Integrating Linux Systems with Active Directory Environments

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Abstract

Heterogeneous IT environments often contain various different domains and operating systems that need to be able to seamlessly communicate. Red Hat Enterprise Linux offers multiple ways to tightly integrate Linux domains with Active Directory (AD) on Microsoft Windows. The integration is possible on different domain objects that include users, groups, services, or systems. This guide also covers different integration scenarios, ranging from lightweight AD pass-through authentication to full-fledged Kerberos trusted realms. In addition to this guide, you can find documentation on other features and services related to Red Hat Enterprise Linux Identity Management in the following guides: The Linux Domain Identity, Authentication, and Policy Guide documents Red Hat Identity Management, a solution that provides a centralized and unified way to manage identity stores as well as authentication and authorization policies in a Linux-based domain. The System-Level Authentication Guide documents different applications and services available to configure
authentication on local systems, including the authconfig utility, the System Security Services Daemon (SSSD) service, the Pluggable Authentication Module (PAM) framework, Kerberos, the certmonger utility, and single sign-on (SSO) for applications.
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CHAPTER 1. WAYS TO INTEGRATE ACTIVE DIRECTORY AND LINUX ENVIRONMENTS

IT environments have a structure. The systems in them are arranged with a purpose. Integrating two separate infrastructures requires an assessment of the purpose of each of those environments and an understanding of how and where they interact.

1.1. DEFINING WINDOWS INTEGRATION

Windows integration can mean very different things, depending on the desired interaction between the Linux environment and the Windows environment. It could mean that individual Linux systems are enrolled into a Windows domain, it could mean that a Linux domain is configured to be a peer to the Windows domain, or it could simply mean that information is copied between environments.

There are several points of contact between a Windows domain and Linux systems. Each of these points revolve around identifying different domain objects (users, groups, systems, services) and the services which are used in that identification.

User Identities and Authentication

- Where are user accounts located; in a central authentication system running on Windows (AD domain) or in a central identity and authentication server running on Linux?
- How are users authenticated on a Linux system; through a local Linux authentication system or a central authentication system running on Windows?
- How is group membership configured for users? How is that group membership determined?
- Will users authenticate using a user name/password pair, Kerberos tickets, certificates, or a combination of methods?
- POSIX attributes are required to access services on Linux machines. How are these attributes stored: are they set in the Windows domain, configured locally on the Linux system, or dynamically mapped (for UID/GID numbers and Windows SIDs)?
- What users will be accessing what resources? Will Windows-defined users access Linux resources? Will Linux-defined users access Windows resources?

In most environments, the Active Directory domain is the central hub for user information, which means that there needs to be some way for Linux systems to access that user information for authentication requests. The real question then is how to obtain that user information and how much of that information is available to external systems. There also needs to be a balance between information required for Linux systems (POSIX attributes) and Linux users (certain application administrators) and how that information is managed.

Host and Service Principals

- What resources will be accessed?
- What authentication protocols are required?
- How will Kerberos tickets be obtained? How will SSL certificates be requested or verified?
- Will users need access to a single domain or to both Linux and Windows domains?

DNS Domains, Queries, and Name Resolution
What will be the DNS configuration?

Is there a single DNS domain? Are there subdomains?

How will system host names be resolved?

How will service discovery be configured?

Security Policies

Where are access control instructions set?

Which administrators are configured for each domain?

Change Management

How frequently are systems added to the domain?

If the underlying configuration for something related to Windows integration is changed, for example the DNS service, how are those changes propagated?

Is configuration maintained through domain-related tools or a provisioning system?

Does the integration path require additional applications or configuration on the Windows server?

As important as which elements in the domains are integrated, is how that integration is maintained. If a particular instrument of integration is heavily manual, yet the environment has a large number of systems which are frequently updated, then that one instrument may not work for that environment from a maintenance standpoint.

The following sections outline the main scenarios for integration with Windows. In direct integration, Linux systems are connected to Active Directory without any additional intermediaries. Indirect integration, on the other hand, involves an identity server that centrally manages Linux systems and connects the whole environment to Active Directory of the server-to-server level.

1.2. DIRECT INTEGRATION

You need two components to connect a Linux system to Active Directory (AD). One component interacts with the central identity and authentication source, which is AD in this case. The other component detects available domains and configures the first component to work with the right identity source. There are different options that can be used to retrieve information and perform authentication against AD. Among them are:

Native LDAP and Kerberos PAM and NSS modules

Among these modules are nss_ldap, pam_ldap, and pam_krb5. As PAM and NSS modules are loaded into every application process, they directly affect the execution environment. With no caching, offline support, or sufficient protection of access credentials, use of the basic LDAP and Kerberos modules for NSS and PAM is discouraged due to their limited functionality.

Samba Winbind

Samba Winbind had been a traditional way of connecting Linux systems to AD. Winbind emulates a Windows client on a Linux system and is able to communicate to AD servers. The recent versions of the System Security Services Daemon (SSSD) closed a feature gap between Samba Winbind and SSSD and SSSD can now be used as a replacement for Winbind. In certain corner cases, Winbind might still be necessary to use but it is no longer the first choice in general.
Note that:

- Direct integration with Winbind in a multi-forest AD setup requires bidirectional trusts.
- Remote forests must trust the local forest to ensure that the `idmap_ad` plug-in handles remote forest users correctly.

**System Security Services Daemon (SSSD)**

The primary function of SSSD is to access a remote identity and authentication resource through a common framework that provides caching and offline support to the system. SSSD is highly configurable; it provides PAM and NSS integration and a database to store local users, as well as core and extended user data retrieved from a central server. SSSD is the recommended component to connect a Linux system with an identity server of your choice, be it Active Directory, Identity Management (IdM) in Red Hat Enterprise Linux, or any generic LDAP or Kerberos server.

Note that:

- Direct integration with SSSD works only within a single AD forest by default. For multi-forest setup, configure manual domain enumeration as described in this Knowledgebase solution: [Joining SSSD to domains in different forests](#).
- Remote forests must trust the local forest to ensure that the `idmap_ad` plug-in handles remote forest users correctly.

The main reason to transition from Winbind to SSSD is that SSSD can be used for both direct and indirect integration and allows to switch from one integration approach to another without significant migration costs. The most convenient way to configure SSSD or Winbind in order to directly integrate a Linux system with AD is to use the `realmd` service. It allows callers to configure network authentication and domain membership in a standard way. The `realmd` service automatically discovers information about accessible domains and realms and does not require advanced configuration to join a domain or realm.

Direct integration is a simple way to introduce Linux systems to AD environment. However, as the share of Linux systems grows, the deployments usually see the need for a better centralized management of the identity-related policies such as host-based access control, sudo, or SELinux user mappings. At first, the configuration of these aspects of the Linux systems can be maintained in local configuration files. With a growing number of systems though, distribution and management of the configuration files is easier with a provisioning system such as Red Hat Satellite. This approach creates an overhead of changing the configuration files and then distributing them. When direct integration does not scale anymore, it is more beneficial to consider indirect integration described in the next section.

### 1.3. INDIRECT INTEGRATION

The main advantage of the indirect integration is to manage Linux systems and policies related to those systems centrally while enabling users from Active Directory (AD) domains to transparently access Linux systems and services. There are two different approaches to the indirect integration:

**Trust-based solution**

The recommended approach is to leverage Identity Management (IdM) in Red Hat Enterprise Linux as the central server to control Linux systems and then establish cross-realm Kerberos trust with AD, enabling users from AD to log on to and to use single sign-on to access Linux systems and resources. This solution uses the Kerberos capability to establish trusts between different identity sources. IdM presents itself to AD as a separate forest and takes advantage of the forest-level trusts supported by AD.
In complex environments, a single IdM forest can be connected to multiple AD forests. This setup enables better separation of duties for different functions in the organization. AD administrators can focus on users and policies related to users while Linux administrators have full control over the Linux infrastructure. In such a case, the Linux realm controlled by IdM is analogous to an AD resource domain or realm but with Linux systems in it.

**NOTE**

In Windows, every domain is a Kerberos realm and a DNS domain at the same time. Every domain managed by the domain controller needs to have its own dedicated DNS zone. The same applies when IdM is trusted by AD as a forest. AD expects IdM to have its own DNS domain. For the trust setup to work, the DNS domain needs to be dedicated to the Linux environment.

Note that in trust environments, IdM enables you to use *ID views* to configure POSIX attributes for AD users on the IdM server. For details, see:

- Chapter 8, *Using ID Views in Active Directory Environments*
- SSSD Client-side Views in the *System-Level Authentication Guide*

**Synchronization-based solution**

An alternative to a trust-based solution is to leverage user synchronization capability, also available in IdM or Red Hat Directory Server (RHDS), allowing user accounts (and with RHDS also group accounts) to be synchronized from AD to IdM or RHDS, but not in the opposite direction. User synchronization has certain limitations, including:

- duplication of users
- the need to synchronize passwords, which requires a special component on all domain controllers in an AD domain
- to be able to capture passwords, all users must first manually change them
- synchronization supports only a single domain
- only one domain controller in AD can be used to synchronize data to one instance of IdM or RHDS

In some integration scenarios, the user synchronization may be the only available option, but in general, use of the synchronization approach is discouraged in favor of the cross-realm trust-based integration.
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CHAPTER 2. USING ACTIVE DIRECTORY AS AN IDENTITY PROVIDER FOR SSSD

The System Security Services Daemon (SSSD) is a system service to access remote directories and authentication mechanisms. It connects a local system (an SSSD client) to an external back-end system (a domain). This provides the SSSD client with access to identity and authentication remote services using an SSSD provider. For example, these remote services include: an LDAP directory, an Identity Management (IdM) or Active Directory (AD) domain, or a Kerberos realm.

When used as an identity management service for AD integration, SSSD is an alternative to services such as NIS or Winbind. This chapter describes how SSSD works with AD. For more details on SSSD, see the System-Level Authentication Guide.

2.1. CONFIGURING AN AD PROVIDER FOR SSSD

The AD provider enables SSSD to use the LDAP identity provider and the Kerberos authentication provider with optimizations for AD environments.

2.1.1. Overview of the Integration Options

Linux and Windows systems use different identifiers for users and groups:

- Linux uses user IDs (UID) and group IDs (GID). See Managing Users and Groups in the System Administrator's Guide. Linux UIDs and GIDs are compliant with the POSIX standard.
- Windows use security IDs (SID).

Users authenticating to a Red Hat Enterprise Linux system, including AD users, must have a UID and GID assigned. For this purpose, SSSD provides the following integration options:

Automatically generate new UIDs and GIDs for AD users

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.

See Section 2.1.2, “Configuring an AD Domain with ID Mapping as a Provider for SSSD”.
NOTE

When all client systems use SSSD to map SIDs to Linux IDs, the mapping is consistent. If some clients use different software, choose one of the following:

- Ensure that the same mapping algorithm is used on all clients.
- Use explicit POSIX attributes, as described in Use POSIX attributes defined in AD.

Use POSIX attributes defined in AD

AD can create and store POSIX attributes, such as `uidNumber`, `gidNumber`, `unixHomeDirectory`, or `loginShell`.

When using ID mapping described in Automatically generate new UIDs and GIDs for AD users, SSSD creates new UIDs and GIDs, which overrides the values defined in AD. To keep the AD-defined values, you must disable ID mapping in SSSD.

See Section 2.1.3, “Configuring SSSD to Use POSIX Attributes Defined in AD”.

2.1.2. Configuring an AD Domain with ID Mapping as a Provider for SSSD

Prerequisites

Make sure that both the AD system and the Linux system are properly configured:

- Verify the configuration for name resolution. In particular, verify the DNS SRV records. For example, for a domain named `ad.example.com`:
  
  - To verify the DNS SRV LDAP records:
    
    ```bash
    # dig -t SRV _ldap._tcp.ad.example.com
    ```
  
  - To verify AD records:
    
    ```bash
    # dig -t SRV _ldap._tcp.dc._msdcs.ad.example.com
    ```

  If you later connect SSSD to a particular AD domain controller, it is not necessary to verify the DNS SRV records.

- Verify that system time on both systems is synchronized. This ensures that Kerberos is able to work properly.

- Open the required ports on both the Linux system and all AD domain controllers in both directions: from the Linux system to the AD domain controller and back.

Table 2.1. Ports Required for Direct Integration of Linux Systems into AD Using SSSD

<table>
<thead>
<tr>
<th>Service</th>
<th>Port</th>
<th>Protocol</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNS</td>
<td>53</td>
<td>UDP and TCP</td>
<td></td>
</tr>
<tr>
<td>Service</td>
<td>Port</td>
<td>Protocol</td>
<td>Notes</td>
</tr>
<tr>
<td>---------------------</td>
<td>------</td>
<td>-------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>LDAP</td>
<td>389</td>
<td>UDP and TCP</td>
<td></td>
</tr>
<tr>
<td>Kerberos</td>
<td>88</td>
<td>UDP and TCP</td>
<td></td>
</tr>
<tr>
<td>Kerberos</td>
<td>464</td>
<td>UDP and TCP</td>
<td>Used by kadmin for setting and changing a password</td>
</tr>
<tr>
<td>LDAP Global Catalog</td>
<td>3268</td>
<td>TCP</td>
<td>If the id_provider = ad option is being used</td>
</tr>
<tr>
<td>NTP</td>
<td>123</td>
<td>UDP</td>
<td>Optional</td>
</tr>
</tbody>
</table>

**Configure the Local System**

Red Hat recommends using the `realm join` command to configure the system. See Chapter 3, *Using realmd to Connect to an Active Directory Domain*. The `realmd` suite edits all required configuration files automatically. For example:

```bash
# realm join ad.example.com
```

If you do not want to use `realmd`, you can configure the system manually. See *Manually Connecting an SSSD Client to an Active Directory Domain* in the Red Hat Knowledgebase.

**Optional: Configure User Home Directories and Shells**

The `pam_oddjob_mkhomedir.so` library automatically creates home directories when users first log in to the Linux system. By default, SSSD retrieves the format of the home directory from the AD identity provider. To customize the directory format on Linux clients:

1. Open the `/etc/sssd/sssd.conf` file.

2. In the `[domain]` section, use one of these options:

   - `fallback_homedir` sets a fallback home directory format, which is used only if a home directory is not defined in AD
   - `override_homedir` sets a home directory template, which always overrides the home directory defined in AD

For example, to always use the format `/home/domain_name/user_name`:

```bash
[domain/EXAMPLE]
... file truncated ...
override_homedir = /home/%d/%u
```

For details, see the `sssd.conf(5)` man page.

By default, SSSD retrieves information about user shells from the `loginShell` parameter configured in AD. To customize the user shell settings on Linux clients:
1. Open the `/etc/sssd/sssd.conf` file.

2. Define the required user shell settings using these options:
   - `shell_fallback` sets a fallback value, which is used only if no shells are defined in AD
   - `override_shell` sets a value that always overrides the shell defined in AD
   - `default_shell` sets a default shell value
   - `allowed_shells` and `vetoed_shells` set lists of allowed or blacklisted shells

For details, see the `sssd.conf(5)` man page.

Load the New Configuration

- Restart SSSD after changing the configuration file.
  ```bash
  # systemctl restart sssd.service
  ```

Additional Resources

- See the `sssd-ldap(5)` and `sssd-krb5(5)` man pages for other configuration options for LDAP and Kerberos providers.
- See the `sssd-ad(5)` man page for other configuration options for AD providers.

### 2.1.3. Configuring SSSD to Use POSIX Attributes Defined in AD

**NOTE**

Previously, the *Identity Management for UNIX* extension was available to provide POSIX attributes to user accounts. The extension is now deprecated. See the [Microsoft Developer Network](https://docs.microsoft.com) for details.

If you have been using Identity Management for UNIX, see [this Knowledgebase article](https://access.redhat.com/kb/docs) for answers to frequently asked questions.

For old procedures that reference Identity Management for Unix and the *Services for Unix* package, see these Red Hat Knowledgebase articles:

- Configuring an Active Directory Domain with POSIX Attributes
- Configuring Active Directory as an LDAP Domain

**Recommendations**

For best performance, publish the POSIX attributes to the AD global catalog. If POSIX attributes are not present in the global catalog, SSSD connects to the individual domain controllers directly on the LDAP port.

**Join the Linux System to the AD Domain**

Follow the steps in Section 2.1.2, “Configuring an AD Domain with ID Mapping as a Provider for SSSD”.

**Disable ID Mapping in SSSD**
1. Open the `/etc/sssd/sssd.conf` file.

2. In the AD domain section, add the `ldap_id_mapping = false` setting.

   **NOTE**
   
   If you used the `realm` utility to join the domain and added the `--automatic-id-mapping=no` switch, the `realm` utility already set up SSSD with `ldap_id_mapping = false`.

3. If you previously requested any users with the default ID mapping configuration, remove the SSSD caches:

   ```
   rm -f /var/lib/sss/db/*
   ```

   SSSD will now use POSIX attributes from AD, instead of creating them locally.

### 2.2. AUTOMATIC KERBEROS HOST KEYTAB RENEWAL

SSSD automatically renews the Kerberos host keytab file in an AD environment if the `adcli` package is installed. The daemon checks daily if the machine account password is older than the configured value and renews it if necessary.

The default renewal interval is 30 days. To change the default:

1. Add the following parameter to the AD provider in your `/etc/sssd/sssd.conf` file:

   ```
   ad_maximum_machine_account_password_age = value_in_days
   ```

2. Restart SSSD:

   ```
   # systemctl restart sssd
   ```

   To disable the automatic Kerberos host keytab renewal, set `ad_maximum_machine_account_password_age = 0`.

### 2.3. ENABLING DYNAMIC DNS UPDATES

AD allows its clients to refresh their DNS records automatically. AD also actively maintains DNS records to make sure they are updated, including timing out (aging) and removing (scavenging) inactive records. DNS scavenging is not enabled by default on the AD side.

SSSD allows the Linux system to imitate a Windows client by refreshing its DNS record, which also prevents its record from being marked inactive and removed from the DNS record. When dynamic DNS updates are enabled, the client's DNS record is refreshed:

- when the identity provider comes online (always)
- when the Linux system reboots (always)
- at a specified interval (optional configuration); by default, the AD provider updates the DNS record every 24 hours
You can set this behavior to the same interval as the DHCP lease. In this case, the Linux client is renewed after the lease is renewed.

DNS updates are sent to the AD server using Kerberos/GSSAPI for DNS (GSS-TSIG). This means that only secure connections need to be enabled.

The dynamic DNS configuration is set for each domain. For example:

```
[domain/ad.example.com]
id_provider = ad
auth_provider = ad
chpass_provider = ad
access_provider = ad

ldap_schema = ad

dyndns_update = true
dyndns_refresh_interval = 43200
dyndns_update_ptr = true
dyndns_ttl = 3600
```

For details on these options, see the sssd-ad(5) man page.

2.4. USING RANGE RETRIEVAL SEARCHES WITH SSSD

SSSD supports AD’s Searching Using Range Retrieval feature. For details on range retrieval searches, see the Microsoft Developer Network.

**IMPORTANT**

If you set custom filters in the group or search bases, the filters might not work well with very large groups.

2.5. GROUP POLICY OBJECT ACCESS CONTROL

Group Policy is a Microsoft Windows feature that enables administrators to centrally manage policies for users and computers in AD environments. A *group policy object* (GPO) is a collection of policy settings, such as name and value pairs, that are stored on a domain controller (DC) and can be applied to policy targets, such as computers and users.

GPO policy settings related to Windows *logon rights* are commonly used to manage computer-based access control in AD environments. SSSD can retrieve GPOs applicable to host systems and AD users; based on the retrieved GPO configuration, it determines if a user is allowed to log on to a particular host. Therefore, with the GPO-based access control provided by SSSD, the administrator can define login policies that are honored by both Red Hat Enterprise Linux and Windows clients centrally on the AD DC.

**NOTE**

SSSD only allows using GPO for the computer-based access control. Other GPO-related access control options are currently not supported.
2.5.1. Configuring GPO-based Access Control

GPO-based access control can be configured in the `/etc/sssd/sssd.conf` file. The `ad_gpo_access_control` option specifies the mode in which the GPO-based access control runs. It can be set to the following values:

- `ad_gpo_access_control = permissive`
  - The `permissive` value specifies that GPO-based access control is evaluated but not enforced; a `syslog` message is recorded every time access would be denied. This is the default setting.

- `ad_gpo_access_control = enforcing`
  - The `enforcing` value specifies that GPO-based access control is evaluated and enforced.

- `ad_gpo_access_control = disabled`
  - The `disabled` value specifies that GPO-based access control is neither evaluated nor enforced.

**IMPORTANT**

Before starting to use the GPO-based access control and setting `ad_gpo_access_control` to enforcing mode, it is recommended to ensure that `ad_gpo_access_control` is set to permissive mode and examine the logs. By reviewing the `syslog` messages, you can test and adjust the current GPO settings as necessary before finally setting the enforcing mode.

The following parameters related to the GPO-based access control can also be specified in the `sssd.conf` file:

- The `ad_gpo_map_*` options and the `ad_gpo_default_right` option configure which PAM services are mapped to specific Windows logon rights.

  To move a service allowed by default to the deny list, remove it from the allow list. For example, to remove the `su` service from the allow list:

  ```
  ad_gpo_map_interactive = -su
  ```

- The `ad_gpo_cache_timeout` option specifies the interval during which subsequent access control requests can reuse the files stored in the cache, instead of retrieving them from the DC anew.
For a detailed list of available GPO parameters as well as their descriptions and default values, see the sssd-ad(5) man page.

## 2.6. SSSD CLIENTS AND ACTIVE DIRECTORY DNS SITE AUTODISCOVERY

Active Directory forests can be very large, with numerous different domain controllers, domains and subdomains, and physical sites. Active Directory uses DNS records to identify a physical location for its domain controllers. This enables clients to first connect to the domain controller that is geographically closest, which increases client performance.

By default, SSSD clients use the autodiscovery to connect to the closest domain controller. To override the autodiscovery, specify the AD site to which you want the client to connect by using the `ad_site` option in the `/etc/sssd/sssd.conf` file.

**Additional Resources**

- See the sssd-ad(5) man page for details on `ad_site`.

- For environments with a trust between Identity Management and Active Directory, see Section 5.5, "Restricting Identity Management or SSSD to Selected Active Directory Servers or Sites in a Trusted Active Directory Domain".
CHAPTER 3. USING REALMD TO CONNECT TO AN ACTIVE DIRECTORY DOMAIN

The **realmd** system provides a clear and simple way to discover and join identity domains to achieve direct domain integration. It configures underlying Linux system services, such as SSSD or Winbind, to connect to the domain.

Chapter 2, *Using Active Directory as an Identity Provider for SSSD* describes how to use the System Security Services Daemon (SSSD) on a local system and Active Directory as a back-end identity provider. Ensuring that the system is properly configured for this can be a complex task: there are a number of different configuration parameters for each possible identity provider and for SSSD itself. In addition, all domain information must be available in advance and then properly formatted in the SSSD configuration for SSSD to integrate the local system with AD.

The **realmd** system simplifies that configuration. It can run a discovery search to identify available AD and Identity Management domains and then join the system to the domain, as well as set up the required client services used to connect to the given identity domain and manage user access. Additionally, because SSSD as an underlying service supports multiple domains, **realmd** can discover and support multiple domains as well.

### 3.1. SUPPORTED DOMAIN TYPES AND CLIENTS

The **realmd** system supports the following domain types:

- Microsoft Active Directory
- Red Hat Enterprise Linux Identity Management

The following domain clients are supported by **realmd**:

- SSSD for both Red Hat Enterprise Linux Identity Management and Microsoft Active Directory
- Winbind for Microsoft Active Directory

### 3.2. PREREQUISITES FOR USING REALMD

To use the **realmd** system, install the realmd package.

```
# yum install realmd
```

In addition, make sure that the oddjob, oddjob-mkhomedir, sssd, and adcli packages are installed. These packages are required to be able to manage the system using **realmd**.

