

Chapter 14

User Management

Proxmox VE supports multiple authentication sources, for example Linux PAM, an integrated Proxmox VE authentication server, LDAP, Microsoft Active Directory and OpenID Connect.

By using role-based user and permission management for all objects (VMs, Storage, nodes, etc.), granular access can be defined.

14.1 Users

Proxmox VE stores user attributes in `/etc/pve/user.cfg`. Passwords are not stored here; users are instead associated with the [authentication realms](#) described below. Therefore, a user is often internally identified by their username and realm in the form `<userid>@<realm>`.

Each user entry in this file contains the following information:

- First name
- Last name
- E-mail address
- Group memberships
- An optional expiration date
- A comment or note about this user
- Whether this user is enabled or disabled
- Optional two-factor authentication keys



Caution

When you disable or delete a user, or if the expiry date set is in the past, this user will not be able to log in to new sessions or start new tasks. All tasks which have already been started by this user (for example, terminal sessions) will **not** be terminated automatically by any such event.

14.1.1 System administrator

The system's root user can always log in via the Linux PAM realm and is an unconfined administrator. This user cannot be deleted, but attributes can still be changed. System mails will be sent to the email address assigned to this user.

14.2 Groups

Each user can be a member of several groups. Groups are the preferred way to organize access permissions. You should always grant permissions to groups instead of individual users. That way you will get a much more maintainable access control list.

14.3 API Tokens

API tokens allow stateless access to most parts of the REST API from another system, software or API client. Tokens can be generated for individual users and can be given separate permissions and expiration dates to limit the scope and duration of the access. Should the API token get compromised, it can be revoked without disabling the user itself.

API tokens come in two basic types:

- Separated privileges: The token needs to be given explicit access with ACLs. Its effective permissions are calculated by intersecting user and token permissions.
- Full privileges: The token's permissions are identical to that of the associated user.



Caution

The token value is only displayed/returned once when the token is generated. It cannot be retrieved again over the API at a later time!

To use an API token, set the HTTP header *Authorization* to the displayed value of the form `PVEAPIToken=USER@` when making API requests, or refer to your API client's documentation.

14.4 Resource Pools

The screenshot shows a web-based dialog box titled "Edit: Pool" with a close button (X) in the top right corner. It contains two text input fields: "Name:" with the value "development" and "Comment:" with the value "IT development pool". At the bottom of the dialog, there are two buttons: "OK" and "Reset".

A resource pool is a set of virtual machines, containers, and storage devices. It is useful for permission handling in cases where certain users should have controlled access to a specific set of resources, as it allows for a single permission to be applied to a set of elements, rather than having to manage this on a per-resource basis. Resource pools are often used in tandem with groups, so that the members of a group have permissions on a set of machines and storage.

14.5 Authentication Realms

As Proxmox VE users are just counterparts for users existing on some external realm, the realms have to be configured in `/etc/pve/domains.cfg`. The following realms (authentication methods) are available:

Linux PAM Standard Authentication

Linux PAM is a framework for system-wide user authentication. These users are created on the host system with commands such as `adduser`. If PAM users exist on the Proxmox VE host system, corresponding entries can be added to Proxmox VE, to allow these users to log in via their system username and password.

Proxmox VE Authentication Server

This is a Unix-like password store, which stores hashed passwords in `/etc/pve/priv/shadow.cfg`. Passwords are hashed using the SHA-256 hashing algorithm. This is the most convenient realm for small-scale (or even mid-scale) installations, where users do not need access to anything outside of Proxmox VE. In this case, users are fully managed by Proxmox VE and are able to change their own passwords via the GUI.

LDAP

LDAP (Lightweight Directory Access Protocol) is an open, cross-platform protocol for authentication using directory services. OpenLDAP is a popular open-source implementations of the LDAP protocol.

Microsoft Active Directory (AD)

Microsoft Active Directory (AD) is a directory service for Windows domain networks and is supported as an authentication realm for Proxmox VE. It supports LDAP as an authentication protocol.

OpenID Connect

OpenID Connect is implemented as an identity layer on top of the OAuth 2.0 protocol. It allows clients to verify the identity of the user, based on authentication performed by an external authorization server.

14.5.1 Linux PAM Standard Authentication

As Linux PAM corresponds to host system users, a system user must exist on each node which the user is allowed to log in on. The user authenticates with their usual system password. This realm is added by default and can't be removed.

Password changes via the GUI or, equivalently, the `/access/password` API endpoint only apply to the local node and not cluster-wide. Even though Proxmox VE has a multi-master design, using different passwords for different nodes can still offer a security benefit.

In terms of configurability, an administrator can choose to require two-factor authentication with logins from the realm and to set the realm as the default authentication realm.

14.5.2 Proxmox VE Authentication Server

The Proxmox VE authentication server realm is a simple Unix-like password store. The realm is created by default, and as with Linux PAM, the only configuration items available are the ability to require two-factor authentication for users of the realm, and to set it as the default realm for login.

Unlike the other Proxmox VE realm types, users are created and authenticated entirely through Proxmox VE, rather than authenticating against another system. Hence, you are required to set a password for this type of user upon creation.

14.5.3 LDAP

You can also use an external LDAP server for user authentication (for example, OpenLDAP). In this realm type, users are searched under a *Base Domain Name* (`base_dn`), using the username attribute specified in the *User Attribute Name* (`user_attr`) field.

A server and optional fallback server can be configured, and the connection can be encrypted via SSL. Furthermore, filters can be configured for directories and groups. Filters allow you to further limit the scope of the realm.

For instance, if a user is represented via the following LDIF dataset:

```
# user1 of People at ldap-test.com
dn: uid=user1,ou=People,dc=ldap-test,dc=com
objectClass: top
objectClass: person
objectClass: organizationalPerson
objectClass: inetOrgPerson
uid: user1
cn: Test User 1
sn: Testers
description: This is the first test user.
```

The *Base Domain Name* would be `ou=People,dc=ldap-test,dc=com` and the user attribute would be `uid`.

