Wheel Fudo PAM 3.6 - System Documentation

Release is not supported

Wheel Systems

September 08, 2021

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CHAPTER 1

General information

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Documentation Structure

1. General information

This chapter covers system overview, data model and user authorization methods.

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This chapter contains information on stored access sessions.

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This chapter contains administration procedures.

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This chapter contains reference information which supplement Wheel Fudo PAM administration topics.

7. Troubleshooting

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This chapter contains frequently requested information about Wheel Fudo PAM.

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This chapter contains list of terms used throughout this documentation.

Conventions and symbols

This section covers conventions used throughout this documentation.

italic

Uster interface elements.

`example`

Example value of a parameter, API method name or code example.

Note: Note. Additional information closely reletad with described topic, e.g. suggestion concerning given procedure step; additional conditions which have to be met.

Warning: Warning. Essential information concerning system's operation. Not adhering to this information may have irreversible consequences.

Disclaimer

CHAPTER 2

System overview

Wheel Fudo PAM is a complete solution for managing remote privileged access.

2.1 PSM

PSM module enables facilitating constant monitoring of remote access sessions to IT infrastructure. Wheel Fudo PAM acts as a proxy between users and monitored servers and it registers users' actions, including mouse pointer moves, keystrokes and transferred files.

The PSM module records complete network traffic along with meta data, enabling precise session playback and full-text content search.

Wheel Fudo PAM enables viewing current connections and intervening in a monitored session in case the administrator notices a potential misuse of access rights.

2.1.1 Citrix StoreFront (HTTP)

Supported connection modes:

- *Gateway*,
- *Proxy*,
- *Transparent*.

Notes:

- Session player displays raw text without graphical rendering.

- Lack of bastion mode support results from protocol's limitations. Citrix StoreFront itself provides access to a bastion of hosts. When logging to Citrix StoreFront, user can select desired host to connect to over ICA protocol.
- Initiating connections with ICA servers over Citrix StoreFront interface requires *anonymous* or *forward* accounts assigned to those servers.

2.1.2 HTTP

Supported connection modes:

- *Gateway*,
- *Proxy*,
- *Transparent*.

Notes:

- Session player displays raw text without graphical rendering.
- Bastion mode is not supported due to limitations of the protocol.
- Access to external resources is not monitored.
- Following redirections is not supported.

2.1.3 ICA

Supported connection modes:

- *Bastion* (option to enter account or target server in the ICA file),
- *Gateway*,
- *Proxy*,
- *Transparent*.

Supported client applications:

- Citrix Receiver.

2.1.4 Modbus

Supported connection modes:

- *Gateway*,
- *Proxy*,
- *Transparent*.

Notes:

- Bastion mode is not supported due to limitations of the protocol.

2.1.5 MS SQL (TDS)

Supported connection modes:

- *Bastion*,
- *Gateway*,
- *Proxy*,
- *Transparent*.

Supported client applications:

- SQL Server Management Studio,
- sqsh.

2.1.6 MySQL

Supported connection modes:

- *Gateway*,
- *Proxy*,
- *Transparent*.

Supported client applications:

- Official MySQL client,
- PyMySQL libraries for Python.

Notes:

- Bastion mode is not supported due to limitations of the protocol.
- Active Directory and other external authentication sources are not supported.

2.1.7 Oracle

Oracle is a proprietary protocol and its implementation requires reverse engineering. This results in a limited support in development of new features as well as addressing potential issues.

Supported connection modes:

- *Gateway*,
- *Proxy*,
- *Transparent*.

Supported client applications:

- SQLDeveloper 4.1.3.20.78,
- SQL*Plus: Release 11.2.0.4.0 Production.

Notes:

- Active Directory and other external authentication sources are not supported.

- Session player only displays clients querries (server's responds are not included).
- Oracle 10 and 11 are supported.
- Bastion mode is not supported due to limitations of the protocol.

2.1.8 RDP

Supported connection modes:

- *Bastion*,
- *Gateway*,
- *Proxy*,
- *Transparent*.

Supported client applications:

- All official Microsoft clients for Windows and macOS,
- FreeRDP 2.0 i newer.

Notes:

- When authenticating Fudo users against AD (or other external source) the TLS+NLA (Network Level Authentication) is not supported; TLS mode is used instead. NLA mode on server side is supported.

RemoteApp

Fudo natively supports RemoteApp connections over RDP protocol. Application windows are recorded the same way as RDP connections, enforcing all Wheel Fudo PAM security restrictions.

To monitor RemoteApp sessions, the connection must be launched through a `*.rdp` configuration file with the Wheel Fudo PAM IP address and the port number defined.

Connections initiated over *Remote Desktop Web Access* can be monitored by Fudo only in Transparent/Gateway mode as the *Remote Desktop Web Access* can not provide Fudo IP address instead of original destination server.

2.1.9 SSH

Supported connection modes:

- *Bastion*,
- *Gateway*,
- *Proxy*,
- *Transparent*.

Supported features:

- Connections multiplexing,
- SCP,
- Ports redirection.

Notes:

- SFTP sessions playback is not supported,
- SSH keys forwarding is not supported.

2.1.10 Telnet 3270

Supported connection modes:

- *Bastion*,
- *Gateway*,
- *Proxy*,
- *Transparent*.

Notes:

- User must authenticate twice - first against Fudo and then against the target host.

Supported client applications:

- IBM Personal Communications,
- c3270.

2.1.11 Telnet 5250

Supported connection modes:

- *Bastion*,
- *Gateway*,
- *Proxy*,
- *Transparent*.

Notes:

- User must authenticate twice - first against Fudo and then against the target host.
- It is not possible to join a Telnet 5250 session.

Supported client applications:

- IBM Personal Communications,
- tn5250.

2.1.12 Telnet

Supported connection modes:

- *Bastion*,
- *Gateway*,
- *Proxy*,

- *Transparent*.

Notes:

- User must authenticate twice - first against Fudo and then against the target host.

2.1.13 VNC

Supported connection modes:

- *Bastion*,
- *Gateway*,
- *Proxy*,
- *Transparent*.

Supported client applications:

- TightVNC,
- RealVNC.

2.1.14 X11

X11 protocol is supported within the SSH protocol.

Supported servers:

- Xorg,
- Xming,
- XQuartz.

The PSM module supports following system configurations:

- Linux,
- FreeBSD,
- Mac OS X
- Microsoft Windows Server,
- Microsoft Windows,
- TightVNC,
- Solaris.

Related topics:

- *Requirements*
- *Data model*
- *Security measures*

2.2 AAPM (Application to Application Password Manager)

AAPM module enables secure passwords exchange between applications.

Related topics:

- *Requirements*
- *Data model*
- *Security measures*

2.3 Secret manager

Wheel Fudo PAM can be also set up to automatically manage login credentials on monitored servers and periodically change passwords at specified time intervals (e.g. 1 hour).

Secret manager module supports password changing on following systems:

- Unix
- MySQL
- Cisco
- Cisco Enable Password
- MS Windows

It also enables configuring a custom password changer as a set of commands executed on remote a host.

Related topics:

- *Requirements*
- *Data model*
- *Security measures*

2.4 Efficiency Analyzer

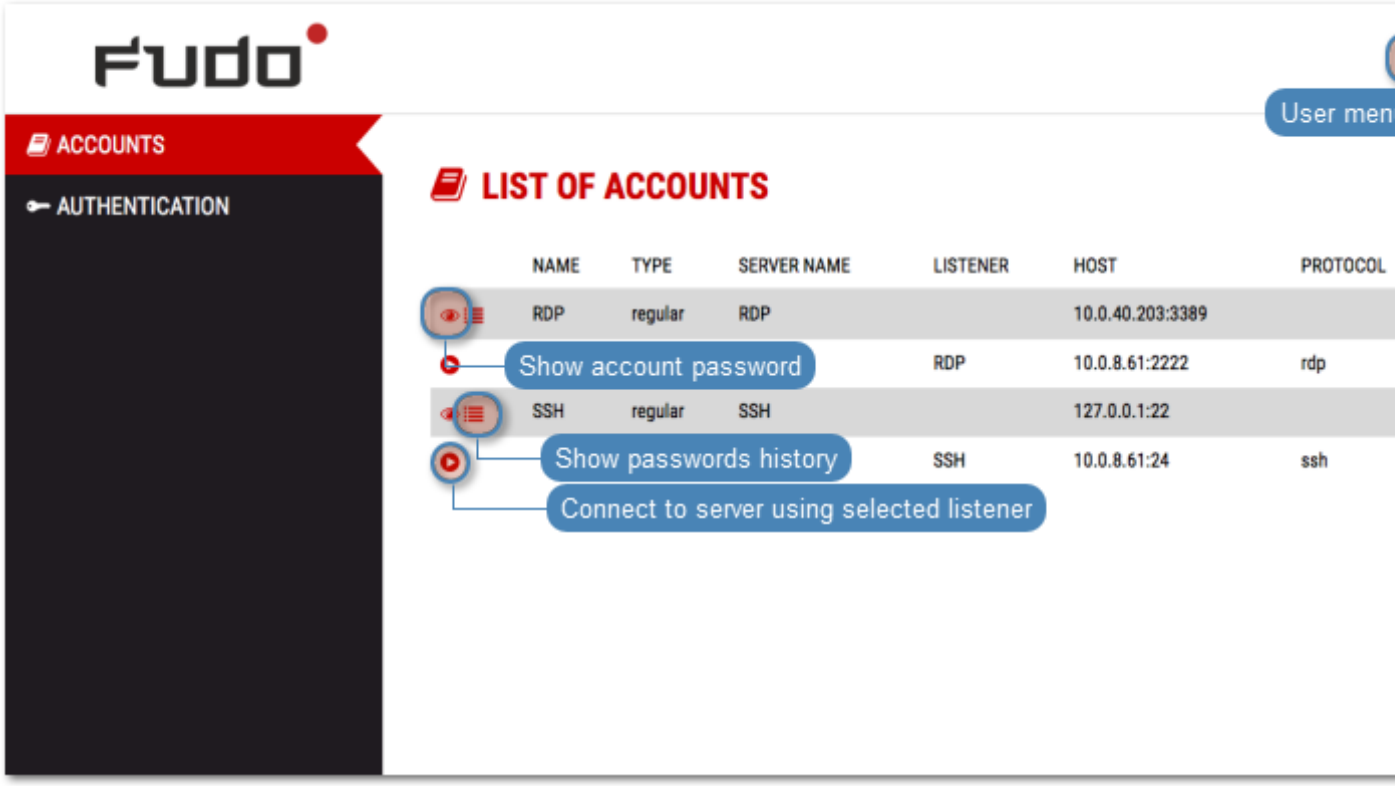
Efficiency Analyzer module tracks users' actions and provides precise information on their activity and idle times.

Related topics:

- *Requirements*
- *Data model*
- *Security measures*

2.5 User portal

User portal enables browsing available resources and initiating connections with monitored servers using selected listener.



Related topics:

- *Requirements*
- *Data model*
- *Security measures*

2.6 Data model

Wheel Fudo PAM defines five base object types: user, server, account, safe and listener.

User defines a subject entitled to connect to servers within monitored IT infrastructure. Detailed object definition (i.e. unique login, full name, email address etc.) enables precise accountability of user actions when login and password are substituted with a shared account login credentials.

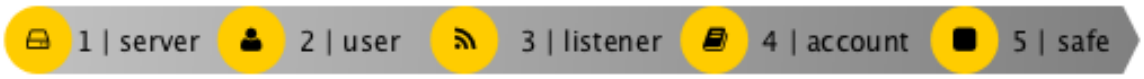
Server is a definition of the IT infrastructure resource, which can be accessed over one of the specified protocols.

Account defines the privileged account existing on the monitored server. It specifies the actual login credentials, user authentication mode: anonymous (without user authentication), regular (with login credentials substitution) or forward (with login and password forwarding); password changing policy as well as the password changer itself.

Safe directly regulates user access to monitored servers. It specifies available protocols' features, policies and other details concerning users and servers relations.

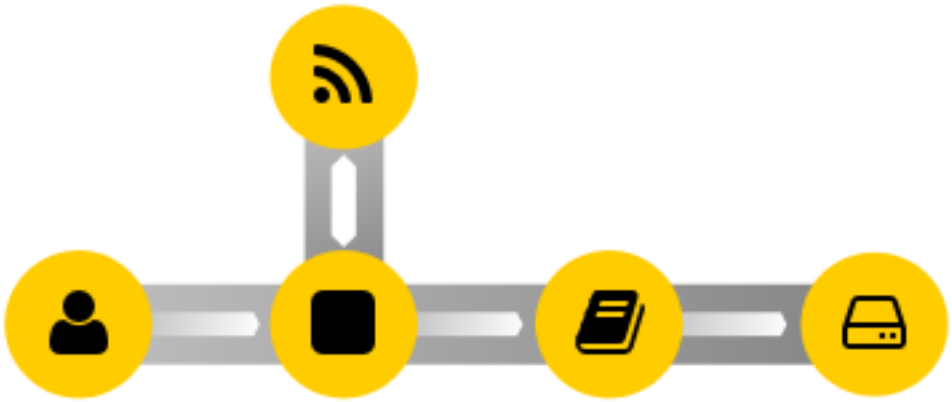
Listener determines server connection mode (proxy, gateway, transparent, bastion) as well as its specifics.

Proper system operation requires configuration of *servers*, *users*, *safes*, *accounts* and *listeners*.



Warning: Data model objects: *safes*, *users*, *servers*, *accounts* and *listeners* are replicated within the cluster and object instances must not be added on each node. In case the replication mechanism fails to copy objects to other nodes, contact technical support department.

Objects relations chart



Related topics:

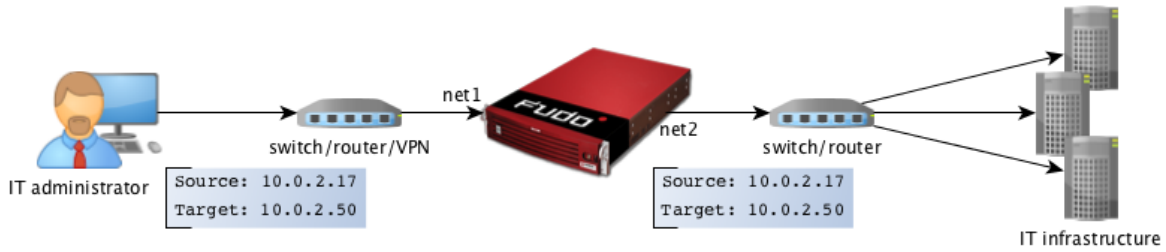
- *System overview*
- *User authorization methods and modes*
- *Quick start*

2.7 Deployment scenarios

Note: It is advised to deploy the Wheel Fudo PAM within the IT infrastructure, so it only mediates administrative connections. It will allow for lowering system load, network traffic optimization as well as maintaining access to hosted services in case of hardware malfunction.

Bridge

In bridge mode Wheel Fudo PAM mediates communication between users and servers regardless whether the traffic is being monitored (i.e. it uses any of supported protocols) or not.



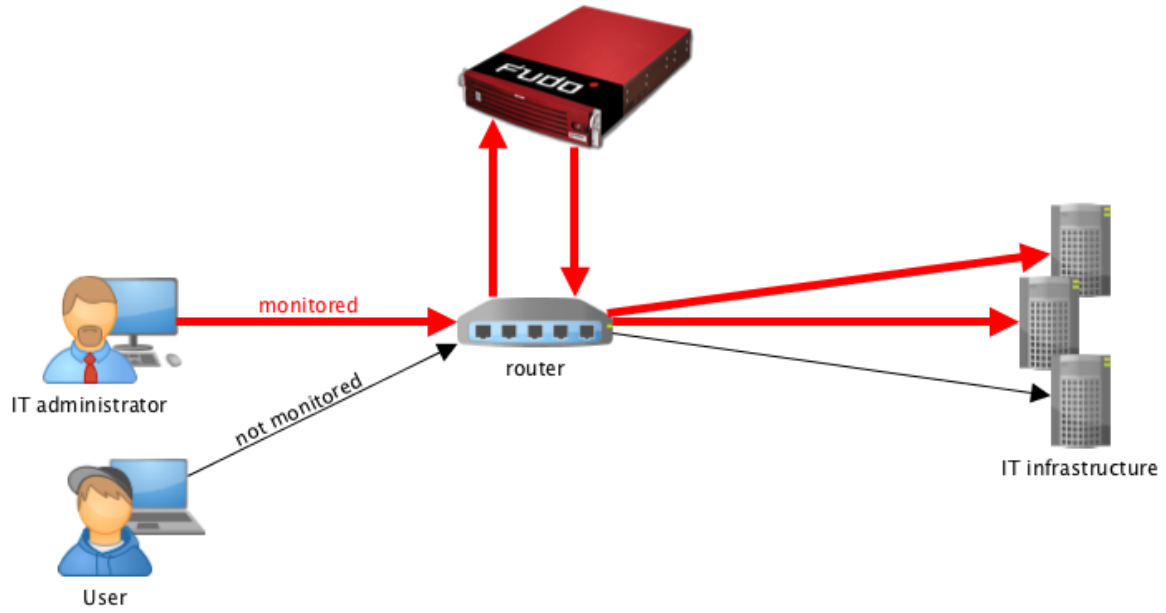
Mediating packages transfer, Wheel Fudo PAM preserves source IP address when forwarding requests to destination servers.

Such solution allows keeping existing rules on firewalls which control access to internal resources.

For more information on configuring bridge refer to the *Network configuration* topic.

Forced routing

Forced routing mode requires using a properly configured router. Such solution allows controlling network traffic in third ISO/OSI network layer, so only administrative requests are routed through Wheel Fudo PAM and the rest of the traffic is forwarded directly to the destination server.



This mode does not require changes in existing network topology and enables network traffic optimization due to separating requests from system administrators and regular users.

Related topics:

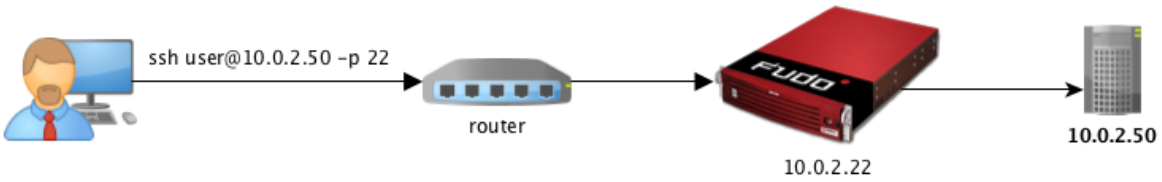
- *Connection modes*
- *Managing servers*
- *User authentication methods and modes*
- *System overview*
- *Quick start - SSH connection configuration*

- *Quick start - RDP connection configuration*
- *Initial boot up*

2.8 Connection modes

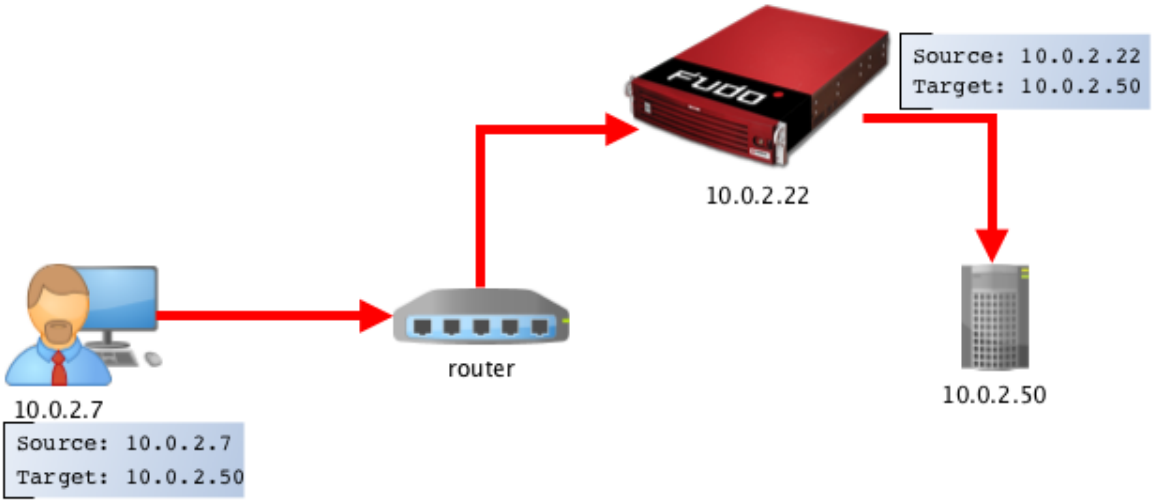
Transparent

In transparent mode, users connect to destination server using given server's IP address.



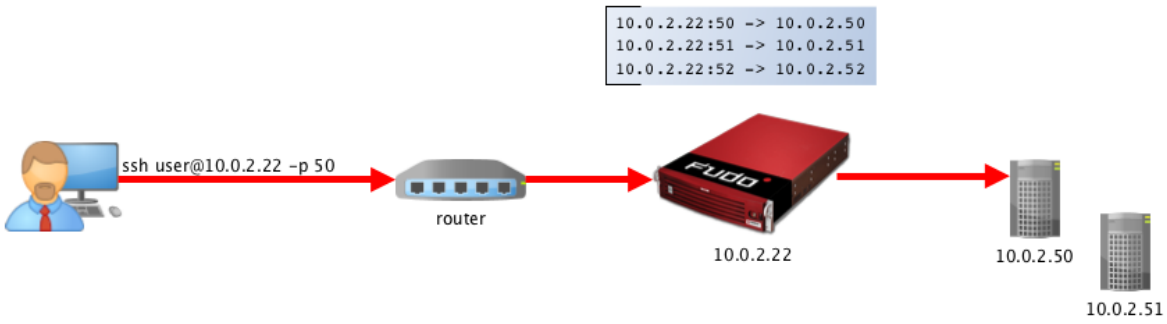
Gateway

In gateway mode, users connect to destination server using the server's actual IP address. Wheel Fudo PAM mediates connection with the server using own IP address. This ensures that the traffic from the server to the user goes through Wheel Fudo PAM.