**NOTE**

As mentioned in Section 3.4, "Discovering and Joining Identity Domains", you can simply use **realmd** to find out which packages to install.

### 3.3. REALMD COMMANDS

The **realmd** system has two major task areas:
managing system enrollment in a domain

setting which domain users are allowed to access the local system resources

The central utility in `realmd` is called `realm`. Most `realm` commands require the user to specify the action that the utility should perform, and the entity, such as a domain or user account, for which to perform the action:

```plaintext
realm command arguments
```

For example:

```plaintext
realm join ad.example.com
realm permit user_name
```

### Table 3.1. realmd Commands

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Realm Commands</strong></td>
<td></td>
</tr>
<tr>
<td>discover</td>
<td>Run a discovery scan for domains on the network.</td>
</tr>
<tr>
<td>join</td>
<td>Add the system to the specified domain.</td>
</tr>
<tr>
<td>leave</td>
<td>Remove the system from the specified domain.</td>
</tr>
<tr>
<td>list</td>
<td>List all configured domains for the system or all discovered and configured domains.</td>
</tr>
<tr>
<td><strong>Login Commands</strong></td>
<td></td>
</tr>
<tr>
<td>permit</td>
<td>Enable access for specified users or for all users within a configured domain to access the local system.</td>
</tr>
<tr>
<td>deny</td>
<td>Restrict access for specified users or for all users within a configured domain to access the local system.</td>
</tr>
</tbody>
</table>

For more information about the `realm` commands, see the `realm(8)` man page.

## 3.4. DISCOVERING AND JOINING IDENTITY DOMAINS

The `realm discover` command returns complete domain configuration and a list of packages that must be installed for the system to be enrolled in the domain.

The `realm join` command then sets up the local machine for use with a specified domain by configuring both the local system services and the entries in the identity domain. The process run by `realm join` follows these steps:

1. Running a discovery scan for the specified domain.
2. Automatic installation of the packages required to join the system to the domain.

This includes SSSD and the PAM home directory job packages. Note that the automatic installation of packages requires the **PackageKit** suite to be running.

**NOTE**

If **PackageKit** is disabled, the system prompts you for the missing packages, and you will be required to install them manually using the **yum** utility.

3. Joining the domain by creating an account entry for the system in the directory.

4. Creating the `/etc/krb5.keytab` host keytab file.

5. Configuring the domain in SSSD and restarting the service.

6. Enabling domain users for the system services in PAM configuration and the `/etc/nsswitch.conf` file.

### Discovering Domains

When run without any options, the `realm discover` command displays information about the default DNS domain, which is the domain assigned through the Dynamic Host Configuration Protocol (DHCP):

```
# realm discover
ad.example.com
  type: kerberos
  realm-name: AD.EXAMPLE.COM
  domain-name: ad.example.com
  configured: no
  server-software: active-directory
  client-software: sssd
  required-package: oddjob
  required-package: oddjob-mkhomedir
  required-package: sssd
  required-package: adcli
  required-package: samba-common
```

It is also possible to run a discovery for a specific domain. To do this, run `realm discover` and add the name of the domain you want to discover:

```
# realm discover ad.example.com
```

The **realm** system will then use DNS SRV lookups to find the domain controllers in this domain automatically.

**NOTE**

The `realm discover` command requires NetworkManager to be running; in particular, it depends on the D-Bus interface of NetworkManager. If your system does not use NetworkManager, always specify the domain name in the `realm discover` command.
The `realm` system can discover both Active Directory and Identity Management domains. If both domains exist in your environment, you can limit the discovery results to a specific type of server using the `--server-software` option. For example:

```
# realm discover --server-software=active-directory
```

One of the attributes returned in the discovery search is `login-policy`, which shows if domain users are allowed to log in as soon as the join is complete. If logins are not allowed by default, you can allow them manually by using the `realm permit` command. For details, see Section 3.7, “Managing Login Permissions for Domain Users”.

For more information about the `realm discover` command, see the `realm`(8) man page.

### Joining a Domain

To join the system to an identity domain, use the `realm join` command and specify the domain name:

```
# realm join ad.example.com
realm: Joined ad.example.com domain
```

By default, the join is performed as the domain administrator. For AD, the administrator account is called `Administrator`; for IdM, it is called `admin`. To connect as a different user, use the `-U` option:

```
# realm join ad.example.com -U user
```

The command first attempts to connect without credentials, but it prompts for a password if required.

If Kerberos is properly configured on a Linux system, joining can also be performed with a Kerberos ticket for authentication. To select a Kerberos principal, use the `-U` option.

```
# kinit user
# realm join ad.example.com -U user
```

The `realm join` command accepts several other configuration options. For more information about the `realm join` command, see the `realm`(8) man page.

### Example 3.1. Example Procedure for Enrolling a System into a Domain

1. Run the `realm discover` command to display information about the domain.

   ```
   # realm discover ad.example.com
   ad.example.com
   type: kerberos
   realm-name: AD.EXAMPLE.COM
   domain-name: ad.example.com
   configured: no
   server-software: active-directory
   client-software: sssd
   ```

2. Run the `realm join` command and pass the domain name to the command. Provide the administrator password if the system prompts for it.

   ```
   # realm join ad.example.com
   Password for Administrator: password
   ```
Note that when discovering or joining a domain, `realm` checks for the DNS SRV record:

- `_ldap._tcp.domain.example.com.` for Identity Management records
- `_ldap._tcp.dc._msdcs.domain.example.com.` for Active Directory records

The record is created by default when AD is configured, which enables it to be found by the service discovery.

Testing the System Configuration after Joining a Domain
To test whether the system was successfully enrolled into a domain, verify that you can log in as a user from the domain and that the user information is displayed correctly:

1. Run the `id user@domain_name` command to display information about a user from the domain.

   ```bash
   # id user@ad.example.com
   uid=1348601103(user@ad.example.com) gid=1348600513(domain group@ad.example.com) groups=1348600513(domain group@ad.example.com)
   
   # id user@domain_name
   
   # id user@ad.example.com
   uid=1348601103(user@ad.example.com) gid=1348600513(domain group@ad.example.com) groups=1348600513(domain group@ad.example.com)
   context=unconfined_u:unconfined_r:unconfined_t:s0-s0:c0.c1023
   ```

2. Using the `ssh` utility, log in as the same user.

   ```bash
   # ssh -l user@ad.example.com linux-client.ad.example.com
   user@ad.example.com@linux-client.ad.example.com's password:
   Creating home directory for user@ad.example.com.
   
   # ssh -l user@domain_name
   
   # ssh -l user@ad.example.com
   user@ad.example.com@linux-client.ad.example.com's password:
   Creating home directory for user@ad.example.com.
   ```

3. Verify that the `pwd` utility prints the user's home directory.

   ```bash
   $ pwd
   /home/ad.example.com/user
   ```

4. Verify that the `id` utility prints the same information as the `id user@domain_name` command from the first step.

   ```bash
   $ id
   uid=1348601103(user@ad.example.com) gid=1348600513(domain group@ad.example.com) groups=1348600513(domain group@ad.example.com)
   context=unconfined_u:unconfined_r:unconfined_t:s0-s0:c0.c1023
   ```

The `kinit` utility is also useful when testing whether the domain join was successful. Note that to use the utility, the krb5-workstation package must be installed.

**3.5. REMOVING A SYSTEM FROM AN IDENTITY DOMAIN**

To remove a system from an identity domain, use the `realm leave` command. The command removes the domain configuration from SSSD and the local system.

```bash
# realm leave ad.example.com
```
By default, the removal is performed as the default administrator. For AD, the administrator account is called **Administrator**; for IdM, it is called **admin**. If a different user was used to join to the domain, it might be required to perform the removal as that user. To specify a different user, use the `-U` option:

```
# realm leave ad.example.com -U 'AD.EXAMPLE.COM\user'
```

The command first attempts to connect without credentials, but it prompts for a password if required.

Note that when a client leaves a domain, the computer account is not deleted from the directory; the local client configuration is only removed. If you want to delete the computer account, run the command with the `--remove` option specified.

For more information about the `realm leave` command, see the `realm(8)` man page.

### 3.6. LISTING DOMAINS

The `realm list` command lists every configured domain for the system, as well as the full details and default configuration for that domain. This is the same information as is returned by the `realm discovery` command, only for a domain that is already in the system configuration.

```
# realm list --all --name-only
ad.example.com
```

The most notable options accepted by `realm list` are:

`--all`

The `--all` option lists all discovered domains, both configured and unconfigured.

`--name-only`

The `--name-only` option limits the results to the domain names and does not display the domain configuration details.

For more information about the `realm list` command, see the `realm(8)` man page.

### 3.7. MANAGING LOGIN PERMISSIONS FOR DOMAIN USERS

By default, **domain-side access control** is applied, which means that login policies for domain users are defined in the domain itself. This default behavior can be overridden so that **client-side access control** is used. With client-side access control, login permission are defined by local policies only.

If a domain applies client-side access control, you can use the `realmd` system to configure basic allow or deny access rules for users from that domain. Note that these access rules either allow or deny access to all services on the system. More specific access rules must be set on a specific system resource or in the domain.

To set the access rules, use the following two commands:

`realm deny`

The `realm deny` command simply denies access to all users within the domain. Use this command with the `--all` option.
realm permit

The `realm permit` command can be used to:

- grant access to all users by using the `--all` option, for example:
  ```
  $ realm permit --all
  ```

- grant access to specified users, for example:
  ```
  $ realm permit user@example.com
  $ realm permit 'AD.EXAMPLE.COM\user'
  ```

- deny access to specified users by using the `-x` option, for example:
  ```
  $ realm permit -x 'AD.EXAMPLE.COM\user'
  ```

Note that allowing access currently only works for users in primary domains, not for users in trusted domains. This is because while user logins must contain the domain name, SSSD currently cannot provide `realmd` with information about available subdomains.

**IMPORTANT**

It is safer to only allow access to specifically selected users or groups than to deny access to some, while enabling it to everyone else. Therefore, it is not recommended to allow access to all by default while only denying it to specified users with `realm permit -x`. Instead, Red Hat recommends to maintain a default no access policy for all users and only grant access to selected users using `realm permit`.

For more information about the `realm deny` and `realm permit` commands, see the `realm(8)` man page.

### 3.8. CHANGING DEFAULT USER CONFIGURATION

The `realmd` system supports modifying the default user home directory and shell POSIX attributes. For example, this might be required when some POSIX attributes are not set in the Windows user accounts or when these attributes are different from POSIX attributes of other users on the local system.

**IMPORTANT**

Changing the configuration as described in this section only works if the `realm join` command has not been run yet. If a system is already joined, change the default home directory and shell in the `/etc/sssd/sssd.conf` file, as described in the section called “Optional: Configure User Home Directories and Shells”.

To override the default home directory and shell POSIX attributes, specify the following options in the `[users]` section in the `/etc/realmd.conf` file:

```
default-home
```
The **default-home** option sets a template for creating a home directory for accounts that have no home directory explicitly set. A common format is `/home/%d/%u`, where `%d` is the domain name and `%u` is the user name.

**default-shell**

The **default-shell** option defines the default user shell. It accepts any supported system shell.

For example:

```plaintext
[users]
default-home = /home/%u
default-shell = /bin/bash
```

For more information about the options, see the `realmd.conf(5)` man page.

### 3.9. ADDITIONAL CONFIGURATION FOR THE ACTIVE DIRECTORY DOMAIN ENTRY

Custom settings for each individual domain can be defined in the `/etc/realmd.conf` file. Each domain can have its own configuration section; the name of the section must match the domain name. For example:

```plaintext
[ad.example.com]
attribute = value
attribute = value
```

**IMPORTANT**

Changing the configuration as described in this section only works if the `realm join` command has not been run yet. If a system is already joined, changing these settings does not have any effect. In such situations, you must leave the domain, as described in Section 3.5, “Removing a System from an Identity Domain”, and then join again, as described in the section called “Joining a Domain”. Note that joining requires the domain administrator’s credentials.

To change the configuration for a domain, edit the corresponding section in `/etc/realmd.conf`. The following example disables ID mapping for the `ad.example.com` domain, sets the host principal, and adds the system to the specified subtree:

```plaintext
[ad.example.com]
computer-ou = ou=Linux Computers,DC=domain,DC=example,DC=com
user-principal = host/linux-client@AD.EXAMPLE.COM
automatic-id-mapping = no
```

Note that the same configuration can also be set when originally joining the system to the domain using the `realm join` command, described in the section called “Joining a Domain”:

```bash
# realm join --computer-ou="ou=Linux Computers,dc=domain,dc=com" --automatic-id-mapping=no --user-principal=host/linux-client@AD.EXAMPLE.COM
```
Table 3.2, “Realm Configuration Options” lists the most notable options that can be set in the domain default section in `/etc/realmd.conf`. For complete information about the available configuration options, see the realmd.conf(5) man page.

Table 3.2. Realm Configuration Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>computer-ou</td>
<td>Sets the directory location for adding computer accounts to the domain. This can be the full DN or an RDN, relative to the root entry. The subtree must already exist.</td>
</tr>
<tr>
<td>user-principal</td>
<td>Sets the <code>userPrincipalName</code> attribute value of the computer account to the provided Kerberos principal.</td>
</tr>
<tr>
<td>automatic-id-mapping</td>
<td>Sets whether to enable dynamic ID mapping or disable the mapping and use POSIX attributes configured in Active Directory.</td>
</tr>
</tbody>
</table>
CHAPTER 4. USING SAMBA, KERBEROS, AND WINBIND

The Samba standard Windows interoperability suite of utilities allows Linux systems to join an Active Directory environment by making them appear to be Windows clients. As a means of systems integration, Samba allows a Linux client to join an Active Directory Kerberos realm and to use Active Directory as its identity store.

Winbind is a component of the Samba suite to provide unified logon. It uses a UNIX implementation of Microsoft RPC calls, Pluggable Authentication Modules (PAMs), and the Name Service Switch (NSS) to allow Windows domain users to appear and operate as UNIX users on a UNIX system.

4.1. ABOUT SAMBA AND ACTIVE DIRECTORY AUTHENTICATION

While the core functionality of Samba is to perform client-server networking for file and printer sharing and associated operations, this chapter only focuses on one aspect of using Samba to interact with Windows: allowing Linux clients to authenticate by using Active Directory.

4.1.1. Samba, Kerberos, and Active Directory Domains

Active Directory is the domain controller for a number of services in Windows environments, including Kerberos realms and DNS domains. Samba supports the full range of protocols used in Active Directory, including Kerberos, DNS, NTLMSSP, or DCE/RPC. Integration with Active Directory means configuring a security environment that uses Kerberos as the native security context in Active Directory.

Several different system services should be configured on the Linux client to use Active Directory as a domain controller:

- Samba – for users and authentication
- DNS – to set the Active Directory server as the name server
- Kerberos – to use the Active Directory KDC
- PAM – to use Winbind
- NSS – to use Winbind

4.1.1.1. Samba

There are several different ways how a Samba server can join an Active Directory domain. In SMB/CIFS networking, there are two types of security: user-level and share level. Samba provides four ways to use user-level security. Collectively, we call them the security modes. Only two of them are important for Windows integration:

- **ads** configures the local Samba server as a domain member within an Active Directory domain. It also enables support for the internal usage of LDAP queries and Kerberos authentication. This is the preferred security mode.
- **domain** configures the Samba server as a domain member server within an Active Directory domain by using the DCE/RPC protocol.

The necessary configuration is located in the [global] section of `/etc/samba/smb.conf`. The essential settings include the security type (**security**); the name of the Active Directory Kerberos realm (**realm**), which is resolved by DNS discovery; and the Samba workgroup (**workgroup**):
# Global Settings

```plaintext
[global]
  workgroup = ADEXAMPLE
  security = ads
  realm = ADEXAMPLE.COM

...```

### 4.1.1.2. Kerberos

Kerberos must be configured to use the Active Directory server as its KDC. It allows users to use Kerberos tickets for authentication. Additionally, Samba must be configured to use the Active Directory Kerberos realm, which allows Winbind to manage the Kerberos principals.

The Active Directory realm should be set as the default domain in the `[libdefaults]` section of the `/etc/krb5.conf` file, and then as a KDC in the `[realms]` section. The `[domain_realm]` section should define the Active Directory domain.

For seamless Kerberos experience, ensure the Winbind Kerberos locator plug-in is installed from the samba-winbind-krb5-locator package. It ensures that Winbind and all its users and the Kerberos library and all its users use the same KDC all the time.

```plaintext
[libdefaults]
...
  default_realm = ADEXAMPLE.COM

[realms]
  ADEXAMPLE.COM = {
    kdc = kdc.adexample.com
  }

[domain_realm]
  adexample.com = ADEXAMPLE.COM
  .adexample.com = ADEXAMPLE.COM
```

### 4.1.1.3. DNS

The local DNS service must be configured to use Active Directory as its domain controller. DNS is critical for proper resolution of host names and domains for Kerberos. While many systems have proper DNS settings so that the Samba-Active Directory integration could work well without configuring Active Directory as a name server, using Active Directory as a name server avoids any potential resolution problems. The domain should also be added as a `search` directive, so that the Active Directory domain is used for searches and discovery.

DNS settings are configured in the `/etc/resolv.conf` file.

```plaintext
nameserver 1.2.3.4
search adexample.com```

### 4.1.1.4. PAM and NSS
PAM and NSS allow local applications to use the Kerberos credentials provided by Active Directory, which enables single sign-on for system applications and domain users. For ease of use, offline caching of credentials, and other features, it is recommended to use Winbind.

For PAM, the Winbind libraries are set for authentication, account, password, and optionally session management. This is configured in the `/etc/pam.d/system-auth` file:

```bash
auth  required pam_env.so
auth  sufficient pam_unix.so nullok try_first_pass
auth  requisite pam_succeed_if.so uid >= 500 quiet
auth  sufficient pam_winbind.so use_first_pass
auth  required pam_deny.so

account  required pam_unix.so broken_shadow
account  sufficient pam_localuser.so
account  sufficient pam_succeed_if.so uid < 500 quiet
account  [default=bad success=ok user_unknown=ignore] pam_winbind.so
account  required pam_permiso

password requisite pam_cracklib.so try_first_pass retry=3 type=
password  sufficient pam_unix.so sha512 shadow nullok try_first_pass
use_authhtok
password  sufficient pam_winbind.so use_authhtok
password  required pam_deny.so

session  optional pam_keyinit.so revoke
session  required pam_limits.so
session  [success=1 default=ignore] pam_succeed_if.so service in crond
quiet use_uid
session  required pam_unix.so
session  optional pam_krb5.so
session  optional pam_winbind.so use_first_pass
```

Another important configuration file is `/etc/security/pam_winbind.conf`. In it, various parameters and defaults are set, including Kerberos authentication, offline authentication, or automatic home directory creation. For further details, see the `pam_winbind.conf(5)` man page.

For NSS, Active Directory can be used for passwords, shadow (users), and groups by setting Winbind as an option. Additionally, you can add the `WINS` service option to use the configuration also for hosts. Always use `files` as the first location to check for accounts; this allows local system users and services to be able to log in and access resources.

NSS settings are configured in the `/etc/nsswitch.conf` file:

```bash
passwd:     files winbind
shadow:     files winbind
group:      files winbind
hosts:      files dns wins
```
Note that PAM and NSS should not be configured manually for integration with Active Directory. Instead, use the `authconfig` utility. See Section 4.3, “Configuring a Domain Member Using authconfig” for details.

### 4.1.2. Authentication Using Winbind and Samba

There are two important tasks when managing files: to establish the proper ownership and to control access to appropriate parties. Both relate to an effective way to identify and authenticate users. Winbind provides three related but separate capabilities:

- Authenticate users using local PAM configuration,
- Resolve IDs, user names, and groups using NSS lookups,
- Create a database of mapped Active Directory SIDs and local UID/GID numbers.

Winbind is part of Samba and connects directly to the Active Directory domain. The local Linux system is a full domain member in Windows terminology, represented with a complete machine account stored in AD. PAM and NSS are configured to use Winbind for user identities on the local system.

Among other aspects of using Winbind are:

- Winbind primarily maintains the machine account credentials (the Linux machine representation as a machine account in Active Directory). Among other functions, it can be used to update the machine account credentials or to update (or comply to) local stores of password policies.
- Winbind supports POSIX attributes in the form of RFC 2307 attributes or in the form of “Microsoft Services for Unix” extensions (both version 3.5 and 3.0). See the `idmap_ad(8)` man page for details.
- Joining the domain is done with utilities provided by Samba (using commands such as `net ads join`). Kerberos ticket management is done by Winbind, including ticket refresh and ticket re-acquisition.
- The `smb.conf` file is the only location for defining ID mappings.

In Red Hat Enterprise Linux, it is recommended to use SSSD as a capable alternative for direct integration with Active Directory. See Chapter 2, Using Active Directory as an Identity Provider for SSSD for more information.

### 4.2. SUMMARY OF CONFIGURATION FILES, OPTIONS, AND PACKAGES

Table 4.1. System Configuration Files, Required Options, and Required Packages
<table>
<thead>
<tr>
<th>Service</th>
<th>Configuration File</th>
<th>Required Parameters</th>
<th>Required Packages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Samba</td>
<td>/etc/samba/smb.conf</td>
<td><code>[global]</code>&lt;br&gt; workgroup = ADEXAMPLE&lt;br&gt; security = ads&lt;br&gt; realm = ADEXAMPLE.COM</td>
<td>samba</td>
</tr>
<tr>
<td>Winbind</td>
<td>/etc/security/pam_winbind.conf</td>
<td></td>
<td>samba-winbind</td>
</tr>
</tbody>
</table>
| Kerberos| /etc/krb5.conf    | `[libdefaults]`<br> default_realm = ADEXAMPLE.COM<br><br> `[realms]`<br> ADEXAMPLE.COM = {
    kdc = kdc.adexample.com
}<br><br> `[domain_realms]`<br> adexample.com = ADEXAMPLE.COM .adexample.com = ADEXAMPLE.COM | krb5-workstation |
| PAM     | /etc/pam.d/system-auth or /etc/pam.d/system-auth-ac (with authconfig) | auth sufficient<br> pam_winbind.so use_first_pass<br> account [default=bad success=ok user_unknown=ignore] pam_winbind.so<br> password sufficient<br> pam_winbind.so use_authtok<br> session optional<br> pam_winbind.so use_first_pass |                  |
| NSS     | /etc/nsswitch.conf | #required<br> passwd: files winbind<br> shadow: files winbind<br> group: files winbind<br><br> #optional<br> hosts: files dns wins |                  |
| DNS     | /etc/resolv.conf  | nameserver IPAddress search `domainName` |                  |
4.3. CONFIGURING A DOMAIN MEMBER USING authconfig

All of the configuration outlined in Section 4.2, “Summary of Configuration Files, Options, and Packages” can be done automatically using the authconfig utility, with the exception of the DNS configuration. Configuration files can also be backed up by authconfig.

4.3.1. Arguments and Configuration Parameters of authconfig

The Authentication Configuration utility automatically updates the required configuration files for Samba, Kerberos, and Active Directory integration when it is used to configure Winbind as the authentication store for the local system. Table 4.2, “authconfig Arguments and Configuration File Parameters” shows what parameters are set with each command option.