If Proxmox VE needs to authenticate (bind) to the LDAP server before being able to query and authenticate users, a bind domain name can be configured via the `bind_dn` property in `/etc/pve/domains.cfg`. Its password then has to be stored in `/etc/pve/priv/realm/<realmname>.pw` (for example, `/etc/pve/priv/realm/ldap-test.pw`). This file should contain a single line with the raw password.

To verify certificates, you need to set `capath`. You can set it either directly to the CA certificate of your LDAP server, or to the system path containing all trusted CA certificates (`/etc/ssl/certs`). Additionally, you need to set the `verify` option, which can also be done over the web interface.

The main configuration options for an LDAP server realm are as follows:

- `Realm (realm)`: The realm identifier for Proxmox VE users
 - `Base Domain Name (base_dn)`: The directory which users are searched under
 - `User Attribute Name (user_attr)`: The LDAP attribute containing the username that users will log in with
 - `Server (server1)`: The server hosting the LDAP directory
 - `Fallback Server (server2)`: An optional fallback server address, in case the primary server is unreachable
 - `Port (port)`: The port that the LDAP server listens on
-

Note

In order to allow a particular user to authenticate using the LDAP server, you must also add them as a user of that realm from the Proxmox VE server. This can be carried out automatically with [syncing](#).

14.5.4 Microsoft Active Directory (AD)

To set up Microsoft AD as a realm, a server address and authentication domain need to be specified. Active Directory supports most of the same properties as LDAP, such as an optional fallback server, port, and SSL encryption. Furthermore, users can be added to Proxmox VE automatically via [sync](#) operations, after configuration.

As with LDAP, if Proxmox VE needs to authenticate before it binds to the AD server, you must configure the *Bind User* (`bind_dn`) property. This property is typically required by default for Microsoft AD.

The main configuration settings for Microsoft Active Directory are:

- `Realm (realm)`: The realm identifier for Proxmox VE users
- `Domain (domain)`: The AD domain of the server
- `Server (server1)`: The FQDN or IP address of the server
- `Fallback Server (server2)`: An optional fallback server address, in case the primary server is unreachable
- `Port (port)`: The port that the Microsoft AD server listens on

Note

Microsoft AD normally checks values like usernames without case sensitivity. To make Proxmox VE do the same, you can disable the default `case-sensitive` option by editing the realm in the web UI, or using the CLI (change the ID with the realm ID): `pveum realm modify ID --case-sensitive 0`

14.5.5 Syncing LDAP-Based Realms

The screenshot shows the 'Add: LDAP Server' dialog box. It has two tabs: 'General' and 'Sync Options'. The 'General' tab is selected. The fields are as follows:

Field	Value
Realm:	office-dc
Base Domain Name:	ou=Users,dc=example,dc=example
User Attribute Name:	uid
Default:	<input type="checkbox"/>
Server:	dc1.example.proxmox.com
Fallback Server:	dc2.example.proxmox.com
Port:	Default
SSL:	<input checked="" type="checkbox"/>
Require TFA:	none
Comment:	

At the bottom, there is a 'Help' button and an 'Add' button.

It's possible to automatically sync users and groups for LDAP-based realms (LDAP & Microsoft Active Directory), rather than having to add them to Proxmox VE manually. You can access the sync options from the Add/Edit window of the web interface's *Authentication* panel or via the `pveum realm add/modify`

commands. You can then carry out the sync operation from the `Authentication` panel of the GUI or using the following command:

```
pveum realm sync <realm>
```

Users and groups are synced to the cluster-wide configuration file, `/etc/pve/user.cfg`.

Attributes to Properties

If the sync response includes user attributes, they will be synced into the matching user property in the `user.cfg`. For example: `firstname` or `lastname`.

If the names of the attributes are not matching the Proxmox VE properties, you can set a custom field-to-field map in the config by using the `sync_attributes` option.

How such properties are handled if anything vanishes can be controlled via the sync options, see below.

Sync Configuration

The configuration options for syncing LDAP-based realms can be found in the `Sync Options` tab of the `Add/Edit` window.

The configuration options are as follows:

- `Bind User (bind_dn)`: Refers to the LDAP account used to query users and groups. This account needs access to all desired entries. If it's set, the search will be carried out via binding; otherwise, the search will be carried out anonymously. The user must be a complete LDAP formatted distinguished name (DN), for example, `cn=admin,dc=example,dc=com`.
- `Groupname attr. (group_name_attr)`: Represents the users' groups. Only entries which adhere to the usual character limitations of the `user.cfg` are synced. Groups are synced with `-$realm` attached to the name, in order to avoid naming conflicts. Please ensure that a sync does not overwrite manually created groups.
- `User classes (user_classes)`: Objects classes associated with users.
- `Group classes (group_classes)`: Objects classes associated with groups.
- `E-Mail attribute`: If the LDAP-based server specifies user email addresses, these can also be included in the sync by setting the associated attribute here. From the command line, this is achievable through the `--sync_attributes` parameter.
- `User Filter (filter)`: For further filter options to target specific users.
- `Group Filter (group_filter)`: For further filter options to target specific groups.

Note

Filters allow you to create a set of additional match criteria, to narrow down the scope of a sync. Information on available LDAP filter types and their usage can be found at ldap.com.

Sync Options

In addition to the options specified in the previous section, you can also configure further options that describe the behavior of the sync operation.

