Red Hat Enterprise Linux 9

Planning Identity Management

Documentation for planning Identity Management and setting up access control

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Legal Notice

Abstract

This document describes the planning of Identity Management services on Red Hat Enterprise Linux 9.

Table of Contents

MAKING OPEN SOURCE MORE INCLUSIVE

Red Hat is committed to replacing problematic language in our code, documentation, and web properties. We are beginning with these four terms: master, slave, blacklist, and whitelist. Because of the enormity of this endeavor, these changes will be implemented gradually over several upcoming releases. For more details, see our CTO Chris Wright's message.

In Identity Management, planned terminology replacements include:

- ***block list*** replaces *blacklist*
- ***allow list*** replaces *whitelist*
- ***secondary*** replaces *slave*
- The word *master* is going to be replaced with more precise language, depending on the context:
  - ***IdM server*** replaces *IdM master*
  - ***CA renewal server*** replaces *CA renewal master*
  - ***CRL publisher server*** replaces *CRL master*
  - ***multi-supplier*** replaces *multi-master*

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CHAPTER 1. OVERVIEW OF PLANNING FOR IDM AND ACCESS CONTROL IN RHEL

The following sections provide an overview of the options for identity management (IdM) and access control in Red Hat Enterprise Linux. After reading these sections, you will be able to approach the planning stage for your environment.

1.1. INTRODUCTION TO IDM

This module explains the purpose of Identity Management (IdM) in Red Hat Enterprise Linux. It also provides basic information about the IdM domain, including the client and server machines that are part of the domain.

The goal of IdM in Red Hat Enterprise Linux

IdM in Red Hat Enterprise Linux provides a centralized and unified way to manage identity stores, authentication, policies, and authorization policies in a Linux-based domain. IdM significantly reduces the administrative overhead of managing different services individually and using different tools on different machines.

IdM is one of the few centralized identity, policy, and authorization software solutions that support:

- Advanced features of Linux operating system environments
- Unifying large groups of Linux machines
- Native integration with Active Directory

IdM creates a Linux-based and Linux-controlled domain:

- IdM builds on existing, native Linux tools and protocols. It has its own processes and configuration, but its underlying technologies are well-established on Linux systems and trusted by Linux administrators.
- IdM servers and clients are Red Hat Enterprise Linux machines. IdM clients can also be other Linux and UNIX distributions if they support standard protocols. Windows client cannot be a member of the IdM domain but user logged into Windows systems managed by Active Directory (AD) can connect to Linux clients or access services managed by IdM. This is accomplished by establishing cross forest trust between AD and IdM domains.

Managing identities and policies on multiple Linux servers

Without IdM: Each server is administered separately. All passwords are saved on the local machines. The IT administrator manages users on every machine, sets authentication and authorization policies separately, and maintains local passwords. However, more often the users rely on other centralized solution, for example direct integration with AD. Systems can be directly integrated with AD using several different solutions:

- Legacy Linux tools (not recommended to use)
- Solution based on Samba winbind (recommended for specific use cases)
- Solution based on a third-party software (usually require a license from another vendor)
- Solution based on SSSD (native Linux and recommended for the majority of use cases)

With IdM: The IT administrator can:

- Maintain the identities in one central place: the IdM server
- Apply policies uniformly to multiples of machines at the same time
- Set different access levels for users by using host-based access control, delegation, and other rules
- Centrally manage privilege escalation rules
- Define how home directories are mounted

Enterprise SSO

In case of IdM Enterprise, single sign-on (SSO) is implemented leveraging the Kerberos protocol. This protocol is popular in the infrastructure level and enables SSO with services such as SSH, LDAP, NFS, CUPS, or DNS. Web services using different web stacks (Apache, EAP, Django, and others) can also be enabled to use Kerberos for SSO. However, practice shows that using OpenID Connect or SAML based on SSO is more convenient for web applications. To bridge the two layers, it is recommended to deploy an Identity Provider (IdP) solution that would be able to convert Kerberos authentication into a OpenID Connect ticket or SAML assertion. Red Hat SSO technology based on the Keycloak open source project is an example of such an IdP

Without IdM: Users log in to the system and are prompted for a password every single time they access a service or application. These passwords might be different, and the users have to remember which credential to use for which application.

With Idm: After users log in to the system, they can access multiple services and applications without being repeatedly asked for their credentials. This helps to:

- Improve usability
- Reduce the security risk of passwords being written down or stored insecurely
- Boost user productivity

Managing a mixed Linux and Windows environment

Without IdM: Windows systems are managed in an AD forest, but development, production, and other teams have many Linux systems. The Linux systems are excluded from the AD environment.

With IdM: The IT administrator can:

- Manage the Linux systems using native Linux tools
- Integrate the Linux systems into the environments centrally managed by Active Directory, thus preserving a centralized user store.
- Easily deploy new Linux systems at scale or as needed.
- Quickly react to business needs and make decisions related to management of the Linux infrastructure without dependency on other teams avoiding delays.

Contrasting IdM with a Standard LDAP Directory

A standard LDAP directory, such as Red Hat Directory Server, is a general-purpose directory: it can be customized to fit a broad range of use cases.

- Schema: a flexible schema that can be customized for a vast array of entries, such as users, machines, network entities, physical equipment, or buildings.
- Typically used as: a back-end directory to store data for other applications, such as business applications that provide services on the Internet.

IdM has a specific purpose: managing internal, inside-the-enterprise identities as well as authentication and authorization policies that relate to these identities.

- Schema: a specific schema that defines a particular set of entries relevant to its purpose, such as entries for user or machine identities.
- Typically used as: the identity and authentication server to manage identities within the boundaries of an enterprise or a project.

The underlying directory server technology is the same for both Red Hat Directory Server and IdM. However, IdM is optimized to manage identities inside the enterprise. This limits its general extensibility, but also brings certain benefits: simpler configuration, better automation of resource management, and increased efficiency in managing enterprise identities.

Additional resources

- Identity Management or Red Hat Directory Server – Which One Should I Use? on the Red Hat Enterprise Linux Blog
- Knowledge Base article about Standard protocols
- Product documentation for Red Hat Enterprise Linux 9

1.2. INTRODUCTION TO IDM SERVERS AND CLIENTS

The Identity Management (IdM) domain includes the following types of systems:

IdM servers

IdM servers are Red Hat Enterprise Linux systems that respond to identity, authentication, and authorization requests within an IdM domain. In most deployments, an integrated certificate authority (CA) is also installed with the IdM server.
IdM servers are the central repositories for identity and policy information. IdM servers can also host any of the optional services used by domain members:

- Certificate authority (CA)
- Key Recovery Authority (KRA)
- DNS
- Active Directory (AD) trust controller
- Active Directory (AD) trust agent

IdM clients

IdM clients are Red Hat Enterprise Linux systems enrolled with the servers and configured to use the IdM services on these servers.
Clients interact with the IdM servers to access services provided by them. For example, clients use the Kerberos protocol to perform authentication and acquire tickets for enterprise single sign-on

(SSO), use LDAP to get identity and policy infromation, use DNS to detect where the servers and services are located and how to connect to them.

IdM servers are also embedded IdM clients. As clients enrolled with themselves, the servers provide the same functionality as other clients.

To provide services for large numbers of clients, as well as for redundancy and availability, IdM allows deployment on multiple IdM servers in a single domain. It is possible to deploy up to 60 servers. This is the maximum number of IdM servers, also called replicas, that is currently supported in the IdM domain. IdM servers provide different services for the client. Not all the servers need to provide all the possible services. Some server components like Kerberos and LDAP are always available on every server. Other services like CA, DNS, Trust Controller or Vault are optional. This means that different servers in general play different roles in the deployment.

If your IdM topology contains an integrated CA, one server has the role of the Certificate revocation list (CRL) publisher server and one server has the role of the CA renewal server.

By default, the first CA server installed fulfills these two roles, but you can assign these roles to separate servers.

WARNING

The *CA renewal server* is critical for your IdM deployment because it is the only system in the domain responsible for tracking CA subsystem certificates and keys. For details about how to recover from a disaster affecting your IdM deployment, see Performing disaster recovery with Identity Management .

For redundancy and load balancing, administrators create additional servers by creating a *replica* of an existing server. When creating a replica, IdM clones the configuration of the existing server. A replica shares with the initial server its core configuration, including internal information about users, systems, certificates, and configured policies.

NOTE

A replica and the server it was created from are functionally identical, except for the *CA renewal* and *CRL publisher* roles. Therefore, the term ***server*** and ***replica*** are used interchangeably here depending on the context.

1.3. IDM AND ACCESS CONTROL IN RHEL: CENTRAL VS. LOCAL

In Red Hat Enterprise Linux, you can manage identities and access control policies using centralized tools for a whole domain of systems, or using local tools for a single system.

Managing identities and policies on multiple Red Hat Enterprise Linux servers: With and without IdM

With Identity Management IdM, the IT administrator can:

- Maintain the identities and grouping mechanisms in one central place: the IdM server

- Centrally manage different types of credentials such as passwords, PKI certificates, OTP tokens, or SSH keys
- Apply policies uniformly to multiples of machines at the same time
- Manage POSIX and other attributes for external Active Directory users
- Set different access levels for users by using host-based access control, delegation, and other rules
- Centrally manage privilege escalation rules (sudo) and mandatory access control (SELinux user mapping)
- Maintain central PKI infrastructure and secrets store
- Define how home directories are mounted

Without IdM:

- Each server is administered separately.
- All passwords are saved on the local machines.
- The IT administrator manages users on every machine, sets authentication and authorization policies separately, and maintains local passwords.

1.4. IDM TERMINOLOGY

Active Directory forest

An Active Directory (AD) forest is a set of one or more domain trees which share a common global catalog, directory schema, logical structure, and directory configuration. The forest represents the security boundary within which users, computers, groups, and other objects are accessible. For more information, see the Microsoft document on Forests.

Active Directory global catalog

The global catalog is a feature of Active Directory (AD) that allows a domain controller to provide information on any object in the forest, regardless of whether the object is a member of the domain controller's domain. Domain controllers with the global catalog feature enabled are referred to as global catalog servers. The global catalog provides a searchable catalog of all objects in every domain in a multi-domain Active Directory Domain Services (AD DS).

Active Directory security identifier

A security identifier (SID) is a unique ID number assigned to an object in Active Directory, such as a user, group, or host. It is the functional equivalent of UIDs and GIDs in Linux.

Ansible play

Ansible plays are the building blocks of Ansible playbooks. The goal of a play is to map a group of hosts to some well-defined roles, represented by Ansible tasks.

Ansible playbook

An Ansible playbook is a file that contains one or more Ansible plays. For more information, see the official Ansible documentation about playbooks .

Ansible task

Ansible tasks are units of action in Ansible. An Ansible play can contain multiple tasks. The goal of each task is to execute a module, with very specific arguments. An Ansible task is a set of instructions to achieve a state defined, in its broad terms, by a specific Ansible role or module, and fine-tuned by

the variables of that role or module. For more information, see the official Ansible tasks documentation.

Apache web server

The Apache HTTP Server, colloquially called Apache, is a free and open-source cross-platform web server application, released under the terms of Apache License 2.0. Apache played a key role in the initial growth of the World Wide Web, and is currently the leading HTTP server. Its process name is **httpd**, which is short for *HTTP daemon*. Red Hat Identity Management (IdM) uses the Apache Web Server to display the IdM Web UI, and to coordinate communication between components, such as the Directory Server and the Certificate Authority.

Certificate

A certificate is an electronic document used to identify an individual, a server, a company, or other entity and to associate that identity with a public key. Such as a driver's license or passport, a certificate provides generally recognized proof of a person's identity. Public-key cryptography uses certificates to address the problem of impersonation.

Certificate Authorities (CAs) in IdM

An entity that issues digital certificates. In Red Hat Identity Management, the primary CA is **ipa**, the IdM CA. The **ipa** CA certificate is one of the following types:

- Self-signed. In this case, the **ipa** CA is the root CA.
- Externally signed. In this case, the **ipa** CA is subordinated to the external CA.

In IdM, you can also create multiple **sub-CAs**. Sub-CAs are IdM CAs whose certificates are one of the following types:

- Signed by the **ipa** CA.
- Signed by any of the intermediate CAs between itself and **ipa** CA. The certificate of a sub-CA cannot be self-signed.

See also Planning your CA services.

Cross-forest trust

A trust establishes an access relationship between two Kerberos realms, allowing users and services in one domain to access resources in another domain.

With a cross-forest trust between an Active Directory (AD) forest root domain and an IdM domain, users from the AD forest domains can interact with Linux machines and services from the IdM domain. From the perspective of AD, Identity Management represents a separate AD forest with a single AD domain. For more information, see How the trust works.

Directory Server

A Directory Server centralizes user identity and application information. It provides an operating system-independent, network-based registry for storing application settings, user profiles, group data, policies, and access control information. Each resource on the network is considered an object by the directory server. Information about a particular resource is stored as a collection of attributes associated with that resource or object. Red Hat Directory Server conforms to LDAP standards.

DNS PTR records

DNS pointer (PTR) records resolve an IP address of a host to a domain or host name. PTR records are the opposite of DNS A and AAAA records, which resolve host names to IP addresses. DNS PTR records enable reverse DNS lookups. PTR records are stored on the DNS server.

DNS SRV records

A DNS service (SRV) record defines the hostname, port number, transport protocol, priority and weight of a service available in a domain. You can use SRV records to locate IdM servers and replicas.

Domain Controller (DC)

A domain controller (DC) is a host that responds to security authentication requests within a domain and controls access to resources in that domain. IdM servers work as DCs for the IdM domain. A DC authenticates users, stores user account information and enforces security policy for a domain. When a user logs into a domain, the DC authenticates and validates their credentials and either allows or denies access.

Fully qualified domain name

A fully qualified domain name (FQDN) is a domain name that specifies the exact location of a host within the hierarchy of the Domain Name System (DNS). A device with the hostname **myhost** in the parent domain **example.com** has the FQDN **myhost.example.com**. The FQDN uniquely distinguishes the device from any other hosts called **myhost** in other domains.

If you are installing an IdM client on host **machine1** using DNS autodiscovery and your DNS records are correctly configured, the FQDN of **machine1** is all you need. For more information, see Host name and DNS requirements for IdM.

GSSAPI

The Generic Security Service Application Program Interface (GSSAPI, or GSS-API) allows developers to abstract how their applications protect data that is sent to peer applications. Security-service vendors can provide GSSAPI implementations of common procedure calls as libraries with their security software. These libraries present a GSSAPI-compatible interface to application writers who can write their application to use only the vendor-independent GSSAPI. With this flexibility, developers do not have to tailor their security implementations to any particular platform, security mechanism, type of protection, or transport protocol.

Kerberos is the dominant GSSAPI mechanism implementation, which allows Red Hat Enterprise Linux and Microsoft Windows Active Directory Kerberos implementations to be API compatible.

Hidden replica

A hidden replica is an IdM replica that has all services running and available, but its server roles are disabled, and clients cannot discover the replica because it has no SRV records in DNS.

Hidden replicas are primarily designed for services such as backups, bulk importing and exporting, or actions that require shutting down IdM services. Since no clients use a hidden replica, administrators can temporarily shut down the services on this host without affecting any clients. For more information, see The hidden replica mode.

HTTP server

See Web server.

ID mapping

SSSD can use the SID of an AD user to algorithmically generate POSIX IDs in a process called *ID mapping*. ID mapping creates a map between SIDs in AD and IDs on Linux.

- When SSSD detects a new AD domain, it assigns a range of available IDs to the new domain. Therefore, each AD domain has the same ID range on every SSSD client machine.
- When an AD user logs in to an SSSD client machine for the first time, SSSD creates an entry for the user in the SSSD cache, including a UID based on the user's SID and the ID range for that domain.
- Because the IDs for an AD user are generated in a consistent way from the same SID, the user has the same UID and GID when logging in to any Red Hat Enterprise Linux system.

ID ranges

An ID range is a range of ID numbers assigned to the IdM topology or a specific replica. You can use ID ranges to specify the valid range of UIDs and GIDs for new users, hosts and groups. ID ranges are used to avoid ID number conflicts. There are two distinct types of ID ranges in IdM:

- *IdM ID range*
  Use this ID range to define the UIDs and GIDs for users and groups in the whole IdM topology. Installing the first IdM server creates the IdM ID range. You cannot modify the IdM ID range after creating it. However, you can create an additional IdM ID range, for example when the original one nears depletion.

- *Distributed Numeric Assignment (DNA) ID range*
  Use this ID range to define the UIDs and GIDs a replica uses when creating new users. Adding a new user or host entry to an IdM replica for the first time assigns a DNA ID range to that replica. An administrator can modify the DNA ID range, but the new definition must fit within an existing IdM ID range.

  Note that the IdM range and the DNA range match, but they are not interconnected. If you change one range, ensure you change the other to match.

For more information, see ID ranges.

ID views

ID views enable you to specify new values for POSIX user or group attributes, and to define on which client host or hosts the new values will apply. For example, you can use ID views to:

- Define different attribute values for different environments.
- Replace a previously generated attribute value with a different value.

In an IdM-AD trust setup, the **Default Trust View** is an ID view applied to AD users and groups. Using the **Default Trust View**, you can define custom POSIX attributes for AD users and groups, thus overriding the values defined in AD.

For more information, see Using an ID view to override a user attribute value on an IdM client .

