
389
dn: cn=TempValue,dc=example,dc=com
changetype: modrdn
newrdn: uid=jsmith
deleteoldrdn: 1
```

Setting the value of the *deleteoldrdn* attribute to **1** deletes the temporary attribute-value pair *cn=TempValue*. To keep this attribute, set the value of the *deleteoldrdn* attribute to **0**.

24.1.9.2.2. Solving Orphan Entry Conflicts

When a delete operation is replicated and the consumer server finds that the entry to be deleted has child entries, the conflict resolution procedure creates a **glue** entry to avoid having orphaned entries in the directory.

In the same way, when an add operation is replicated and the consumer server cannot find the parent entry, the conflict resolution procedure creates a glue entry representing the parent so that the new entry is not an orphan entry.

Glue entries are temporary entries that include the object classes **glue** and **extensibleObject**. Glue entries can be created in several ways:

- ▶ If the conflict resolution procedure finds a deleted entry with a matching unique identifier, the glue entry is a resurrection of that entry, with the addition of the **glue** object class and the **nsds5ReplConflict** attribute.

In such cases, either modify the glue entry to remove the **glue** object class and the **nsds5ReplConflict** attribute to keep the entry as a normal entry or delete the glue entry and its child entries.

- ▶ The server creates a minimalistic entry with the **glue** and **extensibleObject** object classes.

In such cases, modify the entry to turn it into a meaningful entry or delete it and all of its child entries.

24.1.9.3. Cleaning RUV Errors

Each server records changes to its database in a changelog; each change is assigned an identifier called a *replica update vector* (RUV). The RUVs are a way of identifying where changes come from (the replica) and the order to apply them (through the change state number), as changes are made across multiple servers.

When a server is removed from replication, all of the metadata associated with that server is removed from the other servers' replication configuration. However, if one server is offline when the replication topology is updated, then the metadata (RUVs) for the replica remain in that server's configuration. When replication occurs, that server returns an error because it expects information for a given server (based on the RUVs in its configuration), and that one server is not sending updates any more.

```
[09/Sep/2011:09:03:43 -0600] NSMMReplicationPlugin - ruv_compare_ruv: RUV
[changelog max RUV] does not
  contain element [{replica 55 ldap://localhost.localdomain:9389}
4e6a27ca000000370000 4e6a27e8000000370000]
  which is present in RUV [database RUV]
...
[09/Sep/2011:09:03:43 -0600] NSMMReplicationPlugin - replica_check_for_data_reload:
Warning: for replica
  dc=example,dc=com there were some differences between the changelog max RUV and
the database RUV.
```

To resolve those errors, run a **clean-ruv** task to remove any RUVs associated with removed replica. This is run against the replica ID, which would be listed in the 389 Directory Server error logs:

```
...
contain element [{replica 55 ldap://localhost.localdomain:9389}
4e6a27ca000000370000 4e6a27e8000000370000]
...
```

For example:

```
[root@server ~]# ipa-replica-manage clean-ruv 55
```


**WARNING**

Running a `clean-ruv` task against the wrong replica ID will corrupt all of the data associated with that replica in the replication database. In that case, the replica must be reinitialized to correct the errors; reinitializing a replica is in [Section 24.1.8, “Reinitializing IdM Servers”](#).

24.2. Removing a Replica

Deleting or *demoting* a replica removes the IdM replica from the server/replica topology so that it no longer processes IdM requests and it also removes the host machine itself from the IdM domain.

1. On an IdM server, obtain a Kerberos ticket before running IdM tools.

```
[root@replica ~]# kinit admin
```

2. List all of the configured replication agreements for the IdM domain.

```
[root@replica ~]# ipa-replica-manage list
Directory Manager password:

ipaserver.example.com: master
ipaserver2.example.com: master
replica.example.com: master
replica2.example.com: master
```

3. Removing the replica from the topology involves deleting all the agreements between the replica and the other servers in the IdM domain and all of the data about the replica in the domain configuration.

```
[root@replica ~]# ipa-replica-manage del replica.example.com
```

4. *If the replica was configured with its own CA*, then also use the `ipa-csreplica-manage` command to remove all of the replication agreements between the certificate databases for the replica.

This is required if the replica itself was configured with a Dogtag Certificate System CA. It is not required if only the master server or other replicas were configured with a CA.

```
[root@replica ~]# ipa-csreplica-manage del replica.example.com
```

5. On the replica, uninstall the replica packages.

```
[root@replica ~]# ipa-server-install --uninstall -U
```

24.3. Renaming a Server or Replica Host System

There is no way to change the hostname for an IdM server or replica machine. The Kerberos keys and certificate management is too complex to allow the hostname to change.

Rather, if a server or replica needs to be renamed, it is easier to replace the instance.

1. Create a new replica, with a CA, with the new hostname or IP address. This is described in [Chapter 4, *Setting up IdM Replicas*](#).

2. Stop the original IdM server instance.