Proxy

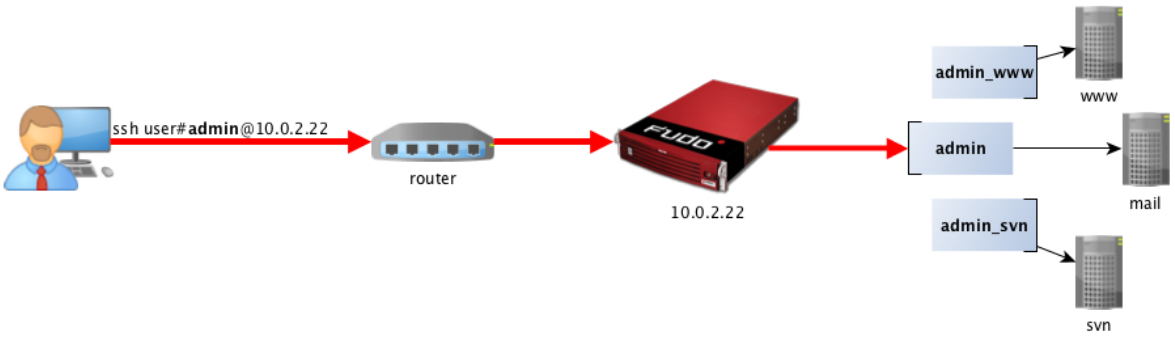
In proxy mode, administrator connects to destination server using combination of Wheel Fudo PAM IP address and unique port number assigned to given server. Uniqueness of this combination enables establishing connection with a particular resource.



Such approach enables concealing actual IP addressing and allows configuring servers to only accept requests sent from Wheel Fudo PAM.

Bastion

In bastion mode, the account on the target host is specified within the string identifying the user, e.g. `ssh john_smith#admin@10.0.0.8`. This enables facilitating access to a group of monitored servers through the same IP address and port number combination.



Note:

- The *bastion* mode is supported when connecting over SSH, RDP, VNC, Telnet or Telnet 3270 protocols.
- In case the specified account is not found, Wheel Fudo PAM will try to match the name with a server object.

Related topics:

- *Deployment scenarios*
- *Managing servers*
- *User authentication methods and modes*
- *System overview*
- *Quick start - SSH connection configuration*
- *Quick start - RDP connection configuration*
- *Initial boot up*

2.9 User authentication methods and modes

User authentication methods

Before establishing connections with server, Fudo authorizes user using one of the following authorization method:

- *Static password*,
- *Public key*,
- *CERB*,
- *RADIUS*,
- *LDAP*,
- *Active Directory*.

Note: External authentication servers CERB, RADIUS, LDAP and Active Directory require configuration. For more information, refer to the *External authentication* topic.

Authentication modes

After authenticating the user, Fudo proceeds with establishing connection with the target system using original user credentials or substituting them with values stored locally or fetched from a password vault.

Authentication with original login and password

In this authentication mode, Fudo uses login and password provided by the user upon logon to authenticate the user on the target system.

Authentication with login and password substitution

In this authentication mode, Fudo substitutes user login and password with previously defined ones.

Authentication with login and password substitution enables precise identification of the person who connected to the server, in case a number of users use the same credentials to access the server.

Note: The password to the target system can be either explicitly defined in the *account* or can be obtained from internal or external password vault upon each access request. For more information, refer to the *Password changers* and *External passwords repositories* topics.

Note: In case of Oracle database, the user password and the privileged account password must be both either shorter than 16 characters or 16-32 characters long.

Two-fold authentication

In two-fold authentication mode user is asked for login and password twice. Once for authenticating against Fudo and once again to access the target system.

Authentication with password substitution

In this authentication mode, Fudo forwards login provided by user and substitutes the password when establishing connection with the target system.

Note: The password to the target system can be either explicitly defined in the connection or can be obtained from the external passwords repository upon each access request. For more information, refer to the *External passwords repositories* topic.

Authentication by target server

In this mode, Wheel Fudo PAM forwards login credentials to the target host, which verifies whether the user is authorized to access it. Verification status is returned to Wheel Fudo PAM, which establishes monitored connection. Authentication by the target server is available only when monitoring SSH connections or RDP with TLS + NLA security option enabled.

Related topics:

- *System overview*

- *External authentication servers configuration*
- *Security measures*

2.10 Security measures

2.10.1 Data encryption

Data stored on Wheel Fudo PAM is encrypted with AES-XTS algorithm using 256 bit encryption keys. AES-XTS algorithm is most effective hard drive encryption solution.

Appliance

Encryption keys are stored on two USB flash drives. Flash drives delivered with Wheel Fudo PAM are uninitialized. Keys initialization takes place during initial system boot-up, during which both flash drives have to be connected (initiation procedure is described in chapter *System initiation*).

After encryption keys have been initiated and Wheel Fudo PAM has booted up, both USB flash drives can be removed and placed somewhere safe. During daily operation, encryption key is required only for system boot up. If safety procedures allow, one USB flash drive can stay connected to Wheel Fudo PAM, which will allow Wheel Fudo PAM to boot up automatically in case of a power outage or system reboot after software update.

Virtual machine distribution

Wheel Fudo PAM's file system, running in virtual environment is encrypted using an encryption phrase, which is set up during system initiation and has to be entered each time the system boots up.

2.10.2 Backups

User sessions data can be backed up on external servers running rsync service.

2.10.3 Permissions

Each data model entity, has a list of users defined, who are allowed to manage given object, according to assigned user role.

For more information on user roles refer to *Roles* topic.

2.10.4 Sandboxing

Wheel Fudo PAM takes advantage of CAPSICUM sandboxing mechanism, which separates each connection on Wheel Fudo PAM operating system level. Precise control over assigned system resources and limiting access to information on the operating system itself, increase security and greatly influence system's stability and availability.

2.10.5 Reliability

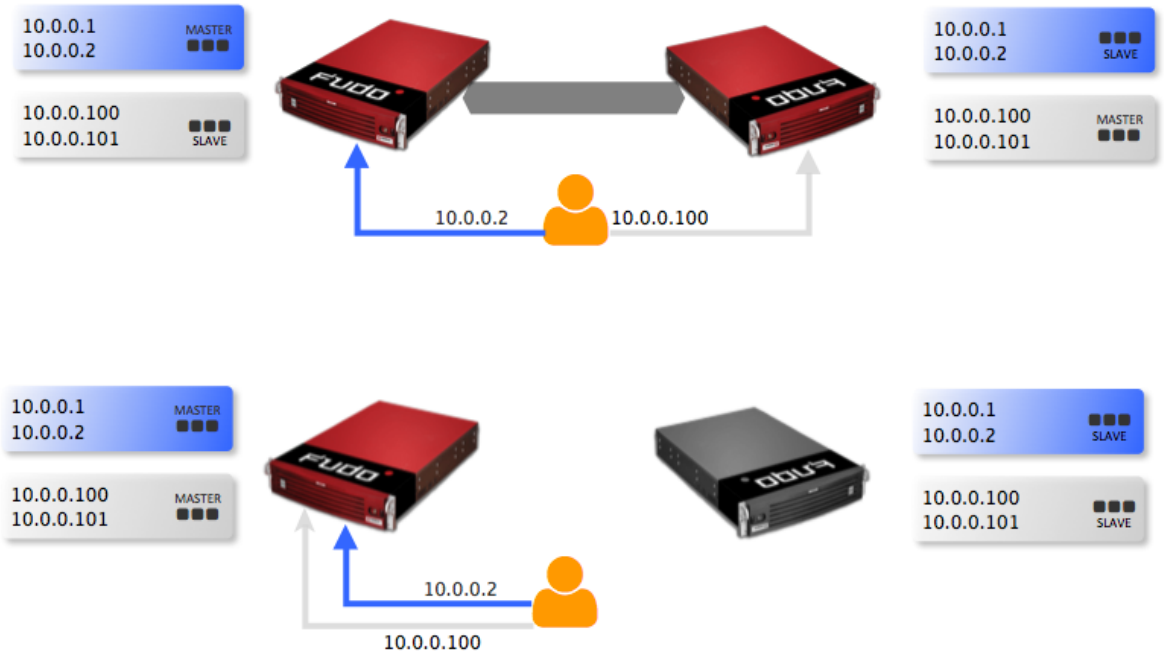
System hardware configuration is optimized to deliver high performance and high availability.

2.10.6 Cluster configuration

Wheel Fudo PAM supports cluster configuration in multimaster mode where system configuration (connections, servers, sessions, etc.) is synchronized on each cluster node and in case a given node crashes, remaining nodes will immediately take over user connection requests ensuring service continuity.

Warning: Cluster configuration does not facilitate data backup. If session data is deleted on one of the cluster nodes, it is also deleted from other nodes.

Virtual IP addresses are aggregated in redundancy groups which enable facilitating static load balancing while preserving cluster's high availability nature.



Related topics:

- *User authorization methods and modes*
- *System overview*
- *Quick start - SSH connection configuration*
- *Quick start - RDP connection configuration*
- *System initiation*

CHAPTER 3

System deployment

This topic describes Wheel Fudo PAM appliance and the system initiation procedure.

3.1 Requirements

Administration panel

System is managed in administration panel available through web browser. Recommended browsers are Google Chrome and Mozilla Firefox.

Network requirements

Correct operation requires:

- ability to establish connections to Wheel Fudo PAM on port 443, for administration purposes,
- ability for users to connect to Wheel Fudo PAM and for Wheel Fudo PAM to connect to target systems.

Hardware requirements (not applicable to virtual appliance distributions)

Wheel Fudo PAM is a complete solution combining both hardware and software. Installing system requires 2U space in 19" rack cabinet and connection to network infrastructure.

VNC software client requirements

VNC connections require 24-bit (true color) mode.

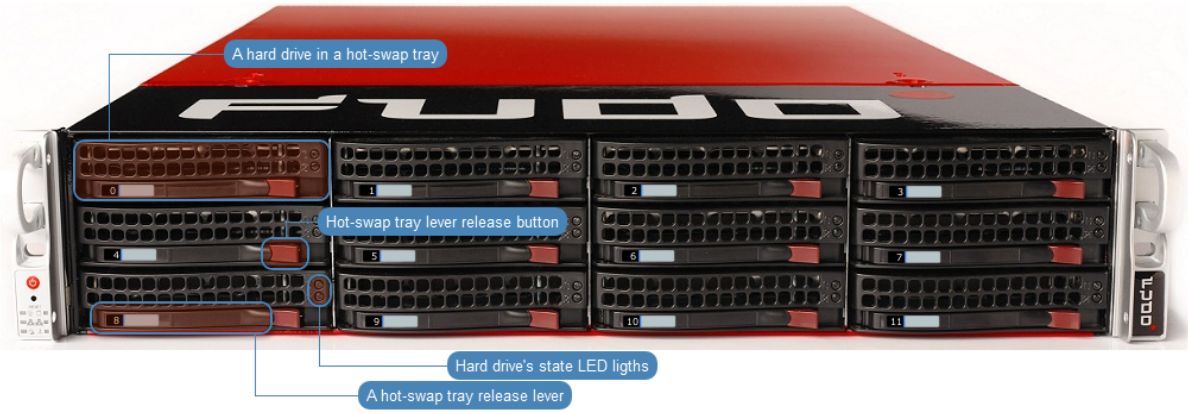
3.2 Hardware overview

Wheel Fudo PAM is delivered in a 2U 19" rack server case.

Front panel view

Hard drive bays

Front panel covers hard drives in hot swap enclosures allowing for removing them without having to shutdown the system.



Related topics:

- *Initial boot up*
- *Quick start - SSH connection configuration*
- *Quick start - RDP connection configuration*

3.3 System initiation

Appliance

Wheel Fudo PAM is delivered with two uninitiated USB flash drives. During initial boot up, Wheel Fudo PAM generates encryption keys, which are stored on enclosed USB flash drives. More information on encryption keys can be found in the *Security measures* chapter.

1. Install device in 19" rack cabinet.
2. Connect both power supply units to 230V/110V power outlets.

Note: Connecting both power supplies is necessary to start the system.

---

3. Connect network cable to one of the RJ-45 ports.

4. Connect both of the USB flash drives delivered with Wheel Fudo PAM.

Note: Initial boot up requires conecting both USB flash drives. More information on encryption keys can be found in *Security measures* chapter.

---

5. Press the power button on the front panel.

6. After keys have been initiated, disconnect USB flash drives.

Warning:

- One of the USB flash drives containing encryption key must be disconnected and placed in a secure location, accessible only to authorized personnel.
- If the USB flash drives with encryption keys are lost, device will not be able to boot up and stored sessions will not be accessible. Manufacturer does not store any encryption keys.

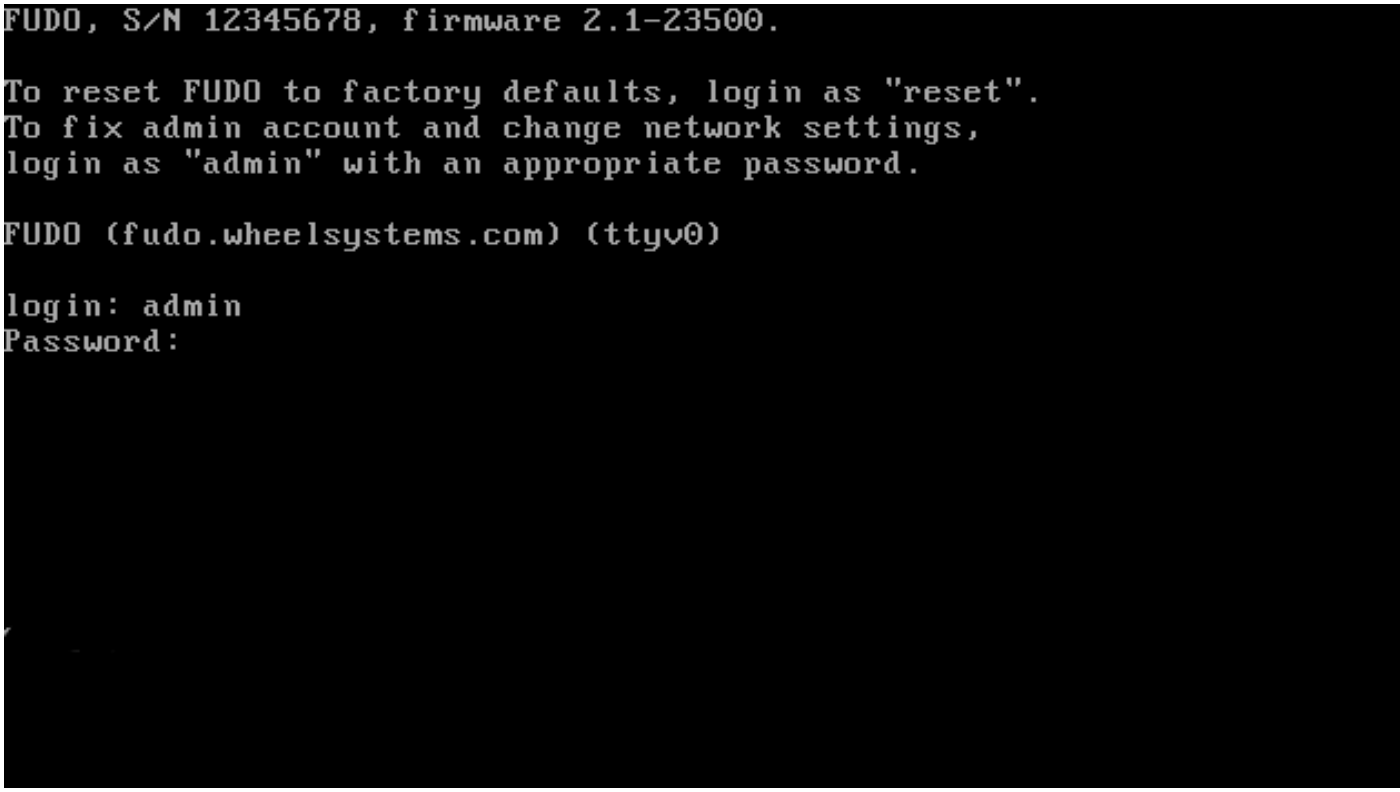
Note:

- In daily operation, one encryption key is required to start the system after which it can be disconnected.
- It is advised to make a backup copy of the encryption key.

Setting IP address using system console

1. Connect monitor and keyboard to the device.
2. Enter administrator account login and press *Enter*.

3. Enter administrator account password and press *Enter*.



4. Enter 2 and press *Enter* to change network configuration.

```
FUDO, S/N 12345678, firmware 2.1-23500.

To reset FUDO to factory defaults, login as "reset".
To fix admin account and change network settings,
login as "admin" with an appropriate password.

FUDO (fudo.wheelsystems.com) (ttyv0)

login: admin
Password:
Last login: Wed Jun 22 10:50:38 on ttyv0

*** FUDO configuration utility ***

Logged into FUDO, S/N 12345678, firmware 2.1-23500.

1. Show status
2. Reset network settings
0. Exit

Choose an option (0):
```

5. Enter `y` and press *Enter* to proceed with resetting network configuration.

```
FUDO, S/N 12345678, firmware 2.1-23500.

To reset FUDO to factory defaults, login as "reset".
To fix admin account and change network settings,
login as "admin" with an appropriate password.

FUDO (fudo.wheelsystems.com) (ttyv0)

login: admin
Password:
Last login: Wed Jun 22 10:50:38 on ttyv0

*** FUDO configuration utility ***

Logged into FUDO, S/N 12345678, firmware 2.1-23500.

1. Show status
2. Reset network settings
0. Exit

Choose an option (0): 2
Are you sure you want to continue? [y/N] (n):
```

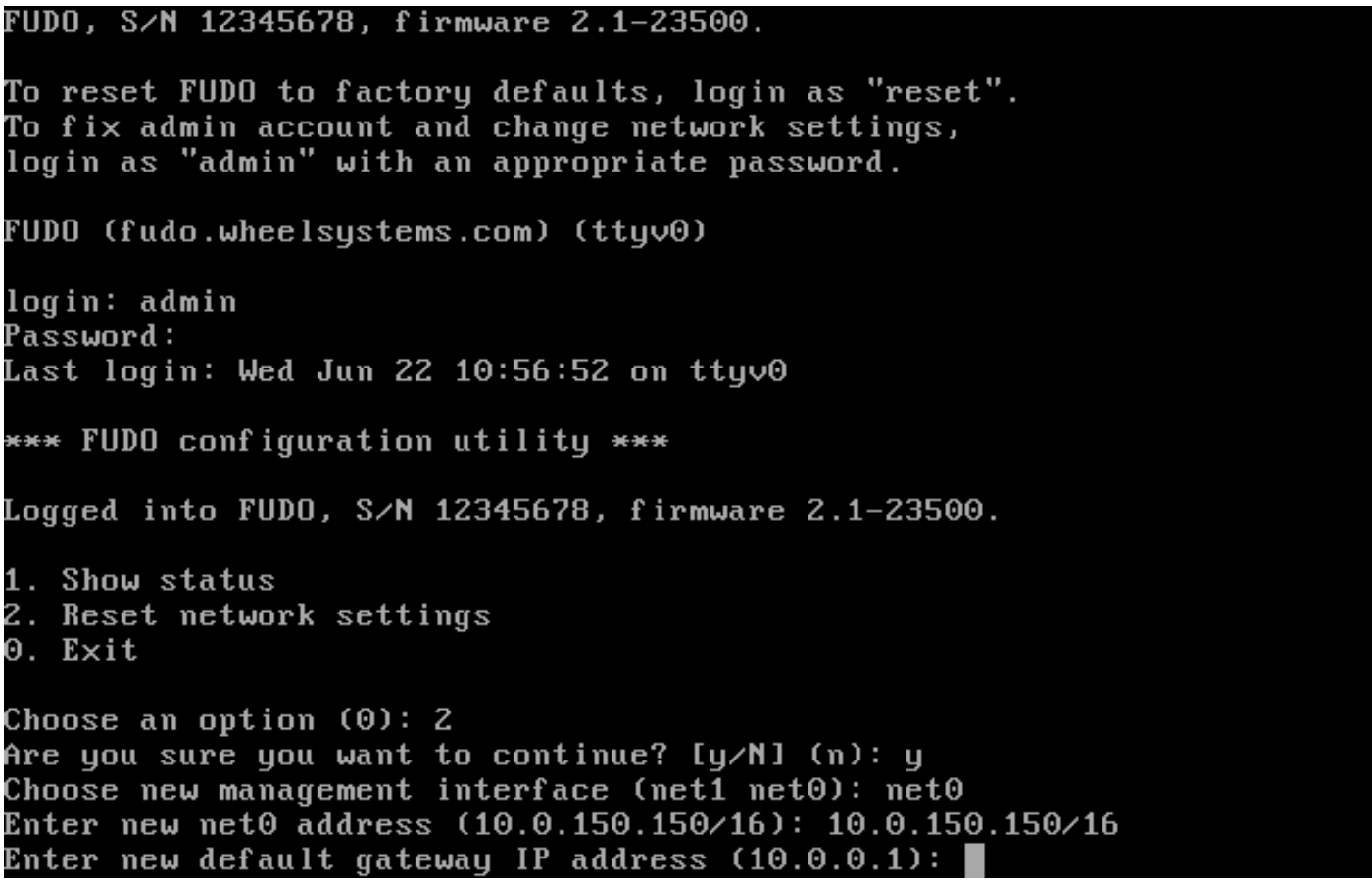
6. Enter the name of the new management interface (Wheel Fudo PAM web interface is accessible through the management interface).

```
FUDO, S/N 12345678, firmware 2.1-23500.

To reset FUDO to factory defaults, login as "reset".
To fix admin account and change network settings,
login as "admin" with an appropriate password.

FUDO (fudo.wheelsystems.com) (ttyv0)

login: admin
Password:
Last login: Wed Jun 22 10:50:38 on ttyv0

*** FUDO configuration utility ***

Logged into FUDO, S/N 12345678, firmware 2.1-23500.

1. Show status
2. Reset network settings
0. Exit

Choose an option (0): 2
Are you sure you want to continue? [y/N] (n): y
Choose new management interface (net1 net0):
```

7. Enter IP address along with the network subnet mask separated with / (e.g. `10.0.0.8/24`) and press *Enter*.

```
FUDO, S/N 12345678, firmware 2.1-23500.

To reset FUDO to factory defaults, login as "reset".
To fix admin account and change network settings,
login as "admin" with an appropriate password.

FUDO (fudo.wheelsystems.com) (ttyv0)

login: admin
Password:
Last login: Wed Jun 22 10:56:52 on ttyv0

*** FUDO configuration utility ***

Logged into FUDO, S/N 12345678, firmware 2.1-23500.

1. Show status
2. Reset network settings
0. Exit

Choose an option (0): 2
Are you sure you want to continue? [y/N] (n): y
Choose new management interface (net1 net0): net0
Enter new net0 address (10.0.150.150/16): 10.0.150.150/16
```

8. Enter network gate and press *Enter*.



Related topics:

- *Requirements*
- *Quick start - SSH connection configuration*
- *Quick start - RDP connection configuration*
- *System overview*
- *Security measures*

CHAPTER 4

Quick start

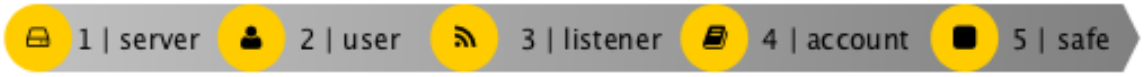
4.1 SSH

This chapter contains an example of a basic Wheel Fudo PAM configuration, to monitor SSH access to a remote server. In this scenario, the user connects to the remote server over the *SSH* protocol and logs in to the Wheel Fudo PAM using an individual login and password combination (`john_smith`/`john`). When establishing the connection with the remote server, Wheel Fudo PAM substitutes the login and the password with the previously defined values: `root`/`password` (authentication modes are described in the *User authentication modes* section).