IdM CA server

An IdM server on which the IdM certificate authority (CA) service is installed and running.
Alternative names: **CA server**

IdM deployment

A term that refers to the entirety of your IdM installation. You can describe your IdM deployment by answering the following questions:

- Is your IdM deployment a testing deployment or production deployment?
  - How many IdM servers do you have?
- Does your IdM deployment contain an integrated CA?
  - If it does, is the integrated CA self-signed or externally signed?
  - If it does, on which servers is the CA role available? On which servers is the KRA role available?

- Does your IdM deployment contain an integrated DNS?
  - If it does, on which servers is the DNS role available?
- Is your IdM deployment in a trust agreement with an AD forest?
  - If it is, on which servers is the AD trust controller or AD trust agent role available?

IdM server and replicas

To install the first server in an IdM deployment, you must use the **ipa-server-install** command. Administrators can then use the **ipa-replica-install** command to install **replicas** in addition to the first server that was installed. By default, installing a replica creates a replication agreement with the IdM server from which it was created, enabling receiving and sending updates to the rest of IdM.

There is no functional difference between the first server that was installed and a replica. Both are fully functional read/write IdM servers.

Deprecated names: **master server**

IdM CA renewal server

If your IdM topology contains an integrated certificate authority (CA), one server has the unique role of the CA renewal server. This server maintains and renews IdM system certificates.
By default, the first CA server you install fulfills this role, but you can configure any CA server to be the CA renewal server. In a deployment without integrated CA, there is no CA renewal server.

Deprecated names: **master CA**

IdM CRL publisher server

If your IdM topology contains an integrated certificate authority (CA), one server has the unique role of the Certificate revocation list (CRL) publisher server . This server is responsible for maintaining the CRL.
By default, the server that fulfills the **CA renewal server** role also fulfills this role, but you can configure any CA server to be the CRL publisher server. In a deployment without integrated CA, there is no CRL publisher server.

IdM topology

A term that refers to the structure of your IdM solution , especially the replication agreements between and within individual data centers and clusters.

Kerberos authentication indicators

Authentication indicators are attached to Kerberos tickets and represent the initial authentication method used to acquire a ticket:

- **otp** for two-factor authentication (password + One-Time Password)
- **radius** for Remote Authentication Dial-In User Service (RADIUS) authentication (commonly for 802.1x authentication)
- **pkinit** for Public Key Cryptography for Initial Authentication in Kerberos (PKINIT), smart card, or certificate authentication
- **hardened** for passwords hardened against brute-force attempts

Kerberos keytab

While a password is the default authentication method for a user, keytabs are the default authentication method for hosts and services. A Kerberos keytab is a file that contains a list of Kerberos principals and their associated encryption keys, so a service can retrieve its own Kerberos key and verify a user's identity.
For example, every IdM client has an **/etc/krb5.keytab** file that stores information about the **host** principal, which represents the client machine in the Kerberos realm.

Kerberos principal

Unique Kerberos principals identify each user, service, and host in a Kerberos realm:

Entity	Naming convention	Example
Users	**identifier@REALM**	**admin@EXAMPLE.COM**
Services	**service/fully-qualified-hostname@REALM**	**http/server.example.com@EXAMPLE.COM**
Hosts	**host/fully-qualified-hostname@REALM**	**host/client.example.com@EXAMPLE.COM**

Kerberos protocol

Kerberos is a network authentication protocol that provides strong authentication for client and server applications by using secret-key cryptography. IdM and Active Directory use Kerberos for authenticating users, hosts and services.

Kerberos realm

A Kerberos realm encompasses all the principals managed by a Kerberos Key Distribution Center (KDC). In an IdM deployment, the Kerberos realm includes all IdM users, hosts, and services.

Kerberos ticket policies

The Kerberos Key Distribution Center (KDC) enforces ticket access control through connection policies, and manages the duration of Kerberos tickets through ticket lifecycle policies. For example, the default global ticket lifetime is one day, and the default global maximum renewal age is one week.

Key Distribution Center (KDC)

The Kerberos Key Distribution Center (KDC) is a service that acts as the central, trusted authority that manages Kerberos credential information. The KDC issues Kerberos tickets and ensures the authenticity of data originating from entities within the IdM network.

LDAP

The Lightweight Directory Access Protocol (LDAP) is an open, vendor-neutral, application protocol for accessing and maintaining distributed directory information services over a network. Part of this specification is a directory information tree (DIT), which represents data in a hierarchical tree-like structure consisting of the Distinguished Names (DNs) of directory service entries. LDAP is a "lightweight" version of the Directory Access Protocol (DAP) described by the ISO X.500 standard for directory services in a network.

Lightweight sub-CA

In IdM, a lightweight sub-CA is a certificate authority (CA) whose certificate is signed by an IdM root CA or one of the CAs that are subordinate to it. A lightweight sub-CA issues certificates only for a specific purpose, for example to secure a VPN or HTTP connection.
For more information, see Restricting an application to trust only a subset of certificates .

Password policy

A password policy is a set of conditions that the passwords of a particular IdM user group must meet. The conditions can include the following parameters:

- The length of the password
- The number of character classes used
- The maximum lifetime of a password.

For more information, see What is a password policy.

POSIX attributes

POSIX attributes are user attributes for maintaining compatibility between operating systems. In a Red Hat Identity Management environment, POSIX attributes for users include:

- **cn**, the user's name
- **uid**, the account name (login)
- **uidNumber**, a user number (UID)
- **gidNumber**, the primary group number (GID)
- **homeDirectory**, the user's home directory

In a Red Hat Identity Management environment, POSIX attributes for groups include:

- **cn**, the group's name
- **gidNumber**, the group number (GID)

These attributes identify users and groups as separate entities.

Replication agreement

A replication agreement is an agreement between two IdM servers in the same IdM deployment. The replication agreement ensures that the data and configuration is continuously replicated between the two servers.
IdM uses two types of replication agreements: *domain replication* agreements, which replicate identity information, and *certificate replication* agreements, which replicate certificate information.

For more information, see:

- Replication agreements
- Determining the appropriate number of replicas
- Connecting the replicas in a topology
- Replica topology examples

Smart card

A smart card is a removable device or card used to control access to a resource. They can be plastic credit card-sized cards with an embedded integrated circuit (IC) chip, small USB devices such as a Yubikey, or other similar devices. Smart cards can provide authentication by allowing users to

connect a smart card to a host computer, and software on that host computer interacts with key material stored on the smart card to authenticate the user.

SSSD

The System Security Services Daemon (SSSD) is a system service that manages user authentication and user authorization on a RHEL host. SSSD optionally keeps a cache of user identities and credentials retrieved from remote providers for offline authentication. For more information, see Understanding SSSD and its benefits .

SSSD backend

An SSSD backend, often also called a data provider, is an SSSD child process that manages and creates the SSSD cache. This process communicates with an LDAP server, performs different lookup queries and stores the results in the cache. It also performs online authentication against LDAP or Kerberos and applies access and password policy to the user that is logging in.

Ticket-granting ticket (TGT)

After authenticating to a Kerberos Key Distribution Center (KDC), a user receives a ticket-granting ticket (TGT), which is a temporary set of credentials that can be used to request access tickets to other services, such as websites and email.

Using a TGT to request further access provides the user with a Single Sign-On experience, as the user only needs to authenticate once in order to access multiple services. TGTs are renewable, and Kerberos ticket policies determine ticket renewal limits and access control.

Web server

A web server is computer software and underlying hardware that accepts requests for web content, such as pages, images, or applications. A user agent, such as a web browser, requests a specific resource using HTTP, the network protocol used to distribute web content, or its secure variant HTTPS. The web server responds with the content of that resource or an error message. The web server can also accept and store resources sent from the user agent. Red Hat Identity Management (IdM) uses the Apache Web Server to display the IdM Web UI, and to coordinate communication between components, such as the Directory Server and the Certificate Authority (CA). See Apache web server.

Additional Glossaries

If you are unable to find an Identity Management term in this glossary, see the Directory Server and Certificate System glossaries:

- Directory Server 11 Glossary
- Certificate System 9 Glossary

1.5. ADDITIONAL RESOURCES

- For general information on Red Hat IdM, see the Red Hat Identity Management product page on the Red Hat Customer Portal.

CHAPTER 2. FAILOVER, LOAD-BALANCING, AND HIGH-AVAILABILITY IN IDM

Identity Management (IdM) has built-in failover mechanisms for IdM clients, and load-balancing and high-availability features for IdM servers.

2.1. CLIENT-SIDE FAILOVER CAPABILITY

- By default, the **SSSD** service on an IdM client is configured to use service (SRV) resource records from DNS to automatically determine the best IdM server to connect to. This behavior is controlled by the **_srv_** option in the **ipa_server** parameter of the **/etc/sssd/sssd.conf** file:

```
[root@client ~]# cat /etc/sssd/sssd.conf

[domain/example.com]
id_provider = ipa
ipa_server = _srv_, server.example.com
...
```

  If an IdM server goes offline, the SSSD service on the IdM client connects to another IdM server it has automatically discovered.

- If you prefer to bypass DNS lookups for performance reasons, remove the **_srv_** entry from the **ipa_server** parameter and specify which IdM servers the client should connect to, in order of preference:

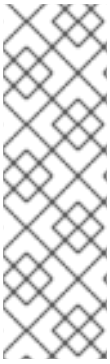
```
[root@client ~]# cat /etc/sssd/sssd.conf

[domain/example.com]
id_provider = ipa
ipa_server = server1.example.com, server2.example.com
...
```

2.2. SERVER-SIDE LOAD-BALANCING AND SERVICE AVAILABILITY

You can achieve load-balancing and high-availability in IdM by installing multiple IdM replicas:

- If you have a geographically dispersed network, you can shorten the path between IdM clients and the nearest accessible server by configuring multiple IdM replicas per data center.
- Red Hat supports environments with up to 60 replicas.
- The IdM replication mechanism provides active/active service availability: services at all IdM replicas are readily available at the same time.



NOTE

Red Hat recommends against combining IdM and other load-balancing or high-availability (HA) software.

Many third-party high availability solutions assume active/passive scenarios and cause unnecessary service interruption to IdM availability. Other solutions use virtual IPs or a single hostname per clustered service. All these methods do not typically work well with the type of service availability provided by the IdM solution. They also integrate very poorly with Kerberos, decreasing the overall security and stability of the deployment.

CHAPTER 3. PLANNING THE REPLICA TOPOLOGY

The following sections provide advice on determining the appropriate replica topology for your use case.

3.1. MULTIPLE REPLICA SERVERS AS A SOLUTION FOR HIGH PERFORMANCE AND DISASTER RECOVERY

Continuous functionality and high availability of Identity Management (IdM) services is vital for users who access resources. One of the built-in solutions for accomplishing continuous functionality and high availability of the IdM infrastructure through load balancing is the replication of the central directory by creating replica servers of the first server.

IdM allows placing additional servers in geographically dispersed data centers to reflect your enterprise organizational structure. In this way, the path between IdM clients and the nearest accessible server is shortened. In addition, having multiple servers allows spreading the load and scaling for more clients.

Maintaining multiple redundant IdM servers and letting them replicate with each other is also a common backup mechanism to mitigate or prevent server loss. For example, if one server fails, the other servers keep providing services to the domain. You can also recover the lost server by creating a new replica based on one of the remaining servers.

3.2. INTRODUCTION TO IDM SERVERS AND CLIENTS

The Identity Management (IdM) domain includes the following types of systems:

IdM servers

IdM servers are Red Hat Enterprise Linux systems that respond to identity, authentication, and authorization requests within an IdM domain. In most deployments, an integrated certificate authority (CA) is also installed with the IdM server.
IdM servers are the central repositories for identity and policy information. IdM servers can also host any of the optional services used by domain members:

- Certificate authority (CA)
- Key Recovery Authority (KRA)
- DNS
- Active Directory (AD) trust controller
- Active Directory (AD) trust agent

IdM clients

IdM clients are Red Hat Enterprise Linux systems enrolled with the servers and configured to use the IdM services on these servers.
Clients interact with the IdM servers to access services provided by them. For example, clients use the Kerberos protocol to perform authentication and acquire tickets for enterprise single sign-on (SSO), use LDAP to get identity and policy infromation, use DNS to detect where the servers and services are located and how to connect to them.

IdM servers are also embedded IdM clients. As clients enrolled with themselves, the servers provide the same functionality as other clients.

To provide services for large numbers of clients, as well as for redundancy and availability, IdM allows deployment on multiple IdM servers in a single domain. It is possible to deploy up to 60 servers. This is the maximum number of IdM servers, also called replicas, that is currently supported in the IdM domain. IdM servers provide different services for the client. Not all the servers need to provide all the possible services. Some server components like Kerberos and LDAP are always available on every server. Other services like CA, DNS, Trust Controller or Vault are optional. This means that different servers in general play different roles in the deployment.

If your IdM topology contains an integrated CA, one server has the role of the Certificate revocation list (CRL) publisher server and one server has the role of the CA renewal server.

By default, the first CA server installed fulfills these two roles, but you can assign these roles to separate servers.

WARNING

The *CA renewal server* is critical for your IdM deployment because it is the only system in the domain responsible for tracking CA subsystem certificates and keys. For details about how to recover from a disaster affecting your IdM deployment, see Performing disaster recovery with Identity Management .

For redundancy and load balancing, administrators create additional servers by creating a *replica* of an existing server. When creating a replica, IdM clones the configuration of the existing server. A replica shares with the initial server its core configuration, including internal information about users, systems, certificates, and configured policies.

NOTE

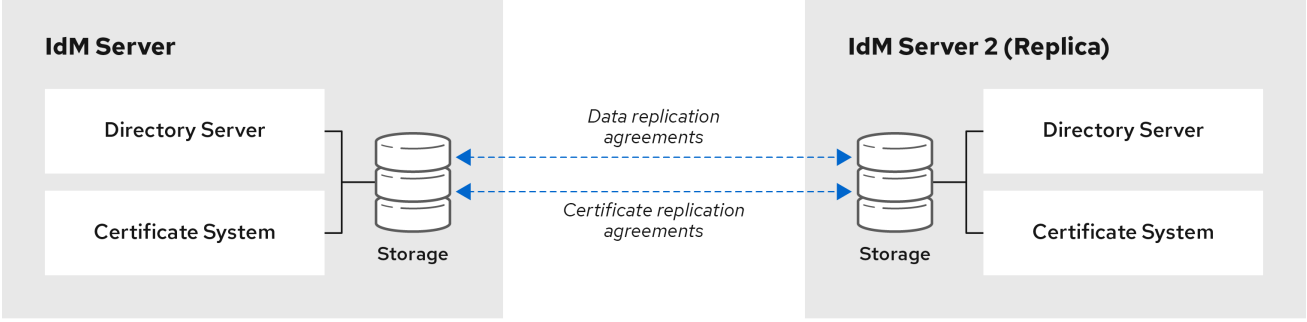
A replica and the server it was created from are functionally identical, except for the *CA renewal* and *CRL publisher* roles. Therefore, the term ***server*** and ***replica*** are used interchangeably here depending on the context.

3.3. REPLICATION AGREEMENTS

When an administrator creates a replica based on an existing server, Identity Management (IdM) creates a *replication agreement* between the initial server and the replica. The replication agreement ensures that the data and configuration is continuously replicated between the two servers.

IdM uses *multiple read/write replica replication* . In this configuration, all replicas joined in a replication agreement receive and provide updates, and are therefore considered suppliers and consumers. Replication agreements are always bilateral.

Figure 3.1. Server and replica agreements



IdM uses two types of replication agreements:

Domain replication agreements

These agreements replicate the identity information.

Certificate replication agreements

These agreements replicate the certificate information.

Both replication channels are independent. Two servers can have one or both types of replication agreements configured between them. For example, when server A and server B have only domain replication agreement configured, only identity information is replicated between them, not the certificate information.

3.4. DETERMINING THE APPROPRIATE NUMBER OF REPLICAS

Set up at least two replicas in each data center (not a hard requirement)

A data center can be, for example, a main office or a geographical location.

Set up a sufficient number of servers to serve your clients

One Identity Management (IdM) server can provide services to 2000 - 3000 clients. This assumes the clients query the servers multiple times a day, but not, for example, every minute. If you expect more frequent queries, plan for more servers.

Set up a sufficient number of Certificate Authority (CA) replicas

Only replicas with the CA role installed can replicate certificate data. If you use the IdM CA, ensure your environment has at least two CA replicas with certificate replication agreements between them.

Set up a maximum of 60 replicas in a single IdM domain

Red Hat supports environments with up to 60 replicas.

3.5. CONNECTING THE REPLICAS IN A TOPOLOGY

Connect each replica to at least two other replicas

Configuring additional replication agreements ensures that information is replicated not just between the initial replica and the first server you installed, but between other replicas as well.

Connect a replica to a maximum of four other replicas (not a hard requirement)

A large number of replication agreements per server does not add significant benefits. A receiving replica can only be updated by one other replica at a time and meanwhile, the other replication agreements are idle. More than four replication agreements per replica typically means a waste of resources.

NOTE

This recommendation applies to both certificate replication and domain replication agreements.

There are two exceptions to the limit of four replication agreements per replica:

- You want failover paths if certain replicas are not online or responding.
- In larger deployments, you want additional direct links between specific nodes.

Configuring a high number of replication agreements can have a negative impact on overall performance: when multiple replication agreements in the topology are sending updates, certain replicas can experience a high contention on the changelog database file between incoming updates and the outgoing updates.

If you decide to use more replication agreements per replica, ensure that you do not experience replication issues and latency. However, note that large distances and high numbers of intermediate nodes can also cause latency problems.

Connect the replicas in a data center with each other

This ensures domain replication within the data center.

Connect each data center to at least two other data centers

This ensures domain replication between data centers.