```
[root@oldserver ~]# ipactl stop
```

3. Verify that all other servers/replicas and clients are working as before.
4. Uninstall the IdM server, as in [Chapter 7, Uninstalling IdM Servers and Replicas](#)

Chapter 25. Migrating from an LDAP Directory to IdM

When an infrastructure has previously deployed an LDAP server for authentication and identity lookups, it is possible to migrate the user data, including passwords, to a new Identity Management instance, without losing user or password data.

Identity Management has migration tools to help move directory data and only requires minimal updates to clients. However, the migration process assumes a simple deployment scenario (one LDAP namespace to one IdM namespace). For more complex environments, such as ones with multiple namespaces or custom schema, contact Red Hat support services for assistance.

Identity Management has migration tools to help move directory data and only requires minimal updates to clients. However, the migration process assumes a very simple deployment scenario (one LDAP directory namespace to one IdM namespace).

25.1. An Overview of LDAP to IdM Migration

The actual migration part of moving from an LDAP server to Identity Management — the process of moving the data from one server to the other — is fairly straightforward. The process is simple: move data, move passwords, and move clients.

The crucial part of migration is not data migration; it is deciding how clients are going to be configured to use Identity Management. For each client in the infrastructure, you need to decide what services (such as Kerberos and SSSD) are being used and what services can be used in the final, IdM deployment.

A secondary, but significant, consideration is planning how to migrate passwords. Identity Management requires Kerberos hashes for every user account in addition to passwords. Some of the considerations and migration paths for passwords are covered in [Section 25.1.2, “Planning Password Migration”](#).

25.1.1. Planning the Client Configuration

Identity Management can support a number of different client configurations, with varying degrees of functionality, flexibility, and security. Decide which configuration is best *for each individual client* based on its operating system, functional area (such as development machines, production servers, or user laptops), and your IT maintenance priorities.



IMPORTANT

The different client configurations *are not mutually exclusive*. Most environments will have a mix of different ways that clients use to connect to the IdM domain. Administrators must decide which scenario is best for each individual client.

25.1.1.1. Initial Client Configuration (Pre-Migration)

Before deciding where you want to go with the client configuration in Identity Management, first establish where you are before the migration.

The initial state for almost all LDAP deployments that will be migrated is that there is an LDAP service providing identity and authentication services.

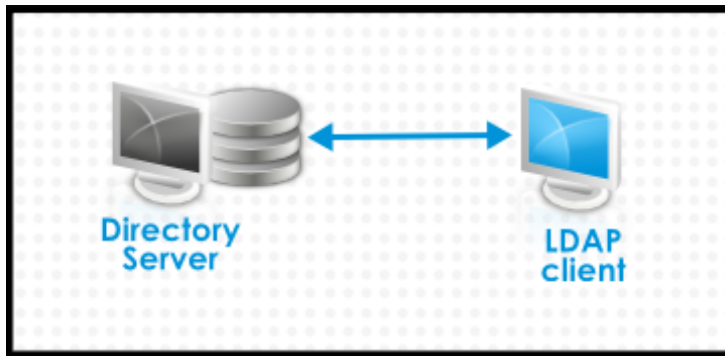


Figure 25.1. Basic LDAP Directory and Client Configuration

Linux and Unix clients use PAM_LDAP and NSS_LDAP libraries to connect directly to the LDAP services. These libraries allow clients to retrieve user information from the LDAP directory *as if* the data were stored in `/etc/passwd` or `/etc/shadow`. (In real life, the infrastructure may be more complex if a client uses LDAP for identity lookups and Kerberos for authentication or other configurations.)

There are structural differences between an LDAP directory and an IdM server, particularly in schema support and the structure of the directory tree. (For more background on those differences, see [Section 1.1, “IdM v. LDAP: A More Focused Type of Service”](#).) While those differences may impact data (especially with the directory tree, which affects entry names), they have little impact on the *client configuration*, so it really has little impact on migrating clients to Identity Management.

25.1.1.2. Recommended Configuration for Red Hat Enterprise Linux Clients

Red Hat Enterprise Linux has a service called the *System Security Services Daemon* (SSSD). SSSD uses special PAM and NSS libraries (`pam_sss` and `nss_sss`, respectively) which allow SSSD to be integrated very closely with Identity Management and leverage the full authentication and identity features in Identity Management. SSSD has a number of useful features, like caching identity information so that users can log in even if the connection is lost to the central server; these are described in the *Red Hat Enterprise Linux Deployment Guide*.

Unlike generic LDAP directory services (using `pam_ldap` and `nss_ldap`), SSSD establishes relationships between identity and authentication information by defining *domains*. A domain in SSSD defines four backend functions: authentication, identity lookups, access, and password changes. The SSSD domain is then configured to use a *provider* to supply the information for any one (or all) of those four functions. An identity provider is always required in the domain configuration. The other three providers are optional; if an authentication, access, or password provider is not defined, then the identity provider is used for that function.

SSSD can use Identity Management for all of its backend functions. This is the ideal configuration because it provides the full range of Identity Management functionality, unlike generic LDAP identity providers or Kerberos authentication. For example, during daily operation, SSSD enforces host-based access control rules and security features in Identity Management.



During the migration process from an LDAP directory to Identity Management, SSSD can seamlessly migrate user passwords without additional user interaction.

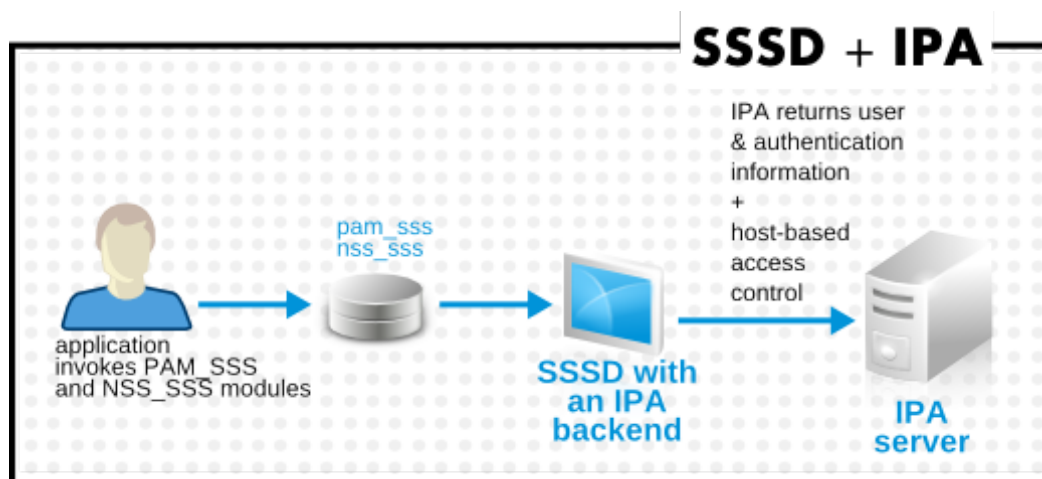


Figure 25.2. Clients and SSSD with an IdM Backend

The `ipa-client-install` script automatically configured SSSD to use IdM for all four of its backend services, so Red Hat Enterprise Linux clients are set up with the recommended configuration by default.

NOTE

This client configuration is only supported for Red Hat Enterprise Linux 6.1 and later and Red Hat Enterprise Linux 5.7 later, which support the latest versions of SSSD and `ipa-client`. Older versions of Red Hat Enterprise Linux can be configured as described in [Section 25.1.1.3, “Alternative Supported Configuration”](#).

NOTE

This client configuration is only supported for Red Hat Enterprise Linux 15 and later, which supports the latest versions of SSSD and `ipa-client`. Older versions of Red Hat Enterprise Linux can be configured as described in [Section 25.1.1.3, “Alternative Supported Configuration”](#).

25.1.1.3. Alternative Supported Configuration

Unix and Linux systems such as Mac, Solaris, HP-UX, AIX, and Scientific Linux support all of the services that IdM manages but do not use SSSD. Likewise, older Red Hat Enterprise Linux versions (6.1 and 5.6) support SSSD but have an older version, which does not support IdM as an identity provider.

Unix and Linux systems such as Mac, Solaris, HP-UX, AIX, and Scientific Linux support all of the services that IdM manages but do not use SSSD. Likewise, older Red Hat Enterprise Linux versions (15) support SSSD but have an older version, which does not support IdM as an identity provider.

When it is not possible to use a modern version of SSSD on a system, then clients can be configured to connect to the IdM server as if it were an LDAP directory service for identity lookups (using `nss_ldap`) and to IdM as if it were a regular Kerberos KDC (using `pam_krb5`).

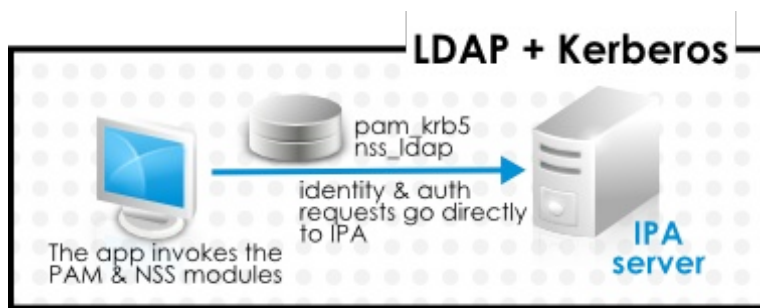


Figure 25.3. Clients and IdM with LDAP and Kerberos

If a Red Hat Enterprise Linux client is using an older version of SSSD, SSSD can still be configured to use the IdM server as its identity provider and its Kerberos authentication domain; this is described in the SSSD configuration section of the *Red Hat Enterprise Linux Deployment Guide*.

Any IdM domain client can be configured to use **nss_ldap** and **pam_krb5** to connect to the IdM server. For some maintenance situations and IT structures, a scenario that fits the lowest common denominator may be required, using LDAP for both identity and authentication (**nss_ldap** and **pam_ldap**). However, it is generally best practice to use the most secure configuration possible for a client (meaning SSSD and Kerberos or LDAP and Kerberos).

25.1.2. Planning Password Migration

Probably the most visible issue that can impact LDAP-to-Identity Management migration is migrating user passwords.

Identity Management (by default) uses Kerberos for authentication and requires that each user has Kerberos hashes stored in the Identity Management Directory Server in addition to the standard user passwords. To generate these hashes, the user password needs to be available to the IdM server in cleartext. This is the case when the user is created in Identity Management. However, when the user is migrated from an LDAP directory, the associated user password is already hashed, so the corresponding Kerberos key cannot be generated.



IMPORTANT

Users cannot authenticate to the IdM domain or access IdM resources until they have Kerberos hashes.

If a user does not have a Kerberos hash ^[7], that user cannot log into the IdM domain even if he has a user account. There are three options for migrating passwords: forcing a password change, using a web page, and using SSSD.

Migrating users from an existing system provides a smoother transition but also requires parallel management of LDAP directory and IdM during the migration and transition process. If you do not preserve passwords, the migration can be performed more quickly but it requires more manual work by administrators and users.

25.1.2.1. Method 1: Using Temporary Passwords and Requiring a Change

When passwords are changed in Identity Management, they will be created with the appropriate Kerberos hashes. So one alternative for administrators is to force users to change their passwords by resetting all user passwords when user accounts are migrated. (This can also be done simply by re-creating the LDAP directory accounts in IdM, which automatically creates accounts with the appropriate keys.) The new users

are assigned a temporary password which they change at the first login. No passwords are migrated.

25.1.2.2. Method 2: Using the Migration Web Page

When it is running in migration mode, Identity Management has a special web page in its web UI that will capture a cleartext password and create the appropriate Kerberos hash.

```
https://ipaserver.example.com/ipa/migration
```

Administrators could tell users to authenticate once to this web page, which would properly update their user accounts with their password and corresponding Kerberos hash, without requiring password changes.

25.1.2.3. Method 3: Using SSSD (Recommended)

SSSD can work with IdM to mitigate the user impact on migrating by generating the required user keys. For deployments with a lot of users or where users shouldn't be burdened with password changes, this is the best scenario.

1. A user tries to log into a machine with SSSD.
2. SSSD attempts to perform Kerberos authentication against the IdM server.
3. Even though the user exists in the system, the authentication will fail with the error *key type is not supported* because the Kerberos hashes do not yet exist.
4. SSSD then performs a plaintext LDAP bind over a secure connection.
5. IdM intercepts this bind request. If the user has a Kerberos principal but no Kerberos hashes, then the IdM identity provider generates the hashes and stores them in the user entry.
6. If authentication is successful, SSSD disconnects from IdM and tries Kerberos authentication again. This time, the request succeeds because the hash exists in the entry.

That entire process is entirely transparent to the user; as far as users know, they simply log into a client service and it works as normal.

25.1.2.4. Migrating Cleartext LDAP Passwords

Although in most deployments LDAP passwords are stored encrypted, there may be some users or some environments that use cleartext passwords for user entries.

When users are migrated from the LDAP server to the IdM server, their cleartext passwords are not migrated over. Identity Management does not allow cleartext passwords. Instead, a Kerberos principle is created for the user, the keytab is set to true, and the password is set as expired. This means that Identity Management requires the user to reset the password at the next login.



NOTE

If passwords are hashed, the password is successfully migrated through SSSD and the migration web page, as in [Section 25.1.2.3, “Method 3: Using SSSD \(Recommended\)”](#).

25.1.2.5. Automatically Resetting Passwords That Do Not Meet Requirements

If user passwords in the original directory do not meet the password policies defined in Identity Management, then the passwords must be reset after migration.

Password resets are done automatically the first time the users attempts to **kinit** into the IdM domain.