These options are either set as parameters before the sync, or as defaults via the realm option `sync-defaults-`

The main options for syncing are:

- `Scope (scope)`: The scope of what to sync. It can be either `users`, `groups` or `both`.
- `Enable new (enable-new)`: If set, the newly synced users are enabled and can log in. The default is `true`.
- `Remove Vanished (remove-vanished)`: This is a list of options which, when activated, determine if they are removed when they are not returned from the sync response. The options are:
 - `ACL (acl)`: Remove ACLs of users and groups which were not returned returned in the sync response. This most often makes sense together with `Entry`.
 - `Entry (entry)`: Removes entries (i.e. users and groups) when they are not returned in the sync response.
 - `Properties (properties)`: Removes properties of entries where the user in the sync response did not contain those attributes. This includes all properties, even those never set by a sync. Exceptions are tokens and the enable flag, these will be retained even with this option enabled.
- `Preview (dry-run)`: No data is written to the config. This is useful if you want to see which users and groups would get synced to the `user.cfg`.

Reserved characters

Certain characters are reserved (see [RFC2253](#)) and cannot be easily used in attribute values in DN's without being escaped properly.

Following characters need escaping:

- Space () at the beginning or end
- Number sign (#) at the beginning
- Comma (,)

- Plus sign (+)
- Double quote (")
- Forward slashes (/)
- Angle brackets (<>)
- Semicolon (;)
- Equals sign (=)

To use such characters in DNs, surround the attribute value in double quotes. For example, to bind with a user with the CN (Common Name) Example, User, use `CN="Example, User", OU=people, DC=example` as value for `bind_dn`.

This applies to the `base_dn`, `bind_dn`, and `group_dn` attributes.

Note

Users with colons and forward slashes cannot be synced since these are reserved characters in usernames.

14.5.6 OpenID Connect

The main OpenID Connect configuration options are:

- `Issuer URL (issuer-url)`: This is the URL of the authorization server. Proxmox VE uses the OpenID Connect Discovery protocol to automatically configure further details.
While it is possible to use unencrypted `http://` URLs, we strongly recommend to use encrypted `https://` connections.
 - `Realm (realm)`: The realm identifier for Proxmox VE users
 - `Client ID (client-id)`: OpenID Client ID.
 - `Client Key (client-key)`: Optional OpenID Client Key.
 - `Autocreate Users (autocreate)`: Automatically create users if they do not exist. While authentication is done at the OpenID server, all users still need an entry in the Proxmox VE user configuration. You can either add them manually, or use the `autocreate` option to automatically add new users.
 - `Username Claim (username-claim)`: OpenID claim used to generate the unique username (`subject`, `username` or `email`).
 - `Autocreate Groups (groups-autocreate)`: Create all groups in the claim instead of using existing PVE groups (default behavior).
 - `Groups Claim (groups-claim)`: OpenID claim used to retrieve the groups from the ID token or `userinfo` endpoint.
 - `Overwrite Groups (groups-overwrite)`: Overwrite all groups assigned to user instead of appending to existing groups (default behavior).
-

Username mapping

The OpenID Connect specification defines a single unique attribute (*claim* in OpenID terms) named `subject`. By default, we use the value of this attribute to generate Proxmox VE usernames, by simple adding `@` and the realm name: `${subject}@${realm}`.

Unfortunately, most OpenID servers use random strings for `subject`, like `DGH76OKH34BNG3245SB`, so a typical username would look like `DGH76OKH34BNG3245SB@yourrealm`. While unique, it is difficult for humans to remember such random strings, making it quite impossible to associate real users with this.

The `username-claim` setting allows you to use other attributes for the username mapping. Setting it to `username` is preferred if the OpenID Connect server provides that attribute and guarantees its uniqueness.

Another option is to use `email`, which also yields human readable usernames. Again, only use this setting if the server guarantees the uniqueness of this attribute.

Groups mapping

Specifying the `groups-claim` setting in the OpenID configuration enables group mapping functionality. The data provided in the `groups-claim` should be a list of strings that correspond to groups that a user should be a member of in Proxmox VE. To prevent collisions, group names from the OpenID claim are suffixed with `-<realm name>` (e.g. for the OpenID group name `my-openid-group` in the realm `oidc`, the group name in Proxmox VE would be `my-openid-group-oidc`).

Any groups reported by the OpenID provider that do not exist in Proxmox VE are ignored by default. If all groups reported by the OpenID provider should exist in Proxmox VE, the `groups-autocreate` option may be used to automatically create these groups on user logins.

By default, groups are appended to the user's existing groups. It may be desirable to overwrite any groups that the user is already a member in Proxmox VE with those from the OpenID provider. Enabling the `groups-overwrite` setting removes all groups from the user in Proxmox VE before adding the groups reported by the OpenID provider.

In some cases, OpenID servers may send groups claims which include invalid characters for Proxmox VE group IDs. Any groups that contain characters not allowed in a Proxmox VE group name are not included and a warning will be sent to the logs.

Advanced settings

- `Query userinfo endpoint (query-userinfo)`: Enabling this option requires the OpenID Connect authenticator to query the "userinfo" endpoint for claim values. Disabling this option is useful for some identity providers that do not support the "userinfo" endpoint (e.g. ADFS).

Examples

Here is an example of creating an OpenID realm using Google. You need to replace `--client-id` and `--client-key` with the values from your Google OpenID settings.

```
pveum realm add myrealm1 --type openid --issuer-url https://accounts. ↵
google.com --client-id XXXX --client-key YYYY --username-claim email
```

The above command uses `--username-claim email`, so that the usernames on the Proxmox VE side look like `example.user@google.com@myrealm1`.

Keycloak (<https://www.keycloak.org/>) is a popular open source Identity and Access Management tool, which supports OpenID Connect. In the following example, you need to replace the `--issuer-url` and `--client-id` with your information:

```
pveum realm add myrealm2 --type openid --issuer-url https://your.server ←  
:8080/realms/your-realm --client-id XXX --username-claim username
```

Using `--username-claim username` enables simple usernames on the Proxmox VE side, like `example.u`.



Warning

You need to ensure that the user is not allowed to edit the username setting themselves (on the Keycloak server).

14.6 Two-Factor Authentication

There are two ways to use two-factor authentication:

It can be required by the authentication realm, either via *TOTP* (Time-based One-Time Password) or *YubiKey OTP*. In this case, a newly created user needs to have their keys added immediately, as there is no way to log in without the second factor. In the case of *TOTP*, users can also change the *TOTP* later on, provided they can log in first.