Connect data centers using at least a pair of replication agreements

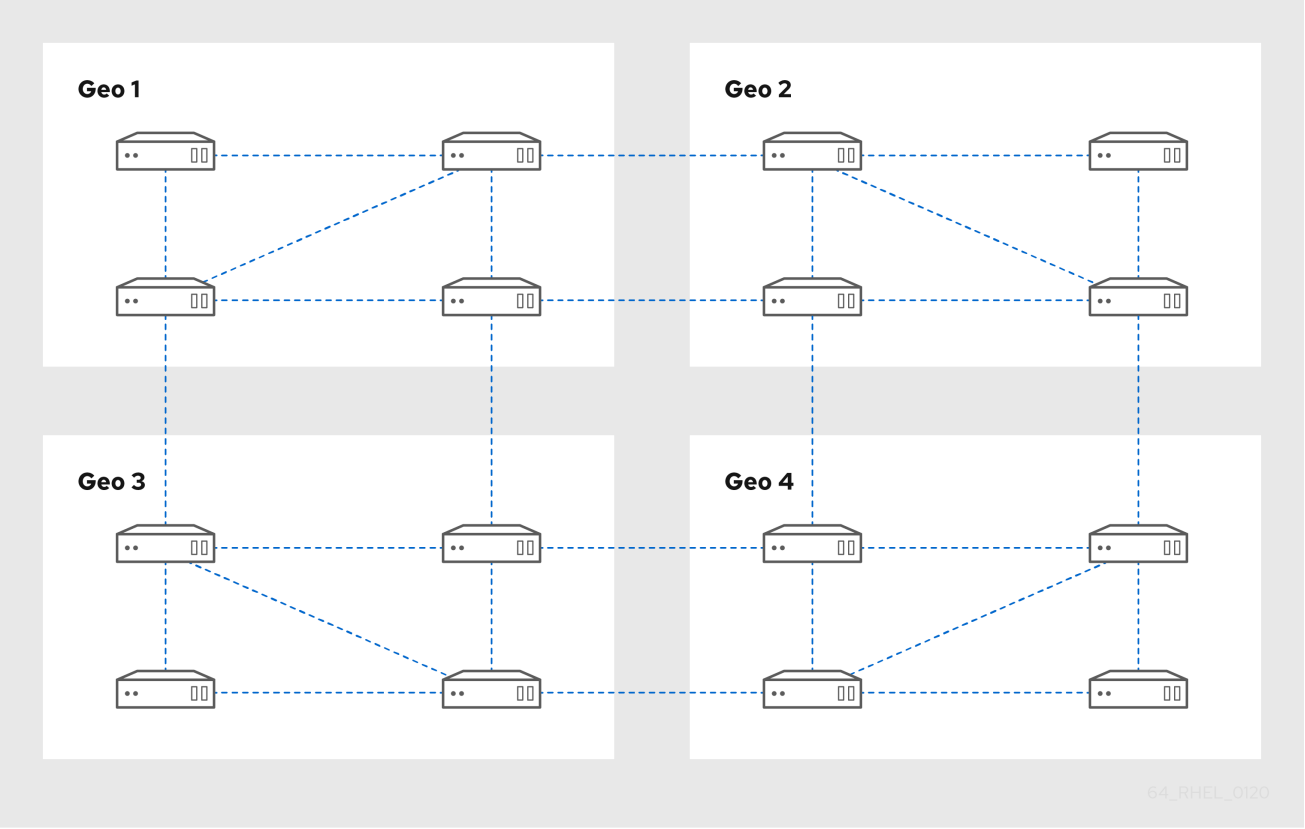
If data centers A and B have a replication agreement from A1 to B1, having a replication agreement from A2 to B2 ensures that if one of the servers is down, the replication can continue between the two data centers.

3.6. REPLICA TOPOLOGY EXAMPLES

The figures below show examples of Identity Management (IdM) topologies based on the guidelines for creating a reliable topology.

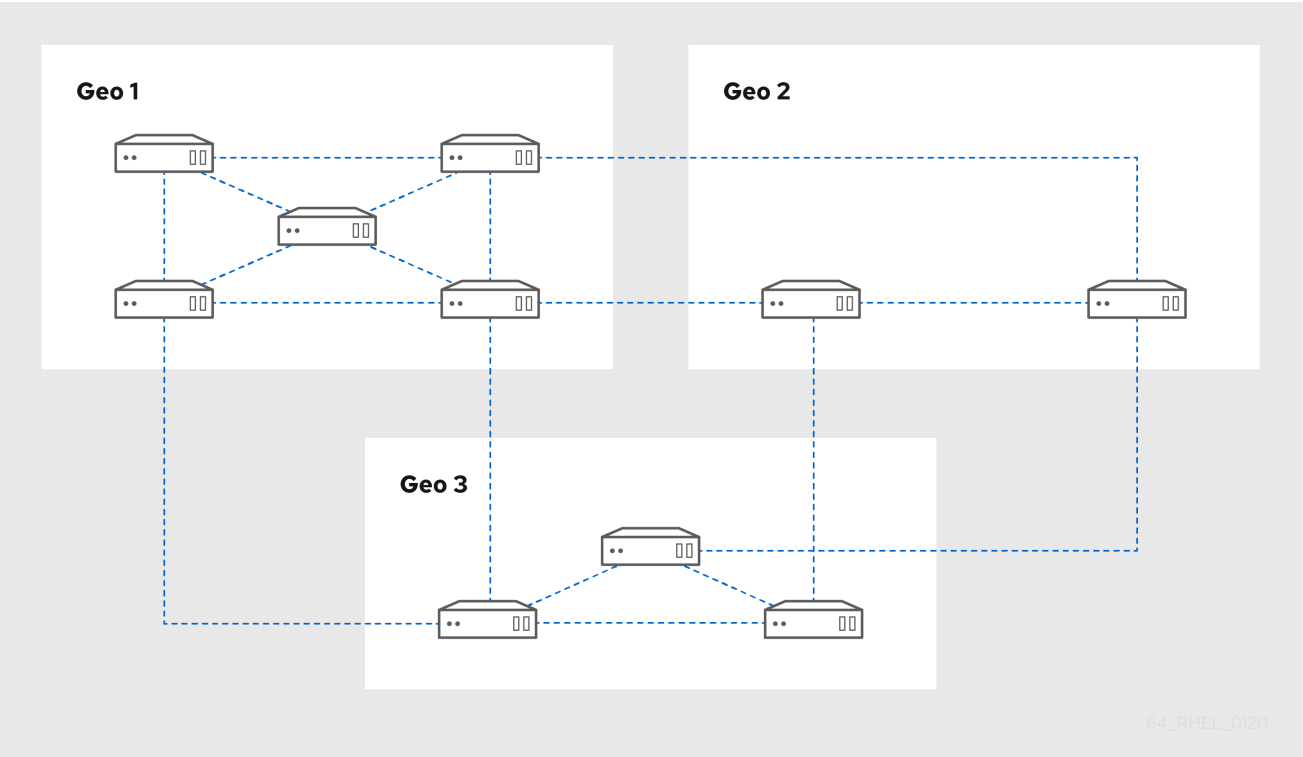
Replica Topology Example 1 shows four data centers, each with four servers. The servers are connected with replication agreements.

Figure 3.2. Replica Topology Example 1



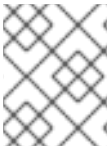
Replica Topology Example 2 shows three data centers, each with a different number of servers. The servers are connected with replication agreements.

Figure 3.3. Replica Topology Example 2



3.7. THE HIDDEN REPLICA MODE

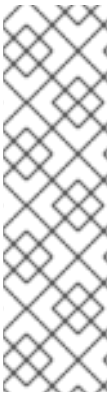
By default, when you set up a new replica, the installer automatically creates service (SRV) resource records in DNS. These records enable clients to auto-discover the replica and its services. A hidden replica is an IdM server that has all services running and available. However, it has no SRV records in DNS, and LDAP server roles are not enabled. Therefore, clients cannot use service discovery to detect these hidden replicas.



NOTE

The hidden replica feature, introduced in RHEL 8.1 as a Technology Preview, is fully supported starting with RHEL 8.2.

Hidden replicas are primarily designed for dedicated services that can otherwise disrupt clients. For example, a full backup of IdM requires to shut down all IdM services on the server. Since no clients use a hidden replica, administrators can temporarily shut down the services on this host without affecting any clients.



NOTE

- Restoring a backup from a hidden replica on a new host always results in a non-hidden (regular) replica.
- All server roles used in a cluster, especially the Certificate Authority role if the integrated CA is used, must be installed on the hidden replica for the backup to be able to restore those services.
- For more information on creating and working with IdM backups, see Backing Up and Restoring IdM.

Other use cases include high-load operations on the IdM API or the LDAP server, such as a mass import or extensive queries. To install a replica as hidden, pass the **--hidden-replica** parameter to the **ipa-replica-install** command.

For further details about installing a replica, see Installing an Identity Management replica .

Alternatively, you can change the state of an existing replica. For details, see

CHAPTER 4. PLANNING YOUR DNS SERVICES AND HOST NAMES

Identity Management (IdM) provides different types of DNS configurations in the IdM server. The following sections describe them and provide advice on how to determine which is the best for your use case.

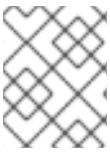
4.1. DNS SERVICES AVAILABLE IN AN IDM SERVER

You can install an Identity Management (IdM) server with or without integrated DNS.

Table 4.1. Comparing IdM with integrated DNS and without integrated DNS

	With integrated DNS	Without integrated DNS
Overview:	IdM runs its own DNS service for the IdM domain.	IdM uses DNS services provided by an external DNS server.
Limitations:	The integrated DNS server provided by IdM only supports features related to IdM deployment and maintenance. It does not support some of the advanced DNS features. It is not designed to be used as a general-purpose DNS server.	DNS is not integrated with native IdM tools. For example, IdM does not update the DNS records automatically after a change in the topology.
Works best for:	Basic usage within the IdM deployment. When the IdM server manages DNS, DNS is tightly integrated with native IdM tools, which enables automating some of the DNS record management tasks.	Environments where advanced DNS features beyond the scope of the IdM DNS are needed. Environments with a well-established DNS infrastructure where you want to keep using an external DNS server.

Even if an Identity Management server is used as a primary DNS server, other external DNS servers can still be used as secondary servers. For example, if your environment is already using another DNS server, such as a DNS server integrated with Active Directory (AD), you can delegate only the IdM primary domain to the DNS integrated with IdM. It is not necessary to migrate DNS zones to the IdM DNS.



NOTE

If you need to issue certificates for IdM clients with an IP address in the Subject Alternative Name (SAN) extension, you must use the IdM integrated DNS service.

4.2. GUIDELINES FOR PLANNING THE DNS DOMAIN NAME AND KERBEROS REALM NAME

When installing the first Identity Management (IdM) server, the installation prompts for a primary DNS name of the IdM domain and Kerberos realm name. The guidelines in this section can help you set the names correctly.

WARNING

You will not be able to change the IdM primary domain name and Kerberos realm name after the server is already installed. Do not expect to be able to move from a testing environment to a production environment by changing the names, for example from ***lab.example.com*** to ***production.example.com***.

A separate DNS domain for service records

Ensure that the *primary DNS domain* used for IdM is not shared with any other system. This helps avoid conflicts on the DNS level.

Proper DNS domain name delegation

Ensure you have valid delegation in the public DNS tree for the DNS domain. Do not use a domain name that is not delegated to you, not even on a private network.

Multi-label DNS domain

Do not use single-label domain names, for example **.company**. The IdM domain must be composed of one or more subdomains and a top level domain, for example **example.com** or **company.example.com**.

A unique Kerberos realm name

Ensure the realm name is not in conflict with any other existing Kerberos realm name, such as a name used by Active Directory (AD).

Kerberos realm name as an upper-case version of the primary DNS name

Consider setting the realm name to an upper-case (***EXAMPLE.COM***) version of the primary DNS domain name (***example.com***).

WARNING

If you do not set the Kerberos realm name to be the upper-case version of the primary DNS name, you will not be able to use AD trusts.

Additional notes on planning the DNS domain name and Kerberos realm name

- One IdM deployment always represents one Kerberos realm.
- You can join IdM clients from multiple distinct DNS domains (***example.com***, ***example.net***, ***example.org***) to a single Kerberos realm (***EXAMPLE.COM***).
- IdM clients do not need to be in the primary DNS domain. For example, if the IdM domain is ***idm.example.com***, the clients can be in the ***clients.example.com*** domain, but clear mapping must be configured between the DNS domain and the Kerberos realm.

NOTE

The standard method to create the mapping is using the **_kerberos** TXT DNS records. The IdM integrated DNS adds these records automatically.

Planning DNS forwarding

- If you want to use only one forwarder for your entire IdM deployment, configure a **global forwarder**.
- If your company is spread over multiple sites in geographically distant regions, global forwarders might be impractical. Configure **per-server forwarders**.
- If your company has an internal DNS network that is not resolvable from the public internet, configure a **forward zone** and **zone forwarders** so that the hosts in the IdM domain can resolve hosts from this other internal DNS network.

CHAPTER 5. PLANNING YOUR CA SERVICES

Identity Management (IdM) in Red Hat Enterprise Linux provides different types of certificate authority (CA) configurations. The following sections describe different scenarios and provide advice to help you determine which configuration is best for your use case.

CA subject DN

The Certificate Authority (CA) subject distinguished name (DN) is the name of the CA. It must be globally unique in the Identity Management (IdM) CA infrastructure and cannot be changed after the installation. In case you need the IdM CA to be externally signed, you might need to consult the administrator of the external CA about the form your IdM CA Subject DN should take.

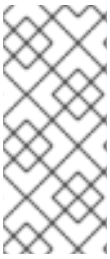
5.1. CA SERVICES AVAILABLE IN AN IDM SERVER

You can install an Identity Management (IdM) server with an integrated IdM certificate authority (CA) or without a CA.

Table 5.1. Comparing IdM with integrated CA and without a CA

	Integrated CA	Without a CA
Overview:	IdM uses its own public key infrastructure (PKI) service with a *CA signing certificate* to create and sign the certificates in the IdM domain. ● If the root CA is the integrated CA, IdM uses a self-signed CA certificate. ● If the root CA is an external CA, the integrated IdM CA is subordinate to the external CA. The CA certificate used by IdM is signed by the external CA, but all certificates for the IdM domain are issued by the integrated Certificate System instance. ● Integrated CA is also able to issue certificates for users, hosts, or services. The external CA can be a corporate CA or a third-party CA.	IdM does not set up its own CA, but uses signed host certificates from an external CA. Installing a server without a CA requires you to request the following certificates from a third-party authority: ● An LDAP server certificate ● An Apache server certificate ● A PKINIT certificate ● Full CA certificate chain of the CA that issued the LDAP and Apache server certificates

	Integrated CA	Without a CA
Limitations:	If the integrated CA is subordinate to an external CA, the certificates issued within the IdM domain are potentially subject to restrictions set by the external CA for various certificate attributes, such as: • The validity period. • Constraints on what subject names can appear on certificates issued by the IDM CA or its subordinates.. • Constraints on whether the IDM CA can itself, issue subordinate CA certificates, or how "deep" the chain of subordinate certificates can go.	Managing certificates outside of IdM causes a lot of additional activities, such as : • Creating, uploading, and renewing certificates is a manual process. • The **certmonger** service does not track the IPA certificates (LDAP server, Apache server, and PKINIT certificates) and does not notify you when the certificates are about to expire. The administrators must manually set up notifications for externally issued certificates, or set tracking requests for those certificates if they want **certmonger** to track them.
Works best for:	Environments that allow you to create and use your own certificate infrastructure.	Very rare cases when restrictions within the infrastructure do not allow you to install certificate services integrated with the server.



NOTE

Switching from the self-signed CA to an externally-signed CA, or the other way around, as well as changing which external CA issues the IdM CA certificate, is possible even after the installation. It is also possible to configure an integrated CA even after an installation without a CA. For more details, see Installing an IdM server: With integrated DNS, without a CA.

5.2. GUIDELINES FOR DISTRIBUTION OF CA SERVICES

The following steps provide guidelines for the distribution of your certificate authority (CA) services.

Procedure

1. Install the CA services on more than one server in the topology.
   Replicas configured without a CA forward all certificate operations requests to the CA servers in your topology.

WARNING

If you lose all servers with a CA, you will lose all the CA configuration without any chance of recovery. In such case you need to set up new CA and issue and install new certificates.

2. Maintain a sufficient number of CA servers to handle the CA requests in your deployment.

See the following table for further recommendations on appropriate number of CA servers:

Table 5.2. Guidelines for setting up appropriate number of CA servers

Description of the deployment	Suggested number of CA servers
A deployment with a very large number of certificates issued	Three or four CA servers
A deployment with bandwidth or availability problems between multiple regions	One CA server per region, with a minimum of three servers total for the deployment
All other deployments	Two CA servers

CHAPTER 6. PLANNING INTEGRATION WITH AD

The following sections introduce the options for integrating Red Hat Enterprise Linux with Active Directory (AD).

6.1. DIRECT INTEGRATION

In direct integration, Linux systems are connected directly to Active Directory (AD). The following types of integration are possible:

Integration with the System Security Services Daemon (SSSD)

SSSD can connect a Linux system with various identity and authentication stores: AD, Identity Management (IdM), or a generic LDAP or Kerberos server.
Notable requirements for integration with SSSD:

- When integrating with AD, SSSD works only within a single AD forest by default. For multi-forest setup, configure manual domain enumeration.
- Remote AD forests must trust the local forest to ensure that the **idmap_ad** plug-in handles remote forest users correctly.