```
[jsmith@server ~]$ kinit
Password for jsmith@EXAMPLE.COM:
Password expired. You must change it now.
Enter new password:
Enter it again:
```

25.1.3. Migration Considerations and Requirements

As you are planning migrating from an LDAP server to Identity Management, make sure that your LDAP environment is able to work with the Identity Management migration script.

25.1.3.1. LDAP Servers Supported for Migration

The migration process from an LDAP server to Identity Management uses a special script, **ipa migrate-ds**, to perform the migration. This script has certain expectations about the structure of the LDAP directory and LDAP entries in order to work. Migration is supported only for LDAPv3-compliant directory services, which include several common directories:

- ▶ SunONE Directory Server
- ▶ Apache Directory Server
- ▶ OpenLDAP

Migration from an LDAP server to Identity Management has been tested with Red Hat Directory Server.



NOTE

Migration using the migration script is *not* supported for Microsoft Active Directory because it is not an LDAPv3-compliant directory. For assistance with migrating from Active Directory, contact Red Hat Professional Services.



NOTE

Migration using the migration script is *not* supported for Microsoft Active Directory because it is not an LDAPv3-compliant directory.

25.1.3.2. Migration Environment Requirements

There are many different possible configuration scenarios for both Red Hat Directory Server and Identity Management, and any of those scenarios may affect the migration process. For the example migration procedures in this chapter, these are the assumptions about the environment:

- ▶ A single LDAP directory domain is being migrated to one IdM realm. No consolidation is involved.
- ▶ User passwords are stored as a hash in the LDAP directory that the IdM Directory Server can support.
- ▶ The LDAP directory instance is both the identity store and the authentication method. Client machines are configured to use **pam_ldap** or **nss_ldap** to connect to the LDAP server.
- ▶ Entries use only standard LDAP schema. Custom attributes will not be migrated to Identity Management.

25.1.3.3. Migration — IdM System Requirements

With a moderately-sized directory (around 10,000 users and 10 groups), it is necessary to have a powerful enough target system (the IdM system) to allow the migration to proceed. The minimum requirements for a migration are:

- ▶ 4 cores
- ▶ 4 GB of RAM
- ▶ 30 GB of disk space
- ▶ A SASL buffer size of 2 MB

This is set in the `nsslapd-sasl-max-buffer-size` attribute in the 389 Directory Server instance for the IdM server. This attribute value is set using the `ldapmodify` command in the `cn=config` subtree.

25.1.3.4. Migration Tools

Identity Management uses a specific command, `ipa migrate-ds`, to drive the migration process so that LDAP directory data are properly formatted and imported cleanly into the IdM server.

The Identity Management server must be configured to run in migration mode, and then the migration script can be used.

25.1.3.5. Improving Migration Performance

An LDAP migration is essentially a specialized import operation for the 389 Directory Server instance within the IdM server. Tuning the 389 Directory Server instance for better import operation performance can help improve the overall migration performance.

There are two parameters that directly affect import performance:

- ▶ The `nsslapd-cachememsize` attribute, which defines the size allowed for the entry cache. This is a buffer, that is automatically set to 80% of the total cache memory size. For large import operations, this parameter (and possibly the memory cache itself) can be increased to more efficiently handle a large number of entries or entries with larger attributes (such as certificate chains and CRLs).

This can be edited using the `ldapmodify` command; the configuration entries are in `cn=config`.

- ▶ The system `ulimit` setting, which sets the maximum number of allowed processes for the system user. Especially on 32-bit systems, it is possible for the Directory Server user to hit its process limit when trying to process a large database.

```
[root@server ~]# ulimit -u 4096
```

This is covered in the Red Hat Directory Server *Performance Tuning Guide* at https://access.redhat.com/site/documentation/en-US/Red_Hat_Directory_Server/9.0/html/Performance_Tuning_Guide/import.html.

25.1.3.6. Migration Sequence

There are four major steps when migrating to Identity Management, but the order varies slightly depending on whether you want to migrate the server first or the clients first.

With a client-based migration, SSSD is used to change the client configuration while an IdM server is configured:

1. Deploy SSSD.
2. Reconfigure clients to connect to the current LDAP server and then fail over to IdM.
3. Install the IdM server.
4. Migrate the user data using the IdM `ipa migrate-ds` script. This exports the data from the LDAP directory, formats for the IdM schema, and then imports it into IdM.
5. Take the LDAP server offline and allow clients to fail over to Identity Management transparently.

With a server migration, the LDAP to Identity Management migration comes first:

1. Install the IdM server.
2. Migrate the user data using the IdM `ipa migrate-ds` script. This exports the data from the LDAP directory, formats it for the IdM schema, and then imports it into IdM.
3. *Optional.* Deploy SSSD.
4. Reconfigure clients to connect to IdM. It is not possible to simply replace the LDAP server. The IdM directory tree — and therefore user entry DNSs — is different than the previous directory tree.

While it is required that clients be reconfigured, clients do not need to be reconfigured immediately. Updated clients can point to the IdM server while other clients point to the old LDAP directory, allowing a reasonable testing and transition phase after the data are migrated.



NOTE

Do not run both an LDAP directory service and the IdM server for very long in parallel. This introduces the risk of user data being inconsistent between the two services.

Both processes provide a general migration procedure, but it may not work in every environment. Set up a test LDAP environment and test the migration process before attempting to migrate the real LDAP environment.

25.2. Examples for Using `migrate-ds`

The data migration is performed with the `ipa migrate-ds` command. At its simplest, the command takes the LDAP URL of the directory to migrate and exports the data based on common default settings.

```
ipa migrate-ds ldap://ldap.example.com:389
```

It is possible to customize how the `migrate-ds` commands identifies and exports data. This is useful if the original directory tree has a unique structure or if some entries or attributes within entries should be excluded from migration.

25.2.1. Migrating Specific Subtrees

The default directory structure places person entries in the `ou=People` subtree and group entries in the `ou=Groups` subtree. These subtrees are container entries for those different types of directory data. If no options are passed with the `migrate-ds` command, then the utility assumes that the given LDAP directory uses the `ou=People` and `ou=Groups` structure.

Many deployments may have an entirely different directory structure (or may only want to export certain

parts of the directory tree). There are two options which allow administrators to give the RDN of a different user or group subtree:

- ▶ **--user-container**
- ▶ **--group-container**



NOTE

In both cases, the subtree must be the RDN only and must be relative to the base DN. For example, the **ou=Employees,dc=example,dc=com** subtree can be migrated using **--user-container=ou=Employees**, but **ou=Employees,ou=People,dc=example,dc=com** cannot be migrated with that option because **ou=Employees** is not a direct child of the base DN.

For example:

```
[root@ipaserver ~]# ipa migrate-ds --user-container=ou=employees --group-
container="ou=employee groups" ldap://ldap.example.com:389
```

There is a third option that allows administrators to set a base DN for migration: **--base-dn**. With this option, it is possible to change the target for container subtrees. For example:

```
[root@ipaserver ~]# ipa migrate-ds --user-container=ou=employees --base-
dn="ou=people,dc=example,dc=com" ldap://ldap.example.com:389
```

Now, the **ou=Employees** user subtree can be migrated from within the larger **ou=People** subtree without migrating every people-related subtree.

25.2.2. Specifically Including or Excluding Entries

By default, the **migrate-ds** script exports every user entry with the **person** object class and every group entry within the given user and group subtrees.

In some migration paths, only specific types of users and groups may need to be exported, or, conversely, specific users and groups may need to be excluded.

One option is to set positively which *types* of users and groups to include. This is done by setting which object classes to search for when looking for user or group entries.

This is a really useful option when there are custom object classes used in an environment for different user types. For example, this migrates only users with the custom **fullTimeEmployee** object class:

```
[root@ipaserver ~]# ipa migrate-ds --user-objectclass=fullTimeEmployee
ldap://ldap.example.com:389
```

Because of the different types of groups, this is also very useful for migrating only certain types of groups (such as user groups) while excluding other types of groups, like certificate groups. For example:

```
[root@ipaserver ~]# ipa migrate-ds --group-objectclass=groupOfNames --group-
objectclass=groupOfUniqueNames ldap://ldap.example.com:389
```

Positively specifying user and groups to migrate based on object class implicitly excludes all other users and groups from migration.

Alternatively, it can be useful to migrate all user and group entries except for just a small handful of entries. Specific user or group accounts can be excluded while all others of that type are migrated. For example, this excludes a hobbies group and two users:

```
[root@ipaserver ~]# ipa migrate-ds --exclude-groups="Golfers Group" --exclude-users=jsmith --exclude-users=bjensen ldap://ldap.example.com:389
```

Specifying an object class to migrate can be used together with excluding specific entries. For example, this specifically includes users with the **fullTimeEmployee** object class, yet excludes three managers:

```
[root@ipaserver ~]# ipa migrate-ds --user-objectclass=fullTimeEmployee --exclude-users=jsmith --exclude-users=bjensen --exclude-users=mreynolds ldap://ldap.example.com:389
```

25.2.3. Excluding Entry Attributes

By default, every attribute and object class for a user or group entry is migrated. There are some cases where that may not be realistic, either because of bandwidth and network constraints or because the attribute data are no longer relevant. For example, if users are going to be assigned new user certificates as they join the IdM domain, then there is no reason to migrate the **userCertificate** attribute.

Specific object classes and attributes can be ignored by the **migrate-ds** by using any of several different options:

- ▶ **--user-ignore-objectclass**
- ▶ **--user-ignore-attribute**
- ▶ **--group-ignore-objectclass**
- ▶ **--group-ignore-attribute**

For example, to exclude the **userCertificate** attribute and **strongAuthenticationUser** object class for users and the **groupOfCertificates** object class for groups:

```
[root@ipaserver ~]# ipa migrate-ds --user-ignore-attribute=userCertificate --user-ignore-objectclass=strongAuthenticationUser --group-ignore-objectclass=groupOfCertificates ldap://ldap.example.com:389
```



NOTE

Make sure not to ignore any required attributes. Also, when excluding object classes, make sure to exclude any attributes which are only supported by that object class.

25.2.4. Setting the Schema to Use

By default, Identity Management uses [RFC2307bis](#) schema to define user, host, host group, and other network identities. This schema option can be reset to use [RFC2307](#) schema instead:

```
[root@ipaserver ~]# ipa migrate-ds --schema=RFC2307 ldap://ldap.example.com:389
```

25.3. Scenario 1: Using SSSD as Part of Migration

**IMPORTANT**

This is a general migration procedure, but it may not work in every environment.

It is strongly recommended that you set up a test LDAP environment and test the migration process before attempting to migrate the real LDAP environment.

1. Set up SSSD. Using SSSD allows the required Kerberos keys and server certificates to be delivered to the clients.

- a. Install SSSD on every client machine:

```
[root@server ]# yum install sssd
```

- b. Configure an LDAP identity provider in SSSD to use the existing Directory Server for all functions (authentication, identity lookups, access, and password changes). This ensures every client works properly with the existing directory service.

2. Install Identity Management, including any custom LDAP directory schema ^[8], on a different machine from the existing LDAP directory.

3. Enable the IdM server to allow migration:

```
[root@server ]# ipa config-mod --enable-migration=TRUE
```

4. Disable the compat plug-in.

```
[root@server ]# ipa-compat-manage disable
```

5. Restart the IdM Directory Server instance.

```
[root@server ]# systemctl restart dirsrv.service
```

6. Run the IdM migration script, **ipa migrate-ds**. At its most basic, this requires only the LDAP URL of the LDAP directory instance to migrate:

```
[root@server ]# ipa migrate-ds ldap://ldap.example.com:389
```

Simply passing the LDAP URL migrates all of the directory data using common default settings. The user and group data can be selectively migrated by specifying other options, as covered in [Section 25.2, “Examples for Using migrate-ds”](#).

Once the information is exported, the script adds all required IdM object classes and attributes and converts DNS in attributes to match the IdM directory tree.

7. Re-enable the compat plug-in.