4.1.1 Prerequisites

Description below assumes that the system has been already initiated. The initiation procedure is described in the *System initiation* topic.

4.1.2 Configuration



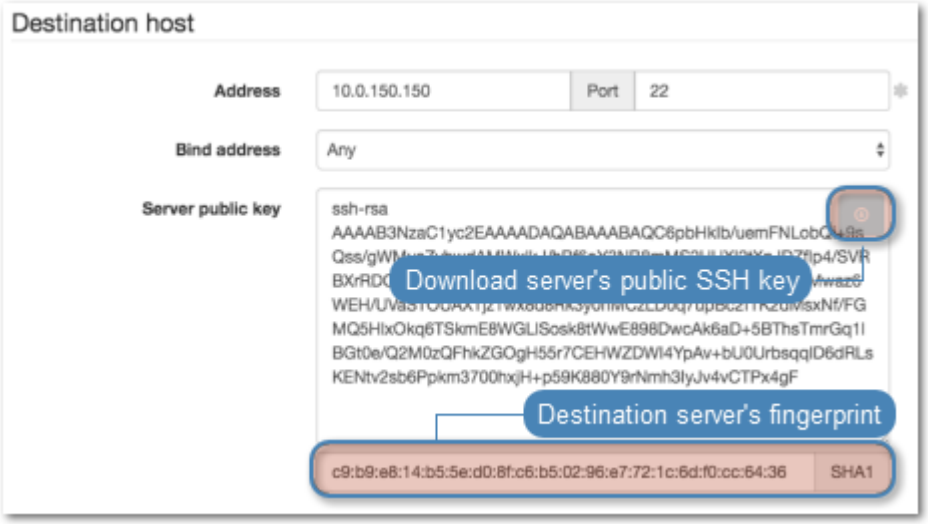
Adding a server

Server is a definition of the IT infrastructure resource, which can be accessed over one of the specified protocols.

1. Select *Management* > *Servers*.
2. Click + *Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`ssh_server`
Blocked	✗
Protocol	`SSH`
Description	✗
Permissions	
Granted users	✗
Destination host	
Address	`10.0.150.150`
Port	22

4. Download or enter target server's public key.



5. Click *Save*.

Adding a user

User defines a subject entitled to connect to servers within monitored IT infrastructure. Detailed object definition (i.e. unique login, full name, email address etc.) enables precise accountability of user actions when login and password are substituted with a shared account login credentials.

1. Select *Management* > *Users*.
2. Click + *Add*.
3. Provide essential user information:

Parameter	Value
General	
Login	`john_smith`
Blocked	
Account validity	`Indefinite`
Role	`user`
Preferred language	`English`
Safes	default settings
Full name	`John Smith`
Email	`john@smith.com`
Organization	
Phone	
AD Domain	
LDAP Base	
Permissions	
Granted users	
Authentication	
Type	`Password`
Password	`john`
Repeat password	`john`

4. Click *Save*.

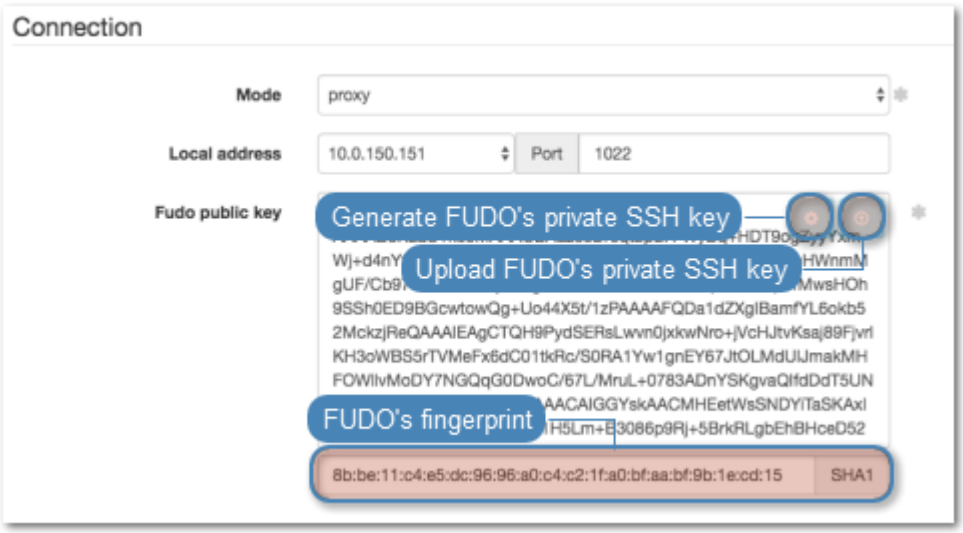
Adding a listener

Listener determines server connection mode (proxy, gateway, transparent, bastion) as well as its specifics.

1. Select *Management* > *Listeners*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`ssh_listener`
Blocked	✗
Protocol	`SSH`
Permissions	
Granted users	✗
Connection	
Mode	`proxy`
Local address	`10.0.150.151`
Port	`1022`

4. Generate or upload proxy server's private key.



Note: For security reasons the form displays server's public key derived from the generated or uploaded private key.

5. Click *Save*.

Adding an account

Account defines the privileged account existing on the monitored server. It specifies the actual login credentials, user authentication mode: anonymous (without user authentication), regular (with login credentials substitution) or forward (with login and password forwarding); password changing policy as well as the password changer itself.

1. Select *Management* > *Accounts*.
2. Click + *Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`admin_ssh_server`
Account type	`regular`
Session recording	`complete`
OCR sessions	
Delete session data after	`61` days
Permissions	
Granted users	
Server	
Server	`ssh_server`
Credentials	
Domain	
login	`root`
Replace secret with	`with password`
Password	`password`
Repeat password	`password`
Password change policy	`Static, without restrictions`
Replace secret	
Password changer	
Password changer	`None`
Privileged user	
Privileged user password	

4. Generate or upload proxy server's private key.

Note: For security reasons the form displays server's public key derived from the generated or uploaded private key.

5. Click *Save*.

Defining a safe

Safe directly regulates user access to monitored servers. It specifies available protocols' features, policies and other details concerning users and servers relations.

1. Select *Management* > *Safes*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

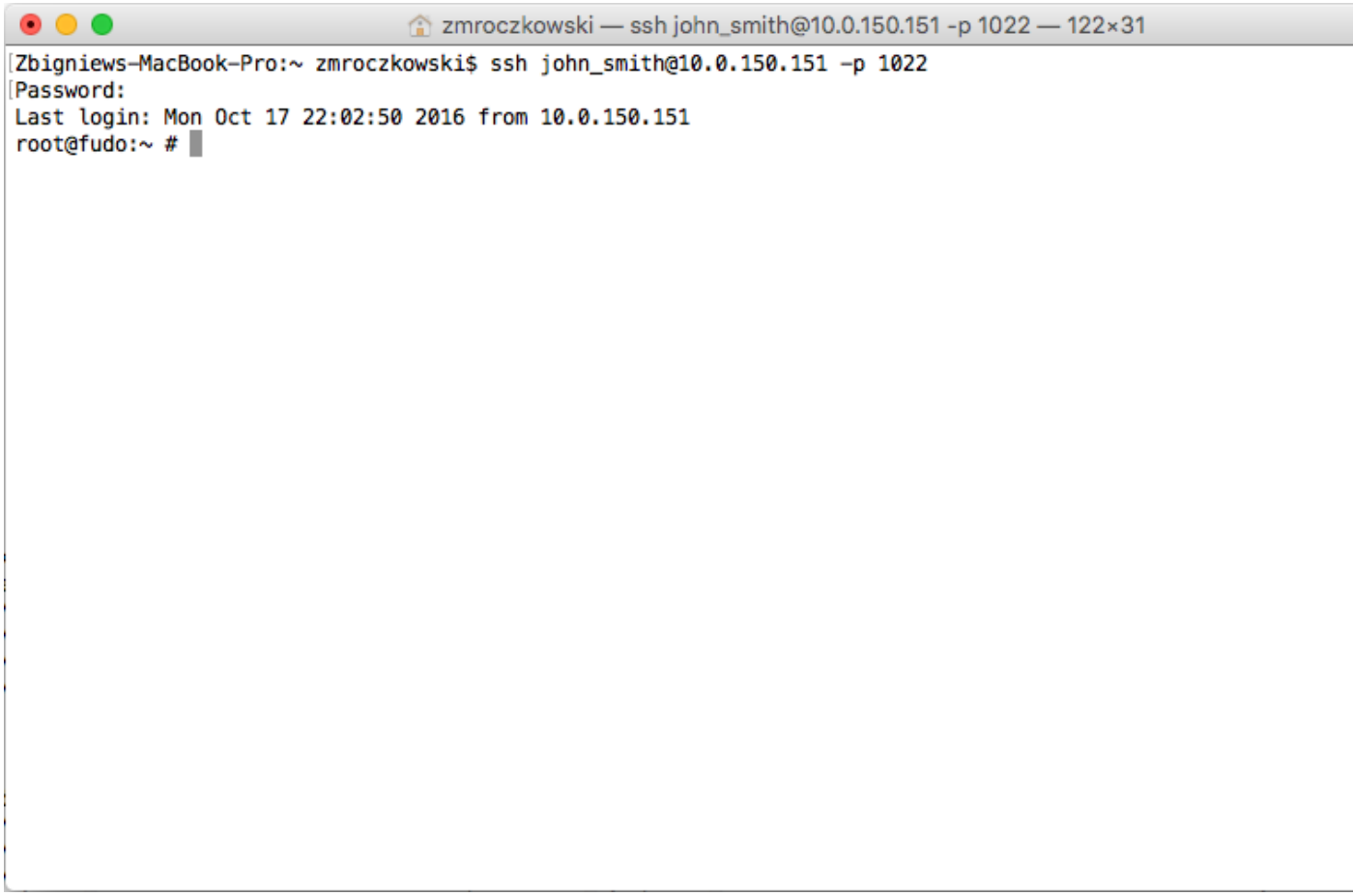
Parameter	Value
General	
Name	`ssh_safe`
Notifications	✗
Ask for login reason	✗
Policies	✗
Users	`john_smith`
Protocol functionality	
RDP	✗
SSH	✓
VNC	✗
Accounts	
`admin_ssh_server`	`ssh_listener`

4. Click *Save*.

4.1.3 Establishing connection

At this point `john_smith` can connect to the target host over the SSH protocol.

Example:

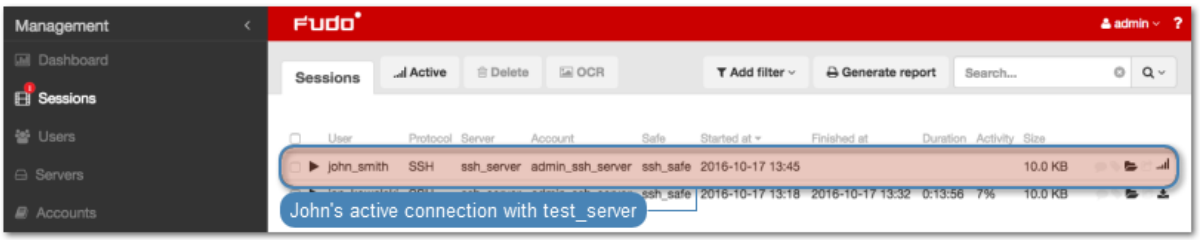


Note: Note that the *fingerprint* displayed when connecting to the target host for the first time is the same as was generated during server configuration.

After accepting the connection, user will be asked for the password. After successful authentication Wheel Fudo PAM starts recording user's activities.

4.1.4 Viewing user session

1. Open a web browser and go to the `10.0.150.151` web address.
2. Enter the login and password to login to the Wheel Fudo PAM administration panel.
3. Select *Management* > *Sessions*.
4. Click *Active*.
5. Find *John Smith's* session and click the playback icon.



Related topics:

- *Requirements*
- *Data model*
- Configuration
- *Quick start - RDP connection configuration*
- *Quick start - HTTP connection configuration*
- *Quick start - MySQL connection configuration*
- *Quick start - Telnet connection configuration*

4.2 SSH in bastion mode

This chapter contains an example of a basic Wheel Fudo PAM configuration, to monitor SSH access in bastion mode. In this scenario, the user connects to the remote server over the *SSH* protocol and logs in to the Wheel Fudo PAM using an individual login and password combination (`john_smith`/`john`). The user specifies account on a target server in the login string (`john_smith#admin_ssh_server`) and connects to it over default SSH port number. Upon establishing connection, login credentials are substituted with the previously defined values: `root`/`password` (authentication modes are described in the *User authentication modes* section).

4.2.1 Prerequisites

Description below assumes that the system has been already initiated. The initiation procedure is described in the *System initiation* topic.

4.2.2 Configuration

Adding a server

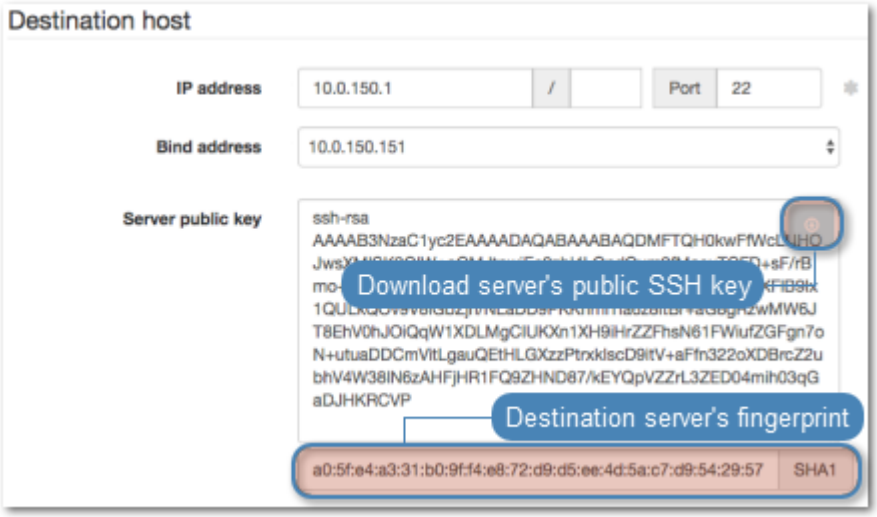
Server is a definition of the IT infrastructure resource, which can be accessed over one of the specified protocols.

1. Select *Management* > *Servers*.
2. Click *+ Add*.

3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`ssh_server`
Blocked	✗
Protocol	SSH
Description	✗
Permissions	
Granted users	✗
Destination host	
Address	`10.0.150.1`
Port	22

4. Download or enter target server's public key.



5. Click *Save*.

Adding a user

User defines a subject entitled to connect to servers within monitored IT infrastructure. Detailed object definition (i.e. unique login, full name, email address etc.) enables precise accountability of user actions when login and password are substituted with a shared account login credentials.

1. Select *Management* > *Users*.
2. Click *+ Add*.
3. Provide essential user information:

Parameter	Value
General	
Login	`john_smith`
Blocked	
Account validity	`Indefinite`
Role	`user`
Preferred language	`English`
Safes	default settings
Full name	`John Smith`
Email	`john@smith.com`
Organization	
Phone	
AD Domain	
LDAP Base	
Permissions	
Granted users	
Authentication	
Type	`Password`
Password	`john`
Repeat password	`john`

4. Click *Save*.

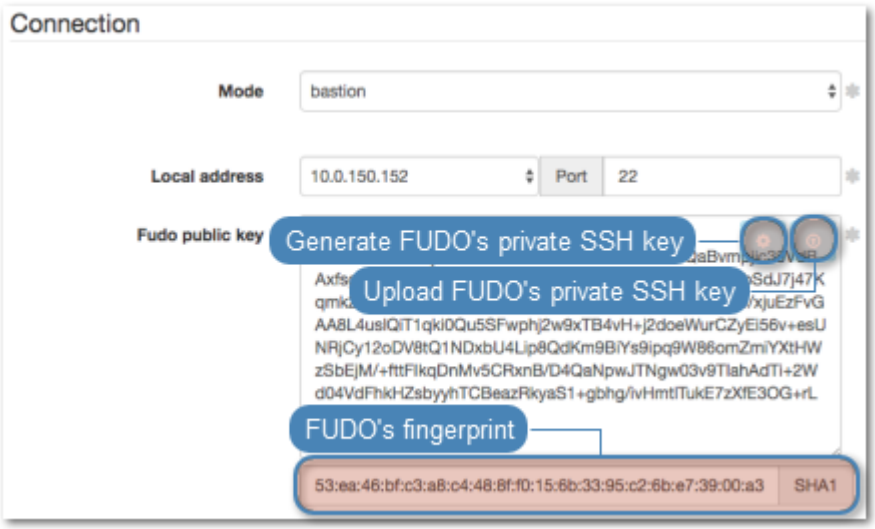
Adding a listener

Listener determines server connection mode (proxy, gateway, transparent, bastion) as well as its specifics.

1. Select *Management* > *Listeners*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`ssh_listener`
Blocked	✗
Protocol	`SSH`
Permissions	
Granted users	✗
Connection	
Mode	`bastion`
Local address	`10.0.150.151`
Port	`22`

4. Generate or upload proxy server's private key.



Note: For security reasons the form displays server's public key derived from the generated or uploaded private key.

5. Click *Save*.

Adding an account

Account defines the privileged account existing on the monitored server. It specifies the actual login credentials, user authentication mode: anonymous (without user authentication), regular (with login credentials substitution) or forward (with login and password forwarding); password changing policy as well as the password changer itself.

1. Select *Management* > *Accounts*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`admin_ssh_server`
Account type	`regular`
Session recording	`complete`
OCR sessions	
Delete session data after	`61` days
Permissions	
Granted users	
Server	
Server	`ssh_server`
Credentials	
Domain	
login	`root`
Replace secret with	`with password`
Password	`password`
Repeat password	`password`
Password change policy	`Static, without restrictions`
Replace secret	
Password changer	
Password changer	`None`
Privileged user	
Privileged user password	

4. Generate or upload proxy server's private key.

Note: For security reasons the form displays server's public key derived from the generated or uploaded private key.

5. Click *Save*.

Defining a safe

Safe directly regulates user access to monitored servers. It specifies available protocols' features, policies and other details concerning users and servers relations.

1. Select *Management* > *Safes*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

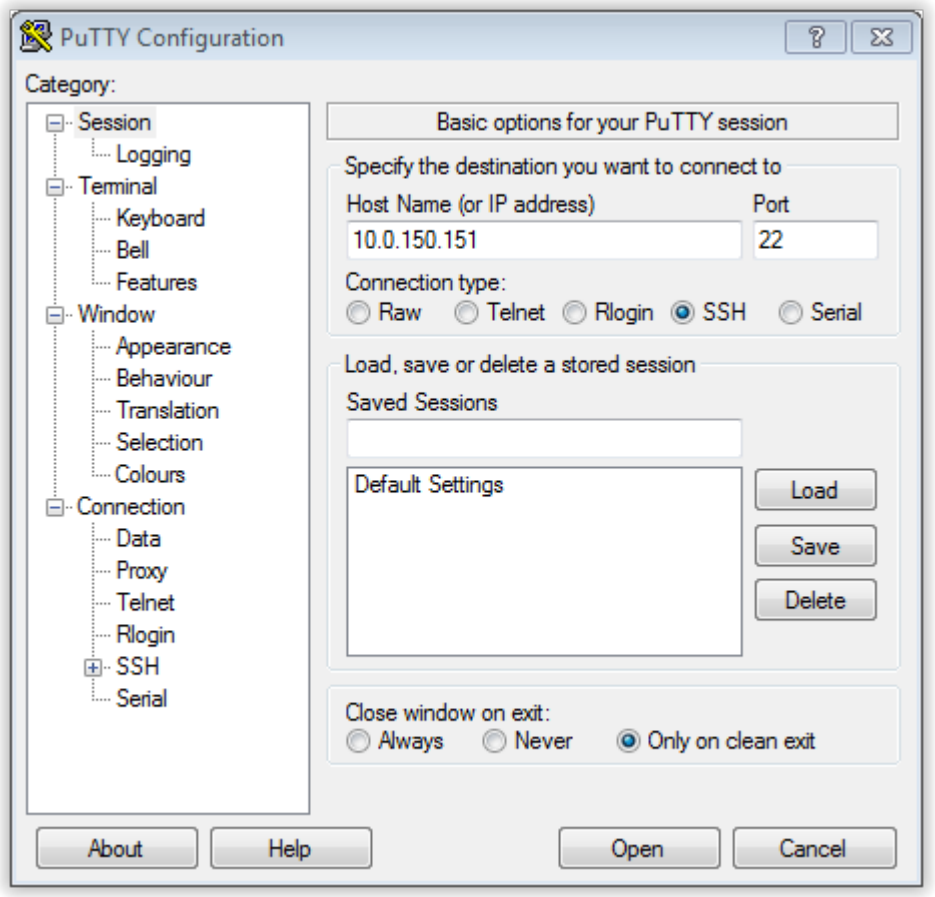
Parameter	Value
General	
Name	`ssh_safe`
Notifications	✗
Ask for login reason	✗
Policies	✗
Users	`john_smith`
Protocol functionality	
RDP	✗
SSH	✓
VNC	✗
Accounts	
`admin_ssh_server`	`ssh_listener`

4. Click *Save*.

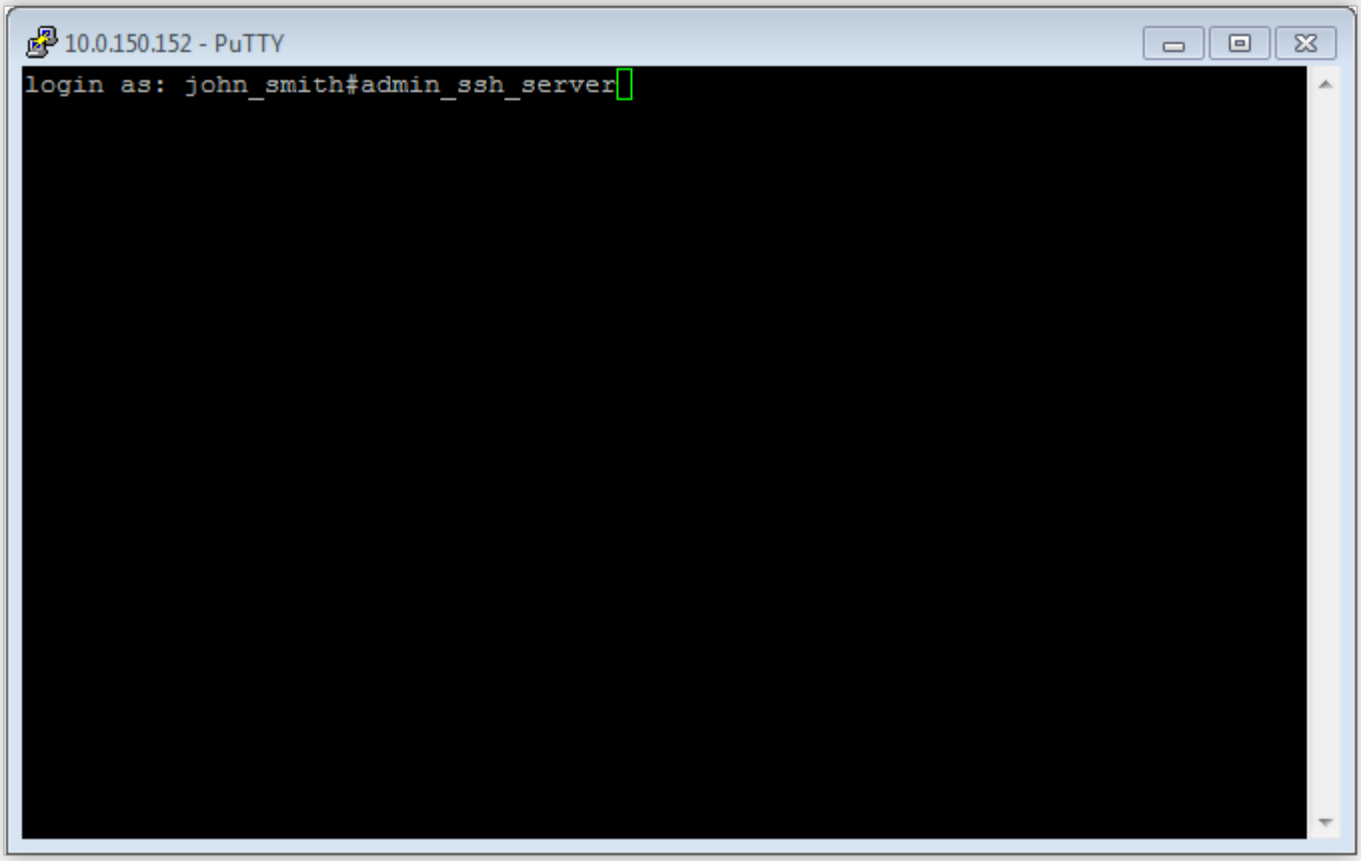
4.2.3 Establishing connection

PuTTY - SSH client for Microsoft Windows

1. Download and launch PuTTY.
2. In the *Host Name (or IP address)* field, enter `10.0.150.151`.
3. Select the `SSH` connection type and leave the default port number unchanged.