SSSD supports both direct and indirect integration. It also enables switching from one integration approach to the other without significant migration costs.

Integration with Samba Winbind

The Winbind component of the Samba suite emulates a Windows client on a Linux system and communicates with AD servers.
Notable requirements for integration with Samba Winbind:

- Direct integration with Winbind in a multi-forest AD setup requires bidirectional trusts.
- A bidirectional path from the local domain of a Linux system must exist to the domain of a user in a remote AD forest to allow full information about the user from the remote AD domain to be available to the **idmap_ad** plug-in.

Recommendations

- SSSD satisfies most of the use cases for AD integration and provides a robust solution as a generic gateway between a client system and different types of identity and authentication providers - AD, IdM, Kerberos, and LDAP.
- Winbind is recommended for deployment on those AD domain member servers on which you plan to deploy Samba FS.

6.2. INDIRECT INTEGRATION

In indirect integration, Linux systems are first connected to a central server which is then connected to Active Directory (AD). Indirect integration enables the administrator to manage Linux systems and policies centrally, while users from AD can transparently access Linux systems and services.

Integration based on cross-forest trust with AD

The Identity Management (IdM) server acts as the central server to control Linux systems. A cross-realm Kerberos trust with AD is established, enabling users from AD to log on to access Linux

systems and resources. IdM presents itself to AD as a separate forest and takes advantage of the forest-level trusts supported by AD.
When using a trust:

- AD users can access IdM resources.
- IdM servers and clients can resolve the identities of AD users and groups.
- AD users and groups access IdM under the conditions defined by IdM, such as host-based access control.
- AD users and groups continue being managed on the AD side.

Integration based on synchronization

This approach is based on the WinSync tool. A WinSync replication agreement synchronizes user accounts from AD to IdM.

WARNING

WinSync is no longer actively developed in Red Hat Enterprise Linux 8. The preferred solution for indirect integration is cross-forest trust.

The limitations of integration based on synchronization include:

- Groups are not synchronized from IdM to AD.
- Users are duplicated in AD and IdM.
- WinSync supports only a single AD domain.
- Only one domain controller in AD can be used to synchronize data to one instance of IdM.
- User passwords must be synchronized, which requires the PassSync component to be installed on all domain controllers in the AD domain.
- After configuring the synchronization, all AD users must manually change passwords before PassSync can synchronize them.

6.3. DECIDING BETWEEN INDIRECT AND DIRECT INTEGRATION

The guidelines in this section can help decide which type of integration fits your use case.

Number of systems to be connected to Active Directory

Connecting less than 30-50 systems (not a hard limit)

If you connect less than 30-50 systems, consider direct integration. Indirect integration might introduce unnecessary overhead.

Connecting more than 30-50 systems (not a hard limit)

If you connect more than 30-50 systems, consider indirect integration with Identity Management. With this approach, you can benefit from the centralized management for Linux systems.

Managing a small number of Linux systems, but expecting the number to grow rapidly

In this scenario, consider indirect integration to avoid having to migrate the environment later.

Frequency of deploying new systems and their type

Deploying bare metal systems on an irregular basis

If you deploy new systems rarely and they are usually bare metal systems, consider direct integration. In such cases, direct integration is usually simplest and easiest.

Deploying virtual systems frequently

If you deploy new systems often and they are usually virtual systems provisioned on demand, consider indirect integration. With indirect integration, you can use a central server to manage the new systems dynamically and integrate with orchestration tools, such as Red Hat Satellite.

Active Directory is the required authentication provider

Do your internal policies state that all users must authenticate against Active Directory?

You can choose either direct or indirect integration. If you use indirect integration with a trust between Identity Management and Active Directory, the users that access Linux systems authenticate against Active Directory. Policies that exist in Active Directory are executed and enforced during authentication.

CHAPTER 7. PLANNING A CROSS-FOREST TRUST BETWEEN IDM AND AD

Active Directory (AD) and Identity Management (IdM) are two alternative environments managing a variety of core services, such as Kerberos, LDAP, DNS, and certificate services. A *cross-forest trust* relationship transparently integrates these two diverse environments by enabling all core services to interact seamlessly. The following sections provide advice on how to plan and design a cross-forest trust deployment.

7.1. CROSS-FOREST TRUSTS BETWEEN IDM AND AD

In a pure Active Directory (AD) environment, a cross-forest trust connects two separate AD forest root domains. When you create a cross-forest trust between AD and IdM, the IdM domain presents itself to AD as a separate forest with a single domain. A trust relationship is then established between the AD forest root domain and the IdM domain. As a result, users from the AD forest can access the resources in the IdM domain.

IdM can establish a trust with one AD forest or multiple unrelated forests.

NOTE

Two separate Kerberos realms can be connected in a *cross-realm trust*. However, a Kerberos realm only concerns authentication, not other services and protocols involved in identity and authorization operations. Therefore, establishing a Kerberos cross-realm trust is not enough to enable users from one realm to access resources in another realm.

An external trust to an AD domain

An external trust is a trust relationship between IdM and an Active Directory domain. While a forest trust always requires establishing a trust between IdM and the root domain of an Active Directory forest, an external trust can be established from IdM to any domain within a forest.

7.2. TRUST CONTROLLERS AND TRUST AGENTS

Identity Management (IdM) provides the following types of IdM servers that support trust to Active Directory (AD):

Trust controllers

IdM servers that can perform identity lookups against AD domain controllers. They also run the Samba suite so they can establish trust with AD. AD domain controllers contact trust controllers when establishing and verifying the trust to AD. AD-enrolled machines communicate with IdM trust controllers for Kerberos authentication requests.

The first trust controller is created when you configure the trust. If you have multiple domain controllers across different geographic locations, use the **ipa-adtrust-install** command to designate RHEL IdM servers as trust controllers in these locations.

Trust controllers run more network-facing services than trust agents, and thus present a greater attack surface for potential intruders.

Trust agents

IdM servers that can resolve identity lookups from RHEL IdM clients against AD domain controllers. Unlike trust controllers, trust agents cannot process Kerberos authentication requests.

In addition to trust agents and controllers, the IdM domain can also include standard IdM servers. However, these servers do not communicate with AD. Therefore, clients that communicate with these standard servers cannot resolve AD users and groups or authenticate and authorize AD users.

NOTE

An IdM server is not configured to operate a Trust Controller or Trust Agent role unless either of the following actions were done:

- You installed the server or replica with the **ipa-server-install** or **ipa-replica-install** commands with the **--setup-ad** option.
- You ran the **ipa-adtrust-install** command on the IdM server to configure the Trust Controller role.
- You ran the **ipa-adtrust-install --add-agents** command on a Trust Controller to designate another IdM replica to be a Trust Agent.
  By default, IdM servers cannot resolve users and groups from trusted domains without these operations.

Table 7.1. Comparing the capabilities supported by trust controllers and trust agents

Capability	Trust agent	Trust controller
Resolve AD users and groups	Yes	Yes
Enroll IdM clients that run services accessible by users from trusted AD forests	Yes	Yes
Add, modify, or remove trust agreements	No	Yes
Assign the trust agent role to an IdM server	No	Yes

When planning the deployment of trust controllers and trust agents, consider these guidelines:

- Configure at least two trust controllers per IdM deployment.
- Configure at least two trust controllers in each data center.

If you ever want to create additional trust controllers or if an existing trust controller fails, create a new trust controller by promoting a trust agent or a standard server. To do this, use the **ipa-adtrust-install** utility on the IdM server.

IMPORTANT

You cannot downgrade an existing trust controller to a trust agent.

7.3. ONE-WAY TRUSTS AND TWO-WAY TRUSTS

In one way trusts, Identity Management (IdM) trusts Active Directory (AD) but AD does not trust IdM. AD users can access resources in the IdM domain but users from IdM cannot access resources within the AD domain. The IdM server connects to AD using a special account, and reads identity information

that is then delivered to IdM clients over LDAP.

In two way trusts, IdM users can authenticate to AD, and AD users can authenticate to IdM. AD users can authenticate to and access resources in the IdM domain as in the one way trust case. IdM users can authenticate but cannot access most of the resources in AD. They can only access those Kerberized services in AD forests that do not require any access control check.

To be able to grant access to the AD resources, IdM needs to implement the Global Catalog service. This service does not yet exist in the current version of the IdM server. Because of that, a two-way trust between IdM and AD is nearly functionally equivalent to a one-way trust between IdM and AD.

7.4. KERBEROS FAST FOR TRUSTED DOMAINS

Kerberos Flexible Authentication Secure Tunneling (FAST) is also called the Kerberos armoring in Active Directory (AD) environment. Kerberos FAST provides an additional security layer for the Kerberos communication between the clients and the Key Distribution Center (KDC). In IdM, the KDCs are running on the IdM servers and FAST is enabled by default. The Two-Factor Authentication (2FA) in IdM also requires enabling FAST.

In AD, Kerberos armoring is disabled by default on the AD Domain Controllers (DC). You can enable it on the Domain Controllers with the group policy settings below:

- Computer Configuration,
- Policies,
- Administrative Templates,
- System,
- KDC,
- KDC support for claims, compound authentication, and Kerberos armoring.

The policy setting allows the following options:

- "Not supported",
- "Supported",
- "Always provide claims",
- "Fail unarmored authentication requests".

Kerberos FAST is implemented in the Kerberos client libraries on the IdM clients. You can configure IdM clients either to use FAST for all trusted domains which advertise FAST or to not use Kerberos FAST at all. If you enable Kerberos armoring in the trusted AD forest the IdM client uses Kerberos FAST by default. FAST establishes a secure tunneling with the help of a cryptographic key. In order to protect a connection to the domain controllers of a trusted domain, Kerberos FAST must get a cross-realm Ticket Granting Tickets (TGTs) from the trusted domain because that keys are valid only inside Kerberos realm. Kerberos FAST uses the Kerberos hosts keys of the IdM client to request the cross-realm TGT with the help of the IdM servers. That only works when the AD forest trusts the IdM domain which means a two-way trust is required.

If AD policies require the enforcing Kerberos FAST use, you need to establish a two-way trust between IdM domain and AD forest. You must plan this before the connection is established because both IdM and AD sides must have records about direction and the type of trust.

If you already establish a one-way trust, the next time you run **ipa trust-add … --two-way=true** command removes existing trust agreement and recreates it. This requires use of the administrative credentials. Since IdM attempts to remove existing trust agreement from the AD side, that requires administrator permissions for AD access. If you establish the original trust by using a shared secret rather than an AD administrative account, it recreates the trust as a two-way and changes trusted domain objects on the IdM side only. Windows administrators must repeat the same procedure using Windows UI by choosing a bi-directional trust and use the same shared secret to recreate the trust.

If using a two-way trust is not possible, you must disable Kerberos FAST on all IdM clients. The users from the trusted AD forest can authenticate with a password or direct Smart Card. To do so, add the following setting to the sssd.conf file in the [domain] section:

```
krb5_use_fast = never
```

Note, you do not need to use this option when the authentication is based on ssh-keys, GSSAPI authentication or ssh with Smart Cards from remote Windows clients. These methodes do not use Kerberos FAST because the IdM client does not have to communicate with a DC. Additionally, after disabling FAST on the IdM client, the two-factor authentication IdM feature is also unavailable.

7.5. POSIX AND ID MAPPING ID RANGE TYPES FOR AD USERS

Identity Management (IdM) enforces access control rules based on the POSIX User ID (UID) and Group ID (GID) of a user. Active Directory (AD) users, however, are identified by Security Identifiers (SIDs). AD administrators can configure AD to store POSIX attributes for your AD users and groups, such as **uidNumber**, **gidNumber**, **unixHomeDirectory**, or **loginShell**.

You can configure a cross-forest trust to reference this information by establishing a trust with the **ipa-ad-trust-posix** ID range:

```
[server ~]# ipa trust-add --type=ad ad.example.com --admin administrator --password  --range-type=ipa-ad-trust-posix
```

If you do not store POSIX attributes in AD, the System Security Services Daemon (SSSD) can consistently map a unique UID based on a user's SID in a process called **ID mapping**. You can explicitly choose this behavior by creating a trust with the **ipa-ad-trust** ID range:

```
[server ~]# ipa trust-add --type=ad ad.example.com --admin administrator --password  --range-type=ipa-ad-trust
```

WARNING

If you do not specify an ID Range type when creating a trust, IdM attempts to automatically select the appropriate range type by requesting details from AD domain controllers in the forest root domain. If IdM does not detect any POSIX attributes, the trust installation script selects the **Active Directory domain** ID range.

If IdM detects any POSIX attributes in the forest root domain, the trust installation script selects the **Active Directory domain with POSIX attributes** ID range and assumes that UIDs and GIDs are correctly defined in AD. If POSIX attributes are not correctly set in AD, you will not be able to resolve AD users.

For example, if the users and groups that need access to IdM systems are not part of the forest root domain, but instead are located in a child domain of the forest domain, the installation script may not detect the POSIX attributes defined in the child AD domain. In this case, Red Hat recommends that you explicitly choose the POSIX ID range type when establishing the trust.

Additional resources

- Options for automatically mapping private groups for AD users

7.6. OPTIONS FOR AUTOMATICALLY MAPPING PRIVATE GROUPS FOR AD USERS: POSIX TRUSTS

Each user in a Linux environment has a primary user group. Red Hat Enterprise Linux (RHEL) uses a user private group (UPG) scheme: a UPG has the same name as the user for which it was created and that user is the only member of the UPG.

If you have allocated UIDs for your AD users, but GIDs were not added, you can configure SSSD to automatically map private groups for users based on their UID by adjusting the auto_private_groups setting for that ID range.

By default, the auto_private_groups option is set to false for **ipa-ad-trust-posix** ID ranges used in a POSIX trust. With this configuration, SSSD retrieves the **uidNumber** and **gidNumber** from each AD user entry.

auto_private_groups = false

SSSD assigns the **uidNumber** value to the user's UID, the **gidNumber** to the user's GID. A group with that GID must exist in AD, or you will not be able to resolve that user. The following table demonstrates whether you will be able to resolve AD users, depending on different AD configurations.

Table 7.2. SSSD behavior when the auto_private_groups variable is set to false for a POSIX ID range

User configuration in AD	Output of **id username**
AD user entry has: • **uidNumber** = 4000 • **gidNumber** is not defined • No group in AD with **gidNumber** = 4000.	SSSD cannot resolve the user.
AD user entry has: • **uidNumber** = 4000 • **gidNumber** = 4000 • No group in AD with **gidNumber** = 4000.	SSSD cannot resolve the user.
AD user entry has: • **uidNumber** = 4000 • **gidNumber** = 4000 • AD has a group with **gidNumber** = 4000.	**# id aduser@AD-DOMAIN.COMuid=4000(aduser@ad-domain.com) gid=4000(adgroup@ad-domain.com) groups=4000(adgroup@ad-domain.com), …**

If an AD user does not have a primary group configured in AD, or its **gidNumber** does not correspond to an existing group, the IdM server is unable to resolve that user correctly because it cannot look up all the groups the user belongs to. To work around this issue, you can enable automatic private group mapping in SSSD by setting the **auto_private_groups** option to **true** or **hybrid**:

auto_private_groups = true

SSSD always maps a private group with the **gidNumber** set to match the **uidNumber** from the AD user entry.

Table 7.3. SSSD behavior when the auto_private_groups variable is set to true for a POSIX ID range

User configuration in AD	Output of **id username**
AD user entry has: • **uidNumber** = 4000 • **gidNumber** is not defined • AD does not have a group with GID=4000.	**# id aduser@AD-DOMAIN.COMuid=4000(aduser@ad-domain.com) gid=4000(aduser@ad-domain.com) groups=4000(aduser@ad-domain.com), …**

User configuration in AD	Output of **id username**
AD user entry has: • **uidNumber** = 4000 • **gidNumber** = 5000 • AD does not have a group with **gidNumber** = 5000.	**# id aduser@AD-DOMAIN.COMuid=4000(aduser@ad-domain.com) gid=4000(aduser@ad-domain.com) groups=4000(aduser@ad-domain.com), …**
AD user entry has: • **uidNumber** = 4000 • **gidNumber** = 4000 • AD does not have a group with **gidNumber** = 4000.	**# id aduser@AD-DOMAIN.COMuid=4000(aduser@ad-domain.com) gid=4000(aduser@ad-domain.com) groups=4000(aduser@ad-domain.com), …**
AD user entry has: • **uidNumber** = 4000 • **gidNumber** = 5000 • AD has a group with **gidNumber** = 5000.	**# id aduser@AD-DOMAIN.COMuid=4000(aduser@ad-domain.com) gid=4000(aduser@ad-domain.com) groups=4000(aduser@ad-domain.com), …**

auto_private_groups = hybrid

If the **uidNumber** value matches **gidNumber**, but there is no group with this **gidNumber**, SSSD maps a private group as the user's primary user group with a **gidNumber** that matches the **uidNumber**. If the **uidNumber** and **gidNumber** values differ, and there is a group with this **gidNumber**, SSSD uses the value from **gidNumber**.

Table 7.4. SSSD behavior when the auto_private_groups variable is set to hybrid for a POSIX ID range

User configuration in AD	Output of **id username**
AD user entry with: • **uidNumber** = 4000 • **gidNumber** is not defined • AD does not have a group with **gidNumber** = 4000.	SSSD cannot resolve the user.