Alternatively, users can choose to opt-in to two-factor authentication later on, even if the realm does not enforce it.

14.6.1 Available Second Factors

You can set up multiple second factors, in order to avoid a situation in which losing your smartphone or security key locks you out of your account permanently.

The following two-factor authentication methods are available in addition to realm-enforced TOTP and YubiKey OTP:

- User configured TOTP (**Time-based One-Time Password**). A short code derived from a shared secret and the current time, it changes every 30 seconds.
- WebAuthn (**Web Authentication**). A general standard for authentication. It is implemented by various security devices, like hardware keys or trusted platform modules (TPM) from a computer or smart phone.
- Single use Recovery Keys. A list of keys which should either be printed out and locked in a secure place or saved digitally in an electronic vault. Each key can be used only once. These are perfect for ensuring that you are not locked out, even if all of your other second factors are lost or corrupt.

Before WebAuthn was supported, U2F could be setup by the user. Existing U2F factors can still be used, but it is recommended to switch to WebAuthn, once it is configured on the server.

14.6.2 Realm Enforced Two-Factor Authentication

This can be done by selecting one of the available methods via the *TFA* dropdown box when adding or editing an Authentication Realm. When a realm has TFA enabled, it becomes a requirement, and only users with configured TFA will be able to log in.

Currently there are two methods available:

Time-based OATH (TOTP)

This uses the standard HMAC-SHA1 algorithm, where the current time is hashed with the user's configured key. The time step and password length parameters are configurable.

A user can have multiple keys configured (separated by spaces), and the keys can be specified in Base32 (RFC3548) or hexadecimal notation.

Proxmox VE provides a key generation tool (`oathkeygen`) which prints out a random key in Base32 notation, that can be used directly with various OTP tools, such as the `oathtool` command-line tool, or on Android Google Authenticator, FreeOTP, andOTP or similar applications.

YubiKey OTP

For authenticating via a YubiKey a Yubico API ID, API KEY and validation server URL must be configured, and users must have a YubiKey available. In order to get the key ID from a YubiKey, you can trigger the YubiKey once after connecting it via USB, and copy the first 12 characters of the typed password into the user's *Key IDs* field.

Please refer to the [YubiKey OTP](#) documentation for how to use the [YubiCloud](#) or [host your own verification server](#).

14.6.3 Limits and Lockout of Two-Factor Authentication

A second factor is meant to protect users if their password is somehow leaked or guessed. However, some factors could still be broken by brute force. For this reason, users will be locked out after too many failed 2nd factor login attempts.

For TOTP, 8 failed attempts will disable the user's TOTP factors. They are unlocked when logging in with a recovery key. If TOTP was the only available factor, admin intervention is required, and it is highly recommended to require the user to change their password immediately.

Since FIDO2/Webauthn and recovery keys are less susceptible to brute force attacks, the limit there is higher (100 tries), but all second factors are blocked for an hour when exceeded.

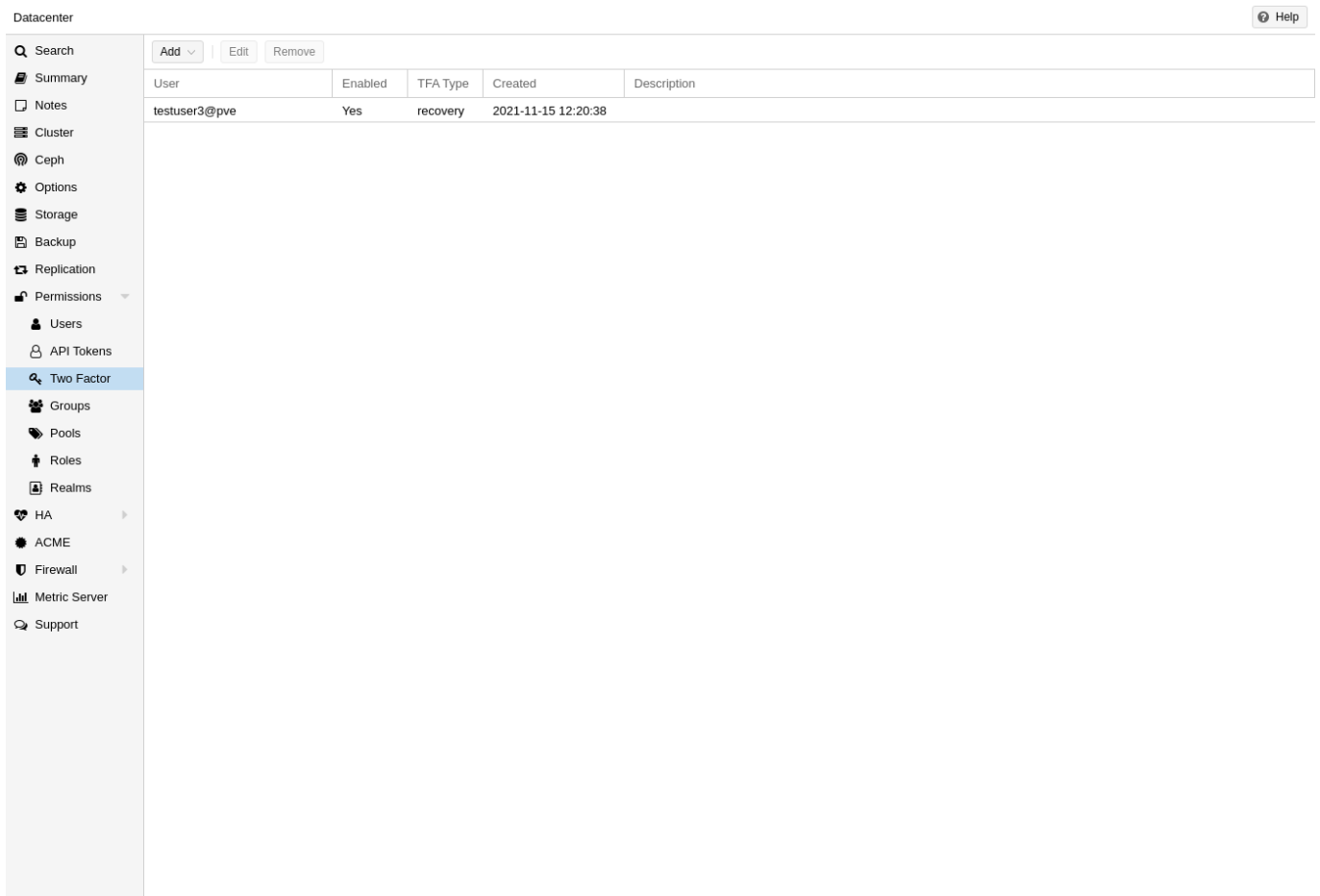
An admin can unlock a user's Two-Factor Authentication at any time via the user list in the UI or the command line:

```
pveum user tfa unlock joe@pve
```