4. Click *Open*.
5. Enter user name along with the account name on the target host.



6. Enter password.

4.2.4 Viewing user session

1. Open a web browser and go to the `10.0.150.150` web address.
2. Enter the login and password to login to the Wheel Fudo PAM administration panel.
3. Select *Management* > *Sessions*.
4. Find *John Smith's* session and click the playback icon.

Related topics:

- *Requirements*
- *Data model*
- Configuration
- *Quick start - RDP connection configuration*
- *Quick start - HTTP connection configuration*
- *Quick start - MySQL connection configuration*
- *Quick start - Telnet connection configuration*

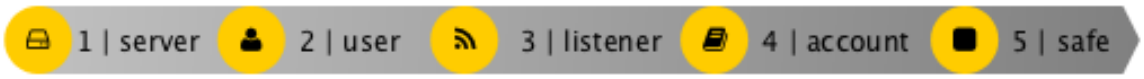
4.3 RDP

This chapter contains an example of a basic Wheel Fudo PAM configuration, to monitor RDP access to a remote server. In this scenario, the user connects to the remote server over the *RDP* protocol and logs in to the Wheel Fudo PAM using an individual login and password combination (`john_smith`/`john`). When establishing the connection with the remote server, Wheel Fudo PAM substitutes the login with specified in *Account* and the password with the password managed by a password changer (authentication modes are described in the *User authentication modes* section).

4.3.1 Prerequisites

Description below assumes that the system has been already initiated. The initiation procedure is described in the *System initiation* topic.

4.3.2 Configuration



Adding a server

Server is a definition of the IT infrastructure resource, which can be accessed over one of the specified protocols.

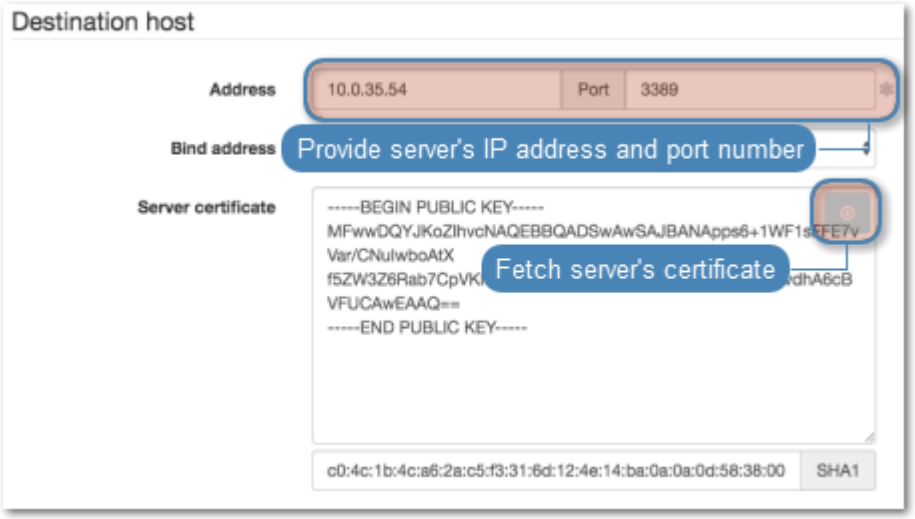
1. Select *Management* > *Servers*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
Name	`rdp_server`
Blocked	✗
Protocol	`RDP`
Description	✗

Permissions	
Granted users	✗

Destination host	
Address	`10.0.35.54`
Port	`3389`
Bind address	`10.0.150.151`

4. Download or enter target server's public key.



5. Click *Save*.

Adding a user

User defines a subject entitled to connect to servers within monitored IT infrastructure. Detailed object definition (i.e. unique login, full name, email address etc.) enables precise accountability of user actions when login and password are substituted with a shared account login credentials.

1. Select *Management* > *Users*.
2. Click *+ Add*.
3. Provide essential user information:

Parameter	Value
Login	`john_smith`
Blocked	
Account validity	`Indefinite`
Role	`user`
Preferred language	`English`
Safes	default settings
Full name	`John Smith`
Email	`john@smith.com`
Organization	
Phone	
AD Domain	
LDAP Base	
Permissions	
Granted users	
Authentication	
Type	`Password`
Password	`john`
Repeat password	`john`

4. Click *Save*.

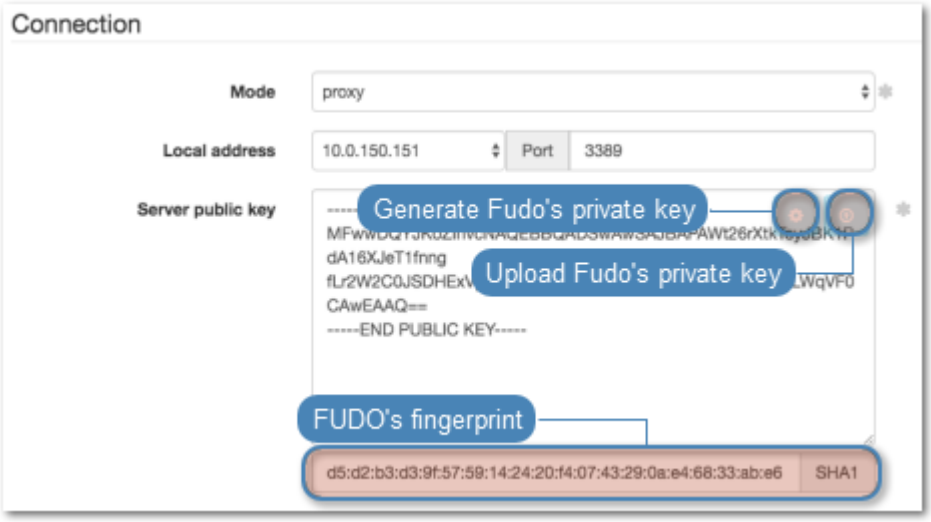
Adding a listener

Listener determines server connection mode (proxy, gateway, transparent, bastion) as well as its specifics.

1. Select *Management* > *Listeners*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`rdp_listener`
Blocked	✗
Protocol	`RDP`
Security	`Standard RDP Security`
Announcement	✗
Permissions	
Granted users	✗
Connection	
Mode	`proxy`
Local address	`10.0.150.151`
Port	`3389`

4. Generate or upload proxy server's private key.



Note: For security reasons the form displays server's public key derived from the generated or uploaded private key.

5. Click *Save*.

Adding an account

Account defines the privileged account existing on the monitored server. It specifies the actual login credentials, user authentication mode: anonymous (without user authentication), regular (with login credentials substitution) or forward (with login and password forwarding); password changing policy as well as the password changer itself.

1. Select *Management* > *Accounts*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`admin_rdp_server`
Blocked	
Type	`regular`
Session recording	`all`
OCR sessions	
OCR Language	`English`
Delete session data after	`61` days
Permissions	
Granted users	
Server	
Server	`rdp_server`
Credentials	
Domain	
Login	`administrator`
Replace secret with	`with password`
Password	`password`
Repeat password	`password`
Password change policy	`Static, without restrictions`
Password changer	
Password changer	`None`
Privileged user	
Privileged user password	

4. Click *Save*.

Defining a safe

Safe directly regulates user access to monitored servers. It specifies available protocols' features, policies and other details concerning users and servers relations.

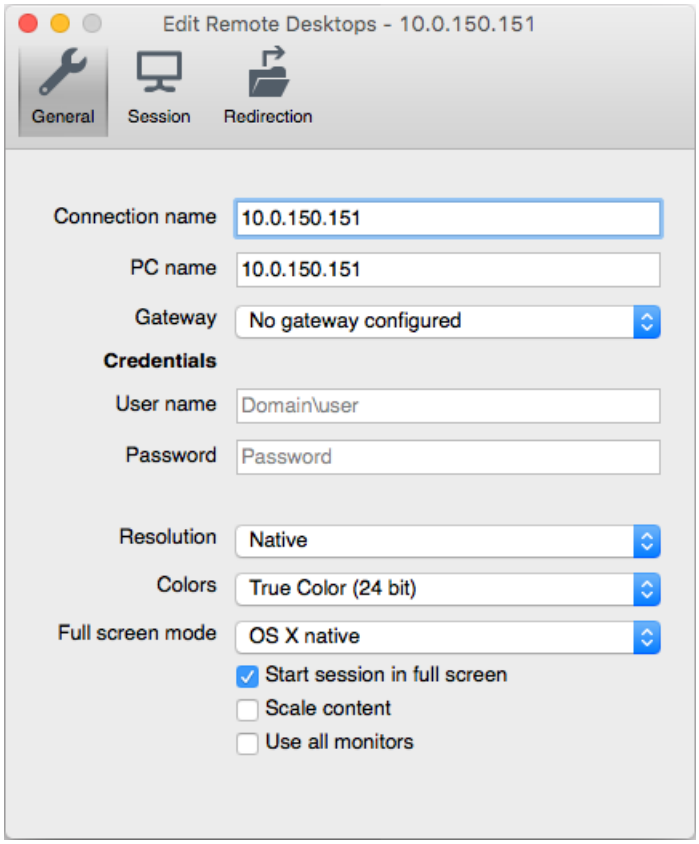
1. Select *Management* > *Safes*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`rdp_safe`
Blocked	
Login reason	
Notifications	
Policies	
Users	`john_smith`
Protocol functionality	
RDP	
SSH	
VNC	
Accounts	
`admin_rdp_server`	`rdp_listener`

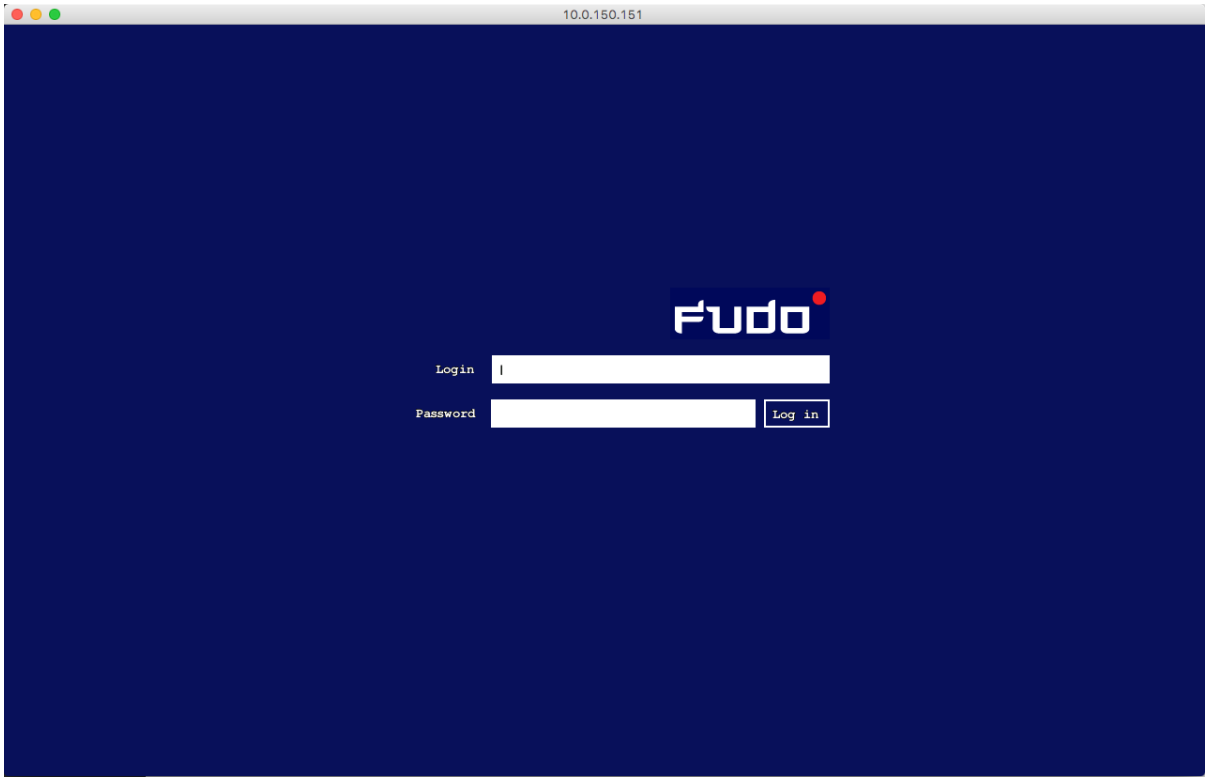
4. Click *Save*.

4.3.3 Establishing an RDP connection with a remote host

1. Launch RDP client of your choice.
2. Enter destination host IP address and RDP service port number.

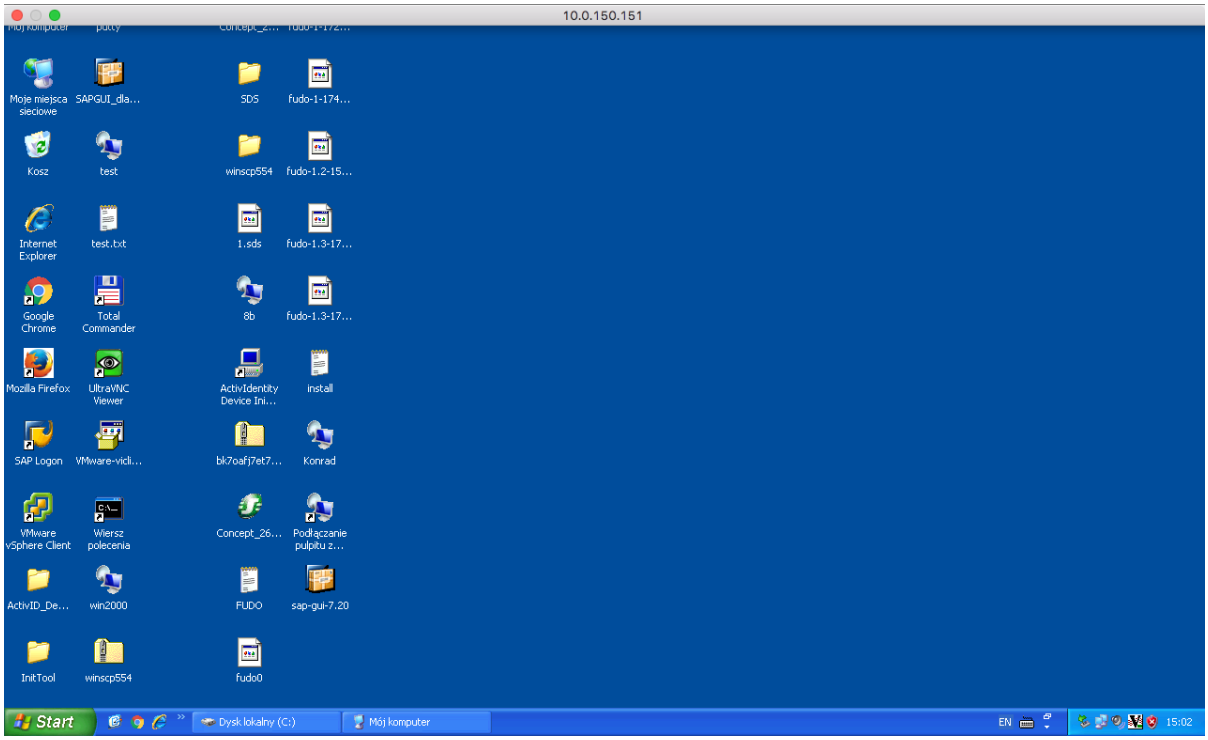


3. Enter user login and password and press the [Enter] keyboard key.



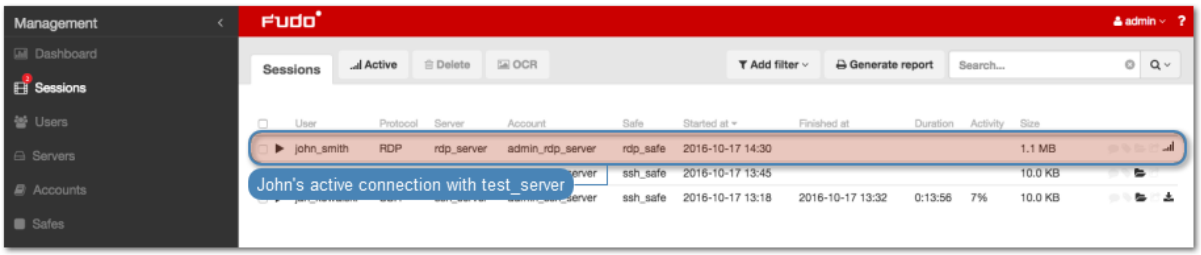
Note: Wheel Fudo PAM enables using custom login, no access and session termination screens for RDP and VNC connections. For more information on user defined images for graphical

remote sessions, refer to the *Resources* topic.



4.3.4 Viewing user session

1. Open a web browser and go to the `10.0.150.151` web address.
2. Enter the login and password to login to the Wheel Fudo PAM administration panel.
3. Select *Management* > *Sessions*.
4. Click *Active*.
5. Find *John Smith's* session and click the playback icon.



Related topics:

- *Requirements*
- *Data model*
- Configuration
- *Quick start - RDP connection configuration*
- *Quick start - HTTP connection configuration*
- *Quick start - MySQL connection configuration*

- *Quick start - Telnet connection configuration*

4.4 Telnet

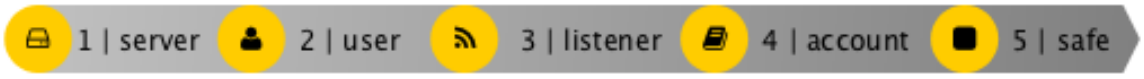
This chapter contains an example of a basic Wheel Fudo PAM configuration, to monitor Telnet connections to a remote server. In this scenario, the user connects to the remote server using Telnet client and logs in using individual login and password. Wheel Fudo PAM authenticates the user against the information stored in the local database, establishes connection with the remote server and starts recording.

Note: Telnet connections do not support login credentials forwarding and login credentials substitution. When connecting to target host over telnet protocol, users are asked to provide their login credentials twice. First time to authenticate against Wheel Fudo PAM and then again, to connect to the target host.

4.4.1 Prerequisites

Description below assumes that the system has been already initiated. For more information on the initiation procedure refer to the *System initiation* topic.

4.4.2 Configuration



Adding a server

Server is a definition of the IT infrastructure resource, which can be accessed over one of the specified protocols.

1. Select *Management* > *Servers*.
2. Click the Add button.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`telnet_server`
Blocked	✗
Protocol	`Telnet`
Enable SSLv2 support	✗
Enable SSLv3 support	✗
Description	✗
Permissions	
Granted users	✗
Destination host	
Address	`10.0.35.137`
Port	`23`

4. Click *Save*.

Adding a user

User defines a subject entitled to connect to servers within monitored IT infrastructure. Detailed object definition (i.e. unique login, full name, email address etc.) enables precise accountability of user actions when login and password are substituted with a shared account login credentials.

1. Select *Management* > *Users*.
2. Click *+ Add*.
3. Provide essential user information:

Parameter	Value
Login	`john_smith`
Blocked	
Account validity	`Indefinite`
Role	`user`
Preferred language	`English`
Full name	`John Smith`
Email	`john@smith.com`
Organization	
Phone	
AD Domain	
LDAP Base	
Permissions	
Granted users	
Connections	
Connections	
Authentication	
Type	`Password`
Password	`john`
Repeat password	`john`

4. Click *Save*.

Adding a listener

Listener determines server connection mode (proxy, gateway, transparent, bastion) as well as its specifics.