User configuration in AD	Output of **id username**
AD user entry with: • **uidNumber** = 4000 • **gidNumber** = 5000 • AD does not have a group with **gidNumber** = 5000.	SSSD cannot resolve the user.
AD user entry with: • **uidNumber** = 4000 • **gidNumber** = 4000 • AD does not have a group with **gidNumber** = 4000.	**# id aduser@AD-DOMAIN.COMuid=4000(aduser@ad-domain.com) gid=4000(aduser@ad-domain.com) groups=4000(aduser@ad-domain.com), …**
AD user entry with: • **uidNumber** = 4000 • **gidNumber** = 5000 • AD has a group with **gidNumber** = 5000.	**# id aduser@AD-DOMAIN.COMuid=4000(aduser@ad-domain.com) gid=5000(aduser@ad-domain.com) groups=5000(adgroup@ad-domain.com), …**

Additional resources

- POSIX and ID mapping ID range types for AD users
- Enabling automatic private group mapping for a POSIX ID range on the CLI
- Enabling automatic private group mapping for a POSIX ID range in the IdM WebUI

7.7. OPTIONS FOR AUTOMATICALLY MAPPING PRIVATE GROUPS FOR AD USERS: ID MAPPING TRUSTS

Each user in a Linux environment has a primary user group. Red Hat Enterprise Linux (RHEL) uses a user private group (UPG) scheme: a UPG has the same name as the user for which it was created and that user is the only member of the UPG.

If you have allocated UIDs for your AD users, but GIDs were not added, you can configure SSSD to automatically map private groups for users based on their UID by adjusting the auto_private_groups setting for that ID range.

By default, the **auto_private_groups** option is set to **true** for **ipa-ad-trust** ID ranges used in an ID mapping trust. With this configuration, SSSD computes the UID and GID for an AD user based on its Security Identifier (SID). SSSD ignores any POSIX attributes in AD, such as **uidNumber**, **gidNumber**, and also ignores the **primaryGroupID**.

auto_private_groups = true

SSSD always maps a private group with the GID set to match the UID, which is based on the SID of the AD user.

Table 7.5. SSSD behavior when the auto_private_groups variable is set to true for an ID mapping ID range

User configuration in AD	Output of id username
AD user entry where: • SID maps to 7000 • **primaryGroupID** maps to 8000	**# id aduser@AD-DOMAIN.COMuid=7000(aduser@ad-domain.com) gid=7000(aduser@ad-domain.com) groups=7000(aduser@ad-domain.com), 8000(adgroup@ad-domain.com), …**

auto_private_groups = false

If you set the **auto_private_groups** option to **false**, SSSD uses the **primaryGroupID** set in the AD entry as the GID number. The default value for **primaryGroupID** corresponds to the **Domain Users** group in AD.

Table 7.6. SSSD behavior when the auto_private_groups variable is set to false for an ID mapping ID range

User configuration in AD	Output of id username
AD user entry where: • SID maps to 7000 • **primaryGroupID** maps to 8000	**# id aduser@AD-DOMAIN.COMuid=7000(aduser@ad-domain.com) gid=8000(adgroup@ad-domain.com) groups=8000(adgroup@ad-domain.com), …**

Additional resources

- POSIX and ID mapping ID range types for AD users

7.8. ENABLING AUTOMATIC PRIVATE GROUP MAPPING FOR A POSIX ID RANGE ON THE CLI

By default, SSSD does not map private groups for Active Directory (AD) users if you have established a POSIX trust that relies on POSIX data stored in AD. If any AD users do not have primary groups configured, IdM is not be able to resolve them.

This procedure explains how to enable automatic private group mapping for an ID range by setting the **hybrid** option for the **auto_private_groups** SSSD parameter on the command line. As a result, IdM is able to resolve AD users that do not have primary groups configured in AD.

Prerequisites

- You have successfully established a POSIX cross-forest trust between your IdM and AD environments.

Procedure

1. Display all ID ranges and make note of the AD ID range you want to modify.

```
[root@server ~]# ipa idrange-find
----------------
2 ranges matched
----------------
  Range name: IDM.EXAMPLE.COM_id_range
  First Posix ID of the range: 882200000
  Number of IDs in the range: 200000
  Range type: local domain range

  Range name: AD.EXAMPLE.COM_id_range
  First Posix ID of the range: 1337000000
  Number of IDs in the range: 200000
  Domain SID of the trusted domain: S-1-5-21-4123312420-990666102-3578675309
  Range type: Active Directory trust range with POSIX attributes
----------------------------
Number of entries returned 2
----------------------------
```

2. Adjust the automatic private group behavior for the AD ID range with the **ipa idrange-mod** command.

```
[root@server ~]# ipa idrange-mod --auto-private-groups=hybrid
AD.EXAMPLE.COM_id_range
```

3. Reset the SSSD cache to enable the new setting.

```
[root@server ~]# sss_cache -E
```

Additional resources

- Options for automatically mapping private groups for AD users

7.9. ENABLING AUTOMATIC PRIVATE GROUP MAPPING FOR A POSIX ID RANGE IN THE IDM WEBUI

By default, SSSD does not map private groups for Active Directory (AD) users if you have established a POSIX trust that relies on POSIX data stored in AD. If any AD users do not have primary groups configured, IdM is not be able to resolve them.

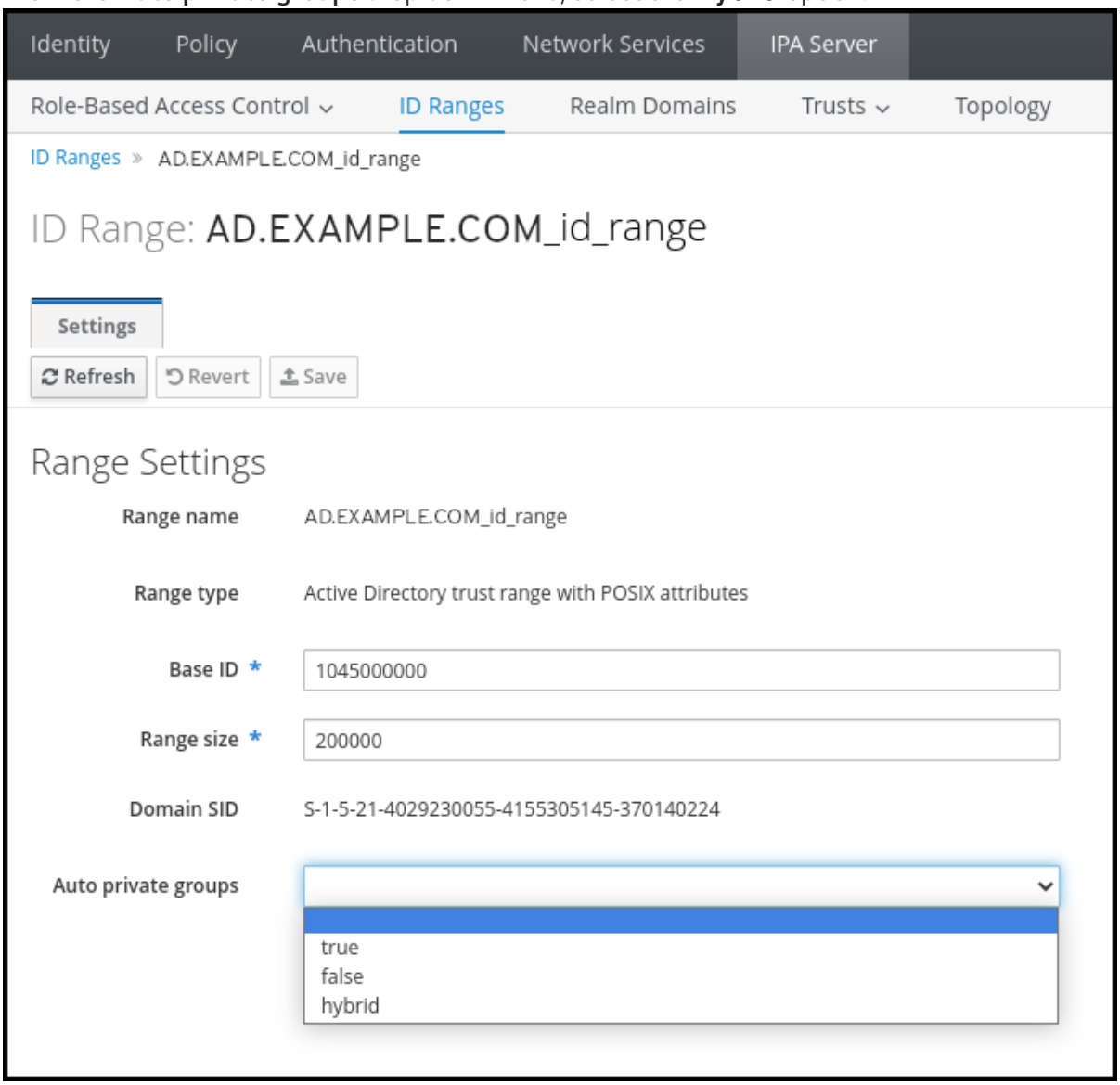
This procedure explains how to enable automatic private group mapping for an ID range by setting the **hybrid** option for the **auto_private_groups** SSSD parameter in the Identity Management (IdM) WebUI. As a result, IdM is able to resolve AD users that do not have primary groups configured in AD.

Prerequisites

- You have successfully established a POSIX cross-forest trust between your IdM and AD environments.

Procedure

1. Log into the IdM Web UI with your user name and password.
2. Open the **IPA Server → ID Ranges** tab.
3. Select the ID range you want to modify, such as **AD.EXAMPLE.COM_id_range**.
4. From the **Auto private groups** drop down menu, select the **hybrid** option.



5. Click the **Save** button to save your changes.

Additional resources

- Options for automatically mapping private groups for AD users

7.10. NON-POSIX EXTERNAL GROUPS AND SID MAPPING

Identity Management (IdM) uses LDAP for managing groups. Active Directory (AD) entries are not synchronized or copied over to IdM, which means that AD users and groups have no LDAP objects in the

LDAP server, so they cannot be directly used to express group membership in the IdM LDAP. For this reason, administrators in IdM need to create non-POSIX external groups, referenced as normal IdM LDAP objects to signify group membership for AD users and groups in IdM.

Security IDs (SIDs) for non-POSIX external groups are processed by SSSD, which maps the SIDs of groups in Active Directory to POSIX groups in IdM. In Active Directory, SIDs are associated with user names. When an AD user name is used to access IdM resources, SSSD uses the user's SID to build up a full group membership information for the user in the IdM domain.

7.11. SETTING UP DNS

These guidelines can help you achieve the right DNS configuration for establishing a cross-forest trust between Identity Management (IdM) and Active Directory (AD).

Unique primary DNS domains

Ensure both AD and IdM have their own unique primary DNS domains configured. For example:

- ***ad.example.com*** for AD and ***idm.example.com*** for IdM
- ***example.com*** for AD and ***idm.example.com*** for IdM

The most convenient management solution is an environment where each DNS domain is managed by integrated DNS servers, but you can also use any other standard-compliant DNS server.

IdM and AD DNS Domains

Systems joined to IdM can be distributed over multiple DNS domains. Red Hat recommends that you deploy IdM clients in a DNS zone different to the ones owned by Active Directory. The primary IdM DNS domain must have proper SRV records to support AD trusts.

NOTE

In some environments with trusts between IdM and Active Directory, you can install an IdM client on a host that is part of the Active Directory DNS domain. The host can then benefit from the Linux-focused features of IdM. This is not a recommended configuration and has some limitations. See Configuring IdM clients in an Active Directory DNS domain for more details.

Proper SRV records

Ensure the primary IdM DNS domain has proper SRV records to support AD trusts.
For other DNS domains that are part of the same IdM realm, the SRV records do not have to be configured when the trust to AD is established. The reason is that AD domain controllers do not use SRV records to discover Kerberos key distribution centers (KDCs) but rather base the KDC discovery on name suffix routing information for the trust.

DNS records resolvable from all DNS domains in the trust

Ensure all machines can resolve DNS records from all DNS domains involved in the trust relationship:

- When configuring the IdM DNS, follow the instructions described in Installing an IdM server with an external CA.
- If you are using IdM without integrated DNS, follow the instructions described in Installing an IdM server without integrated DNS.

Kerberos realm names as upper-case versions of primary DNS domain names

Ensure Kerberos realm names are the same as the primary DNS domain names, with all letters uppercase. For example, if the domain names are ***ad.example.com*** for AD and ***idm.example.com*** for IdM, the Kerberos realm names must be ***AD.EXAMPLE.COM*** and ***IDM.EXAMPLE.COM***.

7.12. NETBIOS NAMES

The NetBIOS name is usually the far-left component of the domain name. For example:

- In the domain name ***linux.example.com***, the NetBIOS name is **linux**.
- In the domain name ***example.com***, the NetBIOS name is **example**.

Different NetBIOS names for the Identity Management (IdM) and Active Directory (AD) domains

Ensure the IdM and AD domains have different NetBIOS names.
The NetBIOS name is critical for identifying the AD domain. If the IdM domain is within a subdomain of the AD DNS, the NetBIOS name is also critical for identifying the IdM domain and services.

Character limit for NetBIOS names

The maximum length of a NetBIOS name is 15 characters.

7.13. SUPPORTED VERSIONS OF WINDOWS SERVER

You can establish a trust relationship with Active Directory (AD) forests that use the following forest and domain functional levels:

- Forest functional level range: Windows Server 2012 – Windows Server 2016
- Domain functional level range: Windows Server 2012 – Windows Server 2016

Identity Management (IdM) supports establishing a trust with Active Directory domain controllers running the following operating systems:

- Windows Server 2022 (RHEL 9.1 and later)
- Windows Server 2019
- Windows Server 2016
- Windows Server 2012 R2
- Windows Server 2012

NOTE

Identity Management (IdM) does not support establishing trust to Active Directory with Active Directory domain controllers running Windows Server 2008 R2 or earlier versions. RHEL IdM requires SMB encryption when establishing the trust relationship, which is only supported in Windows Server 2012 or later.

7.14. CONFIGURING AD SERVER DISCOVERY AND AFFINITY

Server discovery and affinity configuration affects which Active Directory (AD) servers an Identity Management (IdM) client communicates with. This section provides an overview of how discovery and affinity work in an environment with a cross-forest trust between IdM and AD.

Configuring clients to prefer servers in the same geographical location helps prevent time lags and other problems that occur when clients contact servers from another, remote data center. To make sure clients communicate with local servers, you must ensure that:

- Clients communicate with local IdM servers over LDAP and over Kerberos
- Clients communicate with local AD servers over Kerberos
- Embedded clients on IdM servers communicate with local AD servers over LDAP and over Kerberos

Options for configuring LDAP and Kerberos on the IdM client for communication with local IdM servers

When using IdM with integrated DNS

By default, clients use automatic service lookup based on the DNS records. In this setup, you can also use the *DNS locations* feature to configure DNS-based service discovery.
To override the automatic lookup, you can disable the DNS discovery in one of the following ways:

- During the IdM client installation by providing failover parameters from the command line
- After the client installation by modifying the System Security Services Daemon (SSSD) configuration

When using IdM without integrated DNS

You must explicitly configure clients in one of the following ways:

- During the IdM client installation by providing failover parameters from the command line
- After the client installation by modifying the SSSD configuration

Options for configuring Kerberos on the IdM client for communication with local AD servers

IdM clients are unable to automatically discover which AD servers to communicate with. To specify the AD servers manually, modify the **krb5.conf** file:

- Add the AD realm information
- Explicitly list the AD servers to communicate with

For example:

```
[realms]
AD.EXAMPLE.COM = {
kdc = server1.ad.example.com
kdc = server2.ad.example.com
}
```

Options for configuring embedded clients on IdM servers for communication with local AD servers over Kerberos and LDAP

The embedded client on an IdM server works also as a client of the AD server. It can automatically discover and use the appropriate AD site.

When the embedded client performs the discovery, it might first discover an AD server in a remote location. If the attempt to contact the remote server takes too long, the client might stop the operation without establishing the connection. Use the **dns_resolver_timeout** option in the **sssd.conf** file on the client to increase the amount of time for which the client waits for a reply from the DNS resolver. See the *sssd.conf(5)* man page for details.

Once the embedded client has been configured to communicate with the local AD servers, the SSSD remembers the AD site the embedded client belongs to. Thanks to this, SSSD normally sends an LDAP ping directly to a local domain controller to refresh its site information. If the site no longer exists or the client has meanwhile been assigned to a different site, SSSD starts querying for SRV records in the forest and goes through a whole process of autodiscovery.

Using *trusted domain sections* in **sssd.conf**, you can also explicitly override some of the information that is discovered automatically by default.

7.15. OPERATIONS PERFORMED DURING INDIRECT INTEGRATION OF IDM TO AD

This section provides details on which operations and requests are performed during indirect integration of IdM to AD.

Read the table to learn about operations and requests performed during the creation of an Identity Management (IdM) to Active Directory (AD) trust from the IdM trust controller towards AD domain controllers.

Table 7.7. Operations performed from an IdM trust controller towards AD domain controllers

Operation	Protocol used	Purpose
DNS resolution against the AD DNS resolvers configured on an IdM trust controller	DNS	To discover the IP addresses of AD domain controllers
Requests to UDP/UDP6 port 389 on an AD DC	Connectionless LDAP (CLDAP)	To perform AD DC discovery
Requests to TCP/TCP6 ports 389 and 3268 on an AD DC	LDAP	To query AD user and group information
Requests to TCP/TCP6 ports 389 and 3268 on an AD DC	DCE RPC and SMB	To set up and support cross-forest trust to AD
Requests to TCP/TCP6 ports 135, 139, 445 on an AD DC	DCE RPC and SMB	To set up and support cross-forest trust to AD
Requests to dynamically opened ports on an AD DC as directed by the Active Directory domain controller, likely in the range of 49152-65535 (TCP/TCP6)	DCE RPC and SMB	To respond to requests by DCE RPC End-point mapper (port 135 TCP/TCP6)

Operation	Protocol used	Purpose
Requests to ports 88 (TCP/TCP6 and UDP/UDP6), 464 (TCP/TCP6 and UDP/UDP6), and 749 (TCP/TCP6) on an AD DC	Kerberos	To obtain a Kerberos ticket; change a Kerberos password; administer Kerberos remotely

Read the table to learn about operations and requests performed during the creation of an IdM to AD trust from the AD domain controller towards IdM trust controllers.