14.6.4 User Configured TOTP Authentication

Users can choose to enable *TOTP* or *WebAuthn* as a second factor on login, via the *TFA* button in the user list (unless the realm enforces *YubiKey OTP*).

Users can always add and use one time *Recovery Keys*.



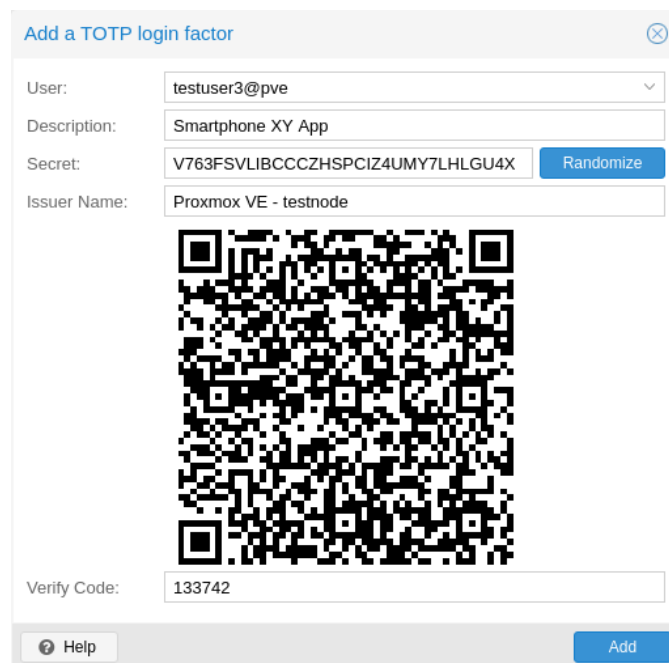
The screenshot shows the Proxmox VE Datacenter interface. On the left is a sidebar with a search bar and a list of navigation items: Summary, Notes, Cluster, Ceph, Options, Storage, Backup, Replication, Permissions (with a dropdown arrow), Users, API Tokens, Two Factor (highlighted with a blue bar), Groups, Pools, Roles, Realms, HA, ACME, Firewall, Metric Server, and Support. The main content area is titled 'Datacenter' and has a 'Help' button in the top right. Below the title bar are buttons for 'Add', 'Edit', and 'Remove'. A table displays the Two Factor settings for a user:

User	Enabled	TFA Type	Created	Description
testuser3@pve	Yes	recovery	2021-11-15 12:20:38	

After opening the *TFA* window, the user is presented with a dialog to set up *TOTP* authentication. The *Secret* field contains the key, which can be randomly generated via the *Randomize* button. An optional *Issuer Name* can be added to provide information to the *TOTP* app about what the key belongs to. Most *TOTP* apps will show the issuer name together with the corresponding *OTP* values. The username is also included in the QR code for the *TOTP* app.

After generating a key, a QR code will be displayed, which can be used with most OTP apps such as FreeOTP. The user then needs to verify the current user password (unless logged in as *root*), as well as the ability to correctly use the *TOTP* key, by typing the current *OTP* value into the *Verification Code* field and pressing the *Apply* button.

14.6.5 TOTP



Dialog: Add a TOTP login factor

User: testuser3@pve

Description: Smartphone XY App

Secret: V763FSVLBCCCCZHSPCIZ4UMY7LHLGU4X [Randomize]

Issuer Name: Proxmox VE - testnode

QR Code

Verify Code: 133742

[Help] [Add]

There is no server setup required. Simply install a TOTP app on your smartphone (for example, [FreeOTP](#)) and use the Proxmox VE web interface to add a TOTP factor.

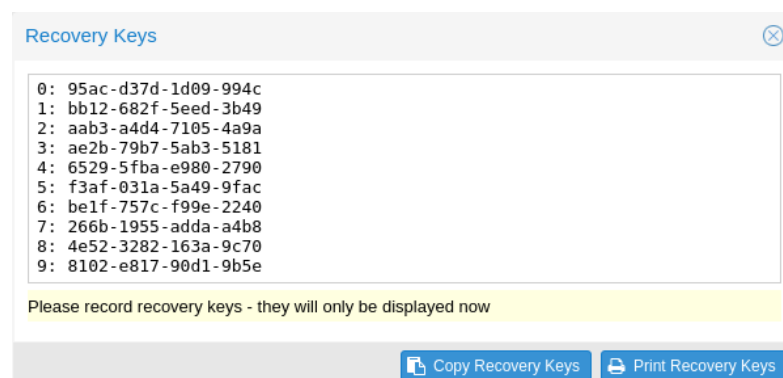
14.6.6 WebAuthn

For WebAuthn to work, you need to have two things:

- A trusted HTTPS certificate (for example, by using [Let's Encrypt](#)). While it probably works with an untrusted certificate, some browsers may warn or refuse WebAuthn operations if it is not trusted.
- Setup the WebAuthn configuration (see **Datacenter** → **Options** → **WebAuthn Settings** in the Proxmox VE web interface). This can be auto-filled in most setups.