Table 4.2. authconfig Arguments and Configuration File Parameters

<table>
<thead>
<tr>
<th>Service</th>
<th>CLI Option</th>
<th>GUI Field</th>
<th>Configuration File</th>
<th>Configuration Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Samba</td>
<td>--smbsecurity</td>
<td>Security Model</td>
<td>/etc/samba/smb.conf</td>
<td>security</td>
</tr>
<tr>
<td>Samba</td>
<td>--smbworkgroup</td>
<td>Winbind Domain</td>
<td>/etc/samba/smb.conf</td>
<td>workgroup</td>
</tr>
<tr>
<td>Samba</td>
<td>--smbrealm</td>
<td>Winbind ADS Realm</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Samba</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>/etc/samba/smb.conf</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kerberos</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>/etc/krb5.conf</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kerberos</td>
<td>--smbservers</td>
<td>Winbind Domain Controllers</td>
<td>/etc/krb5.conf</td>
<td>The KDC in the realm entry (for example, REALMNAME {...}) in [realms]</td>
</tr>
<tr>
<td>Kerberos</td>
<td>--krb5realm</td>
<td></td>
<td>/etc/krb5.conf</td>
<td>The domain entry in [domain_realm]</td>
</tr>
<tr>
<td>PAM</td>
<td>--enablewinbindauth</td>
<td></td>
<td>/etc/pam.d/system-auth</td>
<td>auth, account, password, sessions</td>
</tr>
<tr>
<td>Service</td>
<td>CLI Option</td>
<td>GUI Field</td>
<td>Configuration File</td>
<td>Configuration Parameter</td>
</tr>
<tr>
<td>----------</td>
<td>------------------------</td>
<td>-------------------</td>
<td>------------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>NSS</td>
<td>--enablewinbind</td>
<td></td>
<td>/etc/nsswitch.conf</td>
<td>passwd, shadow, group</td>
</tr>
<tr>
<td>NSS</td>
<td>--enablewins</td>
<td></td>
<td>/etc/nsswitch.conf</td>
<td>hosts</td>
</tr>
<tr>
<td>Winbind</td>
<td>--enablecache</td>
<td></td>
<td>/etc/nsswitch.conf</td>
<td></td>
</tr>
<tr>
<td>Winbind</td>
<td>--enablewinbind</td>
<td></td>
<td>/etc/nsswitch.conf</td>
<td></td>
</tr>
<tr>
<td></td>
<td>dkrb5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Winbind</td>
<td>--enablewinbind</td>
<td></td>
<td>/etc/nsswitch.conf</td>
<td></td>
</tr>
<tr>
<td></td>
<td>doffline</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**IMPORTANT**

The value of the `--krb5realm` option must be identical to the value given in `--smbrealm` for the domain to be configured properly.

### 4.3.2. CLI Configuration of Active Directory Authentication with `authconfig`

1. Install the samba-winbind package. It is required for Windows integration features in Samba services, but is not installed by default:

   ```
   [root@server ~]# yum install samba-winbind
   ```

2. Install the krb5-workstation package. It is required to connect to a Kerberos realm and manage principals and tickets:

   ```
   [root@server ~]# yum install krb5-workstation
   ```

3. Install the samba-winbind-krb5-locator package. It contains a plug-in for the system Kerberos library to allow the local Kerberos library to use the same KDC as Samba and Winbind use.

   ```
   [root@server ~]# yum install samba-winbind-krb5-locator
   ```

4. Edit the DNS configuration in the `/etc/resolv.conf` file to use the Active Directory domain as a name server and for search:

   ```
   nameserver 1.2.3.4
   search adexample.com
   ```
5. The authconfig utility does not set any requirements for what options must be invoked at a given time, since it can be used to modify configuration as well as to define new configuration.

The following example shows all required parameters for Samba, Kerberos, PAM, and NSS. It also includes options for Winbind, which allow offline access, and for the local system, which allow system accounts to continue to work. The example command is split into multiple lines and annotated for better readability.

```
[root@server ~]# authconfig
   // NSS
   --enablewinbind
   --enablewins
   // PAM
   --enablewinbindauth
   // Samba
   --smbsecurity ads
   --smbworkgroup=ADEXAMPLE
   --smbrealm ADEXAMPLE.COM
   // Kerberos
   --smbservers=ad.example.com
   --krb5realm=ADEXAMPLE.COM
   // winbind
   --enablewinbindoffline
   --enablewinbindkrb5
   --winbindtemplateshell=/bin/sh
   // general
   --winbindjoin=admin
   --update
   --enablelocalauthorize
   --savebackup=/backups

[/usr/bin/net join -w ADEXAMPLE -S ad.example.com -U admin]
```

The --winbindjoin option automatically runs the `net join` command to add the system to the Active Directory domain.

The --enablelocalauthorize option sets local authorization operations to check the `/etc/passwd` file. This allows local accounts to be used to authenticate users as well as the Active Directory domain.

**NOTE**

The --savebackup option is recommended but not required. It backs up the configuration files to the specified directory before making the changes. If there is a configuration error or the configuration is later changed, authconfig can use the backups to revert the changes.

### 4.3.3. Configuring Active Directory Authentication in the authconfig GUI

There are fewer configuration options in the authconfig GUI than are in the CLI. For example, it is possible to configure Samba, NSS, Winbind, and to join the domain, but it does not configure Kerberos or PAM. Those must be configured manually if using the UI.
NOTE

The `authconfig` command-line utilities are installed by default, but the GUI requires the authconfig-gtk package, which is not available by default.

1. Install the `samba-winbind` package. It is required for Windows integration features in Samba services, but is not installed by default.
   
   ```
   [root@server ~]# yum install samba-winbind
   ```

2. Install the `krb5-workstation` package. It is required to connect to a Kerberos realm and manage principals and tickets.
   
   ```
   [root@server ~]# yum install krb5-workstation
   ```

3. Configure the Active Directory Kerberos realm as the default realm and KDC for the local system.
   
   ```
   [root@server ~]# vim /etc/krb5.conf
   
   [libdefaults]
   ...
   
   default_realm PLE.COM
   
   [realms]
   ADEXAMPLE.COM
   kdc = kdc.adcom
   }

   [domain_realm]
   adexample.com =LE.COM
   .adexample.comMPLE.COM
   ```

4. Edit the DNS configuration in the `/etc/resolv.conf` file to use the Active Directory domain as a name server and for search:
   
   ```
   nameserver 1.2.3
   search adexample
   ```

5. Open the Authentication Configuration Tool.

   ```
   [root@server ~]# authconfig-gtk
   ```

6. In the **Identity & Authentication** tab, select **Winbind** in the **User Account Database** drop-down menu.
7. Set the information that is required to connect to the Microsoft Active Directory domain controller.

- **Winbind Domain** gives the Windows work group. The entry in this field needs to be in the Windows 2000 format, such as `DOMAIN`.

- **Security Model** sets the security model to use for Samba clients. The correct value is `ads` that configures Samba to act as a domain member in an Active Directory Server realm.

- **Winbind ADS Realm** gives the Active Directory realm that the Samba server will join.
Winbind Domain Controllers gives the host name or IP address of the domain controller to use.

Template Shell sets which login shell to use for Windows user account settings. This setting is optional.

Allow offline login allows authentication information to be stored in a local cache. The cache is referenced when a user attempts to authenticate to system resources while the system is offline.

8. Click the Join Domain button to run the net ads join command and join the Active Directory domain. This action is to join the domain immediately; the configuration can be saved and then the net ads join command can be run manually later.

9. Click the Apply button to save the configuration.

4.4. USING SMB SHARES WITH SSSD

This section describes how you can use SSSD clients to access and fully use shares based on the Server Message Block (SMB) protocol, also known as the Common Internet File System (CIFS) protocol.

NOTE

Prior to Red Hat Enterprise Linux 7.1, only Winbind provided this functionality. In Red Hat Enterprise Linux 7.1 and later, you no longer need to run Winbind and SSSD in parallel to access SMB shares. For example, accessing the Access Control Lists (ACLs) no longer requires Winbind on SSSD clients.

IMPORTANT

SSSD does not support all the services that Winbind provides. For example, SSSD does not support authentication using the NT LAN Manager (NTLM) or NetBIOS name lookup. If you need these services, use Winbind. Note that in Identity Management domains, Kerberos authentication and DNS name lookup are available for the same purposes.

4.4.1. How SSSD Works with SMB

The SMB file-sharing protocol is widely used on Windows machines. In Red Hat Enterprise Linux environments with a trust between Identity Management and Active Directory, SSSD enables seamless use of SMB as if it was a standard Linux file system.

To access a SMB share, the system must be able to translate Windows SIDs to Linux POSIX UIDs and GIDs. SSSD clients use the SID-to-ID or SID-to-name algorithm, which enables this ID mapping.

4.4.2. Determining Whether to Use SSSD or Winbind for SMB Shares

For most SSSD clients, using SSSD is recommended:

- Identity Management clients use SSSD by default to map Active Directory users to UNIX users. Using Winbind for the SMB ID mapping instead of SSSD can result in inconsistent mapping.

- In environments with direct Active Directory integration where the clients use SSSD for general Active Directory user mappings, using Winbind for the SMB ID mapping instead of SSSD can result in inconsistent mapping.
**IMPORTANT**

SSSD does not support all the services that Winbind provides. For example, SSSD does not support authentication using the NT LAN Manager (NTLM) or NetBIOS name lookup. If you need these services, use Winbind. Note that in Identity Management domains, Kerberos authentication and DNS name lookup are available for the same purposes.

### 4.4.3. Accessing SMB Shares from SSSD Clients

You can access SMB shares from all SSSD clients that belong to the Samba domain.

To verify that the system uses SSSD for accessing SMB shares, use the `alternatives` utility. The utility displays the currently used library. In the following example, the system uses the SSSD library:

```
# alternatives --list | grep -E cifs\|libwbclient
cifs-idmap-plugin       auto     /usr/lib64/cifs-utils/cifs_idmap_sss.so
libwbclient.so.0.11-64 auto     /usr/lib64/sssd/modules/libwbclient.so.0.11.0
```

### 4.4.4. Switching Between SSSD and Winbind for SMB Share Access

This procedure describes how you can switch between SSSD and Winbind plug-ins that are used for accessing SMB shares from SSSD clients.

1. **Optional.** Find out whether you are currently using SSSD or Winbind to access SMB shares from the SSSD client:

   ```
   # alternatives --display cifs-idmap-plugin
cifs-idmap-plugin - status is auto.
   link currently points to /usr/lib/cifs-utils/cifs_idmap_sss.so
   /usr/lib/cifs-utils/cifs_idmap_sss.so - priority 20
   /usr/lib/cifs-utils/idmapwb.so - priority 10
   Current 'best' version is /usr/lib/cifs-utils/cifs_idmap_sss.so.
   ```

   If the SSSD plug-in (`cifs_idmap_sss.so`) is installed, it has a higher priority than the Winbind plug-in (`idmapwb.so`) by default.

2. Before switching to the Winbind plug-in, make sure Winbind is running on the system:

   ```
   # systemctl is-active winbind.service
   active
   ```

   Before switching to the SSSD plug-in, make sure SSSD is running on the system:

   ```
   # systemctl is-active sssd.service
   active
   ```

3. To switch to a different plug-in, use the `alternatives --set cifs-idmap-plugin` command, and specify the path to the required plug-in. For example, to switch to Winbind:

   ```
   # alternatives --set cifs-idmap-plugin /usr/lib/cifs-utils/idmapwb.so
   ```
4.4.5. Configuring an SSSD Client to Run a Samba Server Without Using Winbind

This procedure configures the SSSD client to run Samba as a server and use SSSD to authenticate clients to the SMB server.

**IMPORTANT**

Without Winbind, you might experience problems when setting up a Samba server in multi-domain environments. The `winbindd` service is used internally not only for identity resolution, but also for pass-through authentication in Samba. SSSD does not support these modes and therefore cannot serve as a replacement for Winbind in this situation.

**Prerequisites**

Install the `sssd-libwbclient` package:

```
# yum install sssd-libwbclient
```

The package provides the `libwbclient.so` library. The library is the SSSD alternative to the library provided by the `libwbclient` package used by the Winbind service.

**IMPORTANT**

If you use Winbind, `sssd-libwbclient` can cause problems when attempting to access the SMB share.

**Procedure**

1. Open the `/etc/samba/smb.conf` file.

2. In the `[global]` section, use the `kerberos method` option to define the method to verify Kerberos tickets.

   - Example of typical configuration in environments with direct Active Directory integration:

     ```
     [global]
     security = ads
     workgroup = ADSHORTNAME
     realm = ADREALM
     kerberos method = system keytab
     ```

     The `system keytab` value specifies that the keytab required for Kerberos access to the SMB share is the same as the keytab that SSSD uses: `/etc/krb5.keytab`.

   - Example of typical configuration in environments with Active Directory trust:

     ```
     [global]
     security = ads
     workgroup = IDM
     realm = IDMREALM
     kerberos method = dedicated keytab
     dedicated keytab file = /etc/samba/samba.keytab
     ```
The dedicated keytab value specifies that a dedicated keytab is required to verify Kerberos tickets.
PART II. INTEGRATING A LINUX DOMAIN WITH AN ACTIVE DIRECTORY DOMAIN: CROSS-FOREST TRUST
CHAPTER 5. CREATING CROSS-FOREST TRUSTS WITH ACTIVE DIRECTORY AND IDENTITY MANAGEMENT

Kerberos implements a concept of a trust. In a trust, a principal from one Kerberos realm can request a ticket to a service in another Kerberos realm. Using this ticket, the principal can authenticate against resources on machines belonging to the other realm.

Kerberos also has the ability to create a relationship between two otherwise separate Kerberos realms: a cross-realm trust. Realms that are part of a trust use a shared pair of a ticket and key; a member of one realm then counts as a member of both realms.

Red Hat Identity Management supports configuring a cross-forest trust between an IdM domain and an Active Directory domain.

5.1. INTRODUCTION TO CROSS-FOREST TRUSTS

Kerberos realm only concerns authentication. Other services and protocols are involved in complementing identity and authorization for resources running on the machines in the Kerberos realm.

As such, establishing Kerberos cross-realm trust is not enough to allow users from one realm to access resources in the other realm; a support is required at other levels of communication as well.

5.1.1. The Architecture of a Trust Relationship

Both Active Directory and Identity Management manage a variety of core services such as Kerberos, LDAP, DNS, or certificate services. To transparently integrate these two diverse environments, all core services must interact seamlessly with one another.

Active Directory Trusts, Forests, and Cross-forest Trusts

Kerberos cross-realm trust plays an important role in authentication between Active Directory environments. All activities to resolve user and group names in a trusted AD domain require authentication, regardless of how access is performed: using LDAP protocol or as part of the Distributed Computing Environment/Remote Procedure Calls (DCE/RPC) on top of the Server Message Block (SMB) protocol. Because there are more protocols involved in organizing access between two different Active Directory domains, trust relationship has a more generic name, Active Directory trust.

Multiple AD domains can be organized together into an Active Directory forest. A root domain of the forest is the first domain created in the forest. Identity Management domain cannot be part of an existing AD forest, thus it is always seen as a separate forest.

When trust relationship is established between two separate forest root domains, allowing users and services from different AD forests to communicate, a trust is called Active Directory cross-forest trust.

Trust Flow and One-way Trusts

A trust establishes an access relationship between two domains. Active Directory environments can be complex so there are different possible types and arrangements for Active Directory trusts, between subdomains, root domains, or forests. A trust is a path from one domain to another. The way that identities and information move between the domains is called a trust flow.

The trusted domain contains users, and the trusting domain allows access to resources. In a one-way trust, trust flows only in one direction: users can access the trusting domain's resources but users in the trusting domain cannot access resources in the trusted domain. In Figure 5.1, “One-way Trust”, Domain A is trusted by Domain B, but Domain B is not trusted by Domain A.
Figure 5.1. One-way Trust

IdM allows the administrator to configure both one-way and two-way trusts. For details, see Section 5.1.4, “One-Way and Two-Way Trusts”.

Transitive and Non-transitive Trusts

Trusts can be transitive so that a domain trusts another domain and any other domain trusted by that second domain.

Figure 5.2. Transitive Trusts

Trusts can also be non-transitive which means the trust is limited only to the explicitly included domains.

Cross-forest Trust in Active Directory and Identity Management

Within an Active Directory forest, trust relationships between domains are normally two-way and transitive by default.

Because trust between two AD forests is a trust between two forest root domains, it can also be two-way or one-way. The transitivity of the cross-forest trust is explicit: any domain trust within an AD forest that leads to the root domain of the forest is transitive over the cross-forest trust. However, separate cross-forest trusts are not transitive. An explicit cross-forest trust must be established between each AD forest root domain to another AD forest root domain.

From the perspective of AD, Identity Management represents a separate AD forest with a single AD domain. When cross-forest trust between an AD forest root domain and an IdM domain is established, users from the AD forest domains can interact with Linux machines and services from the IdM domain.
5.1.2. Active Directory Security Objects and Trust

Active Directory Global Catalog

The global catalog contains information about objects of an Active Directory. It stores a full copy of objects within its own domain. From objects of other domains in the Active Directory forest, only a partial copy of the commonly most searched attributes is stored in the global catalog. Additionally, some types of groups are only valid within a specific scope and might not be part of the global catalog.

Note that the cross-forest trust context is wider than a single domain. Therefore, some of these server-local or domain-local security group memberships from a trusted forest might not be visible to IdM servers.

Global Catalog and POSIX Attributes

Active Directory does not replicate POSIX attributes with its default settings. If it is required to use POSIX attributes that are defined in AD Red Hat strongly recommends to replicate them to the global catalog service.

5.1.3. Trust Architecture in IdM

On the Identity Management side, the IdM server has to be able to recognize Active Directory identities and appropriately process their group membership for access controls. The Microsoft PAC (MS-PAC, Privilege Account Certificate) contains the required information about the user; their security ID, domain user name, and group memberships. Identity Management has two components to analyze data in the PAC on the Kerberos ticket:

- SSSD, to perform identity lookups on Active Directory and to retrieve user and group security identifiers (SIDs) for authorization. SSSD also caches user, group, and ticket information for users and maps Kerberos and DNS domains,

- Identity Management (Linux domain management), to associate the Active Directory user with an IdM group for IdM policies and access.

**NOTE**

Access control rules and policies for Linux domain administration, such as SELinux, sudo, and host-based access controls, are defined and applied through Identity Management. Any access control rules set on the Active Directory side are not evaluated or used by IdM; the only Active Directory configuration which is relevant is group membership.

### Trusts with Different Active Directory Forests
IdM can also be part of trust relationships with different AD forests. Once a trust is established, additional trusts with other forests can be added later, following the same commands and procedures. IdM can trust multiple entirely unrelated forests at the same time, allowing users from such unrelated AD forests access to resources in the same shared IdM domain.

5.1.3.1. Active Directory PACs and IdM Tickets

Group information in Active Directory is stored in a list of identifiers in the Privilege Attribute Certificate (MS-PAC or PAC) data set. The PAC contains various authorization information, such as group membership or additional credentials information. It also includes security identifiers (SIDs) of users and groups in the Active Directory domain. SIDs are identifiers assigned to Active Directory users and groups when they are created. In trust environments, group members are identified by SIDs, rather than by names or DNs.

A PAC is embedded in the Kerberos service request ticket for Active Directory users as a way of identifying the entity to other Windows clients and servers in the Windows domain. IdM maps the group information in the PAC to the Active Directory groups and then to the corresponding IdM groups to determine access.

When an Active Directory user requests a ticket for a service on IdM resources, the process goes as follows:

1. The request for a service contains the PAC of the user. The IdM KDC analyzes the PAC by comparing the list of Active Directory groups to memberships in IdM groups.

2. For SIDs of the Kerberos principal defined in the MS-PAC, the IdM KDC evaluates external group memberships defined in the IdM LDAP. If additional mappings are available for an SID, the MS-PAC record is extended with other SIDs of the IdM groups to which the SID belongs. The resulting MS-PAC is signed by the IdM KDC.

3. The service ticket is returned to the user with the updated PAC signed by the IdM KDC. Users belonging to AD groups known to the IdM domain can now be recognized by SSSD running on the IdM clients based on the MS-PAC content of the service ticket. This allows to reduce identity traffic to discover group memberships by the IdM clients.

When the IdM client evaluates the service ticket, the process includes the following steps:

1. The Kerberos client libraries used in the evaluation process send the PAC data to the SSSD PAC responder.

2. The PAC responder verifies the group SIDs in the PAC and adds the user to the corresponding groups in the SSSD cache. SSSD stores multiple TGTs and tickets for each user as new services are accessed.

3. Users belonging to the verified groups can now access the required services on the IdM side.

5.1.3.2. Active Directory Users and Identity Management Groups

When managing Active Directory users and groups, you can add individual AD users and whole AD groups to Identity Management groups.

For a description of how to configure IdM groups for AD users, see Section 5.3.3, “Creating IdM Groups for Active Directory Users”.

Non-POSIX External Groups and SID Mapping

Group membership in the IdM LDAP is expressed by specifying a distinguished name (DN) of an LDAP
object that is a member of a group. AD entries are not synchronized or copied over to IdM, which means that AD users and groups have no LDAP objects in the IdM LDAP. Therefore, they cannot be directly used to express group membership in the IdM LDAP.

For this reason, IdM creates non-POSIX external groups: proxy LDAP objects that contain references to SIDs of AD users and groups as strings. Non-POSIX external groups are then referenced as normal IdM LDAP objects to signify group membership for AD users and groups in IdM.

SIDs of non-POSIX external groups are processed by SSSD; SSSD maps SIDs of groups to which an AD user belongs to POSIX groups in IdM. The SIDs on the AD side are associated with user names. When the user name is used to access IdM resources, SSSD in IdM resolves that user name to its SID, and then looks up the information for that SID within the AD domain, as described in Section 5.1.3.1, “Active Directory PACs and IdM Tickets”.

ID Ranges
When a user is created in Linux, it is assigned a user ID number. In addition, a private group is created for the user. The private group ID number is the same as the user ID number. In Linux environment, this does not create a conflict. On Windows, however, the security ID number must be unique for every object in the domain.

Trusted AD users require a UID and GID number on a Linux system. This UID and GID number can be generated by IdM, but if the AD entry already has UID and GID numbers assigned, assigning different numbers creates a conflict. To avoid such conflicts, it is possible to use the AD-defined POSIX attributes, including the UID and GID number and preferred login shell.

NOTE
AD stores a subset of information for all objects within the forest in a global catalog. The global catalog includes every entry for every domain in the forest. If you want to use AD-defined POSIX attributes, Red Hat strongly recommends that you first replicate the attributes to the global catalog.

When a trust is created, IdM automatically detects what kind of ID range to use and creates a unique ID range for the AD domain added to the trust. You can also choose this manually by passing one of the following options to the ipa trust-add command:

ipa-ad-trust
This range option is used for IDs algorithmically generated by IdM based on the SID.

If IdM generates the SIDs using SID-to-POSIX ID mapping, the ID ranges for AD and IdM users and groups must have unique, non-overlapping ID ranges available.

ipa-ad-trust-posix
This range option is used for IDs defined in POSIX attributes in the AD entry.

IdM obtains the POSIX attributes, including uidNumber and gidNumber, from the global catalog in AD or from the directory controller. If the AD domain is managed correctly and without ID conflicts, the ID numbers generated in this way are unique. In this case, no ID validation or ID range is required.

For example:

ipa trust-add --range-type=ipa-ad-trust-posix
5.1.3.3. Active Directory Users and IdM Policies and Configuration

Several IdM policy definitions, such as SELinux, host-based access control, sudo, and netgroups, rely on user groups to identify how the policies are applied.

![Active Directory Users and IdM Groups and Policies](image)

The user SID in the PAC in the ticket is resolved to the AD identity. This means that Active Directory users can be added as group members using their fully-qualified user name or their SID.

5.1.4. One-Way and Two-Way Trusts

IdM supports two types of trust agreements, depending on whether the entities that can establish connection to services in IdM are limited to only AD or can include IdM entities as well.

**One-way trust**

One-way trust enables AD users and groups to access resources in IdM, but not the other way around. The IdM domain trusts the AD forest, but the AD forest does not trust the IdM domain.

One-way trust is the default mode for creating a trust.