Table 7.8. Operations performed from an AD domain controller towards IdM trust controllers

Operation	Protocol used	Purpose
DNS resolution against the IdM DNS resolvers configured on an AD domain controller	DNS	To discover the IP addresses of IdM trust controllers
Requests to UDP/UDP6 port 389 on an IdM trust controller	CLDAP	To perform IdM trust controller discovery
Requests to TCP/TCP6 ports 135, 139, 445 on an IdM trust controller	DCE RPC and SMB	To verify the cross-forest trust to AD
Requests to dynamically opened ports on an IdM trust controller as directed by the IdM trust controller, likely in the range of 49152-65535 (TCP/TCP6)	DCE RPC and SMB	To respond to requests by DCE RPC End-point mapper (port 135 TCP/TCP6)
Requests to ports 88 (TCP/TCP6 and UDP/UDP6), 464 (TCP/TCP6 and UDP/UDP6), and 749 (TCP/TCP6) on an IdM trust controller	Kerberos	To obtain a Kerberos ticket; change a Kerberos password; administer Kerberos remotely

CHAPTER 8. BACKING UP AND RESTORING IDM

Red Hat Enterprise Linux Identity Management provides a solution to manually back up and restore the IdM system. This may be necessary after a data loss event.

During backup, the system creates a directory containing information on your IdM setup and stores it. During restore, you can use this backup directory to bring your original IdM setup back.

NOTE

The IdM backup and restore features are designed to help prevent data loss. To mitigate the impact of losing a server, and ensure continued operation by providing alternative servers to clients, ensure you have a replica topology according to Mitigating server loss with replication.

8.1. IDM BACKUP TYPES

With the **ipa-backup** utility, you can create two types of backups:

Full-server backup

- **Contains** all server configuration files related to IdM, and LDAP data in LDAP Data Interchange Format (LDIF) files
- IdM services must be **offline**.
- **Suitable for** rebuilding an IdM deployment from scratch.

Data-only backup

- **Contains** LDAP data in LDIF files and the replication changelog
- IdM services can be **online or offline**.
- **Suitable for** restoring IdM data to a state in the past

8.2. NAMING CONVENTIONS FOR IDM BACKUP FILES

By default, IdM stores backups as **.tar** archives in subdirectories of the **/var/lib/ipa/backup/** directory.

The archives and subdirectories follow these naming conventions:

Full-server backup

An archive named **ipa-full.tar** in a directory named **ipa-full-*<YEAR-MM-DD-HH-MM-SS>***, with the time specified in GMT time.

```
[root@server ~]# ll /var/lib/ipa/backup/ipa-full-2021-01-29-12-11-46
total 3056
-rw-r--r--. 1 root root     158 Jan 29 12:11 header
-rw-r--r--. 1 root root 3121511 Jan 29 12:11 ipa-full.tar
```

Data-only backup

An archive named **ipa-data.tar** in a directory named **ipa-data-*<YEAR-MM-DD-HH-MM-SS>***, with the time specified in GMT time.

```
[root@server ~]# ll /var/lib/ipa/backup/ipa-data-2021-01-29-12-14-23
total 1072
-rw-r--r--. 1 root root     158 Jan 29 12:14 header
-rw-r--r--. 1 root root 1090388 Jan 29 12:14 ipa-data.tar
```

NOTE

Uninstalling an IdM server does not automatically remove any backup files.

8.3. CONSIDERATIONS WHEN CREATING A BACKUP

This section describes important behaviors and limitations of the **ipa-backup** command.

- By default, the **ipa-backup** utility runs in offline mode, which stops all IdM services. The utility automatically restarts IdM services after the backup is finished.
- A full-server backup must **always** run with IdM services offline, but a data-only backup may be performed with services online.
- By default, the **ipa-backup** utility creates backups on the file system containing the **/var/lib/ipa/backup/** directory. Red Hat recommends creating backups regularly on a file system separate from the production filesystem used by IdM, and archiving the backups to a fixed medium, such as tape or optical storage.
- Consider performing backups on hidden replicas. IdM services can be shut down on hidden replicas without affecting IdM clients.
- The **ipa-backup** utility checks if all of the services used in your IdM cluster, such as a Certificate Authority (CA), Domain Name System (DNS), and Key Recovery Agent (KRA), are installed on the server where you are running the backup. If the server does not have all these services installed, the **ipa-backup** utility exits with a warning, because backups taken on that host would not be sufficient for a full cluster restoration.
  For example, if your IdM deployment uses an integrated Certificate Authority (CA), a backup run on a non-CA replica will not capture CA data. Red Hat recommends verifying that the replica where you perform an **ipa-backup** has all of the IdM services used in the cluster installed.

  You can bypass the IdM server role check with the **ipa-backup --disable-role-check** command, but the resulting backup will not contain all the data necessary to restore IdM fully.

8.4. CREATING AN IDM BACKUP

This section describes how to create a full-server and data-only backup in offline and online modes using the **ipa-backup** command.

Prerequisites

- You must have **root** privileges to run the **ipa-backup** utility.

Procedure

- To create a full-server backup in offline mode, use the **ipa-backup** utility without additional options.

```
[root@server ~]# ipa-backup
Preparing backup on server.example.com
Stopping IPA services
Backing up ipaca in EXAMPLE-COM to LDIF
Backing up userRoot in EXAMPLE-COM to LDIF
Backing up EXAMPLE-COM
Backing up files
Starting IPA service
Backed up to /var/lib/ipa/backup/ipa-full-2020-01-14-11-26-06
The ipa-backup command was successful
```

- To create an offline data-only backup, specify the **--data** option.

```
[root@server ~]# ipa-backup --data
```

- To create a full-server backup that includes IdM log files, use the **--logs** option.

```
[root@server ~]# ipa-backup --logs
```

- To create a data-only backup while IdM services are running, specify both **--data** and **--online** options.

```
[root@server ~]# ipa-backup --data --online
```

NOTE

If the backup fails due to insufficient space in the **/tmp** directory, use the **TMPDIR** environment variable to change the destination for temporary files created by the backup process:

```
[root@server ~]# TMPDIR=/new/location ipa-backup
```

For more details, see ipa-backup Command Fails to Finish .

Verification Steps

- The backup directory contains an archive with the backup.

```
[root@server ~]# ls /var/lib/ipa/backup/ipa-full-2020-01-14-11-26-06
header  ipa-full.tar
```

8.5. CREATING A GPG2-ENCRYPTED IDM BACKUP

You can create encrypted backups using GNU Privacy Guard (GPG) encryption. The following procedure creates an IdM backup and encrypts it using a GPG2 key.

Prerequisites

- You have created a GPG2 key. See Creating a GPG2 key .

Procedure

- Create a GPG-encrypted backup by specifying the **--gpg** option.

```
[root@server ~]# ipa-backup --gpg
Preparing backup on server.example.com
Stopping IPA services
Backing up ipaca in EXAMPLE-COM to LDIF
Backing up userRoot in EXAMPLE-COM to LDIF
Backing up EXAMPLE-COM
Backing up files
Starting IPA service
Encrypting /var/lib/ipa/backup/ipa-full-2020-01-13-14-38-00/ipa-full.tar
Backed up to /var/lib/ipa/backup/ipa-full-2020-01-13-14-38-00
The ipa-backup command was successful
```

Verification Steps

- Ensure that the backup directory contains an encrypted archive with a **.gpg** file extension.

```
[root@server ~]# ls /var/lib/ipa/backup/ipa-full-2020-01-13-14-38-00
header  ipa-full.tar.gpg
```

Additional resources

- Creating a backup .

8.6. CREATING A GPG2 KEY

The following procedure describes how to generate a GPG2 key to use with encryption utilities.

Prerequisites

- You need **root** privileges.

Procedure

1. Install and configure the **pinentry** utility.

```
[root@server ~]# dnf install pinentry
[root@server ~]# mkdir ~/.gnupg -m 700
[root@server ~]# echo "pinentry-program /usr/bin/pinentry-curses" >> ~/.gnupg/gpg-agent.conf
```

2. Create a **key-input** file used for generating a GPG keypair with your preferred details. For example:

```
[root@server ~]# cat >key-input <<EOF
%echo Generating a standard key
Key-Type: RSA
Key-Length: 2048
Name-Real: GPG User
Name-Comment: first key
```

```
Name-Email: root@example.com
Expire-Date: 0
%commit
%echo Finished creating standard key
EOF
```

3. *(Optional)* By default, GPG2 stores its keyring in the ~/**.gnupg** file. To use a custom keyring location, set the **GNUPGHOME** environment variable to a directory that is only accessible by root.

```
[root@server ~]# export GNUPGHOME=/root/backup

[root@server ~]# mkdir -p $GNUPGHOME -m 700
```

4. Generate a new GPG2 key based on the contents of the **key-input** file.

```
[root@server ~]# gpg2 --batch --gen-key key-input
```

5. Enter a passphrase to protect the GPG2 key. You use this passphrase to access the private key for decryption.

```
┌──────────────────────────────────────────────────────┐
│ Please enter the passphrase to                       │
│ protect your new key                                 │
│                                                      │
│ Passphrase: <passphrase>                             │
│                                                      │
│  <OK>                    <Cancel>                    │
└──────────────────────────────────────────────────────┘
```

6. Confirm the correct passphrase by entering it again.

```
┌──────────────────────────────────────────────────────┐
│ Please re-enter this passphrase                      │
│                                                      │
│ Passphrase: <passphrase>                             │
│                                                      │
│  <OK>                    <Cancel>                    │
└──────────────────────────────────────────────────────┘
```

7. Verify that the new GPG2 key was created successfully.

```
gpg: keybox '/root/backup/pubring.kbx' created
gpg: Generating a standard key
gpg: /root/backup/trustdb.gpg: trustdb created
gpg: key BF28FFA302EF4557 marked as ultimately trusted
gpg: directory '/root/backup/openpgp-revocs.d' created
gpg: revocation certificate stored as '/root/backup/openpgp-
revocs.d/8F6FCF10C80359D5A05AED67BF28FFA302EF4557.rev'
gpg: Finished creating standard key
```

Verification Steps

- List the GPG keys on the server.

```
[root@server ~]# gpg2 --list-secret-keys
gpg: checking the trustdb
gpg: marginals needed: 3  completes needed: 1  trust model: pgp
gpg: depth: 0  valid:   1  signed:   0  trust: 0-, 0q, 0n, 0m, 0f, 1u
/root/backup/pubring.kbx
------------------------
sec   rsa2048 2020-01-13 [SCEA]
      8F6FCF10C80359D5A05AED67BF28FFA302EF4557
uid           [ultimate] GPG User (first key) <root@example.com>
```

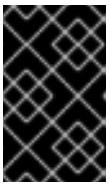
Additional resources

- GNU Privacy Guard

8.7. WHEN TO RESTORE FROM AN IDM BACKUP

You can respond to several disaster scenarios by restoring from an IdM backup:

- **Undesirable changes were made to the LDAP content** Entries were modified or deleted, replication carried out those changes throughout the deployment, and you want to revert those changes. Restoring a data-only backup returns the LDAP entries to the previous state without affecting the IdM configuration itself.
- **Total Infrastructure Loss, or loss of all CA instances** If a disaster damages all Certificate Authority replicas, the deployment has lost the ability to rebuild itself by deploying additional servers. In this situation, restore a backup of a CA Replica and build new replicas from it.
- **An upgrade on an isolated server failed** The operating system remains functional, but the IdM data is corrupted, which is why you want to restore the IdM system to a known good state. Red Hat recommends working with Technical Support in order to diagnose and troubleshoot the issue. If those efforts fail, restore from a full-server backup.



IMPORTANT

The preferred solution for hardware or upgrade failure is to rebuild the lost server from a replica. For more information, see Recovering a single server with replication.

8.8. CONSIDERATIONS WHEN RESTORING FROM AN IDM BACKUP

If you have a backup created with the **ipa-backup** utility, you can restore your IdM server or the LDAP content to the state they were in when the backup was performed.

The following are the key considerations while restoring from an IdM backup:

- You can only restore a backup on a server that matches the configuration of the server where the backup was originally created. The server **must** have:
  - The same hostname
  - The same IP address
  - The same version of IdM software

- If one IdM server among many is restored, the restored server becomes the only source of information for IdM. All other servers **must** be re-initialized from the restored server.
- Since any data created after the last backup will be lost, do not use the backup and restore solution for normal system maintenance.
- If a server is lost, Red Hat recommends rebuilding the server by reinstalling it as a replica, instead of restoring from a backup. Creating a new replica preserves data from the current working environment. For more information, see Preparing for server loss with replication.
- The backup and restore features can only be managed from the command line and are not available in the IdM web UI.
- You cannot restore from backup files located in the **/tmp** or **/var/tmp** directories. The IdM Directory Server uses a **PrivateTmp** directory and cannot access the **/tmp** or **/var/tmp** directories commonly available to the operating system.

TIP

Restoring from a backup requires the same software (RPM) versions on the target host as were installed when the backup was performed. Due to this, Red Hat recommends restoring from a Virtual Machine snapshot rather than a backup. For more information, see Recovering from data loss with VM snapshots .

8.9. RESTORING AN IDM SERVER FROM A BACKUP

The following procedure describes restoring an IdM server, or its LDAP data, from an IdM backup.

Figure 8.1. Replication Topology used in this example

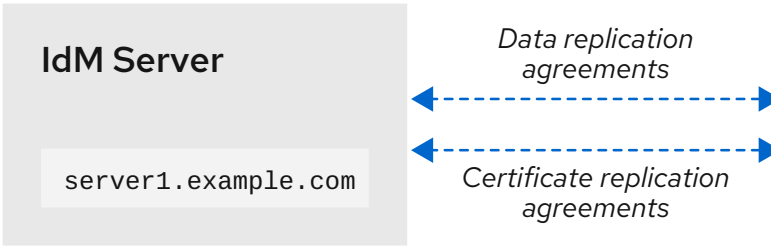


Table 8.1. Server naming conventions used in this example

Server host name	Function
server1.example.com	The server that needs to be restored from backup.
caReplica2.example.com	A Certificate Authority (CA) replica connected to the **server1.example.com** host.
replica3.example.com	A replica connected to the **caReplica2.example.com** host.

Prerequisites

- You have generated a full-server or data-only backup of the IdM server with the **ipa-backup** utility. See Creating a backup .
- Your backup files are not in the **/tmp** or **/var/tmp** directories.
- Before performing a full-server restore from a full-server backup, uninstall IdM from the server and reinstall IdM using the same server configuration as before.