Once you have fulfilled both of these requirements, you can add a WebAuthn configuration in the **Two Factor** panel under **Datacenter** → **Permissions** → **Two Factor**.

14.6.7 Recovery Keys



Dialog: Recovery Keys

0: 95ac-d37d-1d09-994c
1: bb12-682f-5eed-3b49
2: aab3-a4d4-7105-4a9a
3: ae2b-79b7-5ab3-5181
4: 6529-5fba-e980-2790
5: f3af-031a-5a49-9fac
6: be1f-757c-f99e-2240
7: 266b-1955-adda-a4b8
8: 4e52-3282-163a-9c70
9: 8102-e817-90d1-9b5e

Please record recovery keys - they will only be displayed now

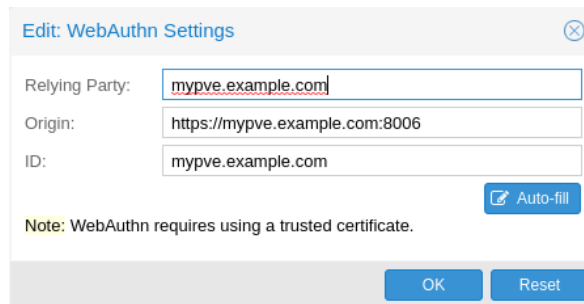
[Copy Recovery Keys] [Print Recovery Keys]

Recovery key codes do not need any preparation; you can simply create a set of recovery keys in the **Two Factor** panel under **Datacenter** → **Permissions** → **Two Factor**.

Note

There can only be one set of single-use recovery keys per user at any time.

14.6.8 Server Side Webauthn Configuration



To allow users to use *WebAuthn* authentication, it is necessary to use a valid domain with a valid SSL certificate, otherwise some browsers may warn or refuse to authenticate altogether.

Note

Changing the *WebAuthn* configuration may render all existing *WebAuthn* registrations unusable!

This is done via `/etc/pve/datacenter.cfg`. For instance:

```
webauthn: rp=mypve.example.com,origin=https://mypve.example.com:8006,id= ↵
mypve.example.com
```

14.6.9 Server Side U2F Configuration

Note

It is recommended to use *WebAuthn* instead.

To allow users to use *U2F* authentication, it may be necessary to use a valid domain with a valid SSL certificate, otherwise, some browsers may print a warning or reject *U2F* usage altogether. Initially, an *AppId*¹ needs to be configured.

Note

Changing the *AppId* will render all existing *U2F* registrations unusable!

This is done via `/etc/pve/datacenter.cfg`. For instance:

```
u2f: appid=https://mypve.example.com:8006
```

¹AppId https://developers.yubico.com/U2F/App_ID.html

For a single node, the *AppId* can simply be the address of the web interface, exactly as it is used in the browser, including the *https://* and the port, as shown above. Please note that some browsers may be more strict than others when matching *AppIds*.

When using multiple nodes, it is best to have a separate *https* server providing an *appid.json*² file, as it seems to be compatible with most browsers. If all nodes use subdomains of the same top level domain, it may be enough to use the TLD as *AppId*. It should however be noted that some browsers may not accept this.

Note

A bad *AppId* will usually produce an error, but we have encountered situations when this does not happen, particularly when using a top level domain *AppId* for a node that is accessed via a subdomain in Chromium. For this reason it is recommended to test the configuration with multiple browsers, as changing the *AppId* later will render existing *U2F* registrations unusable.

14.6.10 Activating U2F as a User

To enable *U2F* authentication, open the *TFA* window's *U2F* tab, type in the current password (unless logged in as root), and press the *Register* button. If the server is set up correctly and the browser accepts the server's provided *AppId*, a message will appear prompting the user to press the button on the *U2F* device (if it is a *YubiKey*, the button light should be toggling on and off steadily, roughly twice per second).

Firefox users may need to enable *security.webauth.u2f* via *about:config* before they can use a *U2F* token.

14.7 Permission Management

In order for a user to perform an action (such as listing, modifying or deleting parts of a VM's configuration), the user needs to have the appropriate permissions.

Proxmox VE uses a role and path based permission management system. An entry in the permissions table allows a user, group or token to take on a specific role when accessing an *object* or *path*. This means that such an access rule can be represented as a triple of (*path*, *user*, *role*), (*path*, *group*, *role*) or (*path*, *token*, *role*), with the role containing a set of allowed actions, and the path representing the target of these actions.

14.7.1 Roles

A role is simply a list of privileges. Proxmox VE comes with a number of predefined roles, which satisfy most requirements.

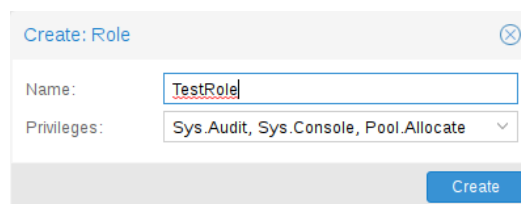
- `Administrator`: has full privileges
- `NoAccess`: has no privileges (used to forbid access)
- `PVEAdmin`: can do most tasks, but has no rights to modify system settings (`Sys.PowerMgmt`, `Sys.ModifyRealm.Allocate`) or permissions (`Permissions.Modify`)
- `PVEAuditor`: has read only access

²Multi-facet apps: https://developers.yubico.com/U2F/App_ID.html

- `PVEDatastoreAdmin`: create and allocate backup space and templates
- `PVEDatastoreUser`: allocate backup space and view storage
- `PVEMappingAdmin`: manage resource mappings
- `PVEMappingUser`: view and use resource mappings
- `PVEPoolAdmin`: allocate pools
- `PVEPoolUser`: view pools
- `PVESDNAdmin`: manage SDN configuration
- `PVESDNUser`: access to bridges/vnets
- `PVESysAdmin`: audit, system console and system logs
- `PVETemplateUser`: view and clone templates
- `PVEUserAdmin`: manage users
- `PVEVMAdmin`: fully administer VMs
- `PVEVMUser`: view, backup, configure CD-ROM, VM console, VM power management

You can see the whole set of predefined roles in the GUI.