1. Select *Management* > *Listeners*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`telnet_listener`
Blocked	✗
Protocol	`Telnet`
Enable SSLv2 support	✗
Enable SSLv3 support	✗

Permissions	
Granted users	✗

Connection	
Mode	`proxy`
Local address	`10.0.150.151`
Port	`23`

4. Click *Save*.

Adding an account

Account defines the privileged account existing on the monitored server. It specifies the actual login credentials, user authentication mode: anonymous (without user authentication), regular (with login credentials substitution) or forward (with login and password forwarding); password changing policy as well as the password changer itself.

1. Select *Management* > *Accounts*.
2. Click + *Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`admin_telnet_server`
Blocked	
Type	`forward`
Session recording	`all`
OCR sessions	
Delete session data after	`61` days
Permissions	
Granted users	
Server	
Server	`telnet_server`
Credentials	
Replace secret with	`with password`
Password	
Repeat password	

4. Click *Save*.

Defining a safe

Safe directly regulates user access to monitored servers. It specifies available protocols' features, policies and other details concerning users and servers relations.

1. Select *Management* > *Safes*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`telnet_safe`
Blocked	✗
Login reason	✗
Notifications	✗
Policies	✗
Protocol functionality	
RDP	✗
SSH	✗
VNC	✗
Permissions	
Granted users	✗
Objects relations	
Users	`john_smith`
Accounts	`admin_telnet_server`
Listeners	`telnet_listener`

4. Click *Save*.

4.4.3 Establishing a telnet connection with the remote host

1. Launch telnet client of your choice.
2. Connect to the remote host:

```
telnet> open 10.0.150.151
Trying 10.0.150.151...
Connected to 10.0.150.151.
Escape character is '^]'.
```

3. Provide user authentication information defined on Wheel Fudo PAM:

```
FUDO Authentication.
FUDO Login: john_smith
FUDO Password:
```

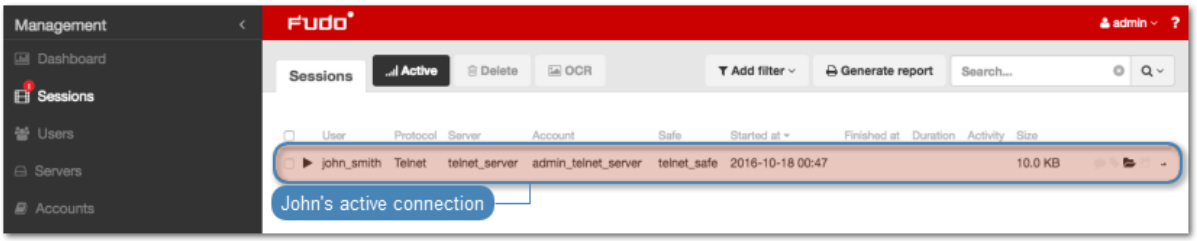
4. Provide user authentication information defined on the target host:

```
FreeBSD/amd64 (fbsd83-cerb.whl) (pts/0)
login:
password:
```

Note: Telnet connections do not support user credentials substitution.

4.4.4 Viewing user's session

1. Open a web browser and go to the `10.0.150.151` web address.
2. Enter the login and the password to log in to the Wheel Fudo PAM administration panel.
3. Select *Management* > *Sessions*.
4. Click *Active*.
5. Find *John Smith's* session and click the playback icon.



Related topics:

- *Quick start - SSH connection configuration*
- *Quick start - HTTP connection configuration*
- *Quick start - MySQL connection configuration*
- *Quick start - RDP connection configuration*
- *Requirements*
- *Data model*
- Configuration
- *Resources*

4.5 Telnet 5250

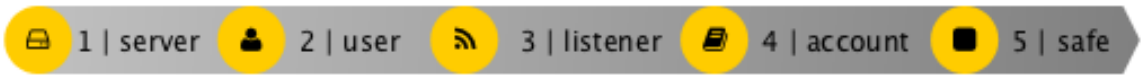
This chapter contains an example of a basic Wheel Fudo PAM configuration, to monitor Telnet 5250 connections to a remote server. In this scenario, the user connects to the remote server using Telnet client and logs in using individual login and password. Wheel Fudo PAM authenticates the user against the information stored in the local database, establishes connection with the remote server and starts recording.

Note: Telnet connections do not support login credentials forwarding and login credentials substitution. When connecting to target host over telnet protocol, users are asked to provide their login credentials twice. First time to authenticate against Wheel Fudo PAM and then again, to connect to the target host.

4.5.1 Prerequisites

Description below assumes that the system has been already initiated. For more information on the initiation procedure refer to the *System initiation* topic.

4.5.2 Configuration



Adding a server

Server is a definition of the IT infrastructure resource, which can be accessed over one of the specified protocols.

1. Select *Management* > *Servers*.
2. Click the Add button.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`telnet_server`
Blocked	✗
Protocol	`Telnet 5250`
Enable SSLv2 support	✗
Enable SSLv3 support	✗
Description	✗
Permissions	
Granted users	✗
Destination host	
Address	`10.0.35.137`
Port	`23`

4. Click *Save*.

Adding a user

User defines a subject entitled to connect to servers within monitored IT infrastructure. Detailed object definition (i.e. unique login, full name, email address etc.) enables precise accountability of user actions when login and password are substituted with a shared account login credentials.

1. Select *Management* > *Users*.
2. Click *+ Add*.
3. Provide essential user information:

Parameter	Value
Login	`john_smith`
Blocked	
Account validity	`Indefinite`
Role	`user`
Preferred language	`English`
Full name	`John Smith`
Email	`john@smith.com`
Organization	
Phone	
AD Domain	
LDAP Base	
Permissions	
Granted users	
Connections	
Connections	
Authentication	
Type	`Password`
Password	`john`
Repeat password	`john`

4. Click *Save*.

Adding a listener

Listener determines server connection mode (proxy, gateway, transparent, bastion) as well as its specifics.

1. Select *Management* > *Listeners*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`telnet_listener`
Blocked	
Protocol	`Telnet`
Enable SSLv2 support	
Enable SSLv3 support	

Permissions	
Granted users	

Connection	
Mode	`proxy`
Local address	`10.0.150.151`
Port	`23`

4. Click *Save*.

Adding an account

Account defines the privileged account existing on the monitored server. It specifies the actual login credentials, user authentication mode: anonymous (without user authentication), regular (with login credentials substitution) or forward (with login and password forwarding); password changing policy as well as the password changer itself.

1. Select *Management* > *Accounts*.
2. Click + *Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`admin_telnet_server`
Blocked	
Type	`forward`
Session recording	`all`
OCR sessions	
Delete session data after	`61` days
Permissions	
Granted users	
Server	
Server	`telnet_server`
Credentials	
Replace secret with	`with password`
Password	
Repeat password	

4. Click *Save*.

Defining a safe

Safe directly regulates user access to monitored servers. It specifies available protocols' features, policies and other details concerning users and servers relations.

1. Select *Management* > *Safes*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`telnet_safe`
Blocked	✗
Login reason	✗
Notifications	✗
Policies	✗
Users	`john_smith`
Protocol functionality	
RDP	✗
SSH	✗
VNC	✗
Permissions	
Granted users	✗
Accounts	
`admin_telnet_server`	`telnet_listener`

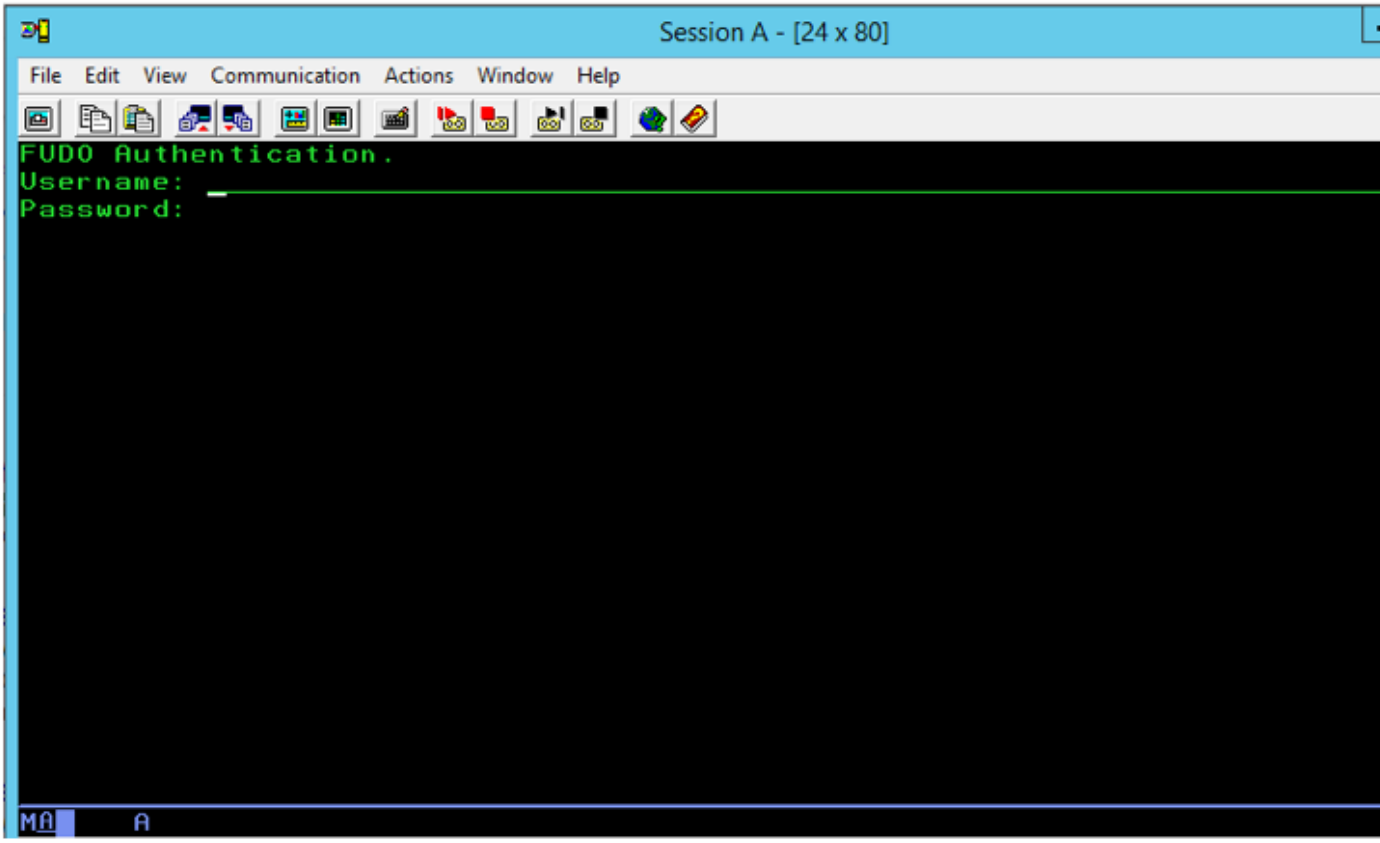
4. Click *Save*.

4.5.3 Establishing a telnet connection with the remote host

1. Launch telnet client of your choice.
2. Connect to the remote host:

```
telnet> open 10.0.150.151
Trying 10.0.150.151...
Connected to 10.0.150.151.
Escape character is '^]'.
```

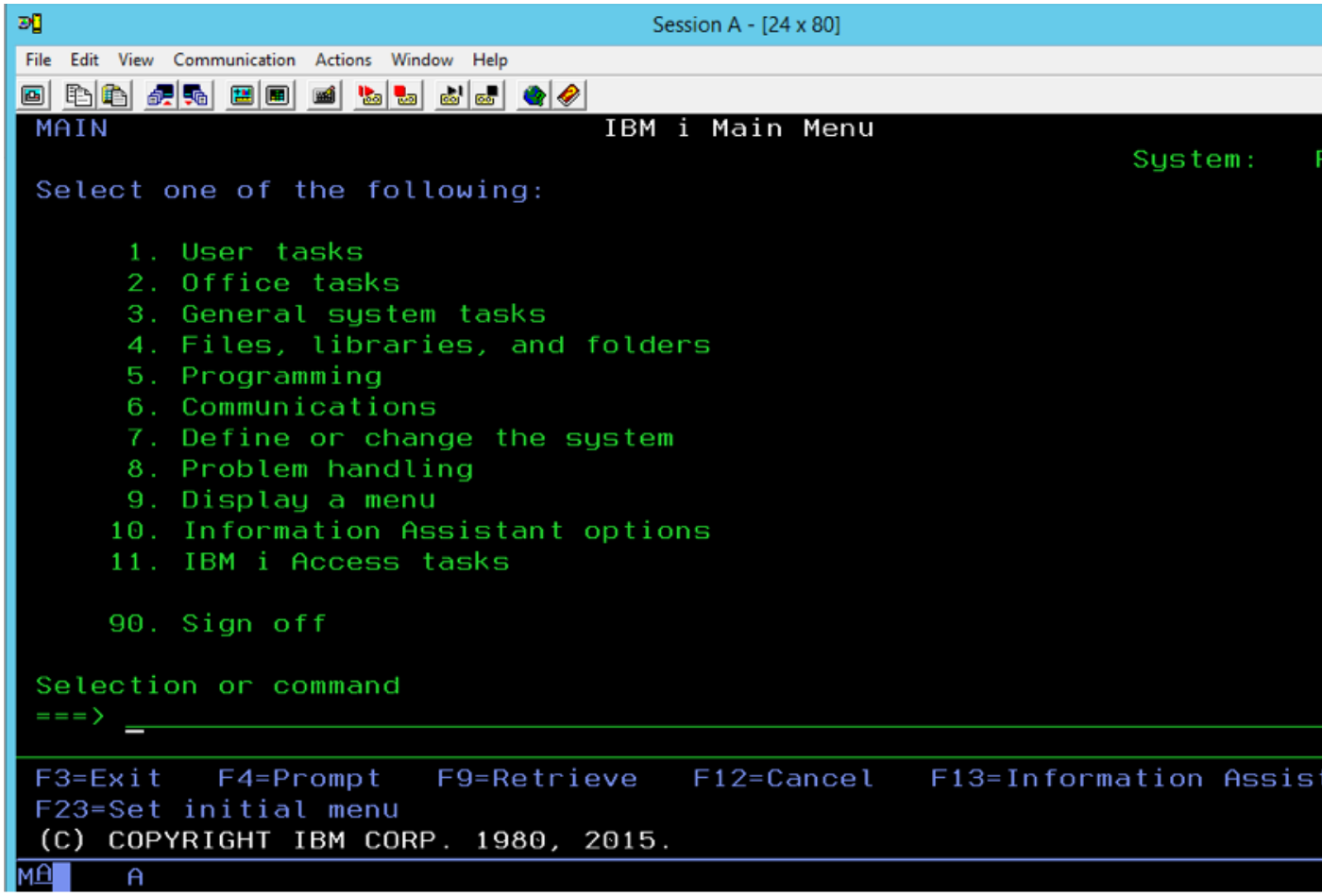
3. Provide user authentication information defined on Wheel Fudo PAM:



4. Provide user authentication information defined on the target host:

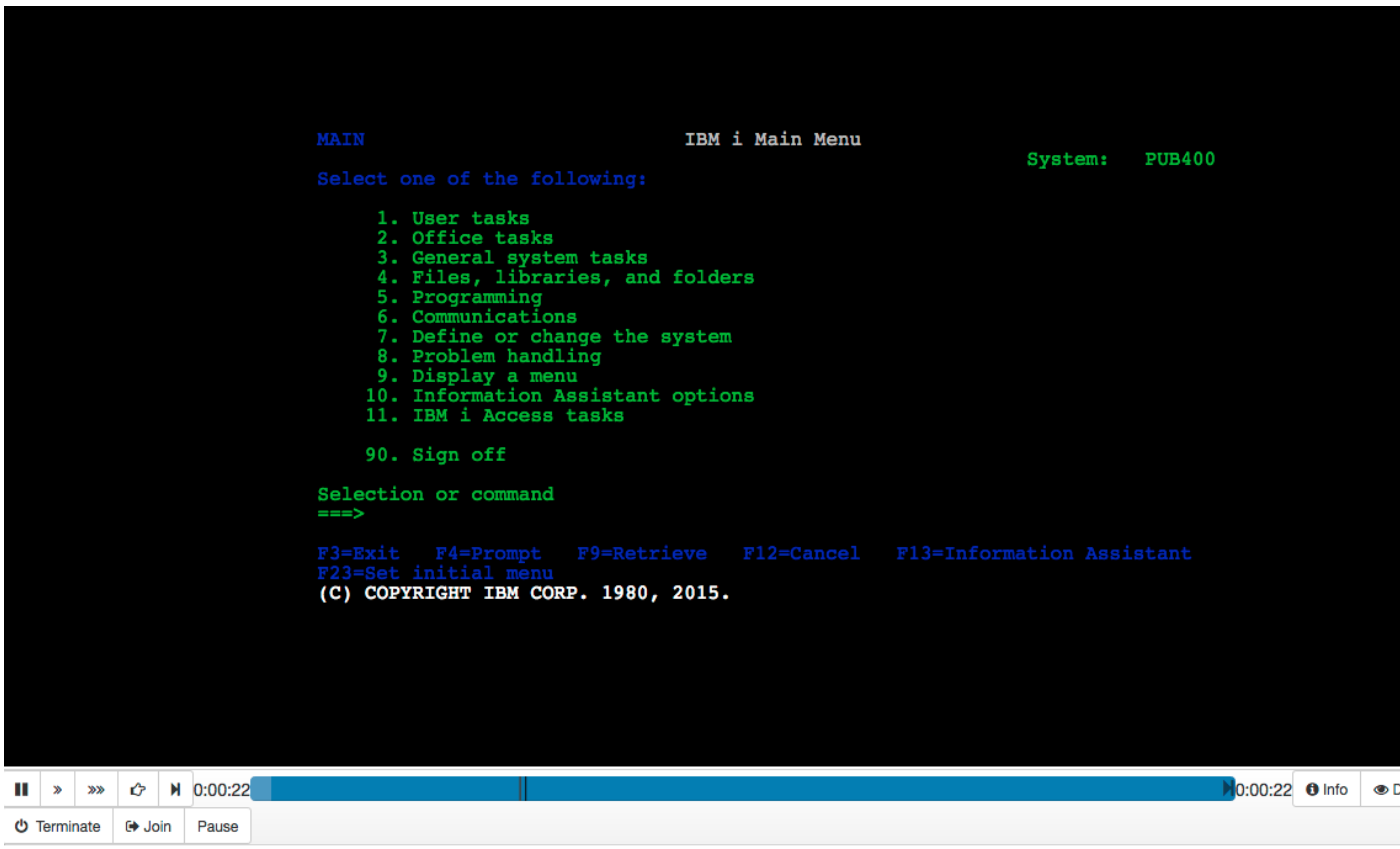
```
FreeBSD/amd64 (fbsd83-cerb.whl) (pts/0)
login:
password:
```

Note: Telnet connections do not support user credentials substitution.



4.5.4 Viewing user's session

1. Open a web browser and go to the `10.0.150.151` web address.
2. Enter the login and the password to log in to the Wheel Fudo PAM administration panel.
3. Select *Management* > *Sessions*.
4. Click *Active*.
5. Find *John Smith's* session and click the playback icon.



Related topics:

- *Quick start - SSH connection configuration*
- *Quick start - HTTP connection configuration*
- *Quick start - MySQL connection configuration*
- *Quick start - RDP connection configuration*
- *Requirements*
- *Data model*
- Configuration
- *Resources*

4.6 MySQL

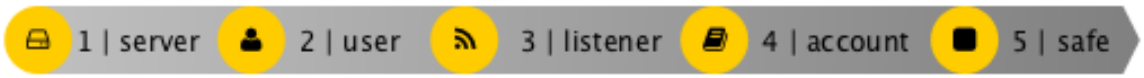
This chapter contains an example of a basic Wheel Fudo PAM configuration, to monitor SQL queries to a remote MySQL database server.

In this scenario, the user connects to a MySQL database using individual login and password. When establishing the connection with the remote server, Wheel Fudo PAM substitutes the login and the password with the previously defined values: `root`/`password` (authorization modes are described in the *User authorization modes* section).

4.6.1 Prerequisites

The following description assumes that the system has been already initiated. For more information on the initiation procedure refer to the *System initiation* topic.

4.6.2 Configuration



Adding a server

Server is a definition of the IT infrastructure resource, which can be accessed over one of the specified protocols.

1. Select *Management* > *Servers*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`mysql_server`
Blocked	✗
Protocol	`MySQL`
Description	✗
Permissions	
Granted users	✗
Destination host	
Address	`10.0.1.35`
Port	`3306`
Bind address	`Any`

4. Click *Save*.

Adding a user

User defines a subject entitled to connect to servers within monitored IT infrastructure. Detailed object definition (i.e. unique login, full name, email address etc.) enables precise accountability of user actions when login and password are substituted with a shared account login credentials.

1. Select *Management* > *Users*.
2. Click *+ Add*.
3. Provide essential user information:

Parameter	Value
Login	`john_smith`
Blocked	
Account validity	`Indefinite`
Role	`user`
Preferred language	`English`
Full name	`John Smith`
Email	`john@smith.com`
Organization	
Phone	
AD Domain	
LDAP Base	
Permissions	
Granted users	
Connections	
Connections	
Authentication	
Type	`Password`
Password	`john`
Repeat password	`john`

4. Click *Save*.

Adding a listener

Listener determines server connection mode (proxy, gateway, transparent, bastion) as well as its specifics.

1. Select *Management* > *Listeners*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`mysql_listener`
Blocked	
Protocol	`Mysql`

Permissions	
Granted users	

Connection	
Mode	`proxy`
Local address	`10.0.150.151`
Port	`3306`

4. Click *Save*.

Adding an account

Account defines the privileged account existing on the monitored server. It specifies the actual login credentials, user authentication mode: anonymous (without user authentication), regular (with login credentials substitution) or forward (with login and password forwarding); password changing policy as well as the password changer itself.

1. Select *Management* > *Accounts*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`admin_mysql_server`
Blocked	
Type	`regular`
Session recording	`all`
OCR sessions	
Delete session data after	`61` days
Permissions	
Granted users	
Server	
Server	`mysql_server`
Credentials	
Domain	
Login	`root`
Replace secret with	`with password`
Password	`password`
Repeat password	`password`
Password change policy	`Static, without restrictions`
Password changer	
Password changer	`None`
Privileged user	
Privileged user password	

4. Click *Save*.

Defining a safe

Safe directly regulates user access to monitored servers. It specifies available protocols' features, policies and other details concerning users and servers relations.