```
[root@server ]# ipa-compat-manage enable
```

8. Restart the IdM Directory Server instance.

```
[root@server ]# systemctl restart dirsrv.service
```

9. Move clients that have SSSD installed from the LDAP backend to the Identity Management backend and enroll them as client with IdM. This downloads the required keys and certificates.

On Red Hat Enterprise Linux clients, this can be done using the `ipa-client-install` command. For example:

```
[root@server ~]# ipa-client-install --enable-dns-updates
```

10. Have users log into a machine with SSSD and Identity Management backend. This generates the required Kerberos keys for the user.

To monitor the user migration process, query the existing LDAP directory to see which user accounts have a password but do not yet have a Kerberos principal key.

```
[jsmith@server ~]$ ldapsearch -LL -x -D 'cn=Directory Manager' -w secret -b 'ou=people,dc=example,dc=com' '(&(!(krbprincipalkey=*)))(userpassword=*)' uid
```



NOTE

Include the quotes around the filter so that it is not interpreted by the shell.

11. Once users have been migrated over, configure non-SSSD clients to use the IdM domain, as required.
12. When the migration of all clients and users is complete, decommission the LDAP directory.

25.4. Scenario 2: Migrating an LDAP Server Directly to Identity Management



IMPORTANT

This is a general migration procedure, but it may not work in every environment.

It is strongly recommended that you set up a test LDAP environment and test the migration process before attempting to migrate the real LDAP environment.

1. Install the IdM server, including any custom LDAP directory schema ^[9], on a different machine from the existing LDAP directory.
2. Disable the compat plug-in.

```
[root@server ~]# ipa-compat-manage disable
```

3. Restart the IdM Directory Server instance.

```
[root@server ~]# systemctl restart dirsrv.service
```

4. Enable the IdM server to allow migration:

```
[root@server ~]# ipa config-mod --enable-migration=TRUE
```

- Run the IdM migration script, **ipa migrate-ds**. At its most basic, this requires only the LDAP URL of the LDAP directory instance to migrate:

```
[root@server ]# ipa migrate-ds ldap://ldap.example.com:389
```

Simply passing the LDAP URL migrates all of the directory data using common default settings. The user and group data can be selectively migrated by specifying other options, as covered in [Section 25.2, “Examples for Using migrate-ds”](#).

Once the information is exported, the script adds all required IdM object classes and attributes and converts DN's in attributes to match the IdM directory tree.

- Re-enable the compat plug-in.

```
[root@server ]# ipa-compat-manage enable
```

- Restart the IdM Directory Server instance.

```
[root@server ]# systemctl restart dirsrv.service
```

- Update the client configuration to use PAM_LDAP and NSS_LDAP to connect to IdM instead of connecting to an LDAP directory, NIS, or local files.
- Optional.* Set up SSSD. Using SSSD migrates user passwords without additional user interaction, as described in [Section 25.1.2, “Planning Password Migration”](#).

- Install SSSD on every client machine:

```
[root@server ]# yum install sssd
```

- Run the **ipa-client-install** to configure SSSD and related services to use the IdM server for identity and Kerberos authentication.

- Instruct users to log into IdM using either SSSD client or the migration web page if SSSD is not available on the client. Both methods automatically migrate the user password into Identity Management.

```
https://ipaserver.example.com/ipa/migration
```

- Optional.* Reconfigure non-SSSD clients to use Kerberos authentication (**pam_krb5**) instead of LDAP authentication (**pam_ldap**).



NOTE

Use PAM_LDAP modules until all of the users have been migrated; then it is possible to use PAM_KRB5.

- When the migration of all clients and users is complete, decommission the LDAP directory.

25.5. Scenario 3: Migrating over SSL

Both migrating using SSSD ([Section 25.3, “Scenario 1: Using SSSD as Part of Migration”](#)) and migrating directly from LDAP ([Section 25.4, “Scenario 2: Migrating an LDAP Server Directly to Identity Management”](#)) can be done over SSL. The migration procedure itself is the same, but it requires additional configuration on the IdM server.

IdM uses the OpenLDAP client libraries to connect to the remote LDAP server. This means that the OpenLDAP configuration on the IdM server machine must have the CA certificate configuration for the LDAP directory's issuing CA.

1. Download the CA certificate for the CA which issued the LDAP directory's certificates. The location and methods to obtain the CA certificate depend on the CA which issued it or the location of the certificate in the LDAP configuration.

Save the CA certificate as `/etc/ipa/remote.crt` on the IdM system.

2. Update the SELinux labels for the CA certificate file. The label should be `unconfined_u:object_r:etc_t:s0`.

```
[root@server ~]# restorecon /etc/ipa/remote.crt
```

3. Configure the OpenLDAP libraries to use the CA certificate for the old LDAP instance.

- a. Open the OpenLDAP configuration file.

```
[root@server ~]# vim /etc/openldap/ldap.conf
```

- b. The CA certificate needs to be imported into the certificate configuration. There are three ways that this can be done:

- ▶ The `TLS_CACERT` parameter can be set to the PEM file (`remote.crt`) for the CA of the remote LDAP server.

```
TLS_CACERT=/etc/ipa/remote.crt
```

- ▶ The CA certificate can be loaded into the IdM NSS database, and that can then be referenced in the `TLS_CACERTDIR` parameter.

```
[root@server ~]# certutil -A -d /etc/dirsrv/slapd-EXAMPLE-COM -n "CA
certificate" -t "CT,," -a -i /etc/ipa/remote.crt
[root@server ~]# vim /etc/openldap/ldap.conf
```

```
....
TLS_CACERTDIR=/etc/dirsrv/slapd-EXAMPLE-COM
```

- ▶ The CA certificate can be in any directory on the system, and that location can be given in the `TLS_CACERTDIR` parameter.

```
[root@server ~]# vim /etc/openldap/ldap.conf
```

```
....
TLS_CACERTDIR=/etc/ipa/
```

Only one of those configuration settings is required.

- c. Restart the IdM Apache instance. The SSL configuration is loaded through the Apache server.

```
[root@server ~]# systemctl restart httpd.service
```


- d. Go through any required migration preparation and run the `ipa migrate-ds` script, as described in [Section 25.3, “Scenario 1: Using SSSD as Part of Migration”](#) and [Section 25.4, “Scenario 2: Migrating an LDAP Server Directly to Identity Management”](#).
- e. Undo any changes that were made to the `ldap.conf` file in step [b](#). This can prevent future problems with trusting the IdM CA or other certificate-related conflicts.
- f. Restart the IdM Apache instance to load the update SSL configuration.

```
[root@server ~]# systemctl restart httpd.service
```

[7] It is possible to use LDAP authentication in Identity Management instead of Kerberos authentication, which means that Kerberos hashes are not required for users. However, this limits the capabilities of Identity Management and is not recommended.

[8] There is limited support for custom user and group schema in Identity Management.

[9] There is limited support for custom user and group schema in Identity Management.

Troubleshooting Identity Management

A.1. Installation Issues

A.1.1. Server Installation

The server installation log is located in `/var/log/ipaserver-install.log`. The IdM logs, both for the server and for IdM-associated services, are covered in [Section 23.1.4, “Checking IdM Server Logs”](#).

A.1.1.1. GSS Failures When Running IPA Commands

Immediately after installation, there can be Kerberos problems when trying to run an `ipa-*` command. For example:

```
ipa: ERROR: Kerberos error: ('Unspecified GSS failure. Minor code may provide more information', 851968)/('Decrypt integrity check failed', -1765328353)
```

There are two potential causes for this:

- ▶ DNS is not properly configured.
- ▶ Active Directory is in the same domain as the IdM server.

A.1.1.2. named Daemon Fails to Start

If an IdM server is configured to manage DNS and is set up successfully, but the `named` service fails to start, this can indicate that there is a package conflict. Check the `/var/log/messages` file for error messages related to the `named` service and the `ldap.so` library:

```
ipaserver named[6886]: failed to dynamically load driver 'ldap.so': libldap-2.4.so.2: cannot open shared object file: No such file or directory
```

This usually means that the `bind-chroot` package is installed and is preventing the `named` service from starting. To resolve this issue, remove the `bind-chroot` package and then restart the IdM server.

```
[root@server ~]# yum remove bind-chroot
# ipactl restart
```

A.1.2. Replica Installation

A.1.2.1. Certificate System setup failed.

If the replica installation fails on step 3 (**[3/11]: configuring certificate server instance**), that usually means that the required port is not available. This can be verified by checking the debug logs for the CA, `/var/log/pki-ca/debug`, which may show error messages about being unable to find certain entries. For example:

```
[04/Feb/2014:22:29:03][http-9445-Processor25]: DatabasePanel
compareAndWaitEntries ou=people,o=ipaca not found, let's wait
```

The only resolution is to uninstall the replica:

```
[root@ipareplica ~]# ipa-server-install --uninstall
```

After uninstalling the replica, ensure that port 7389 on the replica is available, and retry the replica installation.

A.1.2.2. There are SASL, GSS-API, and Kerberos errors in the 389 Directory Server logs when the replica starts.

When the replica starts, there can be a series of SASL bind errors recorded in the 389 Directory Server logs stating that the GSS-API connection failed because it could not find a credentials cache:

```
slapd_ldap_sasl_interactive_bind - Error: could not perform interactive bind for id
[] mech [GSSAPI]: error -2 (Local error) (SASL(-1): generic failure: GSSAPI Error:
Unspecified GSS failure. Minor code may provide more information (Credentials cache
file '/tmp/krb5cc_496' not found)) ...
```

The replica is looking for a credentials cache in `/tmp/krb5cc_496` (where 496 is the 389 Directory Server user ID) and cannot find it.

There may also be messages that the server could not obtain Kerberos credentials for the host principal:

```
set_krb5_creds - Could not get initial credentials for principal [ldap/
replica1.example.com] in keytab [WRFIL:/etc/dirsrv/ds.keytab]: -1765328324 (Generic
error)
```

These errors are both related to how and when the 389 Directory Server instance loads its Kerberos credentials cache.

While 389 Directory Server itself supports multiple different authentication mechanisms, Identity Management only uses GSS-API for Kerberos connections. The 389 Directory Server instance for Identity Management keeps its Kerberos credentials cache in memory. When the 389 Directory Server process ends — like when the IdM replica is stopped — the credentials cache is destroyed.

Also, the 389 Directory Server is used as the backend storage for the principal information for the KDC.

When the replica then restarts, the 389 Directory Server instance starts first, since it supplies information for the KDC, and then the KDC server starts. This start order is what causes the GSS-API and Kerberos connection errors.

The 389 Directory Server attempts to open a GSS-API connection, but since there is no credentials cache yet and the KDC is not started, the GSS connection fails. Likewise, any attempt to obtain the host credentials also fails.

These errors are transient. The 389 Directory Server re-attempts the GSS-API connection after the KDC starts and it has a credentials cache. The 389 Directory Server logs then record a **bind resumed** message.

These startup GSS-API connection failures can be ignored as long as that connection is successfully established.

A.1.2.3. The DNS forward record does not match the reverse address

When configuring a new replica, installation can fail with a series of certificate errors and, ultimately an error that the DNS forward and reverse records do not match.