You can add new roles via the GUI or the command line.



From the GUI, navigate to the *Permissions* → *Roles* tab from *Datacenter* and click on the *Create* button. There you can set a role name and select any desired privileges from the *Privileges* drop-down menu.

To add a role through the command line, you can use the *pveum* CLI tool, for example:

```
pveum role add VM_Power-only --privs "VM.PowerMgmt VM.Console"
pveum role add Sys_Power-only --privs "Sys.PowerMgmt Sys.Console"
```

Note

Roles starting with `PVE` are always builtin, custom roles are not allowed use this reserved prefix.

14.7.2 Privileges

A privilege is the right to perform a specific action. To simplify management, lists of privileges are grouped into roles, which can then be used in the permission table. Note that privileges cannot be directly assigned to users and paths without being part of a role.

We currently support the following privileges:

Node / System related privileges

- `Group.Allocate`: create/modify/remove groups
- `Mapping.Audit`: view resource mappings
- `Mapping.Modify`: manage resource mappings
- `Mapping.Use`: use resource mappings
- `Permissions.Modify`: modify access permissions
- `Pool.Allocate`: create/modify/remove a pool
- `Pool.Audit`: view a pool
- `Realm.AllocateUser`: assign user to a realm
- `Realm.Allocate`: create/modify/remove authentication realms
- `SDN.Allocate`: manage SDN configuration
- `SDN.Audit`: view SDN configuration
- `Sys.Audit`: view node status/config, Corosync cluster config, and HA config
- `Sys.Console`: console access to node
- `Sys.Incoming`: allow incoming data streams from other clusters (experimental)
- `Sys.Modify`: create/modify/remove node network parameters
- `Sys.PowerMgmt`: node power management (start, stop, reset, shutdown, ...)
- `Sys.Syslog`: view syslog
- `User.Modify`: create/modify/remove user access and details.

Virtual machine related privileges

- `SDN.Use`: access SDN vnets and local network bridges
 - `VM.Allocate`: create/remove VM on a server
 - `VM.Audit`: view VM config
 - `VM.Backup`: backup/restore VMs
 - `VM.Clone`: clone/copy a VM
 - `VM.Config.CDROM`: eject/change CD-ROM
 - `VM.Config.CPU`: modify CPU settings
 - `VM.Config.Cloudinit`: modify Cloud-init parameters
 - `VM.Config.Disk`: add/modify/remove disks
 - `VM.Config.HWType`: modify emulated hardware types
 - `VM.Config.Memory`: modify memory settings
 - `VM.Config.Network`: add/modify/remove network devices
 - `VM.Config.Options`: modify any other VM configuration
 - `VM.Console`: console access to VM
 - `VM.Migrate`: migrate VM to alternate server on cluster
 - `VM.Monitor`: access to VM monitor (kvm)
-

- `VM.PowerMgmt`: power management (start, stop, reset, shutdown, ...)
- `VM.Snapshot.Rollback`: rollback VM to one of its snapshots
- `VM.Snapshot`: create/delete VM snapshots

Storage related privileges

- `Datastore.Allocate`: create/modify/remove a datastore and delete volumes
- `Datastore.AllocateSpace`: allocate space on a datastore
- `Datastore.AllocateTemplate`: allocate/upload templates and ISO images
- `Datastore.Audit`: view/browse a datastore



Warning

Both `Permissions.Modify` and `Sys.Modify` should be handled with care, as they allow modifying aspects of the system and its configuration that are dangerous or sensitive.



Warning

Carefully read the section about inheritance below to understand how assigned roles (and their privileges) are propagated along the ACL tree.

14.7.3 Objects and Paths

Access permissions are assigned to objects, such as virtual machines, storages or resource pools. We use file system like paths to address these objects. These paths form a natural tree, and permissions of higher levels (shorter paths) can optionally be propagated down within this hierarchy.

Paths can be templated. When an API call requires permissions on a templated path, the path may contain references to parameters of the API call. These references are specified in curly braces. Some parameters are implicitly taken from the API call's URI. For instance, the permission path `/nodes/{node}` when calling `/nodes/mynode/status` requires permissions on `/nodes/mynode`, while the path `{path}` in a PUT request to `/access/acl` refers to the method's `path` parameter.

Some examples are:

- `/nodes/{node}`: Access to Proxmox VE server machines
 - `/vms`: Covers all VMs
 - `/vms/{vmid}`: Access to specific VMs
 - `/storage/{storeid}`: Access to a specific storage
 - `/pool/{poolname}`: Access to resources contained in a specific [pool](#)
 - `/access/groups`: Group administration
 - `/access/realms/{realmid}`: Administrative access to realms
-

Inheritance

As mentioned earlier, object paths form a file system like tree, and permissions can be inherited by objects down that tree (the propagate flag is set by default). We use the following inheritance rules:

- Permissions for individual users always replace group permissions.
- Permissions for groups apply when the user is member of that group.
- Permissions on deeper levels replace those inherited from an upper level.
- `NoAccess` cancels all other roles on a given path.

Additionally, privilege separated tokens can never have permissions on any given path that their associated user does not have.

14.7.4 Pools

Pools can be used to group a set of virtual machines and datastores. You can then simply set permissions on pools (`/pool/{poolid}`), which are inherited by all pool members. This is a great way to simplify access control.

14.7.5 Which Permissions Do I Need?

The required API permissions are documented for each individual method, and can be found at <https://pve.proxmox.com/pve-docs/api-viewer/>.