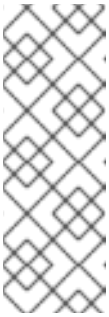
Procedure

1. Use the **ipa-restore** utility to restore a full-server or data-only backup.
   - If the backup directory is in the default **/var/lib/ipa/backup/** location, enter only the name of the directory:

     ```
     [root@server1 ~]# ipa-restore ipa-full-2020-01-14-12-02-32
     ```

   - If the backup directory is not in the default location, enter its full path:

     ```
     [root@server1 ~]# ipa-restore /mybackups/ipa-data-2020-02-01-05-30-00
     ```



NOTE

The **ipa-restore** utility automatically detects the type of backup that the directory contains, and performs the same type of restore by default. To perform a data-only restore from a full-server backup, add the **--data** option to the **ipa-restore** command:

```
[root@server1 ~]# ipa-restore --data ipa-full-2020-01-14-12-02-32
```

2. Enter the Directory Manager password.

   ```
   Directory Manager (existing master) password:
   ```

3. Enter **yes** to confirm overwriting current data with the backup.

   ```
   Preparing restore from /var/lib/ipa/backup/ipa-full-2020-01-14-12-02-32 on
   server1.example.com
   Performing FULL restore from FULL backup
   Temporary setting umask to 022
   Restoring data will overwrite existing live data. Continue to restore? [no]: yes
   ```

4. The **ipa-restore** utility disables replication on all servers that are available:

   ```
   Each master will individually need to be re-initialized or
   re-created from this one. The replication agreements on
   masters running IPA 3.1 or earlier will need to be manually
   re-enabled. See the man page for details.
   Disabling all replication.
   Disabling replication agreement on server1.example.com to caReplica2.example.com
   Disabling CA replication agreement on server1.example.com to caReplica2.example.com
   Disabling replication agreement on caReplica2.example.com to server1.example.com
   ```

```
Disabling replication agreement on caReplica2.example.com to replica3.example.com
Disabling CA replication agreement on caReplica2.example.com to server1.example.com
Disabling replication agreement on replica3.example.com to caReplica2.example.com
```

The utility then stops IdM services, restores the backup, and restarts the services:

```
Stopping IPA services
Systemwide CA database updated.
Restoring files
Systemwide CA database updated.
Restoring from userRoot in EXAMPLE-COM
Restoring from ipaca in EXAMPLE-COM
Restarting GSS-proxy
Starting IPA services
Restarting SSSD
Restarting oddjobd
Restoring umask to 18
The ipa-restore command was successful
```

5. Re-initialize all replicas connected to the restored server:

   a. List all replication topology segments for the **domain** suffix, taking note of topology segments involving the restored server.

```
[root@server1 ~]# ipa topologysegment-find domain
------------------
2 segments matched
------------------
  Segment name: server1.example.com-to-caReplica2.example.com
  Left node: server1.example.com
  Right node: caReplica2.example.com
  Connectivity: both

  Segment name: caReplica2.example.com-to-replica3.example.com
  Left node: caReplica2.example.com
  Right node: replica3.example.com
  Connectivity: both
----------------------------
Number of entries returned 2
----------------------------
```

   b. Re-initialize the **domain** suffix for all topology segments with the restored server. In this example, perform a re-initialization of **caReplica2** with data from **server1**.

```
[root@caReplica2 ~]# ipa-replica-manage re-initialize --from=server1.example.com
Update in progress, 2 seconds elapsed
Update succeeded
```

   c. Moving on to Certificate Authority data, list all replication topology segments for the **ca** suffix.

```
[root@server1 ~]# ipa topologysegment-find ca
----------------
1 segment matched
```

```
----------------
  Segment name: server1.example.com-to-caReplica2.example.com
  Left node: server1.example.com
  Right node: caReplica2.example.com
  Connectivity: both
----------------------------
Number of entries returned 1
----------------------------
```

d. Re-initialize all CA replicas connected to the restored server.
In this example, perform a **csreplica** re-initialization of **caReplica2** with data from **server1**.

```
[root@caReplica2 ~]# ipa-csreplica-manage re-initialize --
from=server1.example.com
Directory Manager password:

Update in progress, 3 seconds elapsed
Update succeeded
```

6. Continue moving outward through the replication topology, re-initializing successive replicas, until all servers have been updated with the data from restored server **server1.example.com**.
In this example, we only have to re-initialize the **domain** suffix on **replica3** with the data from **caReplica2**:

```
[root@replica3 ~]# ipa-replica-manage re-initialize --from=caReplica2.example.com
Directory Manager password:

Update in progress, 3 seconds elapsed
Update succeeded
```

7. Clear SSSD's cache on every server in order to avoid authentication problems due to invalid data:

a. Stop the SSSD service:

```
[root@server ~]# systemctl stop sssd
```

b. Remove all cached content from SSSD:

```
[root@server ~]# sss_cache -E
```

c. Start the SSSD service:

```
[root@server ~]# systemctl start sssd
```

d. Reboot the server.

Additional resources

- The **ipa-restore (1)** man page also covers in detail how to handle complex replication scenarios during restoration.

8.10. RESTORING FROM AN ENCRYPTED BACKUP

This procedure restores an IdM server from an encrypted IdM backup. The **ipa-restore** utility automatically detects if an IdM backup is encrypted and restores it using the GPG2 root keyring.

Prerequisites

- A GPG-encrypted IdM backup. See Creating encrypted IdM backups .
- The LDAP Directory Manager password
- The passphrase used when creating the GPG key

Procedure

1. If you used a custom keyring location when creating the GPG2 keys, make sure that the **$GNUPGHOME** environment variable is set to that directory. See Creating a GPG2 key .

```
[root@server ~]# echo $GNUPGHOME
/root/backup
```

2. Provide the **ipa-restore** utility with the backup directory location.

```
[root@server ~]# ipa-restore ipa-full-2020-01-13-18-30-54
```

   a. Enter the Directory Manager password.

```
Directory Manager (existing master) password:
```

   b. Enter the passphrase you used when creating the GPG key.

```
┌──────────────────────────────────────────────────────┐
│ Please enter the passphrase to unlock the OpenPGP secret key: │
│ "GPG User (first key) <root@example.com>"            │
│ 2048-bit RSA key, ID BF28FFA302EF4557,               │
│ created 2020-01-13.                                  │
│                                                      │
│ Passphrase: <passphrase>                             │
│                                                      │
│       <OK>                    <Cancel>               │
└──────────────────────────────────────────────────────┘
```

3. Re-initialize all replicas connected to the restored server. See Restoring an IdM server from backup.

CHAPTER 9. BACKING UP AND RESTORING IDM SERVERS USING ANSIBLE PLAYBOOKS

Using the **ipabackup** Ansible role, you can automate backing up an IdM server, transferring backup files between servers and your Ansible controller, and restoring an IdM server from a backup.

9.1. USING ANSIBLE TO CREATE A BACKUP OF AN IDM SERVER

The following procedure describes how to use the ipabackup role in an Ansible playbook to create a backup of an IdM server and store it on the IdM server.

Prerequisites

- You have configured an Ansible control node that meets the following requirements:
  - You are using Ansible version 2.8 or later.
  - You have installed the **ansible-freeipa** package.
  - You have created an Ansible inventory file with the fully-qualified domain name (FQDN) of the IdM server where you are configuring these options.
  - Your Ansible inventory file is located in the ~/**MyPlaybooks**/ directory.

Procedure

1. Navigate to the ~/**MyPlaybooks**/ directory:

```
$ cd ~/MyPlaybooks/
```

2. Make a copy of the **backup-server.yml** file located in the **/usr/share/doc/ansible-freeipa/playbooks** directory:

```
$ cp /usr/share/doc/ansible-freeipa/playbooks/backup-server.yml backup-my-server.yml
```

3. Open the **backup-my-server.yml** Ansible playbook file for editing.

4. Adapt the file by setting the **hosts** variable to a host group from your inventory file. In this example, set it to the **ipaserver** host group:

```
---
- name: Playbook to backup IPA server
  hosts: ipaserver
  become: true

  roles:
  - role: ipabackup
    state: present
```

5. Save the file.

6. Run the Ansible playbook, specifying the inventory file and the playbook file:

```
$ ansible-playbook -v -i ~/MyPlaybooks/inventory backup-my-server.yml
```

Verification steps

1. Log into the IdM server that you have backed up.
2. Verify that the backup is in the **/var/lib/ipa/backup** directory.

```
[root@server ~]# ls /var/lib/ipa/backup/
ipa-full-2021-04-30-13-12-00
```

Additional resources

- For more sample Ansible playbooks that use the **ipabackup** role, see:
  - The **README.md** file in the **/usr/share/doc/ansible-freeipa/roles/ipabackup** directory.
  - The **/usr/share/doc/ansible-freeipa/playbooks/** directory.

9.2. USING ANSIBLE TO CREATE A BACKUP OF AN IDM SERVER ON YOUR ANSIBLE CONTROLLER

The following procedure describes how to use the **ipabackup** role in an Ansible playbook to create a backup of an IdM server and automatically transfer it on your Ansible controller. Your backup file name begins with the host name of the IdM server.

Prerequisites

- You have configured an Ansible control node that meets the following requirements:
  - You are using Ansible version 2.8 or later.
  - You have installed the **ansible-freeipa** package.
  - You have created an Ansible inventory file with the fully-qualified domain name (FQDN) of the IdM server where you are configuring these options.
  - Your Ansible inventory file is located in the **~/MyPlaybooks/** directory.

Procedure

1. To store the backups, create a subdirectory in your home directory on the Ansible controller.

```
$ mkdir ~/ipabackups
```

2. Navigate to the **~/MyPlaybooks/** directory:

```
$ cd ~/MyPlaybooks/
```

3. Make a copy of the **backup-server-to-controller.yml** file located in the **/usr/share/doc/ansible-freeipa/playbooks** directory:

```
$ cp /usr/share/doc/ansible-freeipa/playbooks/backup-server-to-controller.yml backup-my-server-to-my-controller.yml
```

4. Open the **backup-my-server-to-my-controller.yml** file for editing.
5. Adapt the file by setting the following variables:
   a. Set the **hosts** variable to a host group from your inventory file. In this example, set it to the **ipaserver** host group.
   b. *(Optional)* To maintain a copy of the backup on the IdM server, uncomment the following line:

```
# ipabackup_keep_on_server: yes
```

6. By default, backups are stored in the present working directory of the Ansible controller. To specify the backup directory you created in Step 1, add the **ipabackup_controller_path** variable and set it to the **/home/user/ipabackups** directory.

```
---
- name: Playbook to backup IPA server to controller
  hosts: ipaserver
  become: true
  vars:
    ipabackup_to_controller: yes
    # ipabackup_keep_on_server: yes
    ipabackup_controller_path: /home/user/ipabackups

  roles:
  - role: ipabackup
    state: present
```

7. Save the file.
8. Run the Ansible playbook, specifying the inventory file and the playbook file:

```
$ ansible-playbook -v -i ~/MyPlaybooks/inventory backup-my-server-to-my-controller.yml
```

Verification steps

- Verify that the backup is in the **/home/user/ipabackups** directory of your Ansible controller:

```
[user@controller ~]$ ls /home/user/ipabackups
server.idm.example.com_ipa-full-2021-04-30-13-12-00
```

Additional resources

- For more sample Ansible playbooks that use the **ipabackup** role, see:
  - The **README.md** file in the **/usr/share/doc/ansible-freeipa/roles/ipabackup** directory.
  - The **/usr/share/doc/ansible-freeipa/playbooks/** directory.

9.3. USING ANSIBLE TO COPY A BACKUP OF AN IDM SERVER TO YOUR ANSIBLE CONTROLLER

The following procedure describes how to use an Ansible playbook to copy a backup of an IdM server from the IdM server to your Ansible controller.

Prerequisites

- You have configured an Ansible control node that meets the following requirements:
  - You are using Ansible version 2.8 or later.
  - You have installed the **ansible-freeipa** package.
  - You have created an Ansible inventory file with the fully-qualified domain name (FQDN) of the IdM server where you are configuring these options.
  - Your Ansible inventory file is located in the **~/MyPlaybooks/** directory.

Procedure

1. To store the backups, create a subdirectory in your home directory on the Ansible controller.

```
$ mkdir ~/ipabackups
```

2. Navigate to the **~/MyPlaybooks/** directory:

```
$ cd ~/MyPlaybooks/
```

3. Make a copy of the **copy-backup-from-server.yml** file located in the **/usr/share/doc/ansible-freeipa/playbooks** directory:

```
$ cp /usr/share/doc/ansible-freeipa/playbooks/copy-backup-from-server.yml copy-backup-from-my-server-to-my-controller.yml
```

4. Open the **copy-my-backup-from-my-server-to-my-controller.yml** file for editing.

5. Adapt the file by setting the following variables:

   a. Set the **hosts** variable to a host group from your inventory file. In this example, set it to the **ipaserver** host group.

   b. Set the **ipabackup_name** variable to the name of the **ipabackup** on your IdM server to copy to your Ansible controller.

   c. By default, backups are stored in the present working directory of the Ansible controller. To specify the directory you created in Step 1, add the **ipabackup_controller_path** variable and set it to the **/home/user/ipabackups** directory.

```
---
- name: Playbook to copy backup from IPA server
  hosts: ipaserver
  become: true
  vars:
    ipabackup_name: ipa-full-2021-04-30-13-12-00
```

```
  ipabackup_to_controller: yes
  ipabackup_controller_path: /home/user/ipabackups

roles:
- role: ipabackup
  state: present
```

6. Save the file.
7. Run the Ansible playbook, specifying the inventory file and the playbook file:

```
$ ansible-playbook -v -i ~/MyPlaybooks/inventory copy-backup-from-my-server-to-my-controller.yml
```

NOTE

To copy **all** IdM backups to your controller, set the **ipabackup_name** variable in the Ansible playbook to **all**:

```
vars:
  ipabackup_name: all
  ipabackup_to_controller: yes
```

For an example, see the **copy-all-backups-from-server.yml** Ansible playbook in the **/usr/share/doc/ansible-freeipa/playbooks** directory.

Verification steps

- Verify your backup is in the **/home/user/ipabackups** directory on your Ansible controller:

```
[user@controller ~]$ ls /home/user/ipabackups
server.idm.example.com_ipa-full-2021-04-30-13-12-00
```

Additional resources

- The **README.md** file in the **/usr/share/doc/ansible-freeipa/roles/ipabackup** directory.
- The **/usr/share/doc/ansible-freeipa/playbooks/** directory.

9.4. USING ANSIBLE TO COPY A BACKUP OF AN IDM SERVER FROM YOUR ANSIBLE CONTROLLER TO THE IDM SERVER

The following procedure describes how to use an Ansible playbook to copy a backup of an IdM server from your Ansible controller to the IdM server.

Prerequisites

- You have configured an Ansible control node that meets the following requirements:
  - You are using Ansible version 2.8 or later.
  - You have installed the **ansible-freeipa** package.

- You have created an Ansible inventory file with the fully-qualified domain name (FQDN) of the IdM server where you are configuring these options.
- Your Ansible inventory file is located in the **~/MyPlaybooks/** directory.

Procedure

1. Navigate to the **~/MyPlaybooks/** directory:

```
$ cd ~/MyPlaybooks/
```

2. Make a copy of the **copy-backup-from-controller.yml** file located in the **/usr/share/doc/ansible-freeipa/playbooks** directory:

```
$ cp /usr/share/doc/ansible-freeipa/playbooks/copy-backup-from-controller.yml copy-backup-from-my-controller-to-my-server.yml
```

3. Open the **copy-my-backup-from-my-controller-to-my-server.yml** file for editing.
4. Adapt the file by setting the following variables:
   a. Set the **hosts** variable to a host group from your inventory file. In this example, set it to the **ipaserver** host group.
   b. Set the **ipabackup_name** variable to the name of the **ipabackup** on your Ansible controller to copy to the IdM server.

```
---
- name: Playbook to copy a backup from controller to the IPA server
  hosts: ipaserver
  become: true

  vars:
    ipabackup_name: server.idm.example.com_ipa-full-2021-04-30-13-12-00
    ipabackup_from_controller: yes

  roles:
  - role: ipabackup
    state: copied
```

5. Save the file.
6. Run the Ansible playbook, specifying the inventory file and the playbook file:

```
$ ansible-playbook -v -i ~/MyPlaybooks/inventory copy-backup-from-my-controller-to-my-server.yml
```

Additional resources

- The **README.md** file in the **/usr/share/doc/ansible-freeipa/roles/ipabackup** directory.
- The **/usr/share/doc/ansible-freeipa/playbooks/** directory.

9.5. USING ANSIBLE TO REMOVE A BACKUP FROM AN IDM SERVER

The following procedure describes how to use an Ansible playbook to remove a backup from an IdM server.

Prerequisites

- You have configured an Ansible control node that meets the following requirements:
  - You are using Ansible version 2.8 or later.
  - You have installed the **ansible-freeipa** package.
  - You have created an Ansible inventory file with the fully-qualified domain name (FQDN) of the IdM server where you are configuring these options.
  - Your Ansible inventory file is located in the **~/MyPlaybooks/** directory.

Procedure

1. Navigate to the ~/MyPlaybooks/ directory:

```
$ cd ~/MyPlaybooks/
```

2. Make a copy of the **remove-backup-from-server.yml** file located in the **/usr/share/doc/ansible-freeipa/playbooks** directory:

```
$ cp /usr/share/doc/ansible-freeipa/playbooks/remove-backup-from-server.yml remove-backup-from-my-server.yml
```

3. Open the **remove-backup-from-my-server.yml** file for editing.
4. Adapt the file by setting the following variables:
   a. Set the **hosts** variable to a host group from your inventory file. In this example, set it to the **ipaserver** host group.
   b. Set the **ipabackup_name** variable to the name of the **ipabackup** to remove from your IdM server.

```
---
- name: Playbook to remove backup from IPA server
  hosts: ipaserver
  become: true

  vars:
    ipabackup_name: ipa-full-2021-04-30-13-12-00

  roles:
  - role: ipabackup
    state: absent
```

5. Save the file.
6. Run the Ansible playbook, specifying the inventory file and the playbook file:

```
$ ansible-playbook -v -i ~/MyPlaybooks/inventory remove-backup-from-my-server.yml
```

NOTE

To remove **all** IdM backups from the IdM server, set the **ipabackup_name** variable in the Ansible playbook to **all**:

```
vars:
  ipabackup_name: all
```

For an example, see the **remove-all-backups-from-server.yml** Ansible playbook in the **/usr/share/doc/ansible-freeipa/playbooks** directory.

Additional resources

- The **README.md** file in the **/usr/share/doc/ansible-freeipa/roles/ipabackup** directory.
- The **/usr/share/doc/ansible-freeipa/playbooks/** directory.

9.6. USING ANSIBLE TO RESTORE AN IDM SERVER FROM A BACKUP STORED ON THE SERVER

The following procedure describes how to use an Ansible playbook to restore an IdM server from a backup stored on that host.

Prerequisites

- You have configured an Ansible control node that meets the following requirements:
  - You are using Ansible version 2.8 or later.
  - You have installed the **ansible-freeipa** package.
  - You have created an Ansible inventory file with the fully-qualified domain name (FQDN) of the IdM server where you are configuring these options.
  - Your Ansible inventory file is located in the **~/MyPlaybooks/** directory.
- You know the LDAP Directory Manager password.