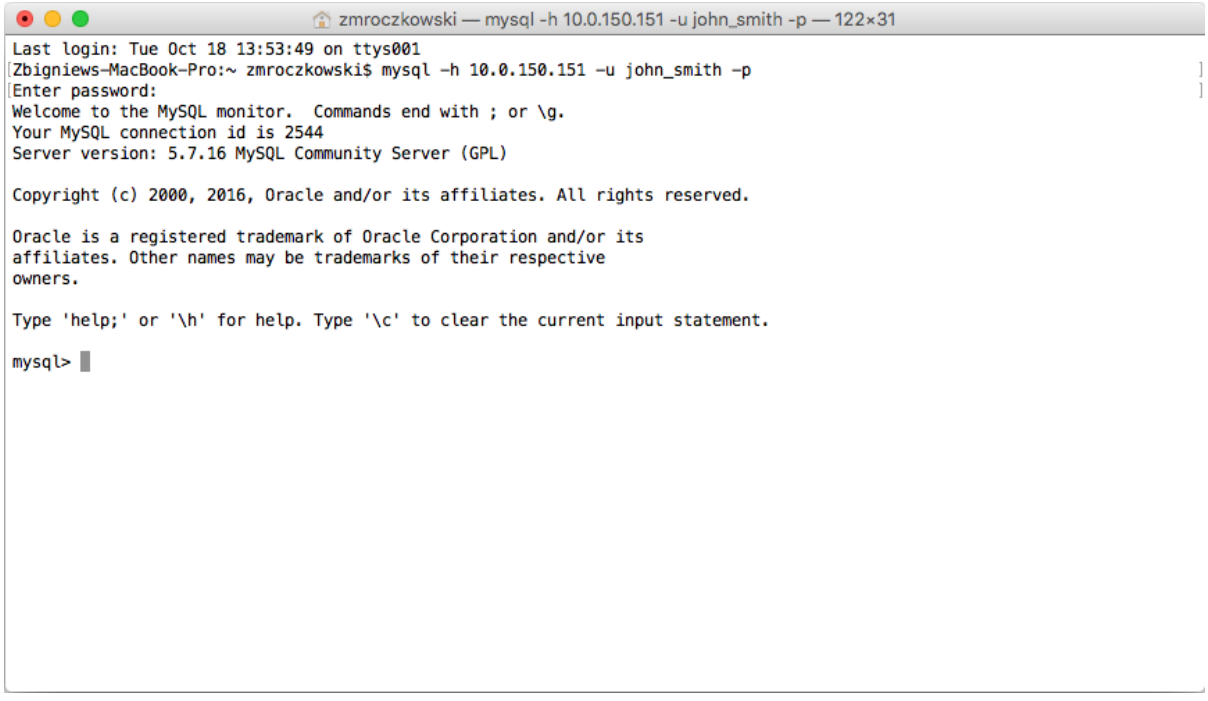
1. Select *Management* > *Safes*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`mysql_safe`
Blocked	✗
Login reason	✗
Notifications	✗
Policies	✗
Users	`john_smith`
Protocol functionality	
RDP	✗
SSH	✗
VNC	✗
Accounts	
`admin_mysql_server`	`mysql_listener`

4. Click *Save*.

4.6.3 Establishing connection with a MySQL database

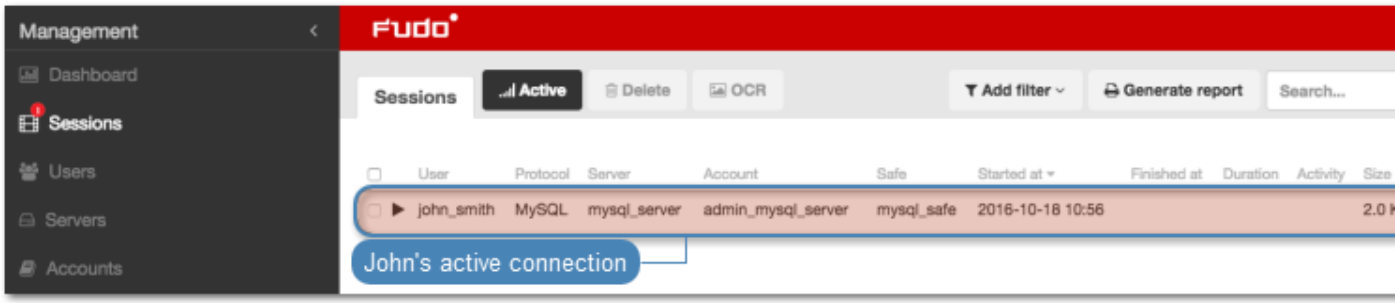
1. Launch a command line interface client.
2. Enter `mysql -h 10.0.150.151 -u john_smith -p`, to connect to the database server.
3. Enter the user's password.

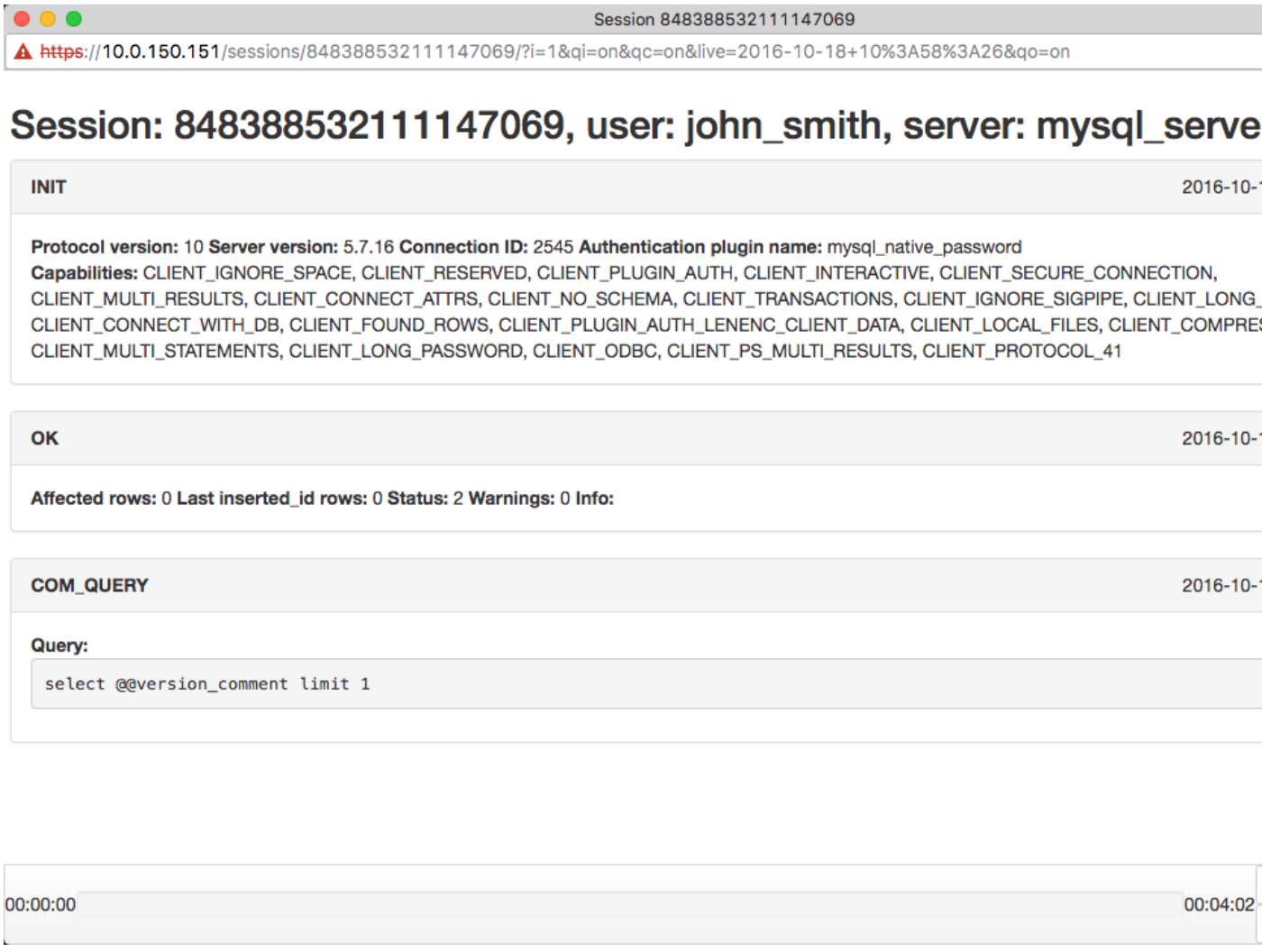


4. Continue browsing the database contents using SQL queries.

4.6.4 Viewing user session

1. Open a web browser and go to the Wheel Fudo PAM administration page.
2. Enter user login and password to log in to Wheel Fudo PAM administration panel.
3. Select *Management* > *Sessions*.
4. Click *Active*.
5. Find *John Smith's* session and click the playback icon.





Related topics:

- *Quick start - SSH connection configuration*

- *Quick start - RDP connection configuration*
- *Quick start - HTTP connection configuration*
- *Quick start - Telnet connection configuration*
- *Requirements*
- *Data model*
- Configuration

4.7 MS SQL

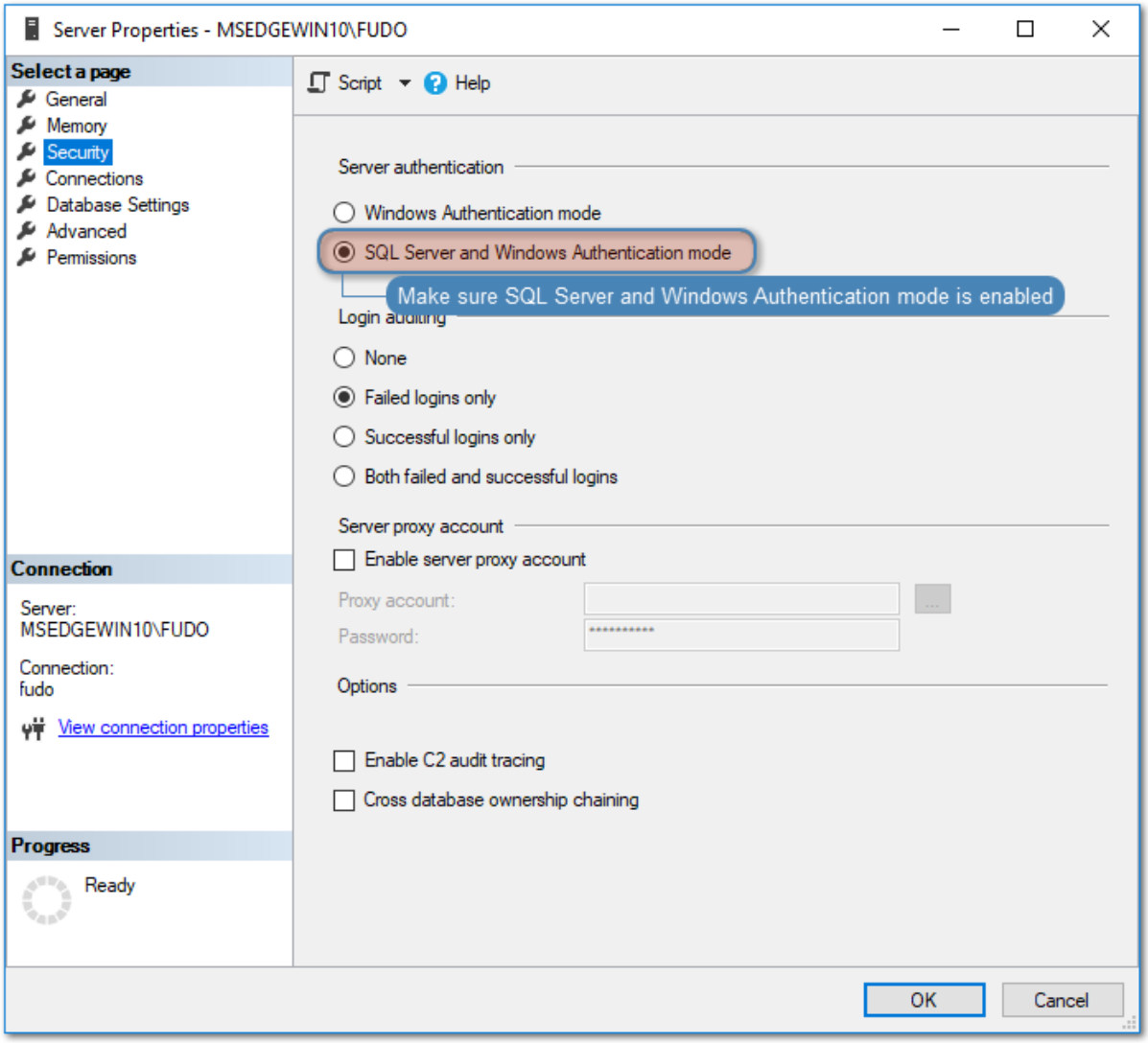
This chapter contains an example of a basic Wheel Fudo PAM configuration, to monitor MS SQL connections to a remote MS SQL database server.

In this scenario, the user connects to a MS SQL database using individual login and password using *SQL Server Management Studio*. When establishing the connection with the remote server, Wheel Fudo PAM substitutes the login and the password with the previously defined values: `fudo`/`password` (authorization modes are described in the *User authorization modes* section).

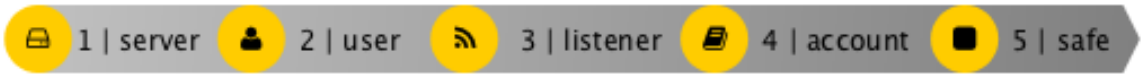
4.7.1 Prerequisites

The following description assumes that the system has been already initiated. For more information on the initiation procedure refer to the *System initiation* topic.

Note: Make sure that the SQL Server has the *SQL Server and Windows Authentication* mode enabled.



4.7.2 Configuration



Adding a server

Server is a definition of the IT infrastructure resource, which can be accessed over one of the specified protocols.

1. Select *Management* > *Servers*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`mssql_server`
Blocked	
Protocol	`MS SQL (TDS)`
Description	
Permissions	
Granted users	
Destination host	
Address	`10.0.150.154`
Port	`1433`
Bind address	`Any`

4. Click *Save*.

Adding a user

User defines a subject entitled to connect to servers within monitored IT infrastructure. Detailed object definition (i.e. unique login, full name, email address etc.) enables precise accountability of user actions when login and password are substituted with a shared account login credentials.

1. Select *Management* > *Users*.
2. Click *+ Add*.
3. Provide essential user information:

Parameter	Value
Login	`john_smith`
Blocked	
Account validity	`Indefinite`
Role	`user`
Preferred language	`English`
Full name	`John Smith`
Email	`john@smith.com`
Organization	
Phone	
AD Domain	
LDAP Base	
Permissions	
Granted users	
Connections	
Connections	
Authentication	
Type	`Password`
Password	`john`
Repeat password	`john`

4. Click *Save*.

Adding a listener

Listener determines server connection mode (proxy, gateway, transparent, bastion) as well as its specifics.

1. Select *Management* > *Listeners*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`MSSQL_proxy`
Blocked	
Protocol	`MS SQL (TDS)`

Permissions	
Granted users	

Connection	
Mode	`proxy`
Local address	`10.0.150.150`
Port	`1433`

4. Click *Save*.

Adding an account

Account defines the privileged account existing on the monitored server. It specifies the actual login credentials, user authentication mode: anonymous (without user authentication), regular (with login credentials substitution) or forward (with login and password forwarding); password changing policy as well as the password changer itself.

1. Select *Management* > *Accounts*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`admin_mssql_server`
Blocked	✗
Type	`regular`
Session recording	`all`
OCR sessions	✗
Delete session data after	`61` days
Permissions	
Granted users	✗
Server	
Server	`mysql_server`
Credentials	
Domain	✗
Login	`fudo`
Replace secret with	`with password`
Password	`password`
Repeat password	`password`
Password change policy	`Static, without restrictions`
Password changer	
Password changer	`None`
Privileged user	✗
Privileged user password	✗

4. Click *Save*.

Defining a safe

Safe directly regulates user access to monitored servers. It specifies available protocols' features, policies and other details concerning users and servers relations.

1. Select *Management* > *Safes*.

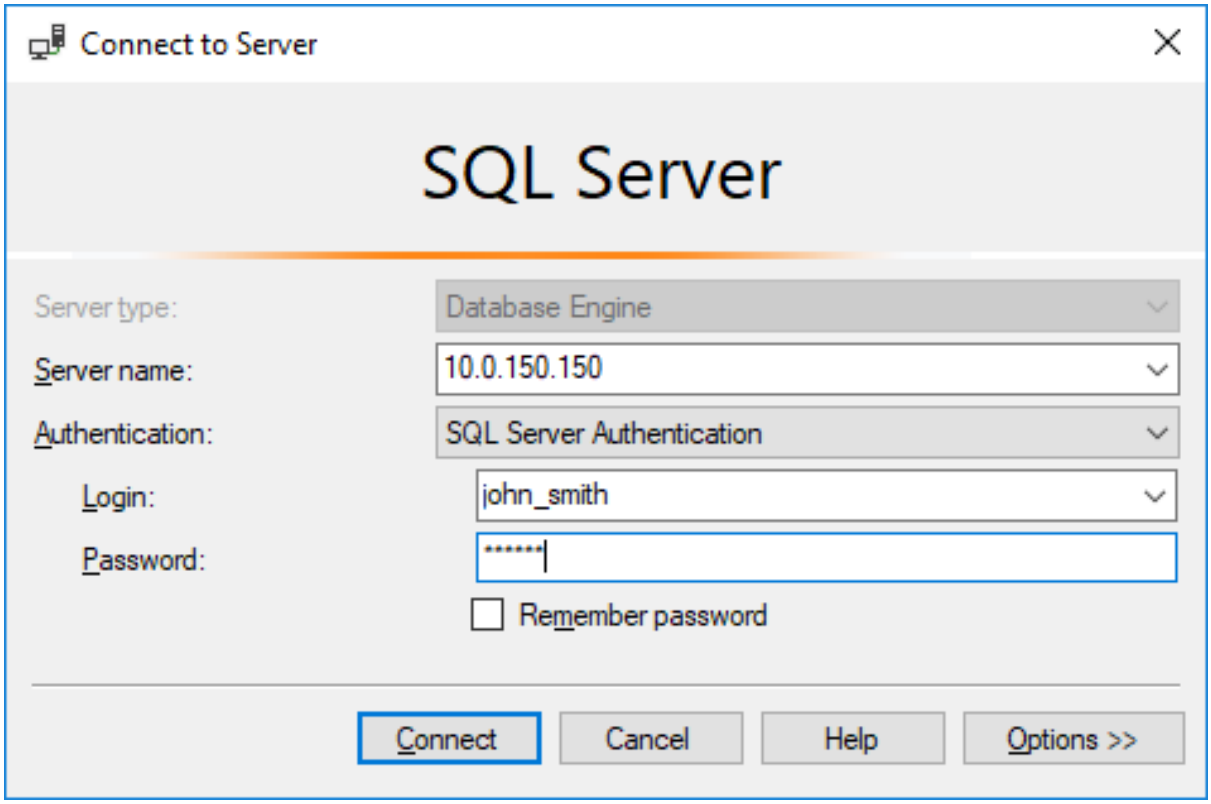
2. Click *+ Add*.
3. Provide essential configuration parameters:

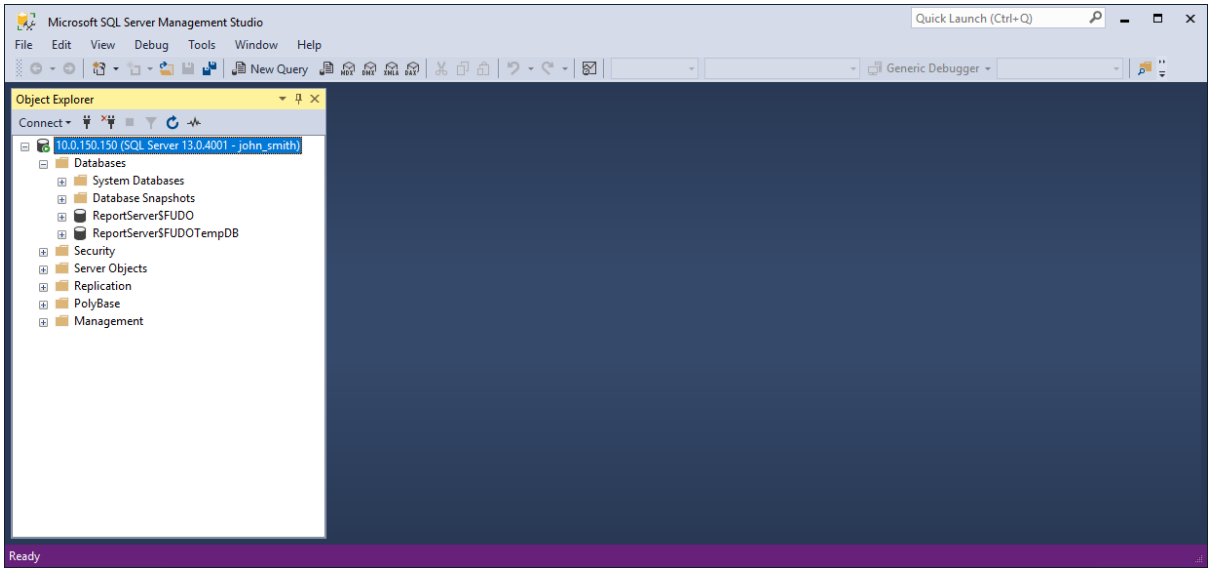
Parameter	Value
General	
Name	`mssql_safe`
Blocked	✗
Login reason	✗
Notifications	✗
Policies	✗
Users	`john_smith`
Protocol functionality	
RDP	✗
SSH	✗
VNC	✗
Accounts	
`admin_mssql_server`	`MSSQL_proxy`

4. Click *Save*.

4.7.3 Establishing connection with a MS SQL database

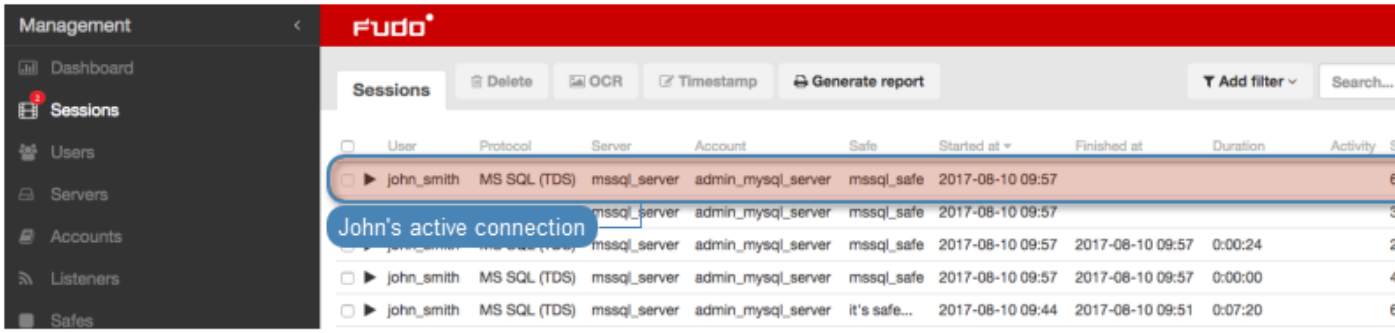
1. Start *SQL Server Management Studio*.
2. Enter previously configured proxy address (10.0.150.150).
3. From the *Authentication* drop-down list, select *SQL Server Authentication*.
4. Enter user login and password.
5. Click *Connect*.