```

ipa: DEBUG: approved_usage = SSLServer intended_usage = SSLServer
ipa: DEBUG: cert valid True for "CN=ipa-server2.example.com,O=EXAMPLE.COM"
ipa: DEBUG: handshake complete, peer = 192.168.17.37:9444
Certificate operation cannot be completed: Unable to communicate with CMS (Not
Found)

...

ipa: DEBUG: Created connection context.ldap2_21534032
ipa: DEBUG: Destroyed connection context.ldap2_21534032
The DNS forward record ipa-server2.example.com. does not match the reverse address
ipa-server2.example.org

```

The hostname for every server and replica in the IdM domain must be fully resolvable for both DNS forward (A) and reverse (PTR) records. Both forward and reverse records are checked during authentication and certificate-related operations. If the hostnames in the records do not match, then both certificate errors and DNS errors are returned.

This problem can occur if multiple hostnames are used for a single PTR record. This is allowed in the DNS standard, but it creates problems during IdM replica creation when it attempts to configure services.

Ensure the primary hostname for the replica host is the only one returned for PTR lookups and remove any duplicate or additional hostnames.

Verifying the DNS A and PTR records is covered in [Section 2.4.1, “DNS Records”](#).

A.1.3. Client Installations

For clients configured using `ipa-client-install`, the client installation log is located in `/var/log/ipaclient-install.log`. The IdM logs, both for the server and client and for IdM-associated services, are covered in [Section 23.1.4, “Checking IdM Server Logs”](#).

These are some issues and workarounds for client installation problems.

A.1.3.1. The client can't resolve reverse hostnames when using an external DNS.

While IdM can host its own DNS server as part of the domain services, it can also use external DNS name server. However, because of some of the limitations of reverse DNS, there can be problems with resolving reverse lookups if the external DNS is listed in the client's `/etc/resolv.conf` file or if there are other resources on the network with SRV records, like Active Directory.

The problem is that the external DNS name server returns the wrong hostname for the IdM server.

One way this exhibits is errors with finding the IdM server in the Kerberos database:

```

Jun 30 11:11:48 server1 krb5kdc[1279](info): AS_REQ (4 etypes {18 17 16 23})
192.168.60.135: NEEDED_PREAUTH: admin EXAMPLE COM for krbtgt/EXAMPLE COM EXAMPLE
COM, Additional pre-authentication required
Jun 30 11:11:48 server1 krb5kdc[1279](info): AS_REQ (4 etypes {18 17 16 23})
192.168.60.135: ISSUE: authtime 1309425108, etypes {rep=18 tkt=18 ses=18}, admin
EXAMPLE COM for krbtgt/EXAMPLE COM EXAMPLE COM
Jun 30 11:11:49 server1 krb5kdc[1279](info): TGS_REQ (4 etypes {18 17 16 23})
192.168.60.135: UNKNOWN_SERVER: authtime 0, admin EXAMPLE COM for
HTTP/server1.wrong.example.com@EXAMPLE.COM, Server not found in Kerberos database

```

There are several ways to work around this issue:

- Edit the `/etc/resolv.conf` file to remove the external DNS name server references.

- ▶ Add reverse lookup records for each IdM server.
- ▶ Give the IdM client or domain a subnet and forward all requests for that subnet.

A.1.3.2. The client is not added to the DNS zone.

If a client is in a subnet not controlled by an IdM DNS server, then the **nsupdate** command may fail to add the client to the DNS zone when **ipa-client-install** runs.

If IdM is managing the DNS domain, then add a zone entry for the client manually, as described in [Section 14.8, “Managing DNS Record Entries”](#). For example:

```
[jsmith@ipaserver ~]$ kinit admin
[jsmith@ipaserver ~]$ ipa dnsrecord-add ipaclient.example.com www --a-rec 1.2.3.4
```

If the DNS domain is managed outside of IdM, the resource record can be added manually to the zone configuration. For information on DNS in Red Hat Enterprise Linux, see [the DNS chapter in the Deployment Guide](#).

A.1.4. Uninstalling an IdM Client

For Red Hat Enterprise Linux clients, the **ipa-client-install** utility can be used to uninstall the client and remove it from the IdM domain. To remove the client, use the **--uninstall** option.

```
# ipa-client-install --uninstall
```



NOTE

There is an uninstall option with the **ipa-join** command. This is called by **ipa-client-install --uninstall** as part of the uninstallation process. However, while the **ipa-join** option removes the client from the domain, it does not actually uninstall the client or properly remove all of the IdM-related configuration. Do not run **ipa-join -u** to attempt to uninstall the IdM client. The only way to uninstall a client completely is to use **ipa-client-install --uninstall**.

A.2. UI Connection Problems

If negotiate authentication is not working, turn on verbose logging for the authentication process to help diagnose the issue:

1. Close all browser windows.
2. In a terminal, set the new log levels for Firefox:

```
export NSPR_LOG_MODULES=negotiateauth:5
export NSPR_LOG_FILE=/tmp/moz.log
```

This enables verbose logging and logs all information to **/tmp/moz.log**.

3. Restart the browser from the same terminal window.

Some of the common error messages and workarounds are in [Table A.1, “UI Error Log Messages”](#).

Table A.1. UI Error Log Messages

Error Log Message	Description and Fix
<pre>-1208550944[90039d0]: entering nsNegotiateAuth::GetNextToken() -1208550944[90039d0]: gss_init_sec_context() failed: Miscellaneous failure No credentials cache found</pre>	<p>There are no Kerberos tickets. Run kinit.</p>
<pre>-1208994096[8d683d8]: entering nsAuthGSSAPI::GetNextToken() -1208994096[8d683d8]: gss_init_sec_context() failed: Miscellaneous failure Server not found in Kerberos database</pre>	<p>This can occur when you have successfully obtained Kerberos tickets but are still unable to authenticate to the UI. This indicates that there is a problem with the Kerberos configuration. The first place to check is the [domain_realm] section in the /etc/krb5.conf file. Make sure that the IdM Kerberos domain entry is correct and matches the configuration in the Firefox negotiation parameters. For example:</p> <pre>.example.com = EXAMPLE.COM example.com = EXAMPLE.COM</pre>
<p>Nothing is in the log file.</p>	<p>It is possible that you are behind a proxy which is removing the HTTP headers required for negotiate authentication. Try to connect to the server using HTTPS instead, which allows the request to pass through unmodified. Then check the log file again.</p>

A.3. IdM Server Problems

A.3.1. There are SASL, GSS-API, and Kerberos errors in the 389 Directory Server logs when the replica starts.

When the replica starts, there can be a series of SASL bind errors recorded in the 389 Directory Server logs stating that the GSS-API connection failed because it could not find a credentials cache:

```
slapd_ldap_sasl_interactive_bind - Error: could not perform interactive bind for id
[] mech [GSSAPI]: error -2 (Local error) (SASL(-1): generic failure: GSSAPI Error:
Unspecified GSS failure. Minor code may provide more information (Credentials cache
file '/tmp/krb5cc_496' not found)) ...
```

The replica is looking for a credentials cache in **/tmp/krb5cc_496** (where 496 is the 389 Directory Server user ID) and cannot find it.

There may also be messages that the server could not obtain Kerberos credentials for the host principal:

```
set_krb5_creds - Could not get initial credentials for principal [ldap/
replica1.example.com] in keytab [WRFIL:/etc/dirsrv/ds.keytab]: -1765328324 (Generic
error)
```

These errors are both related to how and when the 389 Directory Server instance loads its Kerberos credentials cache.

While 389 Directory Server itself supports multiple different authentication mechanisms, Identity Management only uses GSS-API for Kerberos connections. The 389 Directory Server instance for Identity Management keeps its Kerberos credentials cache in memory. When the 389 Directory Server process ends — like when the IdM replica is stopped — the credentials cache is destroyed.

Also, the 389 Directory Server is used as the backend storage for the principal information for the KDC.

When the replica then restarts, the 389 Directory Server instance starts first, since it supplies information for the KDC, and then the KDC server starts. This start order is what causes the GSS-API and Kerberos connection errors.

The 389 Directory Server attempts to open a GSS-API connection, but since there is no credentials cache yet and the KDC is not started, the GSS connection fails. Likewise, any attempt to obtain the host credentials also fails.

These errors are transient. The 389 Directory Server re-attempts the GSS-API connection after the KDC starts and it has a credentials cache. The 389 Directory Server logs then record a **bind resumed** message.

These startup GSS-API connection failures can be ignored as long as that connection is successfully established.

A.4. Host Problems

A.4.1. Certificate Not Found/Serial Number Not Found Errors

The IdM information is stored in a separate LDAP directory than the certificate information, and these two LDAP databases are replicated separately. It is possible for a replication agreement to be broken for one directory and working for another, which can cause problems with managing clients.

Specifically, if the replication agreement between the two CA databases is broken, then a server may not be able to find certificate information about a valid IdM client, causing certificate errors:

```
Certificate operation cannot be completed: EXCEPTION (Certificate serial number 0x2d not found)
```

For example, an IdM server and replica have a function replication agreement between their IdM databases, but the replication agreement between their CA databases is broken. If a host is created on the server, the host entry is replicated over to the replica — but the certificate for that host is not replicated. The replica is aware of the client, but any management operations for that client will fail because the replica doesn't have a copy of its certificate.

A.4.2. Debugging Client Connection Problems

Client connection problems are apparent immediately. This can mean that users cannot log into a machine or attempts to access user and group information fail (for example, **getent passwd admin**).

Authentication in IdM is managed with the SSSD daemon, which is described in the *Red Hat Enterprise Linux Deployment Guide*. If there are problems with client authentication, then check the SSSD information.

First, check the SSSD logs in `/var/log/sss/`. There is a specific log file for the DNS domain, such as **sss_example.com.log**. If there is not enough information in the logs at the default logging level, then increase the log level.

To increase the log level:

1. Open the `sssd.conf` file.