Procedure

1. Navigate to the **~/MyPlaybooks/** directory:

```
$ cd ~/MyPlaybooks/
```

2. Make a copy of the **restore-server.yml** file located in the **/usr/share/doc/ansible-freeipa/playbooks** directory:

```
$ cp /usr/share/doc/ansible-freeipa/playbooks/restore-server.yml restore-my-server.yml
```

3. Open the **restore-my-server.yml** Ansible playbook file for editing.
4. Adapt the file by setting the following variables:

a. Set the **hosts** variable to a host group from your inventory file. In this example, set it to the **ipaserver** host group.

b. Set the **ipabackup_name** variable to the name of the **ipabackup** to restore.

c. Set the **ipabackup_password** variable to the LDAP Directory Manager password.

```
---
- name: Playbook to restore an IPA server
  hosts: ipaserver
  become: true

  vars:
    ipabackup_name: ipa-full-2021-04-30-13-12-00
    ipabackup_password: <your_LDAP_DM_password>

  roles:
  - role: ipabackup
    state: restored
```

5. Save the file.

6. Run the Ansible playbook specifying the inventory file and the playbook file:

```
$ ansible-playbook -v -i ~/MyPlaybooks/inventory restore-my-server.yml
```

Additional resources

- The **README.md** file in the **/usr/share/doc/ansible-freeipa/roles/ipabackup** directory.
- The **/usr/share/doc/ansible-freeipa/playbooks/** directory.

9.7. USING ANSIBLE TO RESTORE AN IDM SERVER FROM A BACKUP STORED ON YOUR ANSIBLE CONTROLLER

The following procedure describes how to use an Ansible playbook to restore an IdM server from a backup stored on your Ansible controller.

Prerequisites

- You have configured an Ansible control node that meets the following requirements:
  - You are using Ansible version 2.8 or later.
  - You have installed the **ansible-freeipa** package.
  - You have created an Ansible inventory file with the fully-qualified domain name (FQDN) of the IdM server where you are configuring these options.
  - Your Ansible inventory file is located in the **~/MyPlaybooks/** directory.
- You know the LDAP Directory Manager password.

Procedure

1. Navigate to the **~/MyPlaybooks/** directory:

```
$ cd ~/MyPlaybooks/
```

2. Make a copy of the **restore-server-from-controller.yml** file located in the **/usr/share/doc/ansible-freeipa/playbooks** directory:

```
$ cp /usr/share/doc/ansible-freeipa/playbooks/restore-server-from-controller.yml restore-my-server-from-my-controller.yml
```

3. Open the **restore-my-server-from-my-controller.yml** file for editing.

4. Adapt the file by setting the following variables:

   a. Set the **hosts** variable to a host group from your inventory file. In this example, set it to the **ipaserver** host group.

   b. Set the **ipabackup_name** variable to the name of the **ipabackup** to restore.

   c. Set the **ipabackup_password** variable to the LDAP Directory Manager password.

```
---
- name: Playbook to restore IPA server from controller
  hosts: ipaserver
  become: true

  vars:
    ipabackup_name: server.idm.example.com_ipa-full-2021-04-30-13-12-00
    ipabackup_password: <your_LDAP_DM_password>
    ipabackup_from_controller: yes

  roles:
  - role: ipabackup
    state: restored
```

5. Save the file.

6. Run the Ansible playbook, specifying the inventory file and the playbook file:

```
$ ansible-playbook -v -i ~/MyPlaybooks/inventory restore-my-server-from-my-controller.yml
```

Additional resources

- The **README.md** file in the **/usr/share/doc/ansible-freeipa/roles/ipabackup** directory.
- The **/usr/share/doc/ansible-freeipa/playbooks/** directory.

CHAPTER 10. IDM INTEGRATION WITH OTHER RED HAT PRODUCTS

This section provides links to documentation for other Red Hat products that integrate with IdM. You can configure these products to allow your IdM users to access their services.

Ansible Automation Platform

Setting up LDAP authentication

OpenShift Container Platform

Configuring an LDAP identity provider

OpenStack Platform

Integrating OpenStack Identity (keystone) with Red Hat Identity Manager (IdM)

Satellite

Using Red Hat Identity Management

Single Sign-On

SSSD and FreeIPA Identity Management integration

Virtualization

Configuring an external LDAP provider

CHAPTER 11. CONFIGURING SINGLE SIGN-ON FOR THE RHEL 9 WEB CONSOLE IN THE IDM DOMAIN

Learn how to use Single Sign-on (SSO) authentication provided by Identity Management (IdM) in the RHEL 9 web console.

Advantages:

- IdM domain administrators can use the RHEL 9 web console to manage local machines.
- Users with a Kerberos ticket in the IdM domain do not need to provide login credentials to access the web console.
- All hosts known to the IdM domain are accessible via SSH from the local instance of the RHEL 9 web console.
- Certificate configuration is not necessary. The console's web server automatically switches to a certificate issued by the IdM certificate authority and accepted by browsers.

This chapter covers the following steps to configure SSO for logging into the the RHEL web console:

1. Add machines to the IdM domain using the RHEL 9 web console.
   For details, see Joining a RHEL 9 system to an IdM domain using the web console .
2. If you want to use Kerberos for authentication, you need to obtain a Kerberos ticket on your machine.
   For details, see Logging in to the web console using Kerberos authentication .
3. Allow administrators on the IdM server to run any command on any host.
   For details, see Enabling admin sudo access to domain administrators on the IdM server

Prerequisites

- The RHEL web console installed on RHEL 9 systems.
  For details, see Installing the web console.
- IdM client installed on systems with the RHEL web console.
  For details, see IdM client installation.

11.1. JOINING A RHEL 9 SYSTEM TO AN IDM DOMAIN USING THE WEB CONSOLE

You can use the web console to join the Red Hat Enterprise Linux 9 system to the Identity Management (IdM) domain.

Prerequisites

- The IdM domain is running and reachable from the client you want to join.
- You have the IdM domain administrator credentials.

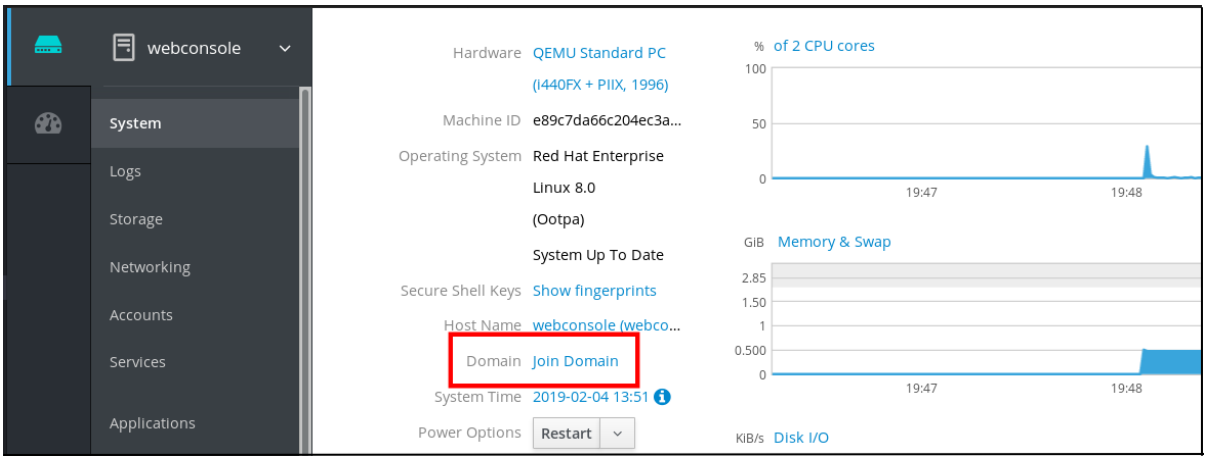
Procedure

1. Log into the RHEL web console.

For details, see Logging in to the web console .

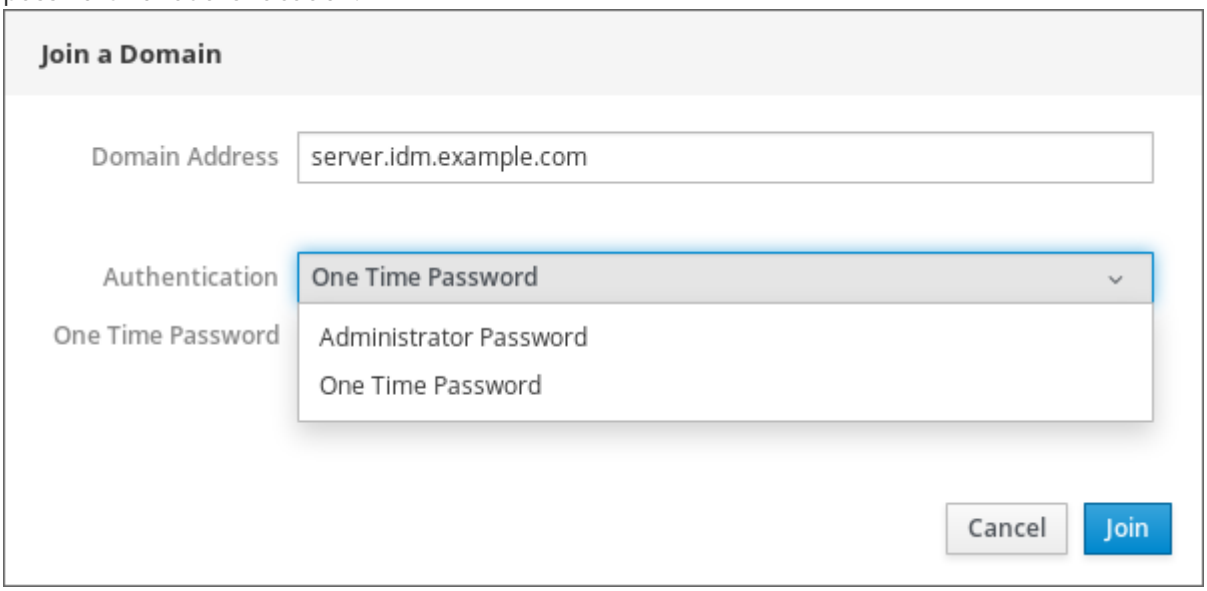
2. Open the **System** tab.

3. Click **Join Domain**.



4. In the **Join a Domain** dialog box, enter the host name of the IdM server in the **Domain Address** field.

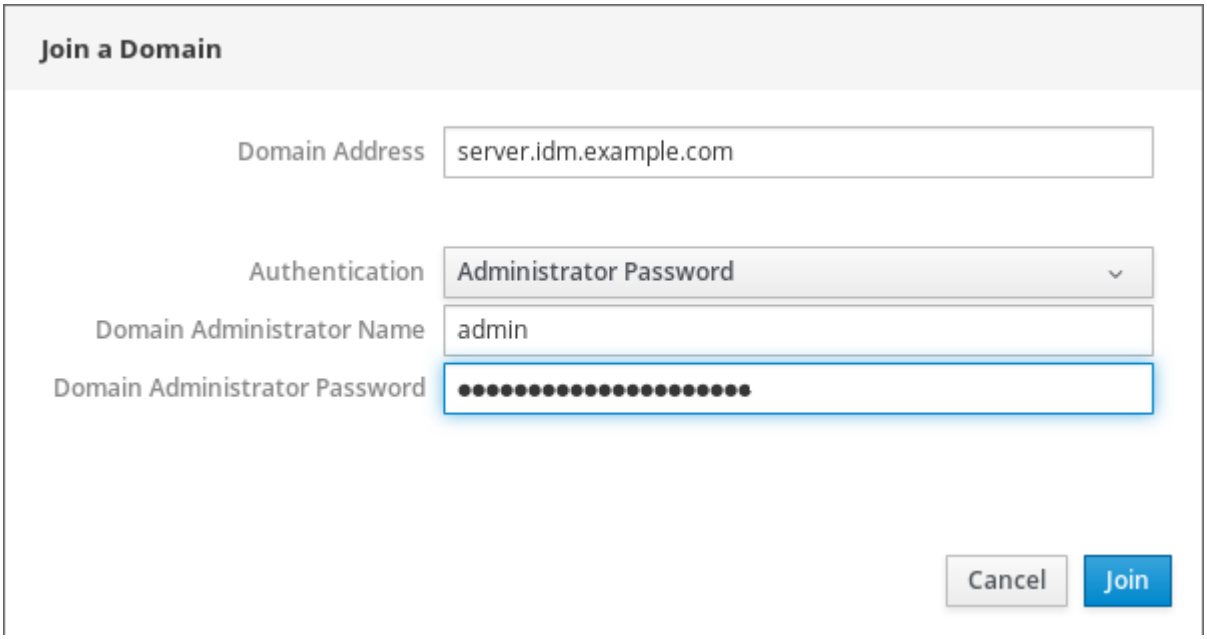
5. In the **Authentication** drop down list, select if you want to use a password or a one-time password for authentication.



6. In the **Domain Administrator Name** field, enter the user name of the IdM administration account.

7. In the password field, add the password or one-time password according to what you selected in the **Authentication** drop down list earlier.

8. Click **Join**.



Verification steps

1. If the RHEL 9 web console did not display an error, the system has been joined to the IdM domain and you can see the domain name in the **System** screen.
2. To verify that the user is a member of the domain, click the Terminal page and type the **id** command:

```
$ id
euid=548800004(example_user) gid=548800004(example_user)
groups=548800004(example_user) context=unconfined_u:unconfined_r:unconfined_t:s0-
s0:c0.c1023
```

Additional resources

- Planning Identity Management
- Installing Identity Management
- Managing IdM users, groups, hosts, and access control rules

11.2. LOGGING IN TO THE WEB CONSOLE USING KERBEROS AUTHENTICATION

The following procedure describes steps on how to set up the RHEL 9 system to use Kerberos authentication.

IMPORTANT

With SSO you usually do not have any administrative privileges in the web console. This only works if you configured passwordless sudo. The web console does not interactively ask for a sudo password.

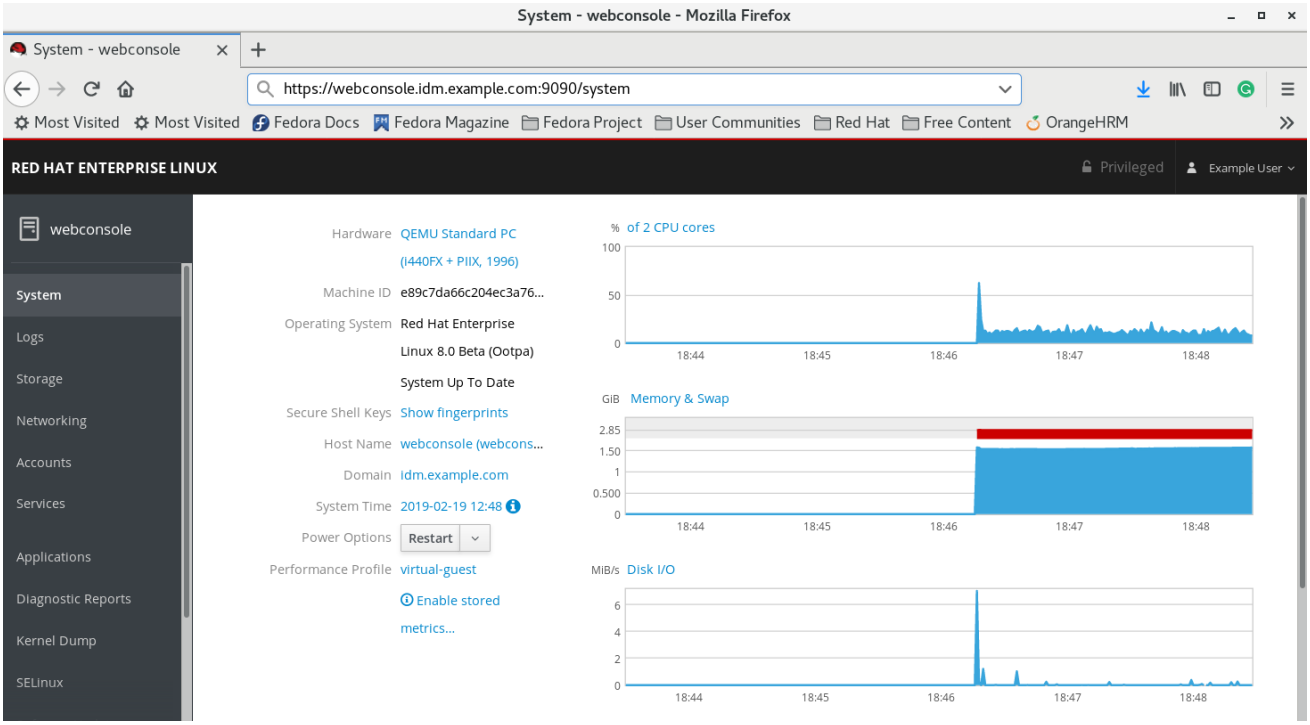
Prerequisites

- IdM domain running and reachable in your company environment.
  For details, see Joining a RHEL 9 system to an IdM domain using the web console .
- Enable the **cockpit.socket** service on remote systems to which you want to connect and manage them with the RHEL web console.
  For details, see Installing the web console.
- If the system does not use a Kerberos ticket managed by the SSSD client, try to request the ticket with the **kinit** utility manually.

Procedure

Log in to the RHEL web console with the following address: **https://dns_name:9090**.

At this point, you are successfully connected to the RHEL web console and you can start with configuration.



11.3. ENABLING ADMIN SUDO ACCESS TO DOMAIN ADMINISTRATORS ON THE IDM SERVER

The following procedure describes steps on how to allow domain administrators to run any command on any host in the Identity Management (IdM) domain.

To accomplish this, enable sudo access to the **admins** user group created automatically during the IdM server installation.

All users added to the **admins** group will have sudo access if you run **ipa-advise** script on the group.

Prerequisites

- The server runs IdM 4.7.1 or later.

Procedure

1. Connect to the IdM server.
2. Run the ipa-advise script:

```
$ ipa-advise enable-admins-sudo | sh -ex
```

If the console did not display an error, the **admins** group have admin permissions on all machines in the IdM domain.