The permissions are specified as a list, which can be interpreted as a tree of logic and access-check functions:

`["and", <subtests>...] and ["or", <subtests>...]`

Each(`and`) or any(`or`) further element in the current list has to be true.

`["perm", <path>, [<privileges>...], <options>...]`

The `path` is a templated parameter (see [Objects and Paths](#)). All (or, if the `any` option is used, any) of the listed privileges must be allowed on the specified path. If a `require-param` option is specified, then its specified parameter is required even if the API call's schema otherwise lists it as being optional.

`["userid-group", [<privileges>...], <options>...]`

The caller must have any of the listed privileges on `/access/groups`. In addition, there are two possible checks, depending on whether the `groups_param` option is set:

- `groups_param` is set: The API call has a non-optional `groups` parameter and the caller must have any of the listed privileges on all of the listed groups.
 - `groups_param` is not set: The user passed via the `userid` parameter must exist and be part of a group on which the caller has any of the listed privileges (via the `/access/groups/<group>` path).
-

["userid-param", "self"]

The value provided for the API call's `userid` parameter must refer to the user performing the action (usually in conjunction with `or`, to allow users to perform an action on themselves, even if they don't have elevated privileges).

["userid-param", "Realm.AllocateUser"]

The user needs `Realm.AllocateUser` access to `/access/realm/<realm>`, with `<realm>` referring to the realm of the user passed via the `userid` parameter. Note that the user does not need to exist in order to be associated with a realm, since user IDs are passed in the form of `<username>@<realm>`.

["perm-modify", <path>]

The `path` is a templated parameter (see [Objects and Paths](#)). The user needs either the `Permissions.Modify` privilege or, depending on the path, the following privileges as a possible substitute:

- `/storage/...`: requires `'Datastore.Allocate'`
- `/vms/...`: requires `'VM.Allocate'`
- `/pool/...`: requires `'Pool.Allocate'`

If the path is empty, `Permissions.Modify` on `/access` is required.

If the user does not have the `Permissions.Modify` privilege, they can only delegate subsets of their own privileges on the given path (e.g., a user with `PVEVMAdmin` could assign `PVEVMUser`, but not `PVEAdmin`).

14.8 Command-line Tool

Most users will simply use the GUI to manage users. But there is also a fully featured command-line tool called `pveum` (short for “**P**roxmox **VE** **U**ser **M**anager”). Please note that all Proxmox VE command-line tools are wrappers around the API, so you can also access those functions through the REST API.

Here are some simple usage examples. To show help, type:

```
pveum
```

or (to show detailed help about a specific command)

```
pveum help user add
```

Create a new user:

```
pveum user add testuser@pve -comment "Just a test"
```

Set or change the password (not all realms support this):

```
pveum passwd testuser@pve
```

Disable a user:

```
pveum user modify testuser@pve -enable 0
```

Create a new group:

```
pveum group add testgroup
```

Create a new role:

```
pveum role add PVE_Power-only -privs "VM.PowerMgmt VM.Console"
```

14.9 Real World Examples

14.9.1 Administrator Group

It is possible that an administrator would want to create a group of users with full administrator rights (without using the root account).

To do this, first define the group:

```
pveum group add admin -comment "System Administrators"
```

Then assign the role:

```
pveum acl modify / -group admin -role Administrator
```

Finally, you can add users to the new *admin* group:

```
pveum user modify testuser@pve -group admin
```

14.9.2 Auditors

You can give read only access to users by assigning the `PVEAuditor` role to users or groups.

Example 1: Allow user `joe@pve` to see everything

```
pveum acl modify / -user joe@pve -role PVEAuditor
```

Example 2: Allow user `joe@pve` to see all virtual machines

```
pveum acl modify /vms -user joe@pve -role PVEAuditor
```

14.9.3 Delegate User Management

If you want to delegate user management to user `joe@pve`, you can do that with:

```
pveum acl modify /access -user joe@pve -role PVEUserAdmin
```

User `joe@pve` can now add and remove users, and change other user attributes, such as passwords. This is a very powerful role, and you most likely want to limit it to selected realms and groups. The following example allows `joe@pve` to modify users within the realm `pve`, if they are members of group `customers`:

```
pveum acl modify /access/realm/pve -user joe@pve -role PVEUserAdmin  
pveum acl modify /access/groups/customers -user joe@pve -role PVEUserAdmin
```

Note

The user is able to add other users, but only if they are members of the group `customers` and within the realm `pve`.

14.9.4 Limited API Token for Monitoring

Permissions on API tokens are always a subset of those of their corresponding user, meaning that an API token can't be used to carry out a task that the backing user has no permission to do. This section will demonstrate how you can use an API token with separate privileges, to limit the token owner's permissions further.

Give the user `joe@pve` the role `PVEVMAdmin` on all VMs:

```
pveum acl modify /vms -user joe@pve -role PVEVMAdmin
```

Add a new API token with separate privileges, which is only allowed to view VM information (for example, for monitoring purposes):

```
pveum user token add joe@pve monitoring -privsep 1
pveum acl modify /vms -token 'joe@pve!monitoring' -role PVEAuditor
```

Verify the permissions of the user and token:

```
pveum user permissions joe@pve
pveum user token permissions joe@pve monitoring
```

14.9.5 Resource Pools

An enterprise is usually structured into several smaller departments, and it is common that you want to assign resources and delegate management tasks to each of these. Let's assume that you want to set up a pool for a software development department. First, create a group:

```
pveum group add developers -comment "Our software developers"
```

Now we create a new user which is a member of that group:

```
pveum user add developer1@pve -group developers -password
```

Note

The `"-password"` parameter will prompt you for a password

Then we create a resource pool for our development department to use:

```
pveum pool add dev-pool --comment "IT development pool"
```

Finally, we can assign permissions to that pool:

```
pveum acl modify /pool/dev-pool/ -group developers -role PVEAdmin
```

Our software developers can now administer the resources assigned to that pool.