```
vim /etc/sss/sss.conf
```

2. In the `[domain/example.com]` section, set `debug_level`.

```
debug_level = 9
```

3. Restart the `sssd` daemon.

```
service sssd restart
```

4. Check the `/var/log/sss/sss_example.com.log` file for the debug messages.

A.5. Kerberos Errors

Kerberos errors frequently become apparent when trying to connect to the realm using `kinit` or a similar client. For information related to Kerberos, first check the Kerberos manpages, help files, and other resources.



IMPORTANT

Identity Management has its own command-line tools to use to manage Kerberos policies. **Do not** use `kadmin` or `kadmin.local` to manage IdM Kerberos settings.

There are several places to look for Kerberos error log information:

- ▶ For `kinit` problems or other Kerberos server problems, look at the KDC log in `/var/log/krb5kdc.log`.
- ▶ For IdM-specific errors, look in `/var/log/httpd/error_log`.

The IdM logs, both for the server and for IdM-associated services, are covered in [Section 23.1.4, “Checking IdM Server Logs”](#).

A.5.1. Problems making connections with SSH when using GSS-API

If there are bad reverse DNS entries in the DNS configuration, then it may not be possible to log into IdM resources using SSH. When SSH attempts to connect to a resource using GSS-API as its security method, GSS-API first checks the DNS records. The bad records prevent SSH from locating the resource.

It is possible to disable reverse DNS lookups in the SSH configuration. Rather than using reverse DNS records, SSH passes the given username directly to GSS-API.

To disable reverse DNS lookups with SSH, add or edit the `GSSAPITrustDNS` directive and set the value to `no`.