**Two-way trust**

Two-way trust enables AD users and groups to access resources in IdM. However, the two-way trust in IdM does not give the users any additional rights compared to the one-way trust solution in AD. Both solutions are considered equally secure because of default cross-forest trust SID filtering settings.

For more general information on one-way and two-way trusts, see Section 5.1.1, “The Architecture of a Trust Relationship”.

After a trust is established, it is not possible to modify its type. If you require a different type of trust, run the `ipa trust-add` command again; by doing this, you can delete the existing trust and establish a new one.
5.1.5. External Trusts to Active Directory

An external trust is a trust relationship between domains that are in a different forests. While forest trusts always require to establish the trust between the root domains of Active Directory forests, you can establish an external trust to any domain within the forest.

External trusts are non-transitive. For this reason, users and groups from other Active Directory domains have no access to IdM resources. For further information, see the section called “Transitive and Non-transitive Trusts”.

5.1.6. Trust Controllers and Trust Agents

IdM provides the following types of IdM servers that support trust to Active Directory:

Trust agents
IdM servers that can perform identity lookups against Active Directory domain controllers.

Trust controllers
IdM servers with the capabilities of trust agents that also run the Samba suite. Active Directory domain controllers contact trust controllers when establishing and verifying the trust to Active Directory.

The first trust controller is created when you configure the trust as described in Section 5.2.2.1.1, “Preparing the IdM Server for Trust”.

Trust controllers run an increased amount of network-facing services compared to trust agents, and thus present a greater attack surface for potential intruders.

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

Table 5.1. A comparison of the capabilities provided by trust controllers and trust agents

<table>
<thead>
<tr>
<th>Capability</th>
<th>Trust agents</th>
<th>Trust controllers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolve Active Directory users and groups</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Enroll IdM clients that run services accessible by users from trusted Active Directory forests</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Manage the trust (for example, add trust agreements)</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

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

- Configure at least two trust controllers per Identity Management 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 as described in Section 5.2.2.1.1, “Preparing the IdM Server for Trust”.

**IMPORTANT**

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

Additional Resources

- Adding a trust controller is described in Section 5.2.2, “Creating Trusts”.
- Adding a trust agent is described in Section 5.2.3.2, “Configuring Trust Agents”.

5.2. CREATING CROSS-FOREST TRUSTS

5.2.1. Environment and Machine Requirements

Before configuring a trust agreement, make sure that both the Active Directory and Identity Management servers, machines, and environments meet the requirements and settings described in this section.

5.2.1.1. Supported Windows Platforms

You can establish a trust relationship with the following Active Directory functional levels:


The following operating systems are explicitly supported and tested for establishing a trust using the mentioned functional levels:

- Windows Server 2012 R2
- Windows Server 2016

5.2.1.2. DNS and Realm Settings

To establish a trust, Active Directory and Identity Management require specific DNS configuration:

**Unique primary DNS domains**

Each system must have its own unique primary DNS domain 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 it is possible to use any other standard-compliant DNS server as well.

It is not possible for AD or IdM to share the primary DNS domain with another system for identity management. For more information, see documentation for host name and DNS configuration requirements in the Linux Domain Identity, Authentication, and Policy Guide.
Kerberos realm names as upper-case versions of primary DNS domain names

Kerberos realm names must be 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 are required to be `AD.EXAMPLE.COM` and `IDM.EXAMPLE.COM`.

DNS records resolvable from all DNS domains in the trust

All machines must be able to resolve DNS records from all DNS domains involved in the trust relationship:

- When configuring IdM DNS, follow the instructions described in the section on configuring DNS services within the IdM domain and section on managing DNS forwarding in the *Linux Domain Identity, Authentication, and Policy Guide*.

- If you are using IdM without integrated DNS, follow the instructions described in the section describing the server installation without integrated DNS in the *Linux Domain Identity, Authentication, and Policy Guide*.

No overlap between IdM and AD DNS domains

Machines joined to IdM can be distributed over multiple DNS domains. DNS domains containing IdM clients must not overlap with DNS domains containing machines joined to AD. The primary IdM DNS domain must have proper SRV records to support AD trusts.

For other DNS domains that are part of the same IdM realm, it is not required for the SRV records to be configured when the trust to AD is configured. The reason is that AD domain controllers do not use SRV records to discover KDCs but rather base the KDC discovery on name suffix routing information for the trust.

Verifying the DNS Configuration

Before configuring trust, verify that the Identity Management and Active Directory servers can resolve themselves and also each other.

If running the commands described below does not display the expected results, inspect the DNS configuration on the host where the commands were executed. If the host configuration seems correct, make sure that DNS delegations from the parent to child domains are set up correctly.

Note that AD caches the results of DNS lookups, and changes you make in DNS are therefore sometimes not visible immediately. You can delete the current cache by running the `ipconfig /flushdns` command.

Verify that the IdM-hosted services are resolvable from the IdM domain server used for establishing trust

1. Run a DNS query for the Kerberos over UDP and LDAP over TCP service records.

   ```
   [root@ipaserver ~]# dig +short -t SRV _kerberos._udp.ipa.example.com.
   0 100 88 ipamaster1.ipa.example.com.
   
   [root@ipaserver ~]# dig +short -t SRV _ldap._tcp.ipa.example.com.
   0 100 389 ipamaster1.ipa.example.com.
   ```

   The commands are expected to list all IdM servers.
2. Run a DNS query for the TXT record with the IdM Kerberos realm name. The obtained value is expected to match the Kerberos realm that you specified when installing IdM.

```
[root@ipaserver ~]# dig +short -t TXT _kerberos.ipa.example.com.
IPA.EXAMPLE.COM
```

3. After you execute the `ipa-adtrust-install` utility, as described in Section 5.2.2.1.1, “Preparing the IdM Server for Trust”, run a DNS query for the MS DC Kerberos over UDP and LDAP over TCP service records.

```
[root@ipaserver ~]# dig +short -t SRV _kerberos._udp.dc._msdcs.ipa.example.com.
0 100 88 ipamaster1.ipa.example.com.
[root@ipaserver ~]# dig +short -t SRV _ldap._tcp.dc._msdcs.ipa.example.com.
0 100 389 ipamaster1.ipa.example.com.
```

The commands are expected to list all IdM servers on which `ipa-adtrust-install` has been executed. Note that the output is empty if `ipa-adtrust-install` has not been executed on any IdM server, which is typically before establishing the very first trust relationship.

**Verify that IdM is able to resolve service records for AD**

Run a DNS query for the Kerberos over UDP and LDAP over TCP service records.

```
[root@ipaserver ~]# dig +short -t SRV _kerberos._udp.dc._msdcs.ad.example.com.
0 100 88 addc1.ad.example.com.
[root@ipaserver ~]# dig +short -t SRV _ldap._tcp.dc._msdcs.ad.example.com.
0 100 389 addc1.ad.example.com.
```

These commands are expected to return the names of AD domain controllers.

**Verify that the IdM-hosted services are resolvable from the AD server**

1. On the AD server, set the `nslookup.exe` utility to look up service records.

```
C:\>nslookup.exe
> set type=SRV
```

2. Enter the domain name for the Kerberos over UDP and LDAP over TCP service records.

```
> _kerberos._udp.ipa.example.com.
_kerberos._udp.ipa.example.com.       SRV service location:
    priority    = 0
    weight      = 100
    port        = 88
    srv hostname = ipamaster1.ipa.example.com
> _ldap._tcp.ipa.example.com
ldap._tcp.ipa.example.com.       SRV service location:
```
priority = 0
weight = 100
port = 389
svr hostname = ipamaster1.ipa.example.com

The expected output contains the same set of IdM servers as displayed in Verify that the IdM-hosted services are resolvable from the IdM domain server used for establishing trust.

3. Change the service type to TXT and run a DNS query for the TXT record with the IdM Kerberos realm name.

C:\>nslookup.exe
> set type=TXT
> _kerberos.ipa.example.com.
_kerberos.ipa.example.com. text =
"IPA.EXAMPLE.COM"

The output is expected to contain the same value as displayed in Verify that the IdM-hosted services are resolvable from the IdM domain server used for establishing trust.

4. After you execute the `ipa-adtrust-install` utility, as described in Section 5.2.2.1.1, “Preparing the IdM Server for Trust”, run a DNS query for the MS DC Kerberos over UDP and LDAP over TCP service records.

C:\>nslookup.exe
> set type=SRV
> _kerberos._udp.dc._msdcs.ipa.example.com.
_kerberos._udp.dc._msdcs.ipa.example.com. SRV service
location:
  priority = 0
  weight = 100
  port = 88
  svr hostname = ipamaster1.ipa.example.com
> _ldap._tcp.dc._msdcs.ipa.example.com.
_ldap._tcp.dc._msdcs.ipa.example.com. SRV service
location:
  priority = 0
  weight = 100
  port = 389
  svr hostname = ipamaster1.ipa.example.com

The command is expected to list all IdM servers on which the `ipa-adtrust-install` utility has been executed. Note that the output is empty if `ipa-adtrust-install` has not been executed on any IdM server, which is typically before establishing the very first trust relationship.

**Verify that AD services are resolvable from the AD server**

1. On the AD server, set the `nslookup.exe` utility to look up service records.

C:\>nslookup.exe
> set type=SRV
2. Enter the domain name for the Kerberos over UDP and LDAP over TCP service records.

```
> _kerberos._udp.dc._msdcs.ad.example.com.
_kerberos._udp.dc._msdcs.ad.example.com. SRV service location:
  priority = 0
  weight = 100
  port = 88
  svr hostname = addc1.ad.example.com
> _ldap._tcp.dc._msdcs.ad.example.com.
_ldap._tcp.dc._msdcs.ad.example.com. SRV service location:
  priority = 0
  weight = 100
  port = 389
  svr hostname = addc1.ad.example.com
```

The expected output contains the same set of AD servers as displayed in Verify that IdM is able to resolve service records for AD.

### 5.2.1.3. NetBIOS Names

The NetBIOS name is critical for identifying the AD domain and, if the IdM domain is within a subdomain of Active Directory DNS, for identifying the IdM domain and services. The IdM domain and Active Directory domain must have different NetBIOS names.

**NOTE**

The NetBIOS name is usually the far-left component of the domain name. For example, if the domain is `linux.example.com`, the NetBIOS name is `linux`. If the domain name is `example.com`, the NetBIOS name is `example`.

The maximum length of the NetBIOS name is 15 characters.

### 5.2.1.4. Firewalls and Ports

To enable communication between AD domain controllers and IdM servers, make sure you meet the following port requirements:

- Open ports required for an AD trust and ports required by an IdM server in an AD trust on IdM servers and all AD domain controllers in both directions: from the IdM servers to the AD domain controllers and back.

- Open the port required by an IdM client in an AD trust on all AD domain controllers of the trusted AD forest. On the IdM clients, make sure the port is open in the outgoing direction (see Prerequisites for Installing a Client in the Linux Domain Identity, Authentication, and Policy Guide).

#### Table 5.2. Ports Required for an AD Trust

<table>
<thead>
<tr>
<th>Service</th>
<th>Port</th>
<th>Protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endpoint resolution portmapper</td>
<td>135</td>
<td>TCP</td>
</tr>
<tr>
<td>Service</td>
<td>Port</td>
<td>Protocol</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>------</td>
<td>-------------------</td>
</tr>
<tr>
<td>NetBIOS-DGM</td>
<td>138</td>
<td>TCP and UDP</td>
</tr>
<tr>
<td>NetBIOS-SSN</td>
<td>139</td>
<td>TCP and UDP</td>
</tr>
<tr>
<td>Microsoft-DS</td>
<td>445</td>
<td>TCP and UDP</td>
</tr>
<tr>
<td>Endpoint mapper listener range</td>
<td>1024-1300</td>
<td>TCP</td>
</tr>
<tr>
<td>AD Global Catalog</td>
<td>3268</td>
<td>TCP</td>
</tr>
<tr>
<td>LDAP</td>
<td>389</td>
<td>TCP [a] and UDP</td>
</tr>
</tbody>
</table>

[a] The TCP port 389 is not required to be open on IdM servers for trust, but it is necessary for clients communicating with the IdM server.

### Table 5.3. Ports Required by IdM Servers in a Trust

<table>
<thead>
<tr>
<th>Service</th>
<th>Port</th>
<th>Protocol</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kerberos</td>
<td>See</td>
<td></td>
<td>Port Requirements in the Linux Domain Identity, Authentication, and Policy Guide.</td>
</tr>
<tr>
<td>LDAP</td>
<td>88</td>
<td>UDP and TCP</td>
<td>The port is not required if you have configured Key Distribution Center (KDC) proxy, in which case the IdM clients send Kerberos requests via the IdM servers.</td>
</tr>
<tr>
<td>DNS</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 5.4. Ports Required by IdM Clients in an AD Trust

### Additional Resources

- For advice on how to open the required ports, see Port Requirements in the Linux Domain Identity, Authentication, and Policy Guide.

### 5.2.1.5. IPv6 Settings

The IdM system must have the IPv6 protocol enabled in the kernel. If IPv6 is disabled, then the CLDAP plug-in used by the IdM services fails to initialize.

### 5.2.1.6. Clock Settings

Both the Active Directory server and the IdM server must have their clocks in sync.

5.2.1.7. Supported User Name Formats

IdM performs user name mapping in the local SSSD client. The default user name format supported by SSSD is `name@domain`. Active Directory supports several different kinds of name formats: `username`, `username@domain.name`, and `DOMAIN\username`.

To identify the user name and the domain to which the user name belongs, SSSD uses a regular expression defined in the `re_expression` option. The regular expression is used for IdM back ends or AD back ends and supports all the mentioned formats:

```
re_expression = (((?P<domain>[^\\]+)\(?P<name>.+$))|((?P<name>[^@]+)@(?
P<domain>.+$))|(^(?P<name>[^@\\]+)$))
```

5.2.2. Creating Trusts

The following sections describe creating trusts in various configuration scenarios. Section 5.2.2.1, “Creating a Trust from the Command Line” contains the full procedure for configuring a trust from the command line. The other sections describe the steps which are different from this basic configuration scenario and reference the basic procedure for all other steps.

After creating a trust, see Section 5.2.3, “Post-installation Considerations for Cross-forest Trusts”.

5.2.2.1. Creating a Trust from the Command Line

Creating a trust relationship between the IdM and Active Directory Kerberos realms involves the following steps:

1. Preparing the IdM server for the trust, described in Section 5.2.2.1.1, “Preparing the IdM Server for Trust”
2. Creating a trust agreement, described in Section 5.2.2.1.2, “Creating a Trust Agreement”
3. Verifying the Kerberos configuration, described in Section 5.2.2.1.3, “Verifying the Kerberos Configuration”

5.2.2.1.1. Preparing the IdM Server for Trust

To set up the IdM server for a trust relationship with AD, follow these steps:

1. Install the required IdM, trust, and Samba packages:

   `[root@ipaserver ]# yum install ipa-server ipa-server-trust-ad samba-client`

2. Configure the IdM server to enable trust services:

   a. Run the `ipa-adtrust-install` utility. The utility adds DNS service records required for AD trusts. These records are created automatically if IdM was installed with an integrated DNS server.

      If IdM was installed without an integrated DNS server, `ipa-adtrust-install` prints a list of service records that must be manually added to DNS before you can continue.
IMPORTANT

Red Hat strongly recommends to verify the DNS configuration as described in the section called “Verifying the DNS Configuration” every time after running `ipa-adtrust-install`, especially if IdM or AD do not use integrated DNS servers.

b. The script prompts to configure the `slapi-nis` plug-in, a compatibility plug-in that allows older Linux clients to work with trusted users.

Do you want to enable support for trusted domains in Schema Compatibility plugin?
This will allow clients older than SSSD 1.9 and non-Linux clients to work with trusted users.

Enable trusted domains support in slapi-nis? [no]: y

c. At least one user (the IdM administrator) exists when the directory is first installed. The SID generation task can create a SID for any existing users, to support the trust environment. This is a resource-intensive task; for a high number of users, this can be run separately.

Do you want to run the `ipa-sidgen` task? [no]: yes

3. Make sure that DNS is properly configured, as described in Section 5.2.1.2, “DNS and Realm Settings”.

4. Start the `smb` daemon and use the `smbclient` utility to verify that Samba responds to Kerberos authentication from the IdM side.

```
[root@ipaserver ~]# systemctl start smb
[root@ipaserver ~]# smbclient -L ipaserver.ipa.example.com -k
lp_load_ex: changing to config backend registry
Domain=[IDM] OS=[Windows 6.1] Server=[Samba 4.2.10]

Sharename       Type      Comment
---------       ----      -------
IP$            IPC       IPC Service (Samba 4.2.10)
Domain=[IDM] OS=[Windows 6.1] Server=[Samba 4.2.10]

Server               Comment
---------            -------
Workgroup            Master
---------            -------
```

5.2.2.1.2. Creating a Trust Agreement

Create a trust agreement for the Active Directory domain and the IdM domain by using the `ipa trust-add` command:

```
# ipa trust-add --type=type ad_domain_name --admin ad_admin_username --password
```

The `ipa trust-add` command sets up a one-way trust by default. To establish a two-way trust, pass the `--two-way=true` option. See Section 5.1.4, “One-Way and Two-Way Trusts” for details.
To establish an external trust, pass the `--external=true` option to the `ipa trust-add` command. See Section 5.1.5, “External Trusts to Active Directory” for details.

**NOTE**

The `ipa trust-add` command configures the server as a trust controller by default. See Section 5.1.6, “Trust Controllers and Trust Agents” for details.

The following example establishes a two-way trust by using the `--two-way=true` option:

```
[root@ipaserver ~]# ipa trust-add --type=ad ad.example.com --admin Administrator --password --two-way=true
```

Active Directory domain administrator's password:

```
-------------------------------------------------------
```

```
Added Active Directory trust for realm "ad.example.com"
```

```
Realm-Name: ad.example.com
Domain NetBIOS name: AD
Domain Security Identifier: S-1-5-21-796215754-1239681026-23416912
SID blacklist incoming: S-1-5-20, S-1-5-3, S-1-5-2, S-1-5-1, S-1-5-7, S-1-5-6, S-1-5-5, S-1-5-4, S-1-5-9, S-1-5-8, S-1-5-17, S-1-5-16, S-1-5-15, S-1-5-14, S-1-5-13, S-1-5-12, S-1-5-11, S-1-5-10, S-1-3, S-1-2, S-1-1, S-1-0, S-1-5-19, S-1-5-18
SID blacklist outgoing: S-1-5-20, S-1-5-3, S-1-5-2, S-1-5-1, S-1-5-7, S-1-5-6, S-1-5-5, S-1-5-4, S-1-5-9, S-1-5-8, S-1-5-17, S-1-5-16, S-1-5-15, S-1-5-14, S-1-5-13, S-1-5-12, S-1-5-11, S-1-5-10, S-1-3, S-1-2, S-1-1, S-1-0, S-1-5-19
Trust direction: Two-way trust
Trust type: Active Directory domain
Trust status: Established and verified
```

5.2.2.1.3. Verifying the Kerberos Configuration

To verify the Kerberos configuration, test if it is possible to obtain a ticket for an IdM user and if the IdM user can request service tickets.

To verify a two-way trust:

1. Request a ticket for an IdM user:

```
[root@ipaserver ~]# kinit user
```

2. Request service tickets for a service within the IdM domain:

```
[root@ipaserver ~]# kvno -S host ipaserver.example.com
```

3. Request service tickets for a service within the AD domain:

```
[root@ipaserver ~]# kvno -S cifs adserver.example.com
```
If the AD service ticket is successfully granted, there is a cross-realm ticket-granting ticket (TGT) listed with all of the other requested tickets. The TGT is named `krbtgt/AD.DOMAIN@IPA.DOMAIN`.

```
[root@ipaserver ]# klist
Ticket cache: FILE:/tmp/krb5cc_0
Default principal: jsmith@IPA.DOMAIN

Valid starting   Expires             Service principal
06/15/12 12:13:04  06/16/12 12:12:55  krbtgt/IPA.DOMAIN@IPA.DOMAIN
06/15/12 12:13:13  06/16/12 12:12:55  host/ipaserver.ipa.example.com@IPA.DOMAIN
06/15/12 12:13:23  06/16/12 12:12:55  krbtgt/AD.DOMAIN@IPA.DOMAIN
06/15/12 12:14:58  06/15/12 22:14:58  cifs/adserver.ad.example.com@AD.DOMAIN
```

To verify a one-way trust from the IdM side:

1. Request a ticket for an Active Directory user:

   ```
   [root@ipaserver ~]# kinit user@AD.DOMAIN
   ```

2. Request service tickets for a service within the IdM domain:

   ```
   [root@ipaserver ~]# kvno -S host ipaserver.example.com
   ```

If the AD service ticket is successfully granted, there is a cross-realm ticket-granting ticket (TGT) listed with all of the other requested tickets. The TGT is named `krbtgt/IPA.DOMAIN@AD.DOMAIN`.

```
[root@ipaserver ]# klist
Ticket cache: KEYRING:persistent:0:krb_ccache_hRtox00
Default principal: jsmith@AD.DOMAIN

Valid starting   Expires             Service principal
03.05.2016 18:31:06  04.05.2016 04:31:01  host/ipaserver.ipa.example.com@IPA.DOMAIN
renew until 04.05.2016 18:31:00
03.05.2016 18:31:06  04.05.2016 04:31:01  krbtgt/IPA.DOMAIN@AD.DOMAIN
renew until 04.05.2016 18:31:00
03.05.2016 18:31:01  04.05.2016 04:31:01  krbtgt/AD.DOMAIN@AD.DOMAIN
renew until 04.05.2016 18:31:00
```

The `localauth` plug-in maps Kerberos principals to local SSSD user names. This allows AD users to use Kerberos authentication and access Linux services, which support GSSAPI authentication directly.

**NOTE**

For more information about the plug-in, see Section 5.3.7.1, “Using SSH Without Passwords”.

### 5.2.2.2. Creating a Two-Way Trust with a Shared Secret
A shared secret is a password that is known to trusted peers and can be used by other domains to join the trust. Two-way trusts within Active Directory can be configured with a shared secret. In AD, the shared secret is stored as a trusted domain object (TDO) within the trust configuration.

**NOTE**

The shared secret password can only be used to create a two-way trust. To establish a one-way trust, use administrator credentials.

IdM supports creating a two-way trust using a shared secret instead of the AD administrator credentials. Setting up such a trust requires the administrator to create the shared secret in AD and manually validate the trust on the AD side.

To create a two-way trust with a shared secret:

1. Prepare the IdM server for the trust, as described in Section 5.2.2.1.1, “Preparing the IdM Server for Trust”.

2. Configure a trust in the Active Directory Domains and Trusts console. Use these settings:
   - Right-click the appropriate domain, and choose Properties.
   - Navigate to the Trusts tab, and click the New Trust button.
   - Enter the IdM DNS name. For example, idm.example.com.
   - On the Trust Type page, select Forest trust.
   - On the Direction of Trust page, choose Two-way.
   - On the Sides of Trust page, select This domain only.
   - Set the Trust Password.

   **NOTE**
   
The same password must be used when configuring the trust in IdM.

   When asked to confirm the incoming trust, select No.

3. Create a trust agreement, as described in Section 5.2.2.1.2, “Creating a Trust Agreement”.

   When running the ipa trust-add command, use the --type, --trust-secret and --two-way=True options, and omit the --admin option. For example:

   ```bash
   [root@ipaserver ~]# ipa trust-add --type=ad ad.example.com --trust-secret --two-way=True
   Shared secret for the trust: _____________________________________________
   Added Active Directory trust for realm "ad.example.com"
   _____________________________________________
   Realm-Name: ad.example.com
   Domain NetBIOS name: AD
   Domain Security Identifier: S-1-5-21-796215754-1239681026-23416912```
4. On the IdM server, verify that the trust relationship is established by using the `ipa trust-show` command.