4.7.4 Viewing user session

1. Open a web browser and go to the Wheel Fudo PAM administration page.
2. Enter user login and password to log in to Wheel Fudo PAM administration panel.
3. Select *Management* > *Sessions*.
4. Find *John Smith's* session and click ▶.



Related topics:

- *Quick start - MySQL connection configuration*
- *Quick start - SSH connection configuration*
- *Quick start - RDP connection configuration*
- *Quick start - HTTP connection configuration*
- *Quick start - Telnet connection configuration*
- *Requirements*
- *Data model*
- Configuration

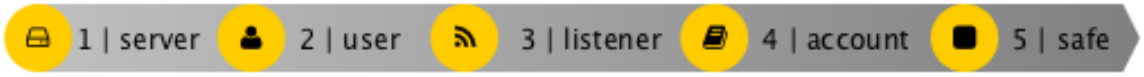
4.8 HTTP

This chapter contains an example of a basic Wheel Fudo PAM configuration, to monitor HTTP access to a remote server. In this scenario, the user browses resources of the monitored server using a web browser. The user is authenticated by Wheel Fudo PAM against the local user database. The connection will timeout after 15 minutes (900 seconds) and the user will have to login again to continue browsing the server's contents.

4.8.1 Prerequisites

The following description assumes that the system has been already initiated. For more information on the initiation procedure refer to the *System initiation* topic.

4.8.2 Configuration



Adding a server

Server is a definition of the IT infrastructure resource, which can be accessed over one of the specified protocols.

1. Select *Management* > *Servers*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
Genera	
Name	`http_server`
Blocked	✗
Protocol	`HTTP`
HTTP timeout	`900`
Enable SSLv2 support	✗
Enable SSLv3 support	✗
Description	✗
Permissions	
Granted users	✗
Destination host	
Address	`www.wheelsystems.com`
Port	`80`
HTTP host	✗

4. Click *Save*.

Adding a user

User defines a subject entitled to connect to servers within monitored IT infrastructure. Detailed object definition (i.e. unique login, full name, email address etc.) enables precise accountability of user actions when login and password are substituted with a shared account login credentials.

1. Select *Management* > *Users*.
2. Click *+ Add*.
3. Provide essential user information:

Parameter	Value
Login	`john_smith`
Blocked	
Account validity	`Indefinite`
Role	`user`
Preferred language	`English`
Full name	`John Smith`
Email	`john@smith.com`
Organization	
Phone	
AD Domain	
LDAP Base	
Permissions	
Granted users	
Connections	
Connections	
Authentication	
Type	`Password`
Password	`john`
Repeat password	`john`

4. Click *Save*.

Adding a listener

Listener determines server connection mode (proxy, gateway, transparent, bastion) as well as its specifics.

1. Select *Management* > *Listeners*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`http_listener`
Blocked	
Protocol	`HTTP`
Enable SSLv2 support	
Enable SSLv3 support	

Permissions	
Granted users	

Connection	
Mode	`proxy`
Local address	`10.0.150.151`
Port	`8080`
Use TLS	

4. Click *Save*.

Adding an account

Account defines the privileged account existing on the monitored server. It specifies the actual login credentials, user authentication mode: anonymous (without user authentication), regular (with login credentials substitution) or forward (with login and password forwarding); password changing policy as well as the password changer itself.

1. Select *Management* > *Accounts*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`admin_http_server`
Blocked	
Type	`forward`
Session recording	`all`
OCR sessions	
Delete session data after	`61` days
Permissions	
Granted users	
Server	
Server	`http_server`
Credentials	
Replace secret with	`with password`
Password	
Repeat password	

4. Click *Save*.

Defining a safe

Safe directly regulates user access to monitored servers. It specifies available protocols' features, policies and other details concerning users and servers relations.

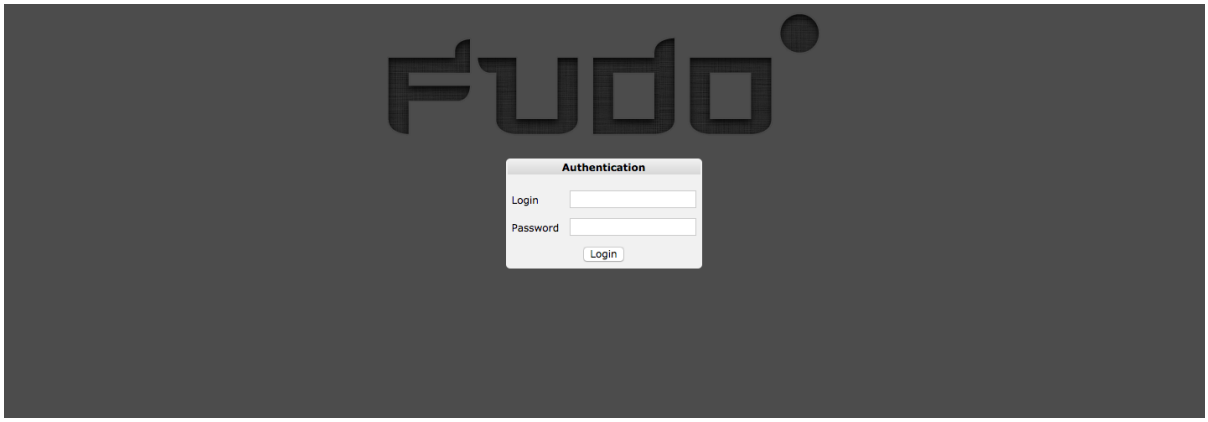
1. Select *Management* > *Safes*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`http_safe`
Blocked	✗
Login reason	✗
Notifications	✗
Policies	✗
Users	`john_smith`
Protocol functionality	
RDP	✗
SSH	✗
VNC	✗
Accounts	
`admin_http_server`	`http_listener`

4. Click *Save*.

4.8.3 Connecting to remote resource

1. Launch a web browser.
2. Go to the `10.0.150.151:8080` web address.
3. Enter user login and password and press the [Enter] key or click the *Login* button.

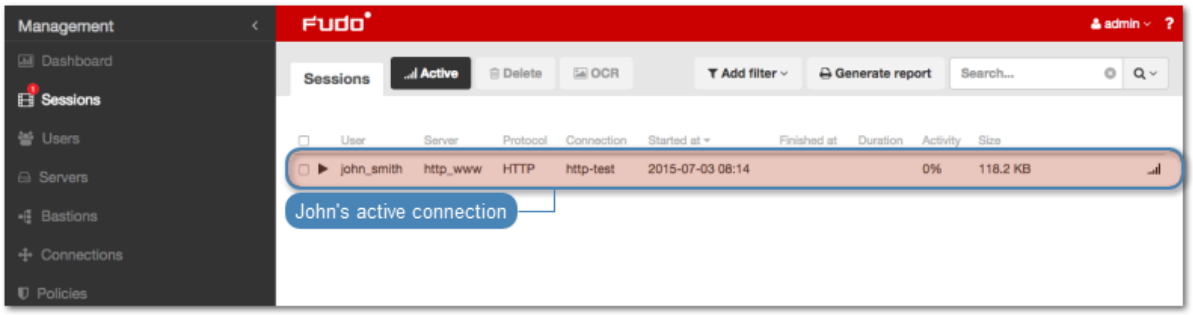


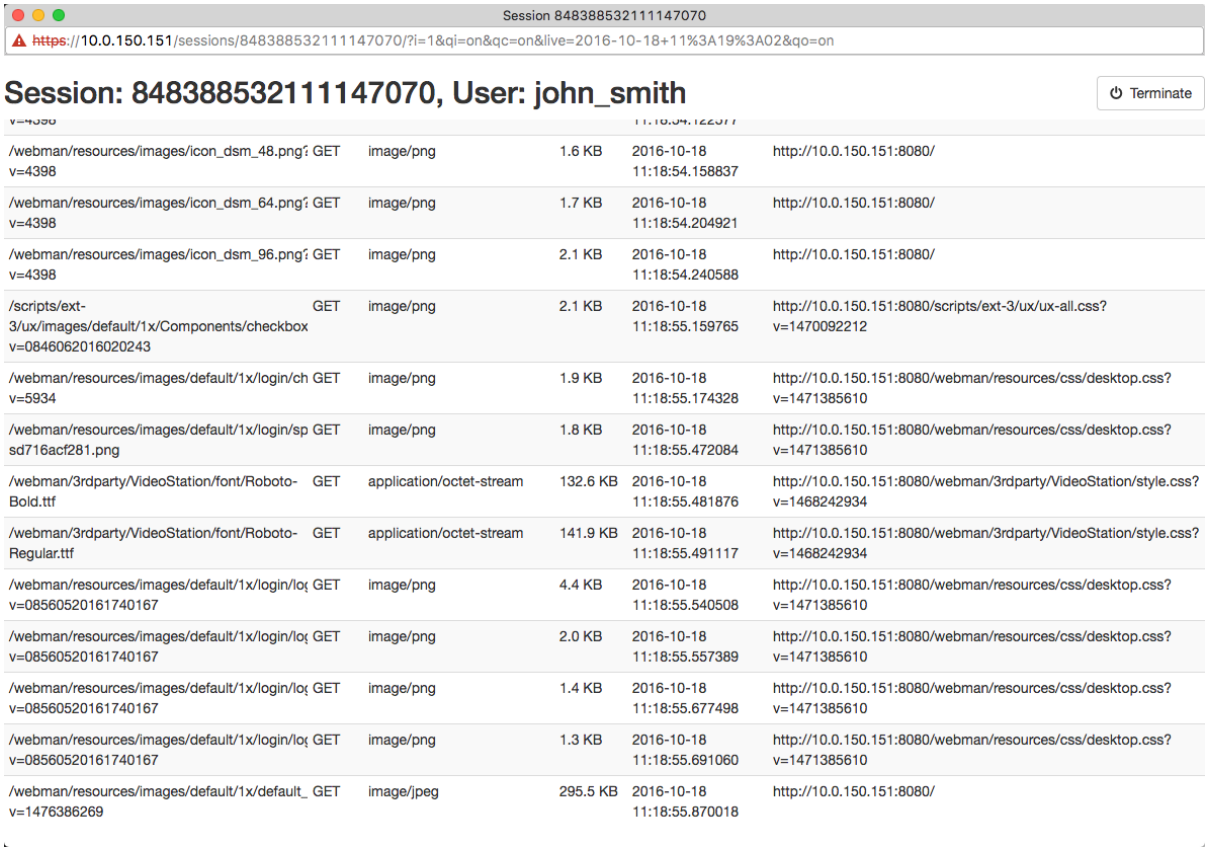
4. Continue browsing the website.

4.8.4 Viewing user session

1. Open a web browser and go to the Wheel Fudo PAM administration page.
2. Enter user login and password to log in to Wheel Fudo PAM administration panel.
3. Select *Management* > *Sessions*.

4. Click *Active*.
5. Find *John Smith's* session and click the playback icon.





Related topics:

- *Quick start - SSH connection configuration*
- *Quick start - RDP connection configuration*
- *Quick start - MySQL connection configuration*
- *Quick start - Telnet connection configuration*
- *Requirements*
- *Data model*
- Configuration

4.9 Citrix

Privileged sessions over ICA protocol cen be established either directly using client software or initiated through Citrix StoreFront interface.

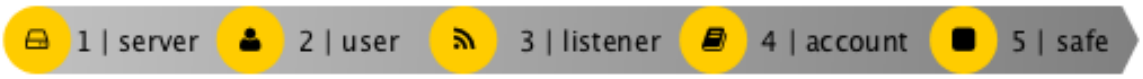
4.9.1 ICA

This chapter contains an example of a basic Wheel Fudo PAM configuration, to monitor direct ICA protocol connections.

4.9.1.1 Prerequisites

The following description assumes that the system has been already initiated. For more information on the initiation procedure refer to the *System initiation* topic.

4.9.1.2 Configuration



Adding a server

Server is a definition of the IT infrastructure resource, which can be accessed over one of the specified protocols.

1. Select *Management* > *Servers*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`ica_server`
Blocked	✗
Protocol	`ICA`
Description	✗
Permissions	
Granted users	✗
Destination host	
Address	`10.0.0.21`
Port	`1494`
Use TLS	✗

4. Click *Save*.

Adding a listener

Listener determines server connection mode (proxy, gateway, transparent, bastion) as well as its specifics.

1. Select *Management* > *Listeners*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`ica_listener`
Blocked	✗
Protocol	`ICA`
Permissions	
Granted users	✗
Connection	
Mode	`proxy`
Local address	`10.0.150.151`
Port	`2494`
Use TLS	✗

4. Click *Save*.

Adding an account

Account defines the privileged account existing on the monitored server. It specifies the actual login credentials, user authentication mode: anonymous (without user authentication), regular

(with login credentials substitution) or forward (with login and password forwarding); password changing policy as well as the password changer itself.

1. Select *Management* > *Accounts*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`admin_ica_server`
Blocked	✗
Type	`regular`
Session recording	`all`
OCR sessions	✗
Delete session data after	`61` days
Permissions	
Granted users	✗
Server	
Server	`ica_server`
Credentials	
Domain	✗
Login	`citrixuser`
Replace secret with	`password`
Password	`password`
Repeat password	`password`
Password change policy	`Static, without restrictions`
Password changer	
Password changer	`none`
Privileged user	✗
Privileged user password	✗

4. Click *Save*.

Adding a user

User defines a subject entitled to connect to servers within monitored IT infrastructure. Detailed object definition (i.e. unique login, full name, email address etc.) enables precise accountability of user actions when login and password are substituted with a shared account login credentials.

1. Select *Management* > *Users*.
2. Click *+ Add*.
3. Provide essential user information:

Parameter	Value
Login	`john_smith`
Blocked	
Account validity	`Indefinite`
Role	`user`
Preferred language	`English`
Full name	`John Smith`
Email	`john@smith.com`
Organization	
Phone	
AD Domain	
LDAP Base	
Permissions	
Granted users	
Connections	
Connections	
Authentication	
Type	`Password`
Password	`john`
Repeat password	`john`

4. Click *Save*.

Defining a safe

Safe directly regulates user access to monitored servers. It specifies available protocols' features, policies and other details concerning users and servers relations.

1. Select *Management* > *Safes*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`ica_safe`
Blocked	✗
Login reason	✗
Notifications	✗
Policies	✗
Users	`john_smith`
Protocol functionality	
RDP	✗
SSH	✗
VNC	✗
Accounts	
`admin_ica_server`	`ica_listener`

4. Click *Save*.

Note: In case of TLS encrypted connections, Fudo returns an *.ica configuration file* to the Citrix client, which has the *FQDN* server address (*Address*) set to the common name defined in the TLS certificate.

4.9.1.3 Creating `.ica` file with connection parameters

Direct connection with remote server over ICA protocol requires preparing a connection configuration file. This file specifies the listener used to connect to the remote host.

Note: Refer to *ICA configuration file* topic for details on the configuration file.

1. Create configuration file containing the following:

```
[ApplicationServers]
ica_connection_example=

[ica_connection_example]
ProxyType=SOCKSV5
ProxyHost=10.0.150.151:2494
ProxyUsername=*
ProxyPassword=*
Address=john_smith
Username=john_smith
ClearPassword=john
TransportDriver=TCP/IP
```

(continues on next page)

(continued from previous page)

```
EncryptionLevelSession=Basic
Compress=Off
```

2. Save the file with `.ica` extension.

4.9.1.4 Connecting to remote resource

1. Double-click the connection configuration file to launch ICA protocol client software.
2. Proceed with using the service.

4.9.1.5 Viewing user session

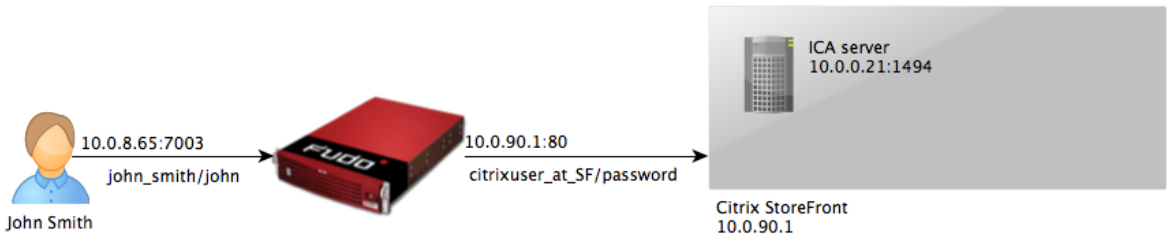
1. Open a web browser and go to the Wheel Fudo PAM administration page.
2. Enter user login and password to log in to Wheel Fudo PAM administration panel.
3. Select *Management* > *Sessions*.
4. Find *John Smith's* session and click the playback icon.

Related topics:

- *Data model*
- *Creating an ICA server*
- *Creating an ICA listener*
- *ICA*

4.9.2 ICA via Citrix StoreFront

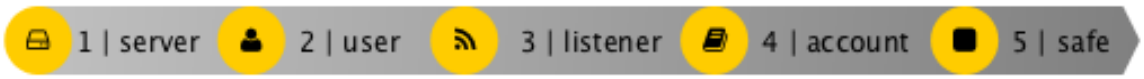
This chapter contains an example of a basic Wheel Fudo PAM configuration, to monitor access to a remote server over ICA protocol with the connection itself being initiated via the Citrix StoreFront.



4.9.2.1 Prerequisites

The following description assumes that the system has been already initiated. For more information on the initiation procedure refer to the *System initiation* topic.

4.9.2.2 Configuration



Adding an ICA server

Server is a definition of the IT infrastructure resource, which can be accessed over one of the specified protocols.

1. Select *Management* > *Servers*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`ica_server`
Blocked	✗
Protocol	`ICA`
Description	✗
Permissions	
Granted users	✗
Destination host	
Address	`10.0.0.21`
Port	`1494`
Use TLS	✗

4. Click *Save*.

Adding an ICA listener

Listener determines server connection mode (proxy, gateway, transparent, bastion) as well as its specifics.

1. Select *Management* > *Listeners*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`ica_listener`
Blocked	✗
Protocol	`ICA`
Permissions	
Granted users	✗
Connection	
Mode	`proxy`
Local address	`10.0.150.151`
Port	`2494`
Use TLS	✗

4. Click *Save*.

Adding an account for the ICA server

Account defines the privileged account existing on the monitored server. It specifies the actual login credentials, user authentication mode: anonymous (without user authentication), regular (with login credentials substitution) or forward (with login and password forwarding); password changing policy as well as the password changer itself.

1. Select *Management* > *Accounts*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`ICA_forward`
Blocked	✗
Type	`forward`
Session recording	`all`
OCR sessions	✗
Delete session data after	`61` days
Permissions	
Granted users	✗
Server	
Server	`ica_server`
Credentials	
Replace secret with	✗
Forward domain	✗

4. Click *Save*.

Adding a Citrix StoreFront server

Server is a definition of the IT infrastructure resource, which can be accessed over one of the specified protocols.

1. Select *Management* > *Servers*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`citrix_storefront`
Blocked	✗
Protocol	`Citrix StoreFront (HTTP)`
HTTP timeout	`900`
Description	✗
Permissions	
Granted users	✗
Destination host	
Address	`10.0.90.1`
Port	`80`
Bind address	`Any`
URL	`http://10.0.90.1/Citrix/StoreWeb/`

4. Click *Save*.

Adding a Citrix StoreFront listener

Listener determines server connection mode (proxy, gateway, transparent, bastion) as well as its specifics.

1. Select *Management* > *Listeners*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`citrix_storefront_listener`
Blocked	✗
Protocol	`Citrix StoreFront (HTTP)`

Permissions	
Granted users	✗

Connection	
Mode	`proxy`
Local address	`10.0.8.65`
Port	`7003`
Use TLS	✗

4. Click *Save*.

Adding an account for the Citrix StoreFront server

Account defines the privileged account existing on the monitored server. It specifies the actual login credentials, user authentication mode: anonymous (without user authentication), regular (with login credentials substitution) or forward (with login and password forwarding); password changing policy as well as the password changer itself.

1. Select *Management* > *Accounts*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

Parameter	Value
General	
Name	`citrixuser_at_SF`
Blocked	
Type	`regular`
Session recording	`all`
OCR sessions	
Delete session data after	`61` days
Permissions	
Granted users	
Server	
Server	`citrix_storefront`
Credentials	
Domain	`tech.whl`
Login	`citrixuser`
Replace secret with	`password`
Password	`password`
Repeat password	`password`
Password change policy	`Static, without restrictions`
Password changer	
Password changer	`none`
Privileged user	
Privileged user password	

Adding a user

User defines a subject entitled to connect to servers within monitored IT infrastructure. Detailed object definition (i.e. unique login, full name, email address etc.) enables precise accountability of user actions when login and password are substituted with a shared account login credentials.

1. Select *Management* > *Users*.
2. Click + *Add*.
3. Provide essential user information:

Parameter	Value
Login	`john_smith`
Blocked	
Account validity	`Indefinite`
Role	`user`
Preferred language	`English`
Full name	`John Smith`
Email	`john@smith.com`
Organization	
Phone	
AD Domain	
LDAP Base	
Permissions	
Granted users	
Connections	
Connections	
Authentication	
Type	`Password`
Password	`john`
Repeat password	`john`

4. Click *Save*.

Defining a safe

Safe directly regulates user access to monitored servers. It specifies available protocols' features, policies and other details concerning users and servers relations.