```
# vim /etc/ssh/ssh_config
GSSAPITrustDNS no
```

A.5.2. There are problems connecting to an NFS server after changing a keytab

Clients attempting to mount NFS exports rely on the existence of a valid principal and secret key on both the NFS server and the client host. Clients themselves should not have access to the NFS keytab. The ticket for the NFS connection will be given to clients from the KDC.

Failure to export an updated keytab can cause problems that are difficult to isolate. For example, existing service connections may continue to function, but no new connections may be possible.

A.6. SELinux Login Problems

SELinux maps only work for remote users, not for users with a local account.

When a remote user logs in, authenticating against the IdM server, then the PAM SELinux modules create a file for that user in `/etc/selinux/policy_name/logins/login`.

If that file does not exist, then it means that SSSD is not properly configured to use the IdM server as one of its identity providers. This is required for SELinux mapping to work. Configuring SSSD is covered in the [Red Hat 6 Deployment Guide](#).

If the file exists but the remote user was given the wrong SELinux context, then the `pam_selinux` module may not be properly configured in the PAM stack. This is the module that reads the SELinux information and sets the user context. If the module is missing, then nothing processes the SELinux map and the user is defined a default context on the system.

Glossary

A

access control instruction

See [ACI](#).

access control list

See [ACL](#).

access rights

In the context of access control, specify the level of access granted or denied. Access rights are related to the type of operation that can be performed on the directory. The following rights can be granted or denied: read, write, add, delete, search, compare, selfwrite, proxy and all.

account inactivation

Disables a user account, group of accounts, or an entire domain so that all authentication attempts are automatically rejected.

ACI

An instruction that grants or denies permissions to entries in the directory.

See Also [access control instruction](#).

ACL

The mechanism for controlling access to your directory.

See Also [access control list](#).

All IDs Threshold

Replaced with the ID list scan limit in Directory Server version 7.1. A size limit which is globally applied to every index key managed by the server. When the size of an individual ID list reaches this limit, the server replaces that ID list with an All IDs token.

See Also [ID list scan limit](#).

All IDs token

A mechanism which causes the server to assume that all directory entries match the index key. In effect, the All IDs token causes the server to behave as if no index was available for the search request.

anonymous access

When granted, allows anyone to access directory information without providing credentials, and regardless of the conditions of the bind.

approximate index

Allows for efficient approximate or "sounds-like" searches.

attribute

Holds descriptive information about an entry. Attributes have a label and a value. Each attribute also follows a standard syntax for the type of information that can be stored as the attribute value.

attribute list

A list of required and optional attributes for a given entry type or object class.

authenticating directory server

In pass-through authentication (PTA), the authenticating Directory Server is the Directory Server that contains the authentication credentials of the requesting client. The PTA-enabled host sends PTA requests it receives from clients to the host.

authentication

(1) Process of proving the identity of the client user to the Directory Server. Users must provide a bind DN and either the corresponding password or certificate in order to be granted access to the directory. Directory Server allows the user to perform functions or access files and directories based on the permissions granted to that user by the directory administrator.

(2) Allows a [client](#) to make sure they are connected to a secure server, preventing another computer from impersonating the server or attempting to appear secure when it is not.

authentication certificate

Digital file that is not transferable and not forgeable and is issued by a third party. Authentication certificates are sent from server to client or client to server in order to verify and authenticate the other party.

B

base distinguished name

See [base DN](#).

base DN

Base distinguished name. A search operation is performed on the base DN, the DN of the entry and all entries below it in the directory tree.

bind distinguished name

See [bind DN](#).

bind DN

Distinguished name used to authenticate to Directory Server when performing an operation.

bind rule

In the context of access control, the bind rule specifies the credentials and conditions that a particular user or client must satisfy in order to get access to directory information.

branch entry

An entry that represents the top of a subtree in the directory.

browser

Software, such as Mozilla Firefox, used to request and view World Wide Web material stored as HTML files. The browser uses the HTTP protocol to communicate with the host server.

browsing index

Speeds up the display of entries in the Directory Server Console. Browsing indexes can be created on any branch point in the directory tree to improve display performance.

See Also [virtual list view index](#) .

C

CA

See [Certificate Authority](#).

cascading replication

In a cascading replication scenario, one server, often called the hub supplier, acts both as a consumer and a supplier for a particular replica. It holds a read-only replica and maintains a changelog. It receives updates from the supplier server that holds the master copy of the data and in turn supplies those updates to the consumer.

certificate

A collection of data that associates the public keys of a network user with their DN in the directory. The certificate is stored in the directory as user object attributes.

Certificate Authority

Company or organization that sells and issues authentication certificates. You may purchase an authentication certificate from a Certification Authority that you trust. Also known as a [CA](#).

CGI

Common Gateway Interface. An interface for external programs to communicate with the HTTP server. Programs written to use CGI are called CGI programs or CGI scripts and can be written in many of the common programming languages. CGI programs handle forms or perform output parsing that is not done by the server itself.

chaining

A method for relaying requests to another server. Results for the request are collected, compiled, and then returned to the client.

changelog

A changelog is a record that describes the modifications that have occurred on a replica. The supplier server then replays these modifications on the replicas stored on replica servers or on other masters, in the case of multi-master replication.

character type

Distinguishes alphabetic characters from numeric or other characters and the mapping of upper-case to lower-case letters.

ciphertext

Encrypted information that cannot be read by anyone without the proper key to decrypt the information.

class definition

Specifies the information needed to create an instance of a particular object and determines how the object works in relation to other objects in the directory.

class of service

See [CoS](#).

classic CoS

A classic CoS identifies the template entry by both its DN and the value of one of the target entry's attributes.

client

See [LDAP client](#).

code page

An internal table used by a locale in the context of the internationalization plug-in that the operating system uses to relate keyboard keys to character font screen displays.

collation order

Provides language and cultural-specific information about how the characters of a given language are to be sorted. This information might include the sequence of letters in the alphabet or how to compare letters with accents to letters without accents.

consumer

Server containing replicated directory trees or subtrees from a supplier server.

consumer server

In the context of replication, a server that holds a replica that is copied from a different server is called a consumer for that replica.

CoS

A method for sharing attributes between entries in a way that is invisible to applications.

CoS definition entry

Identifies the type of CoS you are using. It is stored as an LDAP subentry below the branch it affects.

CoS template entry

Contains a list of the shared attribute values.

See Also [template entry](#).

D**daemon**

A background process on a Unix machine that is responsible for a particular system task. Daemon processes do not need human intervention to continue functioning.

DAP

Directory Access Protocol. The ISO X.500 standard protocol that provides client access to the directory.

data master

The server that is the master source of a particular piece of data.

database link

An implementation of chaining. The database link behaves like a database but has no persistent storage. Instead, it points to data stored remotely.

default index

One of a set of default indexes created per database instance. Default indexes can be modified, although care should be taken before removing them, as certain plug-ins may depend on them.

definition entry

See [CoS definition entry](#).

Directory Access Protocol

See [DAP](#).

Directory Manager

The privileged database administrator, comparable to the root user in UNIX. Access control does not apply to the Directory Manager.

directory service

A database application designed to manage descriptive, attribute-based information about people and resources within an organization.

directory tree

The logical representation of the information stored in the directory. It mirrors the tree model used by most filesystems, with the tree's root point appearing at the top of the hierarchy. Also known as [DIT](#).

distinguished name

String representation of an entry's name and location in an LDAP directory.

DIT

See [directory tree](#).

DM

See [Directory Manager](#).

DN

See [distinguished name](#).

DNS

Domain Name System. The system used by machines on a network to associate standard IP addresses (such as 198.93.93.10) with hostnames (such as **www.example.com**). Machines normally get the IP address for a hostname from a DNS server, or they look it up in tables maintained on their systems.

DNS alias

A DNS alias is a hostname that the DNS server knows points to a different host specifically a DNS CNAME record. Machines always have one real name, but they can have one or more aliases. For example, an alias such as **www.yourdomain.domain** might point to a real machine called **realthing.yourdomain.domain** where the server currently exists.

E

entry

A group of lines in the LDIF file that contains information about an object.

entry distribution

Method of distributing directory entries across more than one server in order to scale to support large numbers of entries.

entry ID list

Each index that the directory uses is composed of a table of index keys and matching entry ID lists. The entry ID list is used by the directory to build a list of candidate entries that may match the client application's search request.

equality index

Allows you to search efficiently for entries containing a specific attribute value.

F**file extension**

The section of a filename after the period or dot (.) that typically defines the type of file (for example, .GIF and .HTML). In the filename **index.html** the file extension is **html**.

file type

The format of a given file. For example, graphics files are often saved in GIF format, while a text file is usually saved as ASCII text format. File types are usually identified by the file extension (for example, .GIF or .HTML).

filter

A constraint applied to a directory query that restricts the information returned.

filtered role

Allows you to assign entries to the role depending upon the attribute contained by each entry. You do this by specifying an LDAP filter. Entries that match the filter are said to possess the role.

G**general access**

When granted, indicates that all authenticated users can access directory information.

GSS-API

Generic Security Services. The generic access protocol that is the native way for UNIX-based systems to access and authenticate Kerberos services; also supports session encryption.

H**hostname**

A name for a machine in the form machine.domain.dom, which is translated into an IP address. For example, **www.example.com** is the machine **www** in the subdomain **example** and **com** domain.

HTML

Hypertext Markup Language. The formatting language used for documents on the World Wide Web. HTML files are plain text files with formatting codes that tell browsers such as the Mozilla Firefox how to display text, position graphics, and form items and to display links to other pages.

HTTP

Hypertext Transfer Protocol. The method for exchanging information between HTTP servers and clients.

HTTPD

An abbreviation for the HTTP daemon or service, a program that serves information using the HTTP protocol. The daemon or service is often called an httpd.

HTTPS

A secure version of HTTP, implemented using the Secure Sockets Layer, SSL.

hub

In the context of replication, a server that holds a replica that is copied from a different server, and, in turn, replicates it to a third server.

See Also [cascading replication](#).

ID list scan limit

A size limit which is globally applied to any indexed search operation. When the size of an individual ID list reaches this limit, the server replaces that ID list with an all IDs token.

index key

Each index that the directory uses is composed of a table of index keys and matching entry ID lists.

indirect CoS

An indirect CoS identifies the template entry using the value of one of the target entry's attributes.

international index

Speeds up searches for information in international directories.

International Standards Organization

See [ISO](#).

IP address

Also Internet Protocol address. A set of numbers, separated by dots, that specifies the actual location of a machine on the Internet (for example, 198.93.93.10). Directory Server supports both IPv4 and IPv6 IP addresses.

ISO

International Standards Organization.

K

knowledge reference

Pointers to directory information stored in different databases.

L

LDAP

Lightweight Directory Access Protocol. Directory service protocol designed to run over TCP/IP and across multiple platforms.

LDAP client

Software used to request and view LDAP entries from an LDAP Directory Server.

See Also [browser](#).

LDAP Data Interchange Format

See [LDAP Data Interchange Format](#).

LDAP URL

Provides the means of locating Directory Servers using DNS and then completing the query via LDAP. A sample LDAP URL is **ldap://ldap.example.com**.

LDAPv3

Version 3 of the LDAP protocol, upon which Directory Server bases its schema format.

LDBM database

A high-performance, disk-based database consisting of a set of large files that contain all of the data assigned to it. The primary data store in Directory Server.

LDIF

LDAP Data Interchange Format. Format used to represent Directory Server entries in text form.

leaf entry

An entry under which there are no other entries. A leaf entry cannot be a branch point in a directory tree.

Lightweight Directory Access Protocol

See [LDAP](#).

locale

Identifies the collation order, character type, monetary format and time / date format used to present data for users of a specific region, culture, and/or custom. This includes information on how data of a given language is interpreted, stored, or collated. The locale also indicates which code page should be used to represent a given language.

M

managed object

A standard value which the SNMP agent can access and send to the NMS. Each managed object is identified with an official name and a numeric identifier expressed in dot-notation.

managed role

Allows creation of an explicit enumerated list of members.

management information base

See [MIB](#).

mapping tree

A data structure that associates the names of suffixes (subtrees) with databases.

master

See [supplier](#).

master agent

See [SNMP master agent](#).

matching rule

Provides guidelines for how the server compares strings during a search operation. In an international search, the matching rule tells the server what collation order and operator to use.

MD5

A message digest algorithm by RSA Data Security, Inc., which can be used to produce a short digest of data that is unique with high probability and is mathematically extremely hard to produce; a piece of data that will produce the same message digest.

MD5 signature

A message digest produced by the MD5 algorithm.

MIB

Management Information Base. All data, or any portion thereof, associated with the SNMP network. We can think of the MIB as a database which contains the definitions of all SNMP managed objects. The MIB has a tree-like hierarchy, where the top level contains the most general information about the network and lower levels deal with specific, separate network areas.

MIB namespace

Management Information Base namespace. The means for directory data to be named and referenced. Also called the [directory tree](#).

monetary format

Specifies the monetary symbol used by specific region, whether the symbol goes before or after its value, and how monetary units are represented.