```
[root@ipaserver ~]# ipa trust-show ad.example.com
```

Domain NetBIOS name: AD
Domain Security Identifier: S-1-5-21-796215754-1239681026-23416912
Trust direction: Trusting forest
Trust type: Active Directory domain
Trust status: Waiting for confirmation by remote side

**NOTE**

Before running `ipa trust-show`, you might be required to run the `ipa trust-fetch-domains ad_domain` command to ensure you obtain a Common Internet File System (CIFS) ticket-granting ticket.

5. Verify the Kerberos configuration, as described in Section 5.2.2.1.3, “Verifying the Kerberos Configuration”.

### 5.2.2.3. Creating a Trust on an Existing IdM Instance

When configuring a trust for an existing IdM instance, certain settings for the IdM server and entries within its domain are already configured. However, you must set the DNS configuration for the Active Directory domain and assign Active Directory SIDs to all existing IdM users and groups.

1. Prepare the IdM server for the trust, as described in Section 5.2.2.1.1, “Preparing the IdM Server for Trust”.

2. Create a trust agreement, as described in Section 5.2.2.1.2, “Creating a Trust Agreement”.

3. Generate SIDs for each IdM user.
NOTE

Do not perform this step if the SIDs were generated when the `ipa-adtrust-install` utility was used to establish the trust.

a. Add a new `ipaNTSecurityIdentifier` attribute, containing a SID, automatically for each entry by running the `ipa-sidgen-task` operation on the back-end LDAP directory.

```
[root@ipaserver ]# ldapmodify -x -H ldap://ipaserver.ipa.example.com:389 -D "cn=directory manager" -w password -f

dn: cn=sidgen,cn=ipa-sidgen-task,cn=tasks,cn=config
changetype: add
objectClass: top
objectClass: extensibleObject
cn: sidgen
nsslapd-basedn: dc=ipadomain,dc=com
delay: 0

adding new entry "cn=sidgen,cn=ipa-sidgen-task,cn=tasks,cn=config"
```

b. After the task completes successfully, a message is recorded in the error logs that the SID generation task (Sidgen task) finished with a status of zero (0).

```
[root@ipaserver ]# grep "sidgen_task_thread" 
/var/log/dirsrv/slapd-IDM-EXAMPLE-COM/errors
[20/Jul/2012:18:17:16 +051800] sidgen_task_thread - [file
ipa_sidgen_task.c, line 191]: Sidgen task starts ...
[20/Jul/2012:18:17:16 +051800] sidgen_task_thread - [file
ipa_sidgen_task.c, line 196]: Sidgen task finished [0].
```

4. Verify the Kerberos configuration, as described in Section 5.2.2.1.3, "Verifying the Kerberos Configuration".

5.2.2.4. Adding a Second Trust

When adding a trust on an IdM server that already has one or more trust agreements configured, certain general IdM trust settings, such as installing the trust-related packages or configuring SIDs, is no longer required. To add an additional trust, you only must configure DNS and establish a trust agreement.

1. Make sure that DNS is properly configured, as described in Section 5.2.1.2, "DNS and Realm Settings".

2. Create a trust agreement, as described in Section 5.2.2.1.2, "Creating a Trust Agreement".

5.2.2.5. Creating a Trust in the Web UI

Before creating a trust in the web UI, prepare the IdM server for the trust. This trust configuration is easiest to perform from the command line, as described in Section 5.2.2.1.1, "Preparing the IdM Server for Trust".

Once the initial configuration is set, a trust agreement can be added in the IdM web UI:
1. Open the IdM web UI:

   https://ipaserver.example.com

2. Open the **IPA Server** main tab, and select the **Trusts** subtab.

3. In the **Trusts** subtab, click **Add** to open the new trust configuration window.

4. Fill in the required information about the trust:
   
   a. Provide the AD domain name in the **Domain** field.
   
   b. To set up the trust as two-way, select the **Two-way trust** check box. To set up the trust as one-way, leave **Two-way trust** unselected.

      For more information about one-way and two-way trusts, see *Section 5.1.4, “One-Way and Two-Way Trusts”*.

   c. To establish an external trust to a domain in another forest, select the **External Trust** check box.

      For more information, see *Section 5.1.5, “External Trusts to Active Directory”*.

   d. The **Establish using** section defines how the trust is to be established:

      - To establish the trust using the AD administrator's user name and password, select **Administrative account** and provide the required credentials.

      - Alternatively, to establish the trust with a shared password, select **Pre-shared password** and provide the trust password.

   e. Define the ID configuration for the trust:

      - The **Range type** option allows you to choose the ID range type. If you want IdM to automatically detect what kind of ID range to use, select **Detect**.

      - To define the starting ID of the ID range, use the **Base ID** field. To define the size of the ID range, use the **Range size** field. If you want IdM to use default values for the ID range, do not specify these options.

      For more information about ID ranges, see *the section called “ID Ranges”*. 
5. Click Add to save the new trust.

After this, verify the Kerberos configuration, as described in Section 5.2.2.1.3, “Verifying the Kerberos Configuration”.

5.2.3. Post-installation Considerations for Cross-forest Trusts

5.2.3.1. Potential Behavior Issues with Active Directory Trust

5.2.3.1.1. Active Directory Users and IdM Administration

Active Directory users exist only within the AD domain. Because they do not exist within IdM, they cannot be administrators for IdM. They also cannot use any IdM administrative tools, including the IdM web UI and command-line utilities.
Additionally, AD users currently cannot manage their own ID overrides. Only IdM users can add and manage ID overrides.

5.2.3.1.2. Authenticating Deleted Active Directory Users

By default, every IdM client uses the SSSD service to cache user identities and credentials. If the IdM or AD back-end provider is temporarily unavailable, SSSD enables the local system to reference identities for users who have already logged in successfully once.

Because SSSD maintains a list of users locally, changes that are made on the back end might not be immediately visible to clients that run SSSD offline. On such clients, users who have previously logged into IdM resources and whose hashed passwords are stored in the SSSD cache are able to log in again even if their user accounts have been deleted in AD.

If the above conditions are met, the user identity is cached in SSSD, and the AD user is able to log into IdM resources even if the user account is deleted AD. This problem will persist until SSSD becomes online and is able to verify AD user logon against AD domain controllers.

If the client system runs SSSD online, the password provided by the user is validated by an AD domain controller. This ensures that deleted AD users are not allowed to log in.

5.2.3.1.3. Credential Cache Collections and Selecting Active Directory Principals

The Kerberos credentials cache attempts to match a client principal to a server principal based on the following identifiers in this order:

1. service name
2. host name
3. realm name

When the client and server mapping is based on the host name or real name and credential cache collections are used, unexpected behavior can occur in binding as an AD user. This is because the realm name of the Active Directory user is different than the realm name of the IdM system.

If an AD user obtains a ticket using the `kinit` utility and then uses SSH to connect to an IdM resource, the principal is not selected for the resource ticket. An IdM principal is used because the IdM principal matches the realm name of the resource.

For example, if the AD user is Administrator and the domain is ADEXAMPLE.ADREALM, the principal is Administrator@ADEXAMPLE.ADREALM.

```
[root@server ~]# kinit Administrator@ADEXAMPLE.ADREALM
Password for Administrator@ADEXAMPLE.ADREALM:
[root@server ~]# klist
Ticket cache: KEYRING:persistent:0:0
Default principal: Administrator@ADEXAMPLE.ADREALM
Valid starting Expires Service principal
krbtgt/ADEXAMPLE.ADREALM@ADEXAMPLE.ADREALM
renew until 28.11.2015 11:25:16
```

This is set as the default principal in the Active Directory ticket cache. However, if any IdM user also has a Kerberos ticket (such as admin), then there is a separate IdM credentials cache, with an IdM default
principal. That IdM default principal is selected for a host ticket if the Active Directory user uses SSH to connect to a resource.

```
[root@vm-197 ~]# ssh -l Administrator@adexample.adrealm
ipaclient.example.com
Administrator@adexample.adrealm@ipaclient.example.com's password:
```

```
[root@vm-197 ~]# klist -A
Ticket cache: KEYRING:persistent:0:0
Default principal: Administrator@ADEXAMPLE.ADREALM

Valid starting       Expires              Service principal
krbtgt/ADEXAMPLE.ADREALM@ADEXAMPLE.ADREALM
  renew until 28.11.2015 11:25:16

Ticket cache: KEYRING:persistent:0:0
Default principal: admin@EXAMPLE.COM >>>>> IdM user

Valid starting       Expires              Service principal
27.11.2015 11:25:18  28.11.2015 11:25:16  krbtgt/EXAMPLE.COM@EXAMPLE.COM
host/ipaclient.example.com@EXAMPLE.COM >>>>> host principal
```

This is because the realm name of the IdM principal matches the realm of the IdM resource.

5.2.3.1.4. Resolving Group SIDs

Losing Kerberos Tickets
Running a command to obtain a SID from the Samba service, such as `net getlocalsid` or `net getdomainsid`, removes any existing admin ticket from the Kerberos cache.

**NOTE**

You are not required to run commands such as `net getlocalsid` or `net getdomainsid` in order to use Active Directory trusts.

Cannot Verify Group Membership for Users
It is not possible to verify that a specific trusted user is associated with a specific IdM group, external or POSIX.

Cannot Display Remote Active Directory Group Memberships for an Active Directory User

**IMPORTANT**

Note that this problem no longer occurs if the IdM server and client run on Red Hat Enterprise Linux 7.1 or later.

The `id` utility can be used to display local group associations for Linux system users. However, `id` does not display Active Directory group memberships for Active Directory users, even though Samba tools do display them.
To work around this, you can use the `ssh` utility to log into an IdM client machine as the given AD user. After the AD user logs in successfully for the first time, the `id` search detects and displays the AD group memberships:

```
[root@ipaserver ~]# id ADDOMAIN\jsmith
uid=1921801107(jsmith@ad.example.com)
gid=1921801107(jsmith@ad.example.com)
groups=1921801107(jsmith@ad.example.com),129600004(ad_users),1921800513(domain users@ad.example.com)
```

### 5.2.3.2. Configuring Trust Agents

To configure a normal IdM master to serve as a trust agent:

1. Run the `ipa-adtrust-install --add-agents` command on a trust controller. The command enters interactive configuration session and prompts you for the information required to set up the agent.

   For more information about the `--add-agents` option, see the `ipa-adtrust-install(1)` man page.

2. Restart the LDAP service.

For more information about trust agents, see Section 5.1.6, “Trust Controllers and Trust Agents”.

### 5.3. MANAGING AND CONFIGURING A CROSS-FOREST TRUST ENVIRONMENT

#### 5.3.1. User Principal Names in a Trusted Domains Environment

IdM supports the logging in using user principal names (UPN). A UPN is an alternative to the user name to authenticate with, and has the format `username@KERBEROS-REALM`. In an Active Directory forest it is possible to configure additional UPN suffixes. These enterprise principal names are used to provide alternative logins to the default UPN.

For example, if a company uses the Kerberos realm `AD.EXAMPLE.COM`, the default UPN for a user is `user@ad.example.com`. However often a company want instead their users to be able to log in using their email addresses, like `user@example.com`. In this case the administrator adds an additional UPN suffix `example.com` to the Active Directory forest and sets the new suffix in the user’s account properties.

When you add or remove UPN suffixes in a trusted AD forest, you have to refresh the information for the trusted forest on the IdM master:

```
[root@ipaserver ~]# ipa trust-fetch-domains
Realm-Name: ad.example.com
-----------------------------
No new trust domains were found
-----------------------------
Number of entries returned 0
-----------------------------
```

Verify that the alternative UPN was fetched, by running:
The UPN suffixes for a domain are stored in the multi-value attribute `ipaNTAdditionalSuffixes` in the `cn=trusted_domain_name,cn=ad,cn=trusts,dc=idm,dc=example,dc=com` subtree.

### 5.3.2. IdM Clients in an Active Directory DNS Domain

In some environments with trusts between IdM and Active Directory, you can configure users to access an IdM client using a host name from the Active Directory DNS domain, while the client itself is joined to IdM to benefit from its Linux-focused features.

**IMPORTANT**

This is not a recommended configuration and has some limitations. Red Hat recommends to always deploy IdM clients in a DNS zone different from the ones owned by Active Directory and access IdM clients through their IdM host names.

#### 5.3.2.1. Kerberos Single Sign-on to the IdM Client is not Required

For IdM clients set up in the Active Directory DNS domain, only password authentication is available to access resources on this IdM host. To configure the client for this scenario:

1. To ensure that the System Security Service Daemon (SSSD) on the client can communicate with the IdM servers, install the IdM client with the `--domain=IPA_DNS_Domain` option:

   ```
   [root@idm-client.ad.example.com ~]# ipa-client-install --domain=idm.example.com
   ```

   This option disables the SRV record auto-detection for the Active Directory DNS domain.

2. Locate the existing mapping for the Active Directory domain in the `domain_realm` section of the `/etc/krb5.conf` configuration file:

   ```
   .ad.example.com = IDM.EXAMPLE.COM
   ad.example.com = IDM.EXAMPLE.COM
   ```

   Replace both lines with a mapping entry for the Linux clients fully qualified domain name (FQDN) in the Active Directory DNS zone to the IdM realm:

   ```
   idm-client.ad.example.com = IDM.EXAMPLE.COM
   ```

   Replacing the default mapping prevents Kerberos from sending its requests for the Active Directory domain to the IdM Kerberos Distribution Center (KDC). Instead Kerberos uses auto-discovery through SRV DNS records to locate the KDC. Only for the added host `idm-client.ad.example.com` the IdM KDC is set.
NOTE

Authenticating to resources on clients that are not within an IdM-owned DNS zone is only possible by using user name and password.

Handling of SSL certificates

SSL-based services require a certificate with dNSName extension records that cover all system host names, because both original (A/AAAA) and CNAME records must be in the certificate. Currently, IdM only issues certificates to host objects in the IdM database.

In the described setup without single sign-on available, IdM already has a host object for the FQDN in the database, and certmonger can request a certificate for this name:

```
[root@idm-client.ad.example.com ~]# ipa-getcert request -r -f /etc/httpd/alias/server.crt -k /etc/httpd/alias/server.key -N CN=ipa-client.ad.example.com -D ipa-client.ad.example.com -K host/idm-client.ad.example.com@IDM.EXAMPLE.COM -U id-kp-serverAuth
```

The certmonger service uses the default host key stored in the /etc/krb5.keytab file to authenticate to the IdM Certificate Authority (CA).

5.3.2.2. Kerberos Single Sign-on to the IdM Client is Required

If you require Kerberos single sign-on to access resources on the IdM client, the client must be within the IdM DNS domain, for example idm-client.idm.example.com. You must create a CNAME record idm-client.ad.example.com in the Active Directory DNS domain pointing to the A/AAAA record of the IdM client.

For Kerberos-based application servers, MIT Kerberos supports a method to allow the acceptance of any host-based principal available in the application's keytab. To disable the strict checks on what Kerberos principal was used to target the Kerberos server, set the following option in the [libdefaults] section of the /etc/krb5.conf configuration file:

```
[libdefaults]
ignore_acceptorHostname = true
```

Handling of SSL certificates

SSL-based services require a certificate with dNSName extension records that cover all system host names, because both original (A/AAAA) and CNAME records must be in the certificate. Currently, IdM only issues certificates to host objects in the IdM database.

In the described setup without single sign-on available, IdM already has a host object for the FQDN in the database, and certmonger can request a certificate for this name:

1. Create a new host object:

   ```
   [root@idm-server.idm.example.com ~]# ipa host-add idm-client.ad.example.com --force
   ```

   Use the --force option, because the host name is a CNAME and not an A/AAAA record.

2. Allow the IdM DNS host name to manage the Active Directory host entry in the IdM database:
With this setup, the IdM client can request an SSL certificate with dNSName extension record for its host name within the Active Directory DNS domain:

```
[root@idm-client.idm.example.com ~]# ipa-getcert request -r \ 
   -f /etc/httpd/alias/server.crt \ 
   -k /etc/httpd/alias/server.key \ 
   -N CN=`hostname --fqdn` \ 
   -D `hostname --fqdn` \ 
   -D idm-client.ad.example.com \ 
   -K host/idm-client.idm.example.com@IDM.EXAMPLE.COM \ 
   -U id-kp-serverAuth
```

### 5.3.3. Creating IdM Groups for Active Directory Users

User groups are required to set access permissions, host-based access control, sudo rules, and other controls on IdM users. These groups are what grant access to IdM domain resources, as well as restricting access.

Both AD users and AD groups can be added directly to IdM user groups. To do that, first add the AD users or groups to a non-POSIX IdM external group and then to a local IdM POSIX group. The POSIX group can then be used for user and role management of the AD users. The principles of handling non-POSIX groups in IdM are described in Section 5.1.3.2, “Active Directory Users and Identity Management Groups”.

**NOTE**

It is also possible to add AD user groups as members to IdM external groups. This might make it easier to define policies for Windows users, by keeping the user and group management within the single AD realm.

1. **Optional.** Create or select the group in the AD domain to use to manage AD users in the IdM realm. Multiple groups can be used and added to different groups on the IdM side.

2. Create an external group in the IdM domain for the Active Directory users by adding the `--external` option to the `ipa group-add` command. The `--external` option indicates that this group is intended to contain members from outside the IdM domain. For example:

   ```
   [root@ipaserver ~]# ipa group-add --desc='AD users external map' \ 
   ad_users_external --external
   -------------------------------
   Added group "ad_users_external"
   -------------------------------
   
   Group name: ad_users_external
   Description: AD users external map
   ```

3. Create a new IdM POSIX group or select an existing one for administering the IdM policies. For example, to create a new group:

   ```
   [root@ipaserver ~]# ipa group-add --desc='AD users' ad_users
   ```
Added group "ad_users"

Group name: ad_users
Description: AD users
GID: 129600004

4. Add the AD users or groups to the IdM external group as an external member. The AD member is identified by its fully-qualified name, such as `DOMAIN\group_name` or `DOMAIN\username`. The AD identity is then mapped to the Active Directory SID for the user or group.

For example, for an AD group:

```
[root@ipaserver ~]# ipa group-add-member ad_users_external --external "AD\Domain Users"
[member user]:
[member group]:
  Group name: ad_users_external
  Description: AD users external map
  External member: S-1-5-21-3655990580-1375374850-1633065477-513
  SID_DOM_GROUP (2)

Number of members added 1
```

5. Add the external IdM group to the POSIX IdM group as a member. For example:

```
[root@ipaserver ~]# ipa group-add-member ad_users --groups ad_users_external
  Group name: ad_users
  Description: AD users
  GID: 129600004
  Member groups: ad_users_external

Number of members added 1
```

**5.3.4. Maintaining Trusts**

Trust management involves several areas, such as global trust configuration, Kerberos trust configuration, DNS realm configuration, or ID ranges assignment to Active Directory users.

**5.3.4.1. Editing the Global Trust Configuration**

The `ipa-adtrust-install` utility automatically configures background information for the IdM domain which is required to create a trust with the Active Directory domain.

The global trust configuration contains five attributes:

- A Windows-style security ID (SID); this attribute is autogenerated and cannot be modified
- A domain GUID; this attribute is autogenerated and cannot be modified
- A Kerberos domain name; this attribute comes from the IdM configuration and cannot be modified
- The default group to which to add IdM users; this attribute can be modified
- The NetBIOS name; it is not recommended to modify this attribute

The trust configuration is stored in the `cn=domain,cn=ad,cn=etc,dc=example,dc=com` subtree.

### 5.3.4.1.1. Changing the NetBIOS Name

**IMPORTANT**

Changing the NetBIOS name in most cases requires to re-establish all existing trusts. Therefore, Red Hat recommends not to change the attribute.

A NetBIOS name compatible within an Active Directory topology is configured for the IdM server when running the `ipa-adtrust-install` utility. To change it later, run `ipa-adtrust-install` again and specify the new NetBIOS name using the `--netbios-name` option:

```
[root@ipaserver ]# ipa-adtrust-install --netbios-name=NEWBIOSNAME
```

### 5.3.4.1.2. Changing the Default Group for Windows Users

When Identity Management is configured to trust an Active Directory forest, an MS-PAC record is added to the Kerberos tickets of IdM users. An MS-PAC record contains security identifiers (SIDs) of the groups to which an IdM user belongs. If the primary group of the IdM user has no SID assigned, the value of the security identifier defined for the Default SMB Group will be used. The same logic is applied by the Samba suite when the AD domain controller requests user information from the IdM trust controller.

The Default SMB Group is a fallback group created automatically by the `ipa-adtrust-install` utility. The default group cannot be deleted, but you can use the global trust configuration to specify another IdM group to be used as a fallback for the primary group of the IdM users.

To set the default group from the command line, use the `ipa trustconfig-mod` command:

```
[root@server ~]# kinit admin
[root@server ~]# ipa trustconfig-mod --fallback-primary-group="Example Windows Group"
```

To set the default group from the IdM web UI:

1. Open the IdM web UI.

   ```
   https://ipaserver.example.com
   ```

2. Under the **IPA Server** main tab, select the **Trusts** subtab, and then open the **Global Configuration** section.

3. Select a new group from all of the IdM groups in the **Fallback primary group** drop-down list.
5.3.4.2. Discovering, Enabling, and Disabling Trust Domains

A transitive trust means that the trust path can follow a chain of domains. It is described in more detail in Section 5.1.1, “The Architecture of a Trust Relationship”.

IdM has a trust with the root domain in a forest, and due to transitivity, all of its subdomains and trusted domains are implicitly included in that trust. IdM follows that topology as Windows users from anywhere in the forest attempt to access IdM resources. Each domain and subdomain is a trust domain in the IdM trust configuration. Each domain is stored in its own entry, `cn=subdomain,cn=trust_name,cn=ad,cn=trusts,dc=example,dc=com` in the trusts subtree.

IdM attempts to discover and map the full Active Directory topology when the trust is first configured, although in some cases it is required or beneficial to retrieve that topology manually. That is done with the `trust-fetch-domains` command:

```
[root@ipaserver ~]# kinit admin
[root@ipaserver ~]# ipa trust-fetch-domains ad.example.com
--------------------------------------------
List of trust domains successfully refreshed
--------------------------------------------
Realm name: test.ad.example.com
Domain NetBIOS name: TEST
Domain Security Identifier: S-1-5-21-87535643-5658642561-5780864324
```
Realm name: users.ad.example.com
Domain NetBIOS name: USERS
Domain Security Identifier: S-1-5-21-91314187-2404433721-1858927112

Realm name: prod.ad.example.com
Domain NetBIOS name: PROD
Domain Security Identifier: S-1-5-21-46580863-3346886432-4578854233

Number of entries returned 3

NOTE

When adding a trust with a shared secret, you need to manually retrieve topology of the AD forest. After running the `ipa trust-add ad.domain --trust-secret` command, validate incoming trust at AD side using forest trust properties in the AD Domains and Trusts tool. Then, run the `ipa trust-fetch-domains ad.domain` command. IdM will receive information about the trust, which will then be usable.

Once the topology is retrieved (through automatic or manual discovery), individual domains and subdomains in that topology can be enabled, disabled, or removed entirely within the IdM trust configuration.

For example, to disallow users from a specific subdomain from using IdM resources, disable that trust domain:

```
[root@ipaserver ~]# kinit admin
[root@ipaserver ~]# ipa trustdomain-disable test.ad.example.com

Disabled trust domain "test.ad.example.com"
```

That trust domain can be re-enabled using the `trustdomain-enable` command.

If a domain should be permanently removed from the topology, then it can be deleted from the IdM trust configuration.