multi-master replication

An advanced replication scenario in which two servers each hold a copy of the same read-write replica. Each server maintains a changelog for the replica. Modifications made on one server are automatically replicated to the other server. In case of conflict, a time stamp is used to determine which server holds the most recent version.

multiplexor

The server containing the database link that communicates with the remote server.

N

n + 1 directory problem

The problem of managing multiple instances of the same information in different directories, resulting in increased hardware and personnel costs.

name collisions

Multiple entries with the same distinguished name.

nested role

Allows the creation of roles that contain other roles.

network management application

Network Management Station component that graphically displays information about SNMP managed devices, such as which device is up or down and which and how many error messages were received.

network management station

See [NMS](#).

NIS

Network Information Service. A system of programs and data files that Unix machines use to collect, collate, and share specific information about machines, users, filesystems, and network parameters throughout a network of computers.

NMS

Powerful workstation with one or more network management applications installed. Also [network management station](#).

ns-slapd

Red Hat's LDAP Directory Server daemon or service that is responsible for all actions of the Directory Server.

See Also [slapd](#).

O

object class

Defines an entry type in the directory by defining which attributes are contained in the entry.

object identifier

A string, usually of decimal numbers, that uniquely identifies a schema element, such as an object class or an attribute, in an object-oriented system. Object identifiers are assigned by ANSI, IETF or similar organizations.

See Also [OID](#).

OID

See [object identifier](#).

operational attribute

Contains information used internally by the directory to keep track of modifications and subtree properties. Operational attributes are not returned in response to a search unless explicitly requested.

P

parent access

When granted, indicates that users have access to entries below their own in the directory tree if the bind DN is the parent of the targeted entry.

pass-through authentication

See [PTA](#).

pass-through subtree

In pass-through authentication, the [PTA directory server](#) will pass through bind requests to the [authenticating directory server](#) from all clients whose DN is contained in this subtree.

password file

A file on Unix machines that stores Unix user login names, passwords, and user ID numbers. It is also known as `/etc/passwd` because of where it is kept.

password policy

A set of rules that governs how passwords are used in a given directory.

PDU

Encoded messages which form the basis of data exchanges between SNMP devices. Also [protocol data unit](#).

permission

In the context of access control, permission states whether access to the directory information is granted or denied and the level of access that is granted or denied.

See Also [access rights](#).

pointer CoS

A pointer CoS identifies the template entry using the template DN only.

presence index

Allows searches for entries that contain a specific indexed attribute.

protocol

A set of rules that describes how devices on a network exchange information.

protocol data unit

See [PDU](#).

proxy authentication

A special form of authentication where the user requesting access to the directory does not bind with its own DN but with a proxy DN.

proxy DN

Used with proxied authorization. The proxy DN is the DN of an entry that has access permissions to the target on which the client-application is attempting to perform an operation.

PTA

Mechanism by which one Directory Server consults another to check bind credentials. Also [pass-through authentication](#).

PTA directory server

In pass-through authentication ([PTA](#)), the PTA Directory Server is the server that sends (passes through) bind requests it receives to the [authenticating directory server](#).

PTA LDAP URL

In pass-through authentication, the URL that defines the [authenticating directory server](#), pass-through subtree(s), and optional parameters.

R

RAM

Random access memory. The physical semiconductor-based memory in a computer. Information stored in RAM is lost when the computer is shut down.

rc.local

A file on Unix machines that describes programs that are run when the machine starts. It is also called `/etc/rc.local` because of its location.

RDN

The name of the actual entry itself, before the entry's ancestors have been appended to the string to form the full distinguished name. Also [relative distinguished name](#).

read-only replica

A replica that refers all update operations to read-write replicas. A server can hold any number of read-only replicas.

read-write replica

A replica that contains a master copy of directory information and can be updated. A server can hold any number of read-write replicas.

referential integrity

Mechanism that ensures that relationships between related entries are maintained within the directory.

referral

(1) When a server receives a search or update request from an LDAP client that it cannot process, it usually sends back to the client a pointer to the LDAP sever that can process the request.

(2) In the context of replication, when a read-only replica receives an update request, it forwards it to the server that holds the corresponding read-write replica. This forwarding process is called a referral.

relative distinguished name

See [RDN](#).

replica

A database that participates in replication.

replica-initiated replication

Replication configuration where replica servers, either hub or consumer servers, pull directory data from supplier servers. This method is available only for legacy replication.

replication

Act of copying directory trees or subtrees from supplier servers to replica servers.

replication agreement

Set of configuration parameters that are stored on the supplier server and identify the databases to replicate, the replica servers to which the data is pushed, the times during which replication can occur, the DN and credentials used by the supplier to bind to the consumer, and how the connection is secured.

RFC

Request for Comments. Procedures or standards documents submitted to the Internet community. People can send comments on the technologies before they become accepted standards.

role

An entry grouping mechanism. Each role has *members*, which are the entries that possess the role.

role-based attributes

Attributes that appear on an entry because it possesses a particular role within an associated CoS template.

root

The most privileged user available on Unix machines. The root user has complete access privileges to all files on the machine.

root suffix

The parent of one or more sub suffixes. A directory tree can contain more than one root suffix.

S**SASL**

An authentication framework for clients as they attempt to bind to a directory. Also [Simple Authentication and Security Layer](#) .

schema

Definitions describing what types of information can be stored as entries in the directory. When information that does not match the schema is stored in the directory, clients attempting to access the directory may be unable to display the proper results.

schema checking

Ensures that entries added or modified in the directory conform to the defined schema. Schema checking is on by default, and users will receive an error if they try to save an entry that does not conform to the schema.

Secure Sockets Layer

See [SSL](#).

self access

When granted, indicates that users have access to their own entries if the bind DN matches the targeted entry.

Server Console

Java-based application that allows you to perform administrative management of your Directory Server from a GUI.

server daemon

The server daemon is a process that, once running, listens for and accepts requests from clients.

Server Selector

Interface that allows you select and configure servers using a browser.

server service

A process on Windows that, once running, listens for and accepts requests from clients. It is the SMB server on Windows NT.

service

A background process on a Windows machine that is responsible for a particular system task. Service processes do not need human intervention to continue functioning.

SIE

Server Instance Entry. The ID assigned to an instance of Directory Server during installation.

Simple Authentication and Security Layer

See [SASL](#).

Simple Network Management Protocol

See [SNMP](#).

single-master replication

The most basic replication scenario in which multiple servers, up to four, each hold a copy of the same read-write replicas to replica servers. In a single-master replication scenario, the supplier server maintains a changelog.

SIR

See [supplier-initiated replication](#).

slapd

LDAP Directory Server daemon or service that is responsible for most functions of a directory except replication.

See Also [ns-slapd](#).

SNMP

Used to monitor and manage application processes running on the servers by exchanging data about network activity. Also [Simple Network Management Protocol](#).

SNMP master agent

Software that exchanges information between the various subagents and the NMS.

SNMP subagent

Software that gathers information about the managed device and passes the information to the master agent. Also called a [subagent](#).

SOA

See [start of authority \(SOA\)](#).

SSL

A software library establishing a secure connection between two parties (client and server) used to implement HTTPS, the secure version of HTTP. Also called [Secure Sockets Layer](#).

standard index

An index maintained by default.

start of authority (SOA)

A record which contains the core information about a DNS zone.

sub suffix

A branch underneath a root suffix.

subagent

See [SNMP subagent](#).

substring index

Allows for efficient searching against substrings within entries. Substring indexes are limited to a minimum of two characters for each entry.

suffix

The name of the entry at the top of the directory tree, below which data is stored. Multiple suffixes are possible within the same directory. Each database only has one suffix.

superuser

The most privileged user available on Unix machines. The superuser has complete access privileges to all files on the machine. Also called [root](#).

supplier

Server containing the master copy of directory trees or subtrees that are replicated to replica servers.

supplier server

In the context of replication, a server that holds a replica that is copied to a different server is called a supplier for that replica.

supplier-initiated replication

Replication configuration where [supplier](#) servers replicate directory data to any replica servers.

symmetric encryption

Encryption that uses the same key for both encrypting and decrypting. DES is an example of a symmetric encryption algorithm.

system index

Cannot be deleted or modified as it is essential to Directory Server operations.

T

target

In the context of access control, the target identifies the directory information to which a particular ACI applies.

target entry

The entries within the scope of a CoS.

TCP/IP

Transmission Control Protocol/Internet Protocol. The main network protocol for the Internet and for enterprise (company) networks.

template entry

See [CoS template entry](#).

time/date format

Indicates the customary formatting for times and dates in a specific region.

TLS

The new standard for secure socket layers; a public key based protocol. Also [Transport Layer Security](#).

topology

The way a directory tree is divided among physical servers and how these servers link with one another.

Transport Layer Security

See [TLS](#).

U

uid

A unique number associated with each user on a Unix system.

URL

Uniform Resource Locator. The addressing system used by the server and the client to request documents. It is often called a location. The format of a URL is *protocol://machine:port/document*. The port number is necessary only on selected servers, and it is often assigned by the server, freeing the user of having to place it in the URL.

V

virtual list view index

Speeds up the display of entries in the Directory Server Console. Virtual list view indexes can be created on any branch point in the directory tree to improve display performance.

See Also [browsing index](#).

X

X.500 standard

The set of ISO/ITU-T documents outlining the recommended information model, object classes and attributes used by directory server implementation.

Index

A

attributes

- setting multi-valued, [From the Command Line](#)

B

bind

- DNS and LDAP, [About DNS in IdM](#)

C

certificates

- automatically renewed, [Viewing Renewal Messages](#), [Renewing CA Certificates Issued by External CAs](#)
- CA expiration, [Renewing CA Certificates Issued by External CAs](#)
- updating CA, [Renewing CA Certificates Issued by External CAs](#)

chkconfig, [Starting and Stopping the IdM Domain](#)

client

- troubleshooting
 - installation, [Client Installations](#)
- uninstalling, [Uninstalling an IdM Client](#)

D

DHCP, [Adding Host Entries from the Command Line](#)

DNS

- adding zone records, [Adding Records to DNS Zones](#)
- adding zones, [Adding Forward DNS Zones](#)
- bind-dyndb-ldap and Directory Server, [About DNS in IdM](#)
- disabling zones, [Enabling and Disabling Zones](#)
- dynamic updates, [Enabling Dynamic DNS Updates](#)
- hosts with DHCP, [Adding Host Entries from the Command Line](#)
- PTR synchronization
 - requirements, [Synchronizing Forward and Reverse Zone Entries](#)

DNS zone records, [Adding Records to DNS Zones](#)

- deleting, [Deleting Records from DNS Zones](#)
- format for adding, [About the Commands to Add DNS Records](#)
- IPv4 example, [Examples of Adding DNS Resource Records](#)
- IPv6 example, [Examples of Adding DNS Resource Records](#)
- PTR example, [Examples of Adding DNS Resource Records](#)

- SRV example, [Examples of Adding DNS Resource Records](#)
- types of records, [Adding Records to DNS Zones](#)

G

glue entries, [Solving Orphan Entry Conflicts](#)

H

hosts

- certificate not found errors, [Serial Numbers Not Found Errors](#)
- creating
 - with DHCP, [Adding Host Entries from the Command Line](#)
- disabling, [Disabling and Re-enabling Host Entries](#)

I

installing clients

- disabling OpenSSH, [About ipa-client-install and OpenSSH](#)

K

Kerberos, [About Kerberos](#)

- separate credentials cache, [Caching User Kerberos Tickets](#)
- SSSD password cache, [Caching Kerberos Passwords](#)
- ticket policies, [Setting Kerberos Ticket Policies](#)
 - global, [Setting Global Ticket Policies](#)
 - user-level, [Setting User-Level Ticket Policies](#)

L

log rotation

- policies, [IdM Domain Services and Log Rotation](#)

logging in

- SELinux problems, [SELinux Login Problems](#)
- separate credentials cache, [Caching User Kerberos Tickets](#)

logrotate, [IdM Domain Services and Log Rotation](#)

N

naming conflicts

- in replication, [Solving Naming Conflicts](#)

P

password expiration, [Managing Password Expiration Limits](#)

password policies

- expiration, [Managing Password Expiration Limits](#)

policies

- log rotation, [IdM Domain Services and Log Rotation](#)

port forwarding

- for the UI, [Using the UI with Proxy Servers](#)

proxy servers

- for the UI, [Using the UI with Proxy Servers](#)

PTR synchronization

- requirements, [Synchronizing Forward and Reverse Zone Entries](#)

R**reboot, [Starting and Stopping the IdM Domain](#)****replicas**

- number in replication, [About IdM Servers and Replicas](#)

replication

- errors, [Serial Numbers Not Found Errors](#)
- size limits, [About IdM Servers and Replicas](#)

S**SELinux**

- login problems, [SELinux Login Problems](#)

servers

- number in replication, [About IdM Servers and Replicas](#)

services

- disabling, [Disabling and Re-enabling Service Entries](#)

SSH

- disabling at client install, [About ipa-client-install and OpenSSH](#)

SSSD

- and Kerberos passwords, [Caching Kerberos Passwords](#)
 - disabling cache, [Caching Kerberos Passwords](#)

starting with chkconfig, [Starting and Stopping the IdM Domain](#)**T****ticket policies, [Setting Kerberos Ticket Policies](#)****troubleshooting**

- client installation, [Client Installations](#)
- Kerberos, unknown server error, [The client can't resolve reverse hostnames when using an external DNS.](#)
- resolving hostnames on client, [The client can't resolve reverse hostnames when using an external DNS.](#)
- SELinux, [SELinux Login Problems](#)

U**uninstalling**

- clients, [Uninstalling an IdM Client](#)

users

- multi-valued attributes, [From the Command Line](#)
- password expiration, [Managing Password Expiration Limits](#)

- separate credentials cache, [Caching User Kerberos Tickets](#)

W

web UI

- port forwarding, [Using the UI with Proxy Servers](#)
- proxy servers, [Using the UI with Proxy Servers](#)

Z

zone records, [Adding Records to DNS Zones](#)

- deleting, [Deleting Records from DNS Zones](#)
- format for adding, [About the Commands to Add DNS Records](#)
- IPv4 example, [Examples of Adding DNS Resource Records](#)
- IPv6 example, [Examples of Adding DNS Resource Records](#)
- PTR example, [Examples of Adding DNS Resource Records](#)
- SRV example, [Examples of Adding DNS Resource Records](#)
- types, [Adding Records to DNS Zones](#)