```
[root@ipaserver ~]# kinit admin
[root@ipaserver ~]# ipa trustdomain-del prod.ad.example.com

Removed information about the trusted domain "prod.ad.example.com"
```

5.3.4.3. Viewing and Managing DNS Realms

When a trust is created, the Active Directory DNS configuration is added to the IdM DNS configuration, with each realm being added as a special `realm domain`. Each domain is stored in the `cn=Realm Domains,cn=ipa,cn=etc,dc=example,dc=com` subtree in the IdM directory.

Since these realm domains are added automatically, the DNS zones do not generally need to be added or modified. The list of configured realm domains can be displayed (instead of listing all DNS zones configured in IdM) using the `realmdomains-show` command.
If a single realm domain should be added to the configuration, this can be done with the \texttt{-add-domain} option.

A single domain can be removed using the \texttt{-del-domain} option.

If there are multiple changes to be made to the list of domains, the list itself can be modified and replaced using the \texttt{-domain} option.

### 5.3.4.4. Adding Ranges for UID and GID Numbers in a Transitive Trust

Creating ID ranges at the time when a trust is originally configured is described in the section called “ID Ranges”. To add an ID range later, use the \texttt{ipa idrange-add} command with the following options:

- the \texttt{-base-id} option sets the base ID for the POSIX range, which is the starting number
- the \texttt{-range-size} option sets the size of the range
- the \texttt{-rid-base} option sets the starting number of the RID, which is the far-right number in the SID; the value represents the range to add to the base ID to prevent conflicts
- the \texttt{-dom-sid} option sets the domain SID, because there can be multiple domains configured for trusts

In the following example, the base ID is 1,200,000 and the RID is 1,000. The resulting ID number is then 1,201,000.

### 5.3.4.5. Kerberos Flags for Services and Hosts

Accessing services or hosts in a trusted domain can require special flags for the Kerberos ticket-granting ticket (TGT). For example, if you want to log in using single sign-on to an IdM client with an Active Directory (AD) account from an AD client, the Kerberos TGT flag \texttt{OK_AS_DELEGATE} is required.
For more information and how to set Kerberos flags, see Kerberos Flags for Services and Hosts in the Linux Domain Identity, Authentication, and Policy Guide.

5.3.5. Setting PAC Types for Services

On IdM resources, if an Active Directory user requests a ticket for a service, then IdM forwards the request to Active Directory to retrieve the user information. Access data, associated with the Active Directory group assignments for the user, is sent back by Active Directory and embedded in the Kerberos ticket.

Group information in Active Directory is stored in a list of identifiers in each Kerberos ticket for Active Directory users in a special data set called privileged access certificates or MS-PAC. The group information in the PAC has to be mapped to the Active Directory groups and then to the corresponding IdM groups to help determine access.

IdM services can be configured to generate PACs for each authentication request when a user first attempts to authenticate to a domain service.

5.3.5.1. Setting Default PAC Types

The IdM server configuration defines which PAC types are generated by default for a service. The global settings can be overridden by changing the local settings on a specific service.

1. Open the IPA Server tab.
2. Select the Configuration subtab.
3. Scroll to the Service Options area.

<table>
<thead>
<tr>
<th>Service Options</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Default PAC types</strong></td>
</tr>
</tbody>
</table>

Figure 5.7. The Service Options Area

4. To use PAC, select the MS-PAC check box, which adds a certificate that can be used by AD services. If no check box is selected, then no PAC is added to Kerberos tickets.

If you select the nfs:NONE check box, the MS-PAC record will not be added to the service tickets issued against NFS servers.

**NOTE**

You can ignore the PAD check box. This functionality is not yet available in IdM.

5. Click the Update link at the top of the page to save the changes.

5.3.5.2. Setting PAC Types for a Service
The global policy sets what PAC types to use for a service if nothing is set explicitly for that service. However, the global settings can be overridden on the local service configuration.

To change the PAC setting from the command line, use the `ipa service-mod` command with the `--pac-type` option. For information on how to use the command, run it with the `--help` option added:

```
$ ipa service-mod --help
Usage: ipa [global-options] service-mod PRINCIPAL [options]
Modify an existing IPA service.
Options:
    -h, --help            show this help message and exit
```

To change the PAC setting in the web UI:

1. Open the Identity tab, and select the Services subtab.
2. Click the name of the service to edit.
3. In the Service Settings area, check the Override inherited settings option and then select the MS-PAC check box to add a certificate that can be used by AD services.

![Service Settings](image)

**Figure 5.8. The Service Settings Area**

If no check box is selected, then no PACs are added to Kerberos tickets.

**NOTE**

You can ignore the PAD check box. This functionality is not yet available in IdM.

4. Click the Update link at the top of the page to save the changes.

5.3.6. Using POSIX Attributes Defined in Active Directory
5.3.6.1. Defining UID and GID Attributes for Active Directory Users

If the Windows administrator manually defines POSIX UID and GID attributes for a user, create a matching group on the IdM server with the same GID for the user.

Creating the group ensures that the user is associated with a primary user group. If such group does not exist, the IdM server is unable to look up all groups to which the user belongs.

5.3.6.2. Transferring Login Shell and Home Directory Attributes

**IMPORTANT**

The client must be enrolled with an IdM server based on Red Hat Enterprise Linux 7.1 or later to benefit from this functionality.

SSSD is able to read the following attribute values from an Active Directory server in a trust relationship with IdM:

- the `loginShell` attribute, which specifies the AD user's shell
- the `unixHomeDirectory` attribute, which specifies the AD user's home directory

When a custom shell or home directory value is defined on the AD server using these attributes, the custom value is then displayed to the IdM client for the AD user. Therefore, the same user shell is displayed for the AD user both on the AD side and on the IdM side.

Note that to display the AD user's home directory to the IdM client, the `subdomain_homedir` option in the `[domain]` section of the `/etc/sssd/sssd.conf` file on the IdM server must be set to `%o`. The `%o` value represents the home directory retrieved from the identity provider. For example:

```
[domain/example.com]
subdomain_homedir = %o
```

If the AD administrator modifies `loginShell` or `unixHomeDirectory` on the AD side, the change is automatically reflected on the IdM side as well. If the attributes are not defined on the AD server, SSSD uses a template default value. This default value is then displayed to the IdM client.

5.3.7. Using SSH from Active Directory Machines for IdM Resources

When a trust is configured, Active Directory users can access machines, services, and files on IdM hosts using SSH and their AD credentials.

5.3.7.1. Using SSH Without Passwords

The `localauth` Kerberos plug-in for local authorization ensures that Kerberos principals are automatically mapped to local SSSD user names. With `localauth`, Windows users from a trusted AD domain are not prompted for a password when logging in using Kerberos and can therefore use SSH without passwords.

The plug-in provides a reliable mapping mechanism across multiple realms and trusts: when `sssd` connects to the Kerberos library to map the principal to a local POSIX identity, the SSSD plug-in maps them according to the trust agreements defined in IdM.
Kerberos Authentication for AD Users on Red Hat Enterprise Linux 7.1 and newer Systems

In Red Hat Enterprise Linux 7.1 and newer systems, SSSD automatically configures the localauth Kerberos plug-in.

SSSD allows user names in the format user@AD.DOMAIN, ad.domain\user and AD\user.

NOTE

On systems with localauth, it is not required to set the auth_to_local option in the /etc/krb5.conf file or list Kerberos principals in the .k5login file. The localauth plug-in makes this previously used configuration for logins without passwords obsolete.

Manual Configuration of Kerberos Authentication for AD Users

On systems where the localauth plug-in is not present, SSH prompts for a user password for Active Directory domain users even if the user obtains a proper Kerberos ticket.

To enable Active Directory users to use Kerberos for authentication in this situation, configure the auth_to_local option in the /etc/krb5.conf file or list the user Kerberos principals in the .k5login file in the home directory of the user.

Configuring /etc/krb5.conf

The following procedure describes how to configure realm mapping in the Kerberos configuration.

1. Open the /etc/krb5.conf file.

2. In the [realms] section, identify the IdM realm by name, and then add two auth_to_local lines to define the Kerberos principal name mapping:
   - In one rule, include a rule to map different Active Directory user name formats and the specific Active Directory domain.
   - In the other rule, set the value of DEFAULT, for standard Unix user names.

For example:

```
[realms]
IDM = {
   ...
   auth_to_local = RULE:[1:$1@$0]
   (^.*@ADDOMAIN$)s/@ADDOMAIN/@addomain/
   auth_to_local = DEFAULT
}
```

3. Restart the KDC service.

```
[root@server ~]# systemctl restart krb5kdc.service
```

Note that if you configure Kerberos authentication using the auth_to_local option, the user name used for SSH access must meet the following criteria:

- The user name must have the format ad_user@ad_domain.
The domain name must be lowercase.

- The case of the user name must match the case of the user name in Active Directory. For example, user and User are considered different users because of the different cases.

For more information about setting auth_to_local, see the krb5.conf(5) man page.

Configuring .k5login

The following procedure configures the system to find the Kerberos principal name for a local user name.

1. Create the .k5login file in the user's home directory.
2. List the Kerberos principals used by the user in the file.

If the authenticating user matches the principal in an existing Kerberos ticket, the user is allowed to log in using the ticket and is not prompted for a password.

Note that if you configure Kerberos authentication using the .k5login configuration, the user name used for SSH access must have the format ad_user@ad_domain.

For more information about configuring the .k5login file, see the .k5login(5) man page.

Either one of these configuration procedures results in AD users being able to log in using Kerberos.

5.3.8. Using a Trust with Kerberos-enabled Web Applications

Any existing web application can be configured to use Kerberos authentication, which references the trusted Active Directory and IdM Kerberos realms. For the full Kerberos configuration directives, see the Configuration page for the mod_auth_kerb module.

NOTE

After changing the Apache application configuration, restart the Apache service:

    [root@ipaserver ~]# systemctl restart httpd.service

For example, for an Apache server, there are several options that define how the Apache server connects to the IdM Kerberos realm:

KrbAuthRealms

The KrbAuthRealms option gives the application location to the name of the IdM domain. This is required.

Krb5Keytab

The Krb5Keytab option gives the location for the IdM server keytab. This is required.

KrbServiceName

The KrbServiceName option sets the Kerberos service name used for the keytab (HTTP). This is recommended.
**KrbMethodK5Passwd and KrbMethodNegotiate**

The **KrbMethodK5Passwd** Kerberos method option enables password-based authentication for valid users. The **KrbMethodNegotiate** option enables single sign-on (SSO) if a valid Kerberos ticket is available.

These options are recommended for ease of use for many users.

**KrbLocalUserMapping**

The **KrbLocalUserMapping** option enables normal web logins (which are usually the UID or common name of the account) to be mapped to the fully-qualified user name (which has a format of *user@REALM.COM*).

This option is strongly recommended. Without the domain name/login name mapping, the web login appears to be a different user account than the domain user. This means that users cannot see their expected data.

For information on supported user name formats, see Section 5.2.1.7, "Supported User Name Formats".

---

**Example 5.1. Kerberos Configuration in an Apache Web Application**

```xml
<Location "/mywebapp"
  AuthType Kerberos
  AuthName "IPA Kerberos authentication"
  KrbMethodNegotiate on
  KrbMethodK5Passwd on
  KrbServiceName HTTP
  KrbAuthRealms IDM_DOMAIN
  Krb5Keytab /etc/httpd/conf/ipa.keytab
  KrbLocalUserMapping on
  KrbSaveCredentials off
  Require valid-user
</Location>
```

---

**5.4. CHANGING THE LDAP SEARCH BASE FOR USERS AND GROUPS IN A TRUSTED ACTIVE DIRECTORY DOMAIN**

As an administrator, you can set a different search base for users and groups in the trusted Active Directory domain. For example, this enables you to filter out users from inactive organizational units so that only active Active Directory users and groups are visible to the SSSD client system.

**5.4.1. Prerequisites**

- To ensure that SSSD does not resolve all groups the users belongs to, consider disabling the support for the **tokenGroups** attribute on the Active Directory side.

  With **tokenGroups** enabled, SSSD resolves all groups the user belongs to because the attribute contains a flat list of SIDs. See **Token-Groups attribute** on Microsoft Developer Network for details about the attribute.
5.4.2. Configuring the LDAP Search Base to Restrict Searches

This procedure describes restricting searches in SSSD to a specific subtree by editing the /etc/sssd/sssd.conf file.

Considerations

- If your SSSD clients are directly joined to an Active Directory domain, perform this procedure on all the clients.
- If your SSSD clients are in an Identity Management domain that is in a trust with Active Directory, perform this procedure only on the Identity Management server.

Procedure

1. Make sure the trusted domain has a separate [domain] section in sssd.conf. The headings of trusted domain sections follow this template:

   [domain/main_domain/trusted_domain]

   For example:

   [domain/idm.example.com/ad.example.com]

2. Edit the sssd.conf file to restrict the search base to a specific organizational unit (OU). For example, the ldap_search_base option changes the search base for all types of objects.

   [domain/idm.example.com/ad.example.com]
   ldap_search_base = ou=finance,dc=ad,dc=example,dc=com

   You can also use the ldap_user_search_base, ldap_group_search_base, ldap_netgroup_search_base, and ldap_service_search_base options. For more details on these options, see the sssd-ldap(5) man page.

3. Restart SSSD.

   # systemctl restart sssd.service

4. To verify, resolve a few Active Directory users on the SSSD client. For example, to test a change to the user search base and group search base:

   # getent passwd ad_user@ad.example.com
   # getent group ad_group@ad.example.com

   If SSSD is configured correctly, you are able to resolve only objects from the configured search base.

   If you are able to resolve users from other search domains, troubleshoot the problem by inspecting the SSSD logs:

   1. Expire the SSSD caches.

      # sss_cache --everything
2. In the general [domain] section of sssd.conf, set the debug_level option to 10.

3. Repeat the command for resolving a user.

4. In the SSSD logs at /var/log/sssd/, look for messages from the sdap_get_generic_* functions. The functions log the filter and search base used in user searches.

Additional Resources

- For a list of options you can use in trusted domain sections of sssd.conf, see Trusted domain section in the sssd.conf(5) man page.

5.5. RESTRICTING IDENTITY MANAGEMENT OR SSSD TO SELECTED ACTIVE DIRECTORY SERVERS OR SITES IN A TRUSTED ACTIVE DIRECTORY DOMAIN

As an administrator, you can disable autodiscovery of Active Directory servers and sites in the trusted Active Directory domain and instead list servers, sites, or both manually, so that you can limit the list of Active Directory servers that SSSD communicates with. For example, this enables you to avoid contacting sites that are not accessible.

5.5.1. Configuring SSSD to Contact a Specific Active Directory Server

This procedure describes manually setting Active Directory servers that SSSD connects to by editing the /etc/sssd/sssd.conf file.

Considerations

- If your SSSD clients are directly joined to an Active Directory domain, perform this procedure on all the clients.

In this setup, restricting the Active Directory domain controllers (DCs) or sites also configures the SSSD clients to connect to a particular server or site for authentication.

- If your SSSD clients are in an Identity Management domain that is in a trust with Active Directory, perform this procedure only on the Identity Management server.

In this setup, restricting the Active Directory DCs or sites does not configure the Identity Management clients to connect to a particular server or site for authentication. Although trusted Active Directory users and groups are resolved through Identity Management servers, authentication is performed directly against the Active Directory DCs. As of Red Hat Enterprise Linux 7.4, you can restrict authentication by defining the required Active Directory DCs in the /etc/krb5.conf file on the clients.

Procedure

1. Make sure the trusted domain has a separate [domain] section in sssd.conf. The headings of trusted domain sections follow this template:

   [domain/main_domain/trusted_domain]

   For example:

   [domain/idm.example.com/ad.example.com]
2. Edit the `sssd.conf` file to list the host names of the Active Directory servers or sites to which you want SSSD to connect.

Use the `ad_server` and, optionally, `ad_server_backup` options for Active Directory servers. Use the `ad_site` option for Active Directory sites. For more details on these options, see the `sssd-ad(5)` man page.

For example:

```plaintext
[domain/idm.example.com/ad.example.com]
ad_server = dc1.ad.example.com
```

3. Restart SSSD.

```plaintext
# systemctl restart sssd.service
```

4. To verify, on the SSSD client, resolve or authenticate as an Active Directory user from the configured server or site. For example:

```plaintext
# id ad_user@ad.example.com
```

If you are unable to resolve the user or authenticate, use these steps to troubleshoot the problem:

1. In the general [domain] section of `sssd.conf`, set the `debug_level` option to `10`.

2. Inspect the SSSD logs at `/var/log/sssd/` to see which servers SSSD contacted.

**Additional Resources**

- For a list of options you can use in trusted domain sections of `sssd.conf`, see `Trusted domain section` in the `sssd.conf(5)` man page.

**5.6. ACTIVE DIRECTORY TRUST FOR LEGACY LINUX CLIENTS**

Linux clients running Red Hat Enterprise Linux with SSSD version 1.8 or earlier (legacy clients) do not provide native support for IdM cross-forest trusts with Active Directory. Therefore, for AD users to be able to access services provided by the IdM server, the legacy Linux clients and the IdM server have to be properly configured.

Instead of using SSSD version 1.9 or later to communicate with the IdM server to obtain LDAP information, legacy clients use other utilities for this purpose, for example `nss_ldap`, `nss-pam-ldapd`, or SSSD version 1.8 or earlier. Clients running the following versions of Red Hat Enterprise Linux do not use SSSD 1.9 and are therefore considered to be legacy clients:

- Red Hat Enterprise Linux 5.7 or later
- Red Hat Enterprise Linux 6.0 – 6.3
IMPORTANT

Do not use the configuration described in this section for non-legacy clients, that is, clients running SSSD version 1.9 or later. SSSD 1.9 or later provides native support for IdM cross-forest trusts with AD, meaning AD users can properly access services on IdM clients without any additional configuration.

When a legacy client joins the domain of an IdM server in a trust relationship with AD, a *compat LDAP tree* provides the required user and group data to AD users. However, the compat tree enables the AD users to access only a limited number of IdM services.

Legacy clients do not provide access to the following services:

- Kerberos authentication
- host-based access control (HBAC)
- SELinux user mapping
- `sudo` rules

Access to the following services is provided even in case of legacy clients:

- information look-up
- password authentication

5.6.1. Server-side Configuration for AD Trust for Legacy Clients

Make sure the IdM server meets the following configuration requirements:

- The `ipa-server` package for IdM and the `ipa-server-trust-ad` package for the IdM trust add-on have been installed.
- The `ipa-server-install` utility has been run to set up the IdM server.
- The `ipa-adtrust-install --enable-compat` command has been run, which ensures that the IdM server supports trusts with AD domains and that the compat LDAP tree is available.
  
  If you have already run `ipa-adtrust-install` without the `--enable-compat` option in the past, run it again, this time adding `--enable-compat`.
- The `ipa trust-add ad.example.org` command has been run to establish the AD trust.

If the host-based access control (HBAC) `allow_all` rule is disabled, enable the `system-auth` service on the IdM server, which allows authentication of the AD users.

You can determine the current status of `allow_all` directly from the command line using the `ipa hbacrule-show` command. If the rule is disabled, `Enabled: FALSE` is displayed in the output:

```
[user@server ~]$ kinit admin
[user@server ~]$ ipa hbacrule-show allow_all
  Rule name: allow_all
  User category: all
  Host category: all
  Service category: all
```
Description: Allow all users to access any host from any host
Enabled: FALSE

NOTE
For information on disabling and enabling HBAC rules, see Configuring Host-Based Access Control in the Linux Domain Identity, Authentication, and Policy Guide.

To enable system-auth on the IdM server, create an HBAC service named system-auth and add an HBAC rule using this service to grant access to IdM masters. Adding HBAC services and rules is described in the Linux Domain Identity, Authentication, and Policy Guide. Note that HBAC services are PAM service names; if you add a new PAM service, make sure to create an HBAC service with the same name and then grant access to this service through HBAC rules.

5.6.2. Client-side Configuration Using the ipa-advise Utility

The ipa-advise utility provides the configuration instructions to set up a legacy client for an AD trust.

To display the complete list of scenarios for which ipa-advise can provide configuration instructions, run ipa-advise without any options. Running ipa-advise prints the names of all available sets of configuration instructions along with the descriptions of what each set does and when it is recommended to be used.

```
[root@server ~]# ipa-advise
config-redhat-nss-ldap : Instructions for configuring a system with nss-ldap as a IPA client.
   This set of instructions is targeted for platforms that include the authconfig utility, which are all Red Hat based platforms.
config-redhat-nss-pam-ldapd : Instructions for configuring a system
   (...)```

To display a set of instructions, run the ipa-advise utility with an instruction set as a parameter:

```
[root@server ~]# ipa-advise config-redhat-nss-ldap
#!/bin/sh
# --------------------------------------------------------------------
# Instructions for configuring a system with nss-ldap as a IPA client.
# This set of instructions is targeted for platforms that include the
# authconfig utility, which are all Red Hat based platforms.
# --------------------------------------------------------------------
# Schema Compatibility plugin has not been configured on this server. To
# configure it, run "ipa-adtrust-install --enable-compat"
# Install required packages via yum
yum install -y wget openssl nss_ldap authconfig

# NOTE: IPA certificate uses the SHA-256 hash function. SHA-256 was
# introduced in RHEL5.2. Therefore, clients older than RHEL5.2 will not
# be able to interoperate with IPA server 3.x.
# Please note that this script assumes /etc/openssl/cacerts as the
```
# default CA certificate location. If this value is different on your
# system the script needs to be modified accordingly.
# Download the CA certificate of the IPA server
mkdir -p -m 755 /etc/openldap/cacerts
wget http://idm.example.com/ipa/config/ca.crt -O
/etc/openldap/cacerts/ca.crt
(...)

You can configure a Linux client using the **ipa-advise** utility by running the displayed instructions as a shell script or by executing the instructions manually.

To run the instructions as a shell script:

1. Create the script file.
   ```bash
   [root@server ~]# ipa-advise config-redhat-nss-ldap > setup_script.sh
   ``

2. Add execute permissions to the file using the **chmod** utility.
   ```bash
   [root@server ~]# chmod +x setup_script.sh
   ``

3. Copy the script to the client using the **scp** utility.
   ```bash
   [root@server ~]# scp setup_script.sh root@client
   ``

4. Run the script on the client.
   ```bash
   [root@client ~]# ./setup_script.sh
   ``

**IMPORTANT**

Always read and review the script file carefully before you run it on the client.

To configure the client manually, follow and execute the instructions displayed by **ipa-advise** from the command line.
PART III. INTEGRATING A LINUX DOMAIN WITH AN ACTIVE DIRECTORY DOMAIN: SYNCHRONIZATION
CHAPTER 6. SYNCHRONIZING ACTIVE DIRECTORY AND IDENTITY MANAGEMENT USERS

Red Hat Enterprise Linux Identity Management uses *synchronization* to combine the user data stored in an Active Directory domain and the user data stored in the IdM domain. Critical user attributes, including passwords, are copied and synchronized between the services.

Entry synchronization is performed through a process similar to replication, which uses hooks to connect to and retrieve directory data from the Windows server.

Password synchronization is performed through a Windows service which is installed on the Windows server and then communicates to the Identity Management server.

6.1. SUPPORTED WINDOWS PLATFORMS

Synchronization is supported with the Active Directory functional levels:


The following operating systems are explicitly supported and tested for synchronization using the mentioned functional levels:

- Windows Server 2012 R2
- Windows Server 2016

PassSync 1.1.5 or later is compatible with all supported Windows Server versions.

6.2. ABOUT ACTIVE DIRECTORY AND IDENTITY MANAGEMENT

Within the IdM domain, information is shared among servers and replicas by copying that information, reliably and predictably, between data masters (servers and replicas). This process is *replication*.

A similar process can be used to share data between the IdM domain and a Microsoft Active Directory domain. This is *synchronization*.

Synchronization is the process of copying user data back and forth between Active Directory and Identity Management. When users are synchronized between Active Directory and Identity Management, the directory synchronization (DirSync) LDAP server extension control is used to search a directory for objects that have changed.
Figure 6.1. Active Directory and IdM Synchronization

Synchronization is defined in an *agreement* between an IdM server and an Active Directory domain controller. The agreement defines all of the information required to identify user entries that can be synchronized, such as the subtree to synchronize, as well as defining how account attributes are handled. The synchronization agreements are created with default values which can be tweaked to meet the needs of a specific domain. When two servers are involved in synchronization, they are called *peers*.

Table 6.1. Information in a Synchronization Agreement

<table>
<thead>
<tr>
<th>Windows Information</th>
<th>IdM Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>- User subtree (**cn=Users,**SUFFIX)</td>
<td>- User subtree (**ou=People,**SUFFIX)</td>
</tr>
<tr>
<td>- Connection information</td>
<td></td>
</tr>
<tr>
<td>- Active Directory administrator user name and password</td>
<td></td>
</tr>
<tr>
<td>- Password Synchronization Service password</td>
<td></td>
</tr>
<tr>
<td>- CA certificate</td>
<td></td>
</tr>
</tbody>
</table>

Synchronization is most commonly *bidirectional*. Information is sent back and forth between the IdM and the Windows domain in a process that is very similar to how IdM servers and replicas share information among themselves. An exception are new user entries, which are only added from the Windows domain to the IdM domain. It is possible to configure synchronization to only synchronize one way. That is *unidirectional* synchronization.

To prevent the risk of data conflicts, only one directory should originate or remove user entries. This is typically the Windows directory, which is the primary identity store in the IT environment, and then new accounts or account deletions are synchronized to the Identity Management peer. Either directory can modify entries.

Synchronization, then, is configured between one Identity Management server and one Active Directory domain controller. The Identity Management server propagates throughout to the IdM domain, while the domain controller propagates changes throughout the Windows domain.
Figure 6.2. Synchronization Topology

There are some key features to IdM synchronization:

- A synchronization operation runs every five minutes. To modify the frequency, set the `winSyncInterval` attribute in the Active Directory peers DN:

  ```
  cn=meTowinserver.ad.example.com,cn=replica,cn=dc\3Didm\,dc\3Dexample
  \,dc\3Dcom,cn=mapping tree,cn=config
  ```

- Synchronization can only be configured with one Active Directory domain.

- Synchronization can only be configured with one Active Directory domain controller.

- Only user information is synchronized; group information is not.

- Both user attributes and passwords can be synchronized.

- While modifications are bidirectional (going both from Active Directory to IdM and from IdM to Active Directory), creating accounts is only unidirectional, from Active Directory to Identity Management. New accounts created in Active Directory are synchronized over to IdM automatically. However, user accounts created in IdM must also be created in Active Directory before they will be synchronized. In this situation, the synchronization process tries to find a matching account with the same value for the `uid` attribute in IdM than for the `sAMAccountName` attribute in Active Directory. If a match is found, the IdM `ntUserDomainId` attribute is set to the Active Directory `objectGUID` value. These attributes are globally unique and immutable, and entries stay synchronized, even if they are moved or renamed.

- Account lock information is synchronized by default, so a user account which is disabled in one domain is disabled in the other.

- Password synchronization changes take effect immediately. If a user password is added or changed on one peer, that change is immediately propagated to the other peer server.

**The Password Synchronization client synchronizes new passwords or password updates.**

Existing passwords, which are stored in a hashed form in both IdM and Active Directory, cannot be decrypted or synchronized when the Password Synchronization client is installed, so existing
passwords are not synchronized. User passwords must be changed to initiate synchronization between the peer servers.

- While there can only be one agreement, the PassSync service must be installed on every Active Directory server.

When Active Directory users are synchronized over to IdM, certain attributes (including Kerberos and POSIX attributes) will have IPA attributes automatically added to the user entries. These attributes are used by IdM within its domain. They are not synchronized back over the corresponding Active Directory user entry.

Some of the data in synchronization can be modified as part of the synchronization process. For examples, certain attributes can be automatically added to Active Directory user accounts when they are synced over to the IdM domain. These attribute changes are defined as part of the synchronization agreement and are described in Section 6.5.2, “Changing the Behavior for Synchronizing User Account Attributes”.

### 6.3. ABOUT SYNCHRONIZED ATTRIBUTES

Identity Management synchronizes a subset of user attributes between IdM and Active Directory user entries. Any other attributes present in the entry, either in Identity Management or in Active Directory, are ignored by synchronization.

**NOTE**

Most POSIX attributes are not synchronized.

Although there are significant schema differences between the Active Directory LDAP schema and the 389 Directory Server LDAP schema used by Identity Management, there are many attributes that are the same. These attributes are simply synchronized between the Active Directory and IdM user entries, with no changes to the attribute name or value format.

**User Schema That Are the Same in Identity Management and Windows Servers**

- `cn`\(^\text{[1]}\)
- `physicalDeliveryOfficeName`
- `description`
- `postOfficeBox`
- `destinationIndicator`
- `postalAddress`
- `facsimileTelephoneNumber`
- `postalCode`
- `givenname`
- `registeredAddress`
- `homePhone`
Some attributes have different names but still have direct parity between IdM (which uses 389 Directory Server) and Active Directory. These attributes are *mapped* by the synchronization process.

**Table 6.2. User Schema Mapped between Identity Management and Active Directory**

<table>
<thead>
<tr>
<th>Identity Management</th>
<th>Active Directory</th>
</tr>
</thead>
<tbody>
<tr>
<td>cn[a]</td>
<td>name</td>
</tr>
<tr>
<td>nsAccountLock</td>
<td>userAccountControl</td>
</tr>
<tr>
<td>ntUserDomainId</td>
<td>sAMAccountName</td>
</tr>
<tr>
<td>ntUserHomeDir</td>
<td>homeDirectory</td>
</tr>
<tr>
<td>ntUserScriptPath</td>
<td>scriptPath</td>
</tr>
<tr>
<td>ntUserLastLogon</td>
<td>lastLogon</td>
</tr>
<tr>
<td>ntUserLastLogoff</td>
<td>lastLogoff</td>
</tr>
</tbody>
</table>
### 6.3.1. User Schema Differences between Identity Management and Active Directory

Even though attributes may be successfully synchronized between Active Directory and IdM, there may still be differences in how Active Directory and Identity Management define the underlying X.500 object classes. This could lead to differences in how the data are handled in the different LDAP services.

This section describes the differences in how Active Directory and Identity Management handle some of the attributes which can be synchronized between the two domains.

#### 6.3.1.1. Values for cn Attributes

In 389 Directory Server, the `cn` attribute can be multi-valued, while in Active Directory this attribute must have only a single value. When the Identity Management `cn` attribute is synchronized, then, only one value is sent to the Active Directory peer.

What this means for synchronization is that, potentially, if a `cn` value is added to an Active Directory entry and that value is not one of the values for `cn` in Identity Management, then all of the Identity Management `cn` values are overwritten with the single Active Directory value.

One other important difference is that Active Directory uses the `cn` attribute as its naming attribute, where Identity Management uses `uid`. This means that there is the potential to rename the entry entirely (and accidentally) if the `cn` attribute is edited in the Identity Management.

#### 6.3.1.2. Values for street and streetAddress

Active Directory uses the attribute `streetAddress` for a user’s postal address; this is the way that 389 Directory Server uses the `street` attribute. There are two important differences in the way that Active Directory and Identity Management use the `streetAddress` and `street` attributes, respectively:

### Table: Attribute Differences

<table>
<thead>
<tr>
<th>Identity Management</th>
<th>Active Directory</th>
</tr>
</thead>
<tbody>
<tr>
<td>ntUserAcctExpires</td>
<td>accountExpires</td>
</tr>
<tr>
<td>ntUserCodePage</td>
<td>codePage</td>
</tr>
<tr>
<td>ntUserLogonHours</td>
<td>logonHours</td>
</tr>
<tr>
<td>ntUserMaxStorage</td>
<td>maxStorage</td>
</tr>
<tr>
<td>ntUserProfile</td>
<td>profilePath</td>
</tr>
<tr>
<td>ntUserParms</td>
<td>userParameters</td>
</tr>
<tr>
<td>ntUserWorkstations</td>
<td>userWorkstations</td>
</tr>
</tbody>
</table>

[a] The `cn` is mapped directly (`cn` to `cn`) when synchronizing from Identity Management to Active Directory. When synchronizing from Active Directory `cn` is mapped from the `name` attribute in Active Directory to the `cn` attribute in Identity Management.
In 389 Directory Server, *streetAddress* is an alias for *street*. Active Directory also has the *street* attribute, but it is a separate attribute that can hold an independent value, not an alias for *streetAddress*.

Active Directory defines both *streetAddress* and *street* as single-valued attributes, while 389 Directory Server defines *street* as a multi-valued attribute, as specified in RFC 4519.

Because of the different ways that 389 Directory Server and Active Directory handle *streetAddress* and *street* attributes, there are two rules to follow when setting address attributes in Active Directory and Identity Management:

- The synchronization process maps *streetAddress* in the Active Directory entry to *street* in Identity Management. To avoid conflicts, the *street* attribute should not be used in Active Directory.

- Only one Identity Management *street* attribute value is synchronized to Active Directory. If the *streetAddress* attribute is changed in Active Directory and the new value does not already exist in Identity Management, then all *street* attribute values in Identity Management are replaced with the new, single Active Directory value.

### 6.3.1.3. Constraints on the initials Attribute

For the *initials* attribute, Active Directory imposes a maximum length constraint of six characters, but 389 Directory Server does not have a length limit. If an *initials* attribute longer than six characters is added to Identity Management, the value is trimmed when it is synchronized with the Active Directory entry.

### 6.3.1.4. Requiring the surname (sn) Attribute

Active Directory allows *person* entries to be created without a surname attribute. However, RFC 4519 defines the *person* object class as requiring a surname attribute, and this is the definition used in Directory Server.

If an Active Directory *person* entry is created without a surname attribute, that entry will not be synchronized over to IdM since it fails with an object class violation.

### 6.3.2. Active Directory Entries and POSIX Attributes

When a Windows user account contains values for the *uidNumber* and *gidNumber* attributes, WinSync does not synchronize these values over to Identity Management. Instead, it creates new UID and GID values in Identity Management.

As a result, the values for *uidNumber* and *gidNumber* are different in Active Directory and in Identity Management.

### 6.4. SETTING UP ACTIVE DIRECTORY FOR SYNCHRONIZATION

Synchronizing user accounts is enabled within IdM. It is only necessary to set up a synchronization agreement (Section 6.5.1, “Creating Synchronization Agreements”). However, the Active Directory does need to be configured in a way that allows the Identity Management server to connect to it.

#### 6.4.1. Creating an Active Directory User for Synchronization
On the Windows server, it is necessary to create the user that the IdM server will use to connect to the Active Directory domain.

The process for creating a user in Active Directory is covered in the Windows server documentation at http://technet.microsoft.com/en-us/library/cc732336.aspx. The new user account must have the proper permissions:

- Grant the synchronization user account Replicating directory changes rights to the synchronized Active Directory subtree. Replicator rights are required for the synchronization user to perform synchronization operations.

  Replicator rights are described in http://support.microsoft.com/kb/303972.

- Add the synchronization user as a member of the Account Operators and Enterprise Read-only Domain Controllers groups. It is not necessary for the user to belong to the Domain Admins group.

6.4.2. Setting up an Active Directory Certificate Authority

The Identity Management server connects to the Active Directory server using a secure connection. This requires that the Active Directory server have an available CA certificate or CA certificate chain available, which can be imported into the Identity Management security databases, so that the Windows server is a trusted peer.

While this could technically be done with an external (to Active Directory) CA, most deployments should use the Certificate Services available with Active Directory.


6.5. MANAGING SYNCHRONIZATION AGREEMENTS

6.5.1. Creating Synchronization Agreements

Synchronization agreements are created on the IdM server using the ipa-replica-manage connect command because it creates a connection to the Active Directory domain. To establish an encrypted connection to Active Directory, IdM must to trust the Windows CA certificate.

1. Copy the root certificate authority (CA) certificate to the IdM server:

   a. If your Active Directory CA certificate is self-signed:

      i. Export the Active Directory CA certificate on the Windows server.

         A. Press the Super key+R combination to open the Run dialog.

         B. Enter certsrv.msc and click OK.

         C. Right-click on the name of the local Certificate Authority and choose Properties.

         D. On the General tab, select the certificate to export in the CA certificates field and click View Certificate.

         E. On the Details tab, click Copy to File to start the Certificate Export Wizard.
F. Click **Next**, and then select **Base-64 encoded X.509 (.CER)**.

![Certificate Export Wizard](image)

G. Specify a suitable directory and file name for the exported file. Click **Next** to export the certificate, and then click **Finish**.

H. Copy the exported certificate to the IdM server machine.

b. If your Active Directory CA certificate is signed by an external CA:

   i. To find out what certificate is the CA root certificate, display the certificate chain:

   ```
   # openssl s_client -connect adserver.example.com:636
   CONNECTED(00000003)
   depth=1 C = US, O = Demo Company, OU = IT, CN = Demo CA-28
   verify error:num=20:unable to get local issuer certificate
   verify return:0
   ---
   Certificate chain
   0 s:/C=US/O=Demo Company/OU=IT/CN=adserver.example.com
    i:/C=US/O=Demo Company/OU=IT/CN=Demo CA-1
   1 s:/C=US/O=Demo Company/OU=IT/CN=Demo CA-1
    i:/C=US/O=Demo Company/OU=IT/CN=Demo Root CA 2
   ---
   ```

   The previous example shows that the Active Directory server’s CA certificate is signed by `CN=Demo CA-1`, which is signed by `CN=Demo Root CA 2`. This means that `CN=Demo Root CA 2` is the root CA.
ii. Copy the CA certificate to the IdM server.

2. Remove any existing Kerberos credentials on the IdM server.

```
$ kdestroy
```

3. Use the `ipa-replica-manage` command to create a Windows synchronization agreement. This requires the `--winsync` option. If passwords will be synchronized as well as user accounts, then also use the `--passsync` option and set a password to use for Password Synchronization.

The `--binddn` and `--bindpw` options give the user name and password of the system account on the Active Directory server that IdM will use to connect to the Active Directory server.

```
$ ipa-replica-manage connect --winsync \
   --binddn cn=administrator,cn=users,dc=example,dc=com \ 
   --bindpw Windows-secret \ 
   --passsync secretpwd \ 
   --cacert /etc/openldap/cacerts/windows.cer \ 
   adserver.example.com -v
```

- `--winsync`: Identifies this as a Windows synchronization agreement.
- `--binddn`: IdM uses this DN of an Active Directory account to bind to the remote directory and synchronize attributes.
- `--bindpw`: Password for the synchronization account.
- `--cacert`: Full path and file name to the:
  - Active Directory CA certificate, if the CA was self-signed.
  - external CA certificate, if the Active Directory CA was signed by an external CA.
- `--win-subtree`: DN of the Windows directory subtree containing the users to synchronize. The default value is `cn=Users,$SUFFIX`.
- `AD_server_name`: Fully qualified domain name (FQDN) of the Active Directory domain controller.

4. When prompted, enter the Directory Manager password.

5. *Optional.* Configure Password Synchronization, as in Section 6.6.2, “Setting up Password Synchronization”. Without the Password Synchronization client, user attributes are synchronized between the peer servers, but passwords are not.
NOTE

The Password Synchronization client captures password changes and then synchronizes them between Active Directory and IdM. This means that it synchronizes new passwords or password updates.

Existing passwords, which are stored in a hashed form in both IdM and Active Directory, cannot be decrypted or synchronized when the Password Synchronization client is installed, so existing passwords are not synchronized. User passwords must be changed to initiate synchronization between the peer servers.

6.5.2. Changing the Behavior for Synchronizing User Account Attributes

When the synchronization agreement is created, it has certain default behaviors defined for how the synchronization process handles the user account attributes during synchronization. The types of behaviors are things like how to handle lockout attributes or how to handle different DN formats. This behavior can be changed by editing the synchronization agreement.

The synchronization agreement exists as a special plug-in entry in the LDAP server and each attribute behavior is set through an LDAP attribute. To change the synchronization behavior, use the `ldapmodify` command to modify the LDAP server entry directly.

For example, account lockout attributes are synchronized between IdM and Active Directory by default, but this can be disabled by editing the `ipaWinSyncAcctDisable` attribute. (Changing this means that if an account is disabled in Active Directory, it is still active in IdM and vice versa.)

```
[jsmith@ipaserver ~]$ ldapmodify -x -D "cn=directory manager" -w password
dn: cn=ipa-winsync,cn=plugins,cn=config
changetype: modify
replace: ipaWinSyncAcctDisable
ipaWinSyncAcctDisable: none
modifying entry "cn=ipa-winsync,cn=plugins,cn=config"
```

The following is an overview of synchronization settings attributes:

**General User Account Parameters**

- **ipaWinSyncNewEntryFilter**: Sets the search filter to use to find the entry which contains the list of object classes to add to new user entries.
  
  Default value: `(cn=ipaConfig)`

- **ipaWinSyncNewUserOCAttr**: Sets the attribute in the configuration entry which actually contains the list of object classes to add to new user entries.
  
  Default value: `ipauserobjectclasses`

- **ipaWinSyncHomeDirAttr**: Identifies which attribute in the entry contains the default location of the POSIX home directory.
  
  Default value: `ipaHomesRootDir`

- **ipaWinSyncUserAttr**: Sets an additional attribute with a specific value to add to
Active Directory users when they are synchronized over from the Active Directory domain. If the attribute is multi-valued, then it can be set multiple times, and the synchronization process adds all of the values to the entry.

Example: `ipaWinSyncUserAttr: attributeName attributeValue`

**NOTE**

This only sets the attribute value if the entry does not already have that attribute present. If the attribute is present, then the entry's value is used when the Active Directory entry is synchronized over.

- `ipaWinSyncForceSync`: Sets whether existing IdM users that match existing AD users should be forced to be synchronized. When set to `true`, such IdM users are automatically edited so that they are synchronized.

  Possible values: `true` | `false`

If an IdM user account has a `uid` parameter which is identical to the `sAMAccountName` in an existing Active Directory user, then that account is not synchronized by default. This attribute tells the synchronization service to add the `ntUser` and `ntUserDomainId` to the IdM user entries automatically, which allows them to be synchronized.

**User Account Lock Parameters**

- `ipaWinSyncAcctDisable`: Sets which way to synchronize account lockout attributes. It is possible to control which account lockout settings are in effect. For example, `to_ad` means that when account lockout attribute is set in IdM, its value is synchronized over to Active Directory and overrides the local Active Directory value. By default, account lockout attributes are synchronized from both domains.

  Possible values: `both` (default), `to_ad`, `to_ds`, `none`

- `ipaWinSyncInactivatedFilter`: Sets the search filter to use to find the DN of the group used to hold inactivated (disabled) users. This does not need to be changed in most deployments.

  Default value: `(&(cn=inactivated)(objectclass=groupOfNames))`

**Group Parameters**

- `ipaWinSyncDefaultGroupAttr`: Sets the attribute in the new user account to reference to see what the default group for the user is. The group name in the entry is then used to find the `gidNumber` for the user account.

  Default value: `ipaDefaultPrimaryGroup`

- `ipaWinSyncDefaultGroupFilter`: Sets the attribute in the new user account to reference to see what the default group for the user is. The group name in the entry is then used to find the `gidNumber` for the user account.

  Default value: `ipaDefaultPrimaryGroup`

**Realm Parameters**
• **ipaWinSyncRealmAttr**: Sets the attribute which contains the realm name in the realm entry.

  Default value: `cn`

• **ipaWinSyncRealmFilter**: Sets the search filter to use to find the entry which contains the IdM realm name.

  Default value: `(objectclass=krbRealmContainer)`

### 6.5.3. Changing the Synchronized Windows Subtree

Creating a synchronization agreement automatically sets the two subtrees to use as the synchronized user database. In IdM, the default is `cn=users,cn=accounts,$SUFFIX`, and for Active Directory, the default is `CN=Users,$SUFFIX`.

The value for the Active Directory subtree can be set to a non-default value when the synchronization agreement is created by using the `--win-subtree` option. After the agreement is created, the Active Directory subtree can be changed by using the `ldapmodify` command to edit the `nsds7WindowsReplicaSubtree` value in the synchronization agreement entry.

1. Get the name of the synchronization agreement, using `ldapsearch`. This search returns only the values for the `dn` and `nsds7WindowsReplicaSubtree` attributes instead of the entire entry.

   ```
   [jsmith@ipaserver ~]$ ldapsearch -xLLL -D "cn=directory manager" -w password -p 389 -h ipaserver.example.com -b cn=config objectclass=nsdswindowsreplicationagreement dn nsds7WindowsReplicaSubtree
   
   dn: cn=meToWindowsBox.example.com,cn=replica,cn=dc\example\c,dc=com
   nsds7WindowsReplicaSubtree: cn=users,dc=example,dc=com
   ...
   ...
   ```

2. Modify the synchronization agreement

   ```
   [jsmith@ipaserver ~]$ ldapmodify -x -D "cn=directory manager" -W -p 389 -h ipaserver.example.com <<EOF
   dn: cn=meToWindowsBox.example.com,cn=replica,cn=dc\example\c,dc=com,
   cn=mapping tree,cn=config
   nsds7WindowsReplicaSubtree: cn=alternateusers,dc=example,dc=com
   
   modifying entry "cn=meToWindowsBox.example.com,cn=replica,cn=dc\example\c,dc=com,
   ,cn=mapping tree,cn=config"
   EOF
   ```

The new subtree setting takes effect immediately. If a synchronization operation is currently running, then it takes effect as soon as the current operation completes.
### 6.5.4. Configuring Uni-directional Synchronization

By default, all modifications and deletions are bidirectional. A change in Active Directory is synchronized over to Identity Management, and a change to an entry in Identity Management is synchronized over to Active Directory. This is essentially an equitable, multi-master relationship, where both Active Directory and Identity Management are equal peers in synchronization and are both data masters.

However, there can be some data structure or IT designs where only one domain should be a data master and the other domain should accept updates. This changes the synchronization relationship from a multi-master relationship (where the peer servers are equal) to a master consumer relationship.

This is done by setting the `oneWaySync` parameter on the synchronization agreement. The possible values are `fromWindows` (for Active Directory to Identity Management synchronization) and `toWindows` (for Identity Management to Active Directory synchronization).

For example, to synchronize changes from Active Directory to Identity Management:

```bash
[jsmith@ipaserver ~]$ ldapmodify -x -D "cn=directory manager" -w password -p 389 -h ipaserver.example.com
dn: cn=meToWindowsBox.example.com,cn=replica,cn=dc\3Dexample\2Cdc\3Dcom,cn=map ping tree,cn=config
changetype: modify
add: oneWaySync
oneWaySync: fromWindows
```

**IMPORTANT**

Enabling unidirectional synchronization does *not* automatically prevent changes on the unsynchronized server, and this can lead to inconsistencies between the synchronization peers between synchronization updates. For example, unidirectional synchronization is configured to go from Active Directory to Identity Management, so Active Directory is (in essence) the data master. If an entry is modified or even deleted on the Identity Management, then the Identity Management information is different then the information and those changes are never carried over to Active Directory. During the next synchronization update, the edits are overwritten on the Directory Server and the deleted entry is re-added.

### 6.5.5. Deleting Synchronization Agreements

Synchronization can be stopped by deleting the synchronization agreement which *disconnects* the IdM and Active Directory servers. In the inverse of creating a synchronization agreement, deleting a synchronization agreement uses the `ipa-replica-manage disconnect` command and then the host name of the Active Directory server.

1. Delete the synchronization agreement.

   ```bash
   # ipa-replica-manage disconnect adserver.ad.example.com
   ```

2. List the certificates in the IdM directory certificate database:

   ```bash
   # certutil -L -d /etc/dirsrv/slapd-IDM-EXAMPLE-COM/
   Certificate Nickname             Trust Attributes
   ```
3. Remove the Active Directory CA certificate from the IdM server database:

```
# certutil -D -d /etc/dirsrv/slapd-IDM-EXAMPLE-COM/ -n "CN=adserver,DC=ad,DC=example,DC=com"
```

### 6.5.6. Winsync Agreement Failures

Creating the synchronization agreement fails because it cannot connect to the Active Directory server.

One of the most common synchronization agreement failures is that the IdM server cannot connect to the Active Directory server:

"Update failed! Status: [81 - LDAP error: Can't contact LDAP server]"

This can occur if the wrong Active Directory CA certificate was specified when the agreement was created. This creates duplicate certificates in the IdM LDAP database (in the `/etc/dirsrv/slapd-DOMAIN/` directory) with the name `Imported CA`. This can be checked using `certutil`:

```
$ certutil -L -d /etc/dirsrv/slapd-DOMAIN/
Certificate Nickname                                         Trust Attributes
SSL,S/MIME,JAR/XPI                                          CTu,u,Cu
CA certificate                                              CT,,C
Imported CA                                                 u,u,u
Server-Cert                                                 CT,,C
Imported CA                                                 CT,,C
```

To resolve this issue, remove the CA certificate from the certificate database:

```
# certutil -d /etc/dirsrv/slapd-DOMAIN-NAME -D -n "Imported CA"
```

**There are errors saying passwords are not being synchronized because it says the entry exists**

For some entries in the user database, there may be an informational error message that the password is not being reset because the entry already exists:

"Windows PassSync entry exists, not resetting password"

This is not an error. This message occurs when an exempt user, the Password Synchronization user, is not being changed. The Password Synchronization user is the operational user which is used by the service to change the passwords in IdM.

### 6.6. MANAGING PASSWORD SYNCHRONIZATION
Synchronizing user entries is configured with the synchronization agreement. However, passwords in both Active Directory and Identity Management are not part of the normal user synchronization process. A separate client must be installed on the Active Directory servers to capture passwords as user accounts are created or passwords are changed, and then to forward that password information with the synchronized updates.

**NOTE**

The Password Synchronization client captures password changes and then synchronizes them between Active Directory and IdM. This means that it synchronizes new passwords or password updates.

Existing passwords, which are stored in a hashed form in both IdM and Active Directory, cannot be decrypted or synchronized when the Password Synchronization client is installed, so existing passwords are not synchronized. User passwords must be changed to initiate synchronization between the peer servers.

### 6.6.1. Setting up the Windows Server for Password Synchronization

Synchronizing passwords requires these things:

- Active Directory must be running in SSL.

**NOTE**

Install the Microsoft Certificate System in Enterprise Root Mode. Active Directory will then automatically enroll to retrieve its SSL server certificate.

- The Password Synchronization Service must be installed on each Active Directory domain controller. To synchronize a password from Windows, the PassSync service requires access to the unencrypted password to synchronize it over a secure connection to IdM. Because users can change their passwords on every domain controller, the installation of the PassSync service on each domain controller is necessary.

- The password policy must be set similar on IdM and Active Directory side. When the synchronization destination receives an updated password, it was only validated to match the policy on the source. It is not re-validated on the synchronization destination.

To verify that the Active Directory password complexity policy is enabled, run on an Active Directory domain controller:

```
> dsquery * -scope base -attr pwdProperties
pwdProperties
1
```

If the value of the attribute `pwdProperties` is set to 1, the password complexity policy is enabled for the domain.

**NOTE**

If you are unsure if group policies define deviating password settings for Organizational Units (ou), ask your group policy administrator.
To enable the Active Directory password complexity setting for the whole domain:

1. Run `gpmc.msc` from the command line.

2. Select **Group Policy Management**.

3. Open **Forest: ad.example.com → Domains → ad.example.com**.

4. Right-click the **Default Domain Policy** entry and select **Edit**.

5. The **Group Policy Management Editor** opens automatically.


7. Enable the **Password must meet complexity requirements** option and save.

### 6.6.2. Setting up Password Synchronization

Install the Password Synchronization Service on every domain controller in the Active Directory domain in order to synchronize Windows passwords.

1. Download the `PassSync.msi` file to the Active Directory machine.
   
   1. Log in to the Customer Portal.
   
   2. Click the **Downloads** link in the upper left corner.
   
   3. Select **Red Hat Enterprise Linux**.
4. Select the most recent version of Red Hat Enterprise Linux 6 or Red Hat Enterprise Linux 7 and architecture.

5. Download **PassSync Installer** by clicking on the ‘Download Now’ button.

**NOTE**

Regardless of the Red Hat Enterprise Linux architecture, there are two PassSync packages available, one for 32-bit Windows servers and one for 64-bit. Make sure to select the appropriate packages for your Windows platform.

2. Double-click the Password Synchronization MSI file to install it.

3. The **Password Synchronization Setup** window appears. Hit **Next** to begin installing.

4. Fill in the information to establish the connection to the IdM server.
   - The IdM server connection information, including the host name and secure port number.
   - The user name of the system user which Active Directory uses to connect to the IdM machine. This account is configured automatically when synchronization is configured on the IdM server. The default account is `uid=passsync,cn=sysaccounts,cn=etc,dc=example,dc=com`.
   - The password set in the `--passsync` option when the synchronization agreement was created.
   - The search base for the people subtree on the IdM server. The Active Directory server connects to the IdM server similar to an `ldapsearch` or replication operation, so it has to know where in the IdM subtree to look for user accounts. The user subtree is `cn=users,cn=accounts,dc=example,dc=com`.
   - The certificate token is not used at this time, so that field should be left blank.
Hit **Next**, then **Finish** to install Password Synchronization.

5. Import the IdM server's CA certificate into the PassSync certificate store.

   1. Download the IdM server's CA certificate from [http://ipa.example.com/ipa/config/ca.crt](http://ipa.example.com/ipa/config/ca.crt).
   
   2. Copy the IdM CA certificate to the Active Directory server.

   3. Install the IdM CA certificate in the Password Synchronization database. For example:

   ```cmd
   cd "C:\Program Files\Red Hat Directory Password Synchronization"
   certutil.exe -d . -A -n "IPASERVER.EXAMPLE.COM IPA CA" -t CT,, -a -i ipaca.crt
   ```

6. Reboot the Windows machine to start Password Synchronization.

   **NOTE**

   The Windows machine must be rebooted. Without the rebooting, **PasswordHook.dll** is not enabled, and password synchronization will not function.

7. If passwords for existing accounts should be synchronized, reset the user passwords.
NOTE

The Password Synchronization client captures password changes and then synchronizes them between Active Directory and IdM. This means that it synchronizes new passwords or password updates.

Existing passwords, which are stored in a hashed form in both IdM and Active Directory, cannot be decrypted or synchronized when the Password Synchronization client is installed, so existing passwords are not synchronized. User passwords must be changed to initiate synchronization between the peer servers.

The first attempt to synchronize passwords, which happened when the Password Synchronization application is installed, will always fail because of the SSL connection between the Directory Server and Active Directory synchronization peers. The tools to create the certificate and key databases is installed with the .msi.

The password synchronization client cannot synchronize passwords for members of the IdM admin group. This is an intended behavior to prevent, for example, password synchronization agents or low level user administrators to change passwords of top level administrators.

NOTE

Passwords are only validated on the synchronization source to match the password policies. To verify and enable the Active Directory password complexity policy, see Section 6.6.1, “Setting up the Windows Server for Password Synchronization”.

[1] The \texttt{cn} is treated differently than other synchronized attributes. It is mapped directly (\texttt{cn} \texttt{to} \texttt{cn}) when synchronizing from Identity Management to Active Directory. When synchronizing from Active Directory to Identity Management, however, \texttt{cn} is mapped from the \texttt{name} attribute on Windows to the \texttt{cn} attribute in Identity Management.
CHAPTER 7. MIGRATING EXISTING ENVIRONMENTS FROM SYNCHRONIZATION TO TRUST

_Synchronization_ and _trust_ are two possible approaches to indirect integration. Synchronization is generally discouraged, and Red Hat recommends to use the approach based on Active Directory (AD) trust instead. See Section 1.3, “Indirect Integration” for details.

This chapter describes how to migrate an existing synchronization-based setup to AD trust. The following migrating options are available in IdM:

- Section 7.1, “Migrate from Synchronization to Trust Automatically Using _ipa-winsync-migrate_
- Section 7.2, “Migrate from Synchronization to Trust Manually Using ID Views”

7.1. MIGRATE FROM SYNCHRONIZATION TO TRUST AUTOMATICALLY USING _IPA-WINSYNC-MIGRATE_

**IMPORTANT**

The _ipa-winsync-migrate_ utility is only available on systems running Red Hat Enterprise Linux 7.2 or later.

7.1.1. How Migration Using _ipa-winsync-migrate_ Works

The _ipa-winsync-migrate_ utility migrates all synchronized users from an AD forest, while preserving the existing configuration in the Winsync environment and transferring it into the AD trust. For each AD user created by the Winsync agreement, _ipa-winsync-migrate_ creates an ID override in the Default Trust View (see Section 8.1, “Active Directory Default Trust View”).

After the migration completes:

- The ID overrides for the AD users have the following attributes copied from the original entry in Winsync:
  - Login name (_uid_)
  - UID number (_uidnumber_)
  - GID number (_gidnumber_)
  - Home directory (_homedirectory_)
  - GECOS entry (_gecos_)

- The user accounts in the AD trust keep their original configuration in IdM, which includes:
  - POSIX attributes
  - User groups
  - Role-based access control rules
Host-based access control rules

SELinux membership

\texttt{sudo} rules

- The new AD users are added as members of an external IdM group.

- The original Winsync replication agreement, the original synchronized user accounts, and all local copies of the user accounts are removed.

### 7.1.2. How to Migrate Using \texttt{ipa-winsync-migrate}

**Before you begin:**

- Back up your IdM setup using the \texttt{ipa-backup} utility. See Backing Up and Restoring Identity Management in the *Linux Domain Identity, Authentication, and Policy Guide*.

  \textit{Reason:} The migration affects a significant part of the IdM configuration and many user accounts. Creating a backup enables you to restore your original setup if necessary.

**To migrate:**

1. Create a trust with the synchronized domain. See Chapter 5, Creating Cross-forest Trusts with Active Directory and Identity Management.

2. Run \texttt{ipa-winsync-migrate} and specify the AD realm name:

\begin{verbatim}
# ipa-winsync-migrate --ad-realm AD.EXAMPLE.COM
\end{verbatim}

If a conflict occurs in the overrides created by \texttt{ipa-winsync-migrate}, information about the conflict is displayed, but the migration continues.

See the \texttt{ipa-winsync-migrate(1)} man page for more details about the utility.

### 7.2. MIGRATE FROM SYNCHRONIZATION TO TRUST MANUALLY USING ID VIEWS

You can use ID views to manually change the POSIX attributes that AD previously generated for AD users.

1. Create a backup of the original synchronized user or group entries.

2. Create a trust with the synchronized domain. For information about creating trusts, see Chapter 5, Creating Cross-forest Trusts with Active Directory and Identity Management.

3. For every synchronized user or group, preserve the UID and GIDs generated by IdM by doing one of the following:

   - Individually create an ID view applied to the specific host and add user ID overrides to the view.

   - Create user ID overrides in the Default Trust View.

For details, see Defining a Different Attribute Value for a User Account on Different Hosts.
NOTE

Only IdM users can manage ID views. AD users cannot.

4. Delete the original synchronized user or group entries.

For general information on using ID views in Active Directory environments, see Chapter 8, Using ID Views in Active Directory Environments.
CHAPTER 8. USING ID VIEWS IN ACTIVE DIRECTORY ENVIRONMENTS

ID views enable you to specify new values for POSIX user or group attributes, as well as to define on which client host or hosts the new values will apply.

Integration systems other than Identity Management (IdM) sometimes generate UID and GID values based on an algorithm different than the algorithm used in IdM. By overriding the previously generated values to make them compliant with the values used in IdM, a client that used to be a member of another integration system can be fully integrated with IdM.

NOTE
This chapter only describes ID views functionality related to Active Directory (AD). For general information about ID views, see the Linux Domain Identity, Authentication, and Policy Guide.

You can use ID views in AD environments for the following purposes:

**Overriding AD User Attributes, such as POSIX Attributes or SSH Login Details**
See Section 8.3, “Using ID Views to Define AD User Attributes” for details.

**Migrating from synchronization-based to trust-based integration**
See Section 7.2, “Migrate from Synchronization to Trust Manually Using ID Views” for details.

**Performing per-host group override of the IdM user attributes**
See Section 8.4, “Migrating NIS Domains to IdM” for details.

8.1. ACTIVE DIRECTORY DEFAULT TRUST VIEW

The Default Trust View is the default ID view always applied to AD users and groups in trust-based setups. It is created automatically when you establish the trust using `ipa-adtrust-install` and cannot be deleted.

Using the Default Trust View, you can define custom POSIX attributes for AD users and groups, thus overriding the values defined in AD.

**Table 8.1. Applying the Default Trust View**

<table>
<thead>
<tr>
<th></th>
<th>Values in AD</th>
<th>Default Trust View</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Login</td>
<td>ad_user</td>
<td>ad_user</td>
<td>→</td>
</tr>
<tr>
<td>UID</td>
<td>111</td>
<td>222</td>
<td>→</td>
</tr>
<tr>
<td>GID</td>
<td>111</td>
<td>(no value)</td>
<td>→</td>
</tr>
</tbody>
</table>
NOTE

The Default Trust View only accepts overrides for AD users and groups, not for IdM users and groups. It is applied on the IdM server and clients and therefore only need to provide overrides for Active Directory users and groups.

Overriding Default Trust View with Other ID Views

If another ID view applied to the host overrides the attribute values in the Default Trust View, IdM applies the values from the host-specific ID view on top of the Default Trust View.

- If an attribute is defined in the host-specific ID view, IdM applies the value from this view.
- If an attribute is not defined in the host-specific ID view, IdM applies the value from the Default Trust View.

The Default Trust View is always applied to IdM servers and replicas as well as to AD users and groups. You cannot assign a different ID view to them: they always apply the values from the Default Trust View.

| Table 8.2. Applying a Host-Specific ID View on Top of the Default Trust View |
|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
| Values in AD | Default Trust View | Host-Specific View | Result |
| Login | ad_user | ad_user | (no value) | → ad_user |
| UID | 111 | 222 | 333 | → 333 |
| GID | 111 | (no value) | 333 | → 333 |

Default Trust View on Clients with Earlier Versions of IdM

Clients running IdM versions earlier than Red Hat Enterprise Linux 7.1 only see the Default Trust View, because ID views are applied on the client side. If you need a client to apply a different ID view, update SSSD on the client to a version with ID views support or have the client use the compat LDAP tree.

NOTE

The compat LDAP tree offers a simplified LDAP tree with user and group data for legacy clients.

8.2. FIXING ID CONFLICTS

IdM uses ID ranges to avoid collisions of POSIX IDs from different domains. For details on ID ranges, see ID Ranges in the Linux Domain Identity, Authentication, and Policy Guide.

POSIX IDs in ID views do not use a special range type, because IdM must allow overlaps with other kinds of ID ranges. For example, AD users created through synchronization have POSIX IDs from the same ID range as IdM users.

POSIX IDs are managed manually in ID views on the IdM side. Therefore, if an ID collision occurs, fix it by changing the conflicting IDs.

8.3. USING ID VIEWS TO DEFINE AD USER ATTRIBUTES
With ID views, you can change the user attribute values defined in AD. For a complete list of the attributes, see Attributes an ID View Can Override.

For example: If you are managing a mixed Linux-Windows environment and want to manually define POSIX attributes or SSH login attributes for an AD user, but the AD policy does not allow it, you can use ID views to override the attribute values. When the AD user authenticates to clients running SSSD or authenticates using a compat LDAP tree, the new values are used in the authentication process.

**NOTE**

Only IdM users can manage ID views. AD users cannot.

The process for overriding the attribute values follows these steps:

1. Create a new ID view.
2. Add a user ID override in the ID view, and specify the require attribute value.
3. Apply the ID view to a specific host.

For details on how to perform these steps, see Defining a Different Attribute Value for a User Account on Different Hosts in the *Linux Domain Identity, Authentication, and Policy Guide*.

### 8.4. MIGRATING NIS DOMAINS TO IDM

If you are managing a Linux environment and want to migrate disparate NIS domains with different UIDs and GIDs into a modern identity management solution, you can use ID views to set host specific UIDs and GIDs for existing hosts to prevent changing the permissions on existing files and directories.

The process for the migration follows these steps:

1. Create the users and groups in the IdM domain. For details, see
   - Adding Stage or Active Users
   - Adding and Removing User Groups
2. Use ID views for existing hosts to override the IDs IdM generated during the user creation:
   1. Create an individual ID view.
   2. Add ID overrides for the users and groups to the ID view.
   3. Assign the ID view to the specific hosts.
   
   For details, see Defining a Different Attribute Value for a User Account on Different Hosts.

4. Decommission the NIS domains.

### 8.5. CONFIGURATION OPTIONS FOR USING SHORT NAMES TO RESOLVE AND AUTHENTICATE USERS AND GROUPS
This section describes configuration options enabling you to use short user or group names instead of the `user_name@domain` or `domain\user_name` fully qualified names format to resolve and authenticate users and groups in an Active Directory (AD) environment. You can configure this:

- in Identity Management (IdM) that trusts AD
- on Red Hat Enterprise Linux joined to an AD using SSSD

### 8.5.1. How Domain Resolution Works

You can use the `domain resolution order` option to specify the order in which a list of domains is searched to return a match for a given user name. You can set the option:

- on the server. See:
  - Section 8.5.2.1, “Setting the Domain Resolution Order Globally”
  - Section 8.5.2.2, “Setting the Domain Resolution Order for an ID view”
- on the client. See Section 8.5.3, “Configuring the Domain Resolution Order on an IdM Client”

In environments with an Active Directory trust, applying one or both of the server-based options is recommended.

From the perspective of a particular client, the `domain resolution order` option can be set in more than one of the three locations above. The order in which a client consults the three locations is:

1. the local `sssd.conf` configuration
2. the id view configuration
3. the global IdM configuration

Only the domain resolution order setting found first will be used.

In environments in which Red Hat Enterprise Linux is directly integrated into an AD, you can only set the domain resolution order on the client.

**NOTE**

You must use qualified names if:

- A user name exists in multiple domains
- The SSSD configuration includes the `default_domain_suffix` option and you want to make a request towards a domain not specified with that option

### 8.5.2. Configuring the Domain Resolution Order on an Identity Management Server

Select the server-based configuration if a large number of clients in a domain or subdomain should use an identical domain resolution order.

#### 8.5.2.1. Setting the Domain Resolution Order Globally
Select this option for setting the domain resolution order to all the clients in the trust. In order to do this, use the `ipa config-mod` command. For example, in an IdM domain that trusts an AD forest with multiple subdomains:

```bash
$ ipa config-mod --domain-resolution-order='idm.example.com:ad.example.com:subdomain1.ad.example.com:subdomain2.ad.example.com'
```

Maximum username length: 32
Home directory base: /home

Domain Resolution Order:
```
idm.example.com:ad.example.com:subdomain1.ad.example.com:subdomain2.ad.example.com
```

With the domain resolution order set in this way, users from both the IdM domain and from the trusted AD forest can log in using short names only.

### 8.5.2.2. Setting the Domain Resolution Order for an ID view

Select this option to apply the setting to the clients in a specific domain.

For example, on your subdomain server, `server.idm.example.com`, you observe many more logins from the `subdomain2.ad.example.com` subdomain than from `subdomain1.ad.example.com`. The global resolution order states, however, that the `subdomain1.ad.example.com` subdomain user database is tried out before `subdomain2.ad.example.com` when resolving user names. To set a different order for certain servers, set up a domain resolution order for a specific view:

1. Create an ID view with the **domain resolution order** option set:

   ```bash
   $ ipa idview-add example_view --desc "ID view for custom shortname resolution on server.idm.example.com" --domain-resolution-order subdomain2.ad.example.com:subdomain1.ad.example.com
   ---------------------------------------------
   Added ID View "example_view"
   ---------------------------------------------
   ID View Name: example_view
   Description: ID view for custom shortname resolution on server.idm.example.com
   Domain Resolution Order:
   subdomain2.ad.example.com:subdomain1.ad.example.com
   ```

2. Apply the view on the clients. For example:

   ```bash
   $ ipa idview-apply example_view --hosts server.idm.example.com
   -----------------------------------
   Applied ID View "example_view"
   -----------------------------------
   hosts: server.idm.example.com
   ---------------------------------------------
   Number of hosts the ID View was applied to: 1
   ```

For further information on ID views, see Chapter 8, *Using ID Views in Active Directory Environments*.  

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8.5.3. Configuring the Domain Resolution Order on an IdM Client

Set the domain resolution order on the client if you want to set it on a low number of clients or if the clients are directly connected to AD.

Set the `domain_resolution_order` option, in the `[sssd]` section, in the `/etc/sssd/sssd.conf` file, for example:

```
    domain_resolution_order = subdomain1.ad.example.com,
                            subdomain2.ad.example.com
```

For further information on configuring the `domain_resolution_order` option, see the `sssd.conf(5)` man page.
APPENDIX A. REVISION HISTORY

Note that revision numbers relate to the edition of this manual, not to version numbers of Red Hat Enterprise Linux.

Revision 7.0-37  Mon Nov 20 2017  Aneta Šteflová Petrová
Updated Creating a Two-Way Trust with a Shared Secret.

Revision 7.0-36  Mon Nov 6 2017  Aneta Šteflová Petrová
Minor fixes.

Revision 7.0-35  Mon Oct 23 2017  Aneta Šteflová Petrová
Updated Active Directory Entries and POSIX Attributes and Configuring an AD Domain with ID Mapping as a Provider for SSSD.

Revision 7.0-34  Mon Oct 9 2017  Aneta Šteflová Petrová
Added Configuration Options for Using Short Names. Updated Trust Controllers and Trust Agents.

Revision 7.0-33  Tue Sep 26 2017  Aneta Šteflová Petrová
Updated the autodiscovery section in the SSSD chapter. Added two sections on configuring trusted domains.

Revision 7.0-32  Tue Jul 18 2017  Aneta Šteflová Petrová
Document version for 7.4 GA publication.

Revision 7.0-31  Tue May 23 2017  Aneta Šteflová Petrová
A minor fix for About Security ID Mapping.

Revision 7.0-30  Mon Apr 24 2017  Aneta Šteflová Petrová
Minor fixes for Defining Windows Integration.

Revision 7.0-29  Mon Apr 10 2017  Aneta Šteflová Petrová
Updated Direct Integration.

Revision 7.0-28  Mon Mar 27 2017  Aneta Šteflová Petrová
Moved Allowing Users to Change Other Users’ Passwords Cleanly to the Linux Domain Identity guide as Enabling Password Reset. Updated Supported Windows Platforms for trusts. Fixed broken links. Other minor updates.

Revision 7.0-27  Mon Feb 27 2017  Aneta Šteflová Petrová
Updated port requirements for trusts. Minor restructuring for trust and sync. Other minor updates.

Revision 7.0-26  Wed Nov 23 2016  Aneta Šteflová Petrová
Added ipa-winsync-migrate. Minor fixes for the trust, SSSD, and synchronization chapters.

Revision 7.0-25  Tue Oct 18 2016  Aneta Šteflová Petrová
Version for 7.3 GA publication.

Revision 7.0-24  Thu Jul 28 2016  Marc Muehlfeld
Updated diagrams, added Kerberos flags for services and hosts, other minor fixes.

Revision 7.0-23  Thu Jun 09 2016  Marc Muehlfeld
Updated the synchronization chapter. Removed the Kerberos chapter. Other minor fixes.

Revision 7.0-22  Tue Feb 09 2016  Aneta Petrová
Updated realmd, removed index, moved a part of ID views to the Linux Domain Identity guide, other minor updates.

Revision 7.0-21  Fri Nov 13 2015  Aneta Petrová
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