1. Select *Management* > *Safes*.
2. Click *+ Add*.
3. Provide essential configuration parameters:

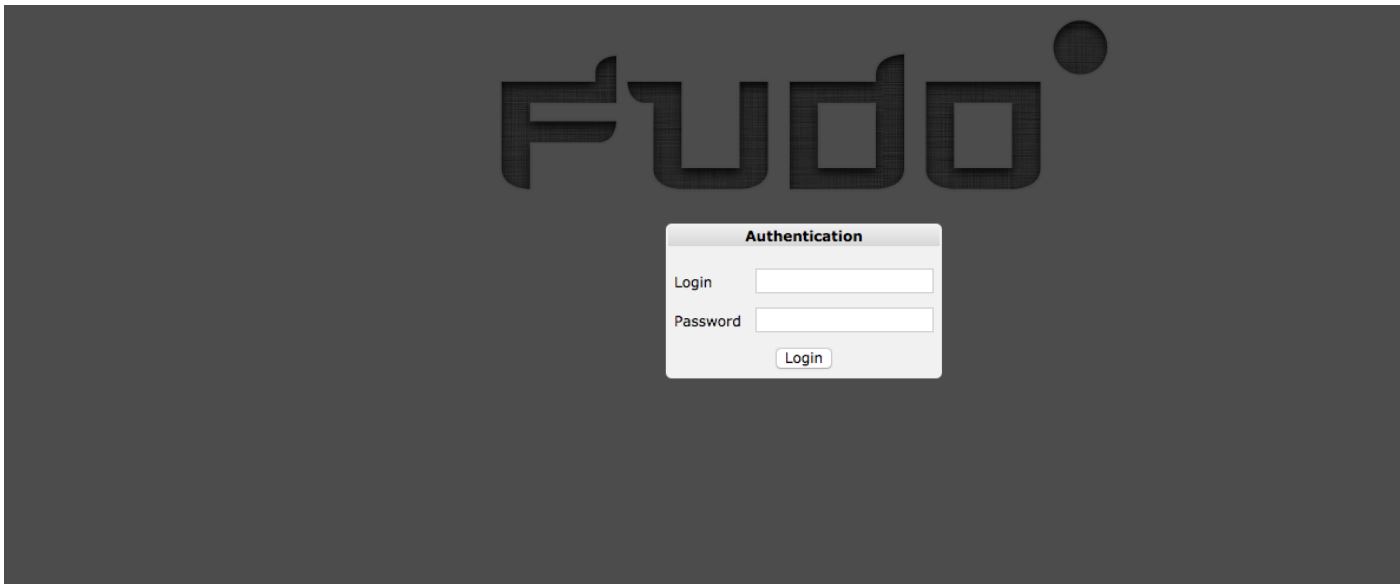
Parameter	Value
General	
Name	`ica_safe`
Blocked	✗
Login reason	✗
Notifications	✗
Policies	✗
Users	`john_smith`
Protocol functionality	
RDP	✗
SSH	✗
VNC	✗
Accounts	
`citrixuser_at_SF`	`citrix_storefront_listener`
`ICA_forward`	`ica_listener`

4. Click *Save*.

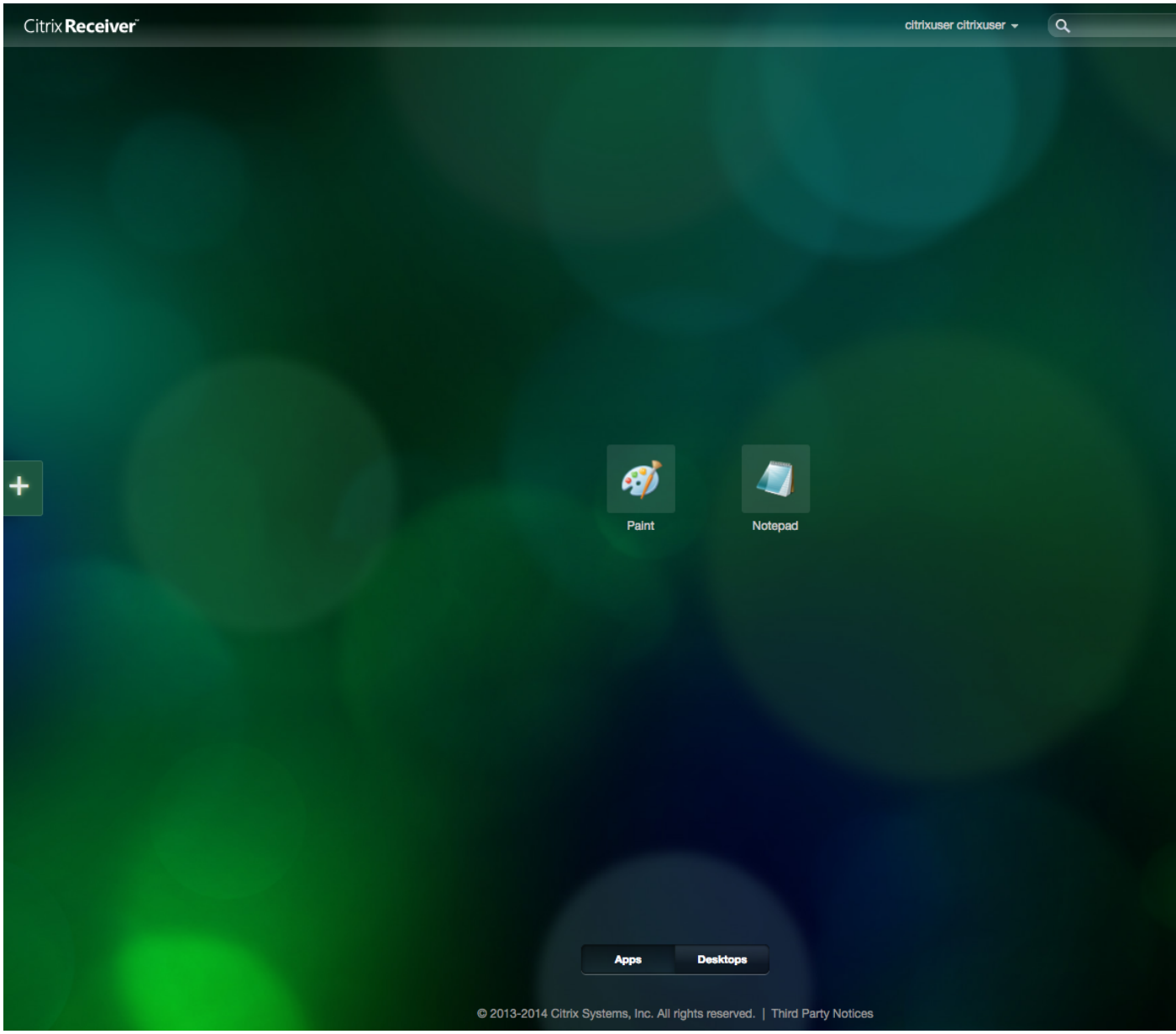
Note: In case of TLS encrypted connections, Fudo returns an *.ica configuration file* to the Citrix client, which has the *FQDN* server address (*Address*) set to the common name defined in the TLS certificate.

4.9.2.3 Connecting to remote resource

1. Navigate your web browser to the `10.0.8.65:7003` web address.
2. Enter user login and password to log in into the Citrix StoreFront interface.

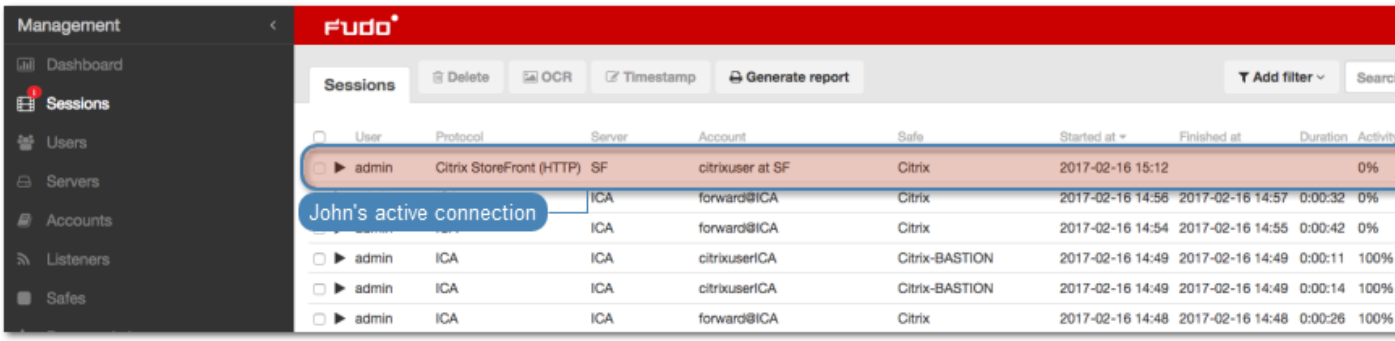


3. Click desired element to establish ICA connection with selected resource.



4.9.2.4 Viewing user session

1. Open a web browser and go to the Wheel Fudo PAM administration page.
2. Enter user login and password to log in to Wheel Fudo PAM administration panel.
3. Select *Management* > *Sessions*.
4. Find *John Smith's* session and click the playback icon.



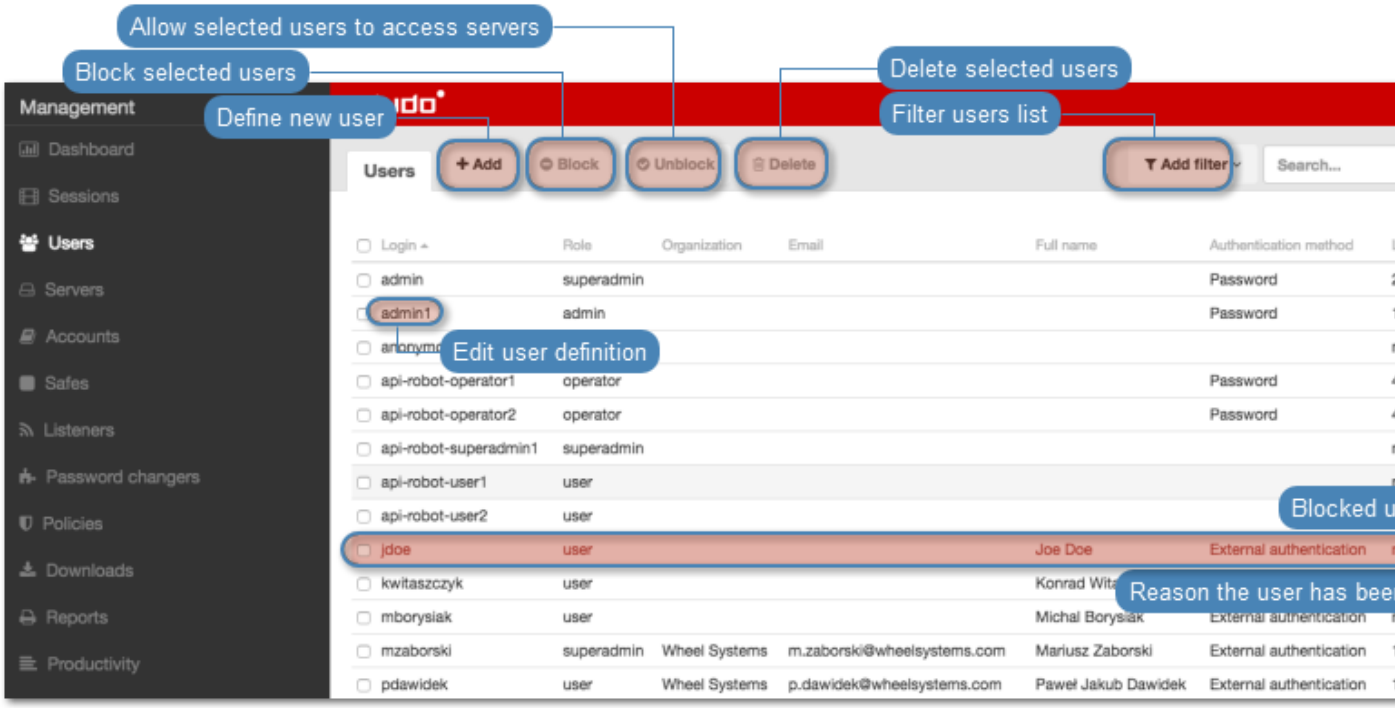
Related topics:

- *Data model*
- *ICA*
- *Citrix StoreFront (HTTP)*
- *Creating a Citrix server*
- *Creating a Citrix listener*

CHAPTER 5

Users

User defines a subject entitled to connect to servers within monitored IT infrastructure. Detailed object definition (i.e. unique login, full name, email address etc.) enables precise accountability of user actions when login and password are substituted with a shared account login credentials.

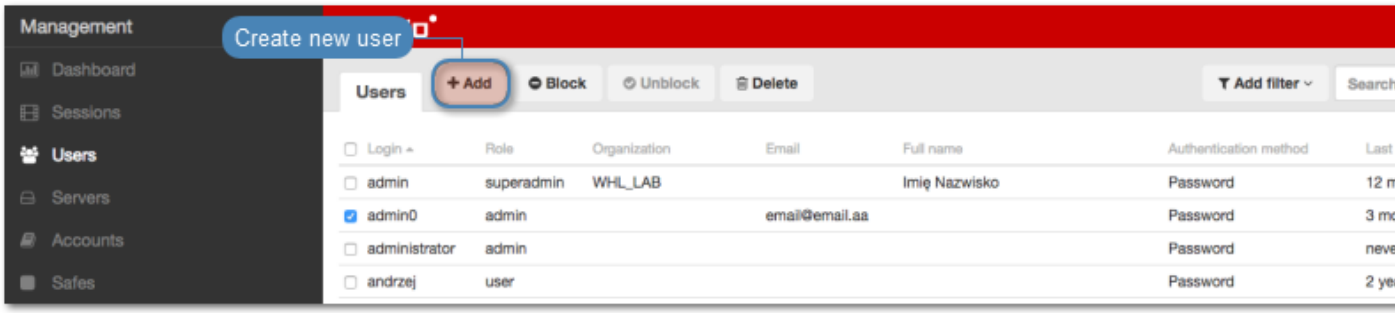


Note: Wheel Fudo PAM allows importing users definitions from directory services such as Active Directory or LDAP. For more information on users synchronization service, refer to the *Users synchronization* topic.

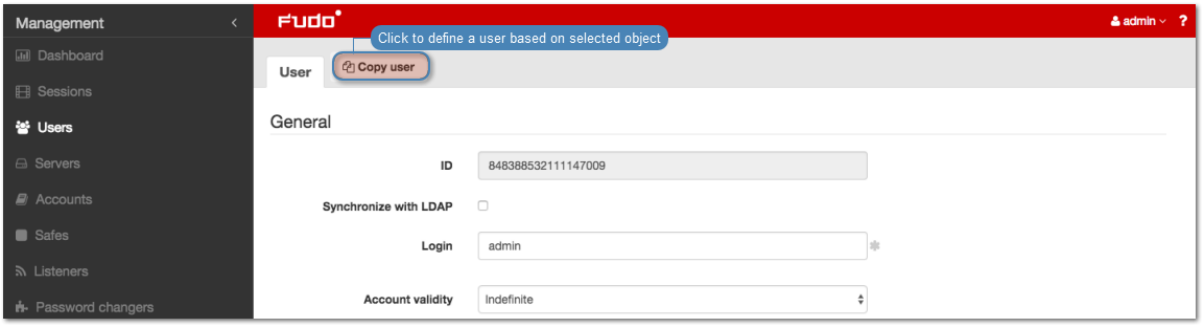
5.1 Creating a user

Warning: Data model objects: *safes*, *users*, *servers*, *accounts* and *listeners* are replicated within the cluster and object instances must not be added on each node. In case the replication mechanism fails to copy objects to other nodes, contact technical support department.

1. Select *Management* > *Users*.
2. Click + *Add*.



Note: Wheel Fudo PAM enables creating users based on the existing definitions. Click desired user to access its configuration parameters and click *Copy user* to create a new object based on the selected definition.



3. Enter a unique user login.

Note: The *Login* field is not case sensitive.

4. Select the *Blocked* option to prevent user from accessing servers and resources monitored by Wheel Fudo PAM.
5. Define account's validity period.
6. Select user's role, which will determine the access rights.

Note: Access rights restrictions also apply to API interface access.

Role	Access rights
user	• Connecting to servers through assigned safes. • Loggin to the User Portal (requires adding the user to the `portal` safe) • Fetching servers' passwords (requires additional access right).
service	Accessing SNMP information.
operator	• Logging in to the administration panel. • Browsing objects: servers, users, safes, listeners, accounts, to which the user has been assigned sufficient access permisions. • Blocking/unblocking objects: servers, users, safes, listeners, accounts, to which the user has been assigned sufficient access permisions. • Generating reports on demand and subscribing to periodic reports. • Activating/deactivating email notifications. • Viewing live and archived sessions involving objects (user, safe, account, listener, server), to which the user has been assigned sufficient access permissions. • Converting sessions and downloading converted content involving objects (user, safe, account, listener, server), to which the user has been assigned sufficient access permissions.
admin	• Logging in to the administration panel. • Managing objects: servers, users, safes, listeners, accounts, to which the user has been assigned sufficient access permisions. • Blocking/unblocking objects: servers, users, safes, listeners, accounts, to which the user has been assigned sufficient access permisions. • Generating reports on demand and subscribing to periodic reports. • Activating/deactivating email notifications. • Viewing live and archived sessions involving objects (user, safe, account, listener, server), to which the user has been assigned management privileges. • Converting sessions and downloading converted content involving objects (user, safe, account, listener, server), to which the user has been assigned sufficient access permissions. • Managing policies.
superadmin	• Full access rights to objects management. • Full access rights to system configuration options.

7. Select user's preferred language in Wheel Fudo PAM administration panel.
8. Grant access to safes.

Note:

- Drag and drop safe objects to change the order in which safes are processed upon establishing connection.
- SSH_safe implies that the Reveal password option is disabled.
- RDP_safe implies, that the Reveal password option is enabled.

9. Enter user's full name.
10. Enter user's email address.
11. Enter user's organizational unit.
12. Enter user's phone number.
13. Provide user's *Active Directory* domain.
14. Enter *LDAP* service *BaseDN* parameter.

Note:

- LDAP base is necessary for authenticating the user using the Active Directory service.
- E.g. for `example.com` domain, the LDAP base parameter value should be `dc=example, dc=com`.

15. In the *Permissions* section, select users allowed to manage this user object.
16. In the *Authentication* section, select authentication type.

External authentication

- Select `External authentication` from the *Type* drop-down list.
- Select external authentication source from the *External authentication source* drop-down list.

Note: Refer to *External authentication* topic for more information on external authentication sources.

Password

- Select `Password` from the *Type* drop-down list.
- Type password in the *Password* field.
- Repeat password in the *Repeat password* field.

SSH key

- Select `SSH key` from the *Type* drop-down list.
- Click the upload icon and browse the file system to find the public SSH key used for verifying user's identity.

One-time password

Warning: One-time passwords are used for implementing *AAPM* use case scenarios.

- Select `One-time password` from the *Type* drop-down list.

17. Click *+ Add authentication method* to define more authentication methods.

Note: When processing user authentication requests, Wheel Fudo PAM verifies login credentials against defined authentication methods in order in which those methods have been defined.

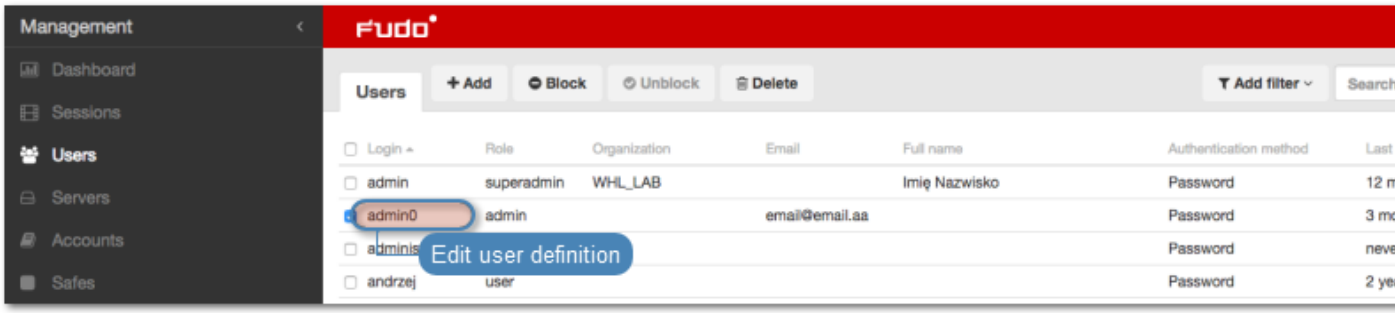
18. Click *Save*.

Related topics:

- *Users synchronization*
- *Data model*
- *System initiation*
- *Servers*
- *Accounts*

5.2 Editing a user

1. Select *Management* > *Users*.
2. Find and click desired user to access its configuration parameters.

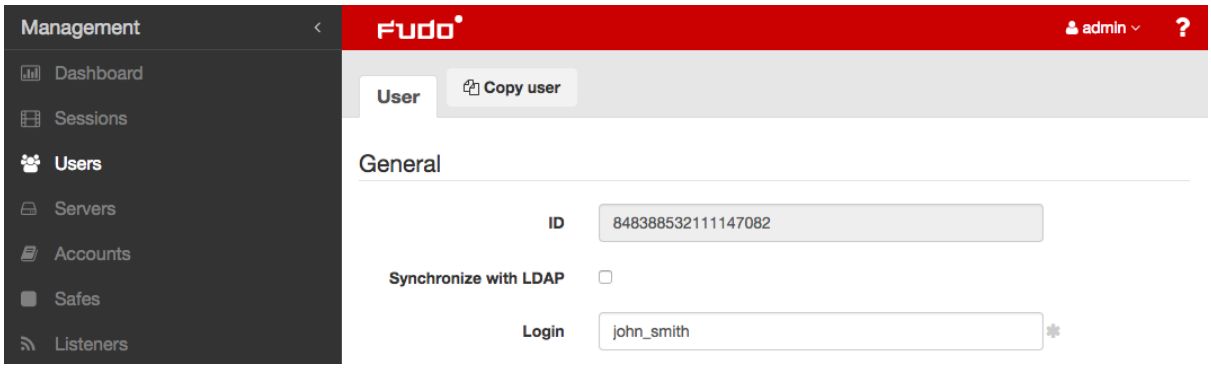


Note: Define filters to limit the number of objects displayed on the list.

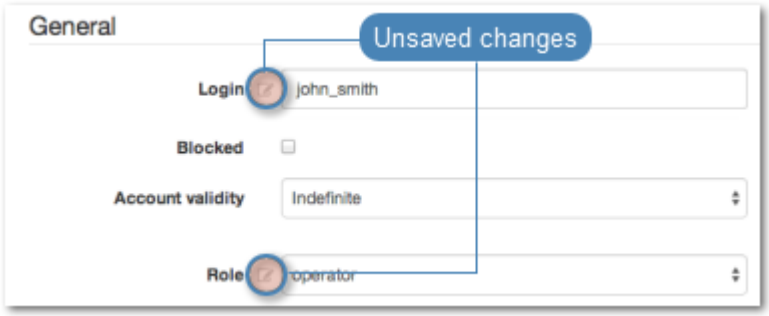
3. Modify configuration values as needed.

Note:

- ID is a read-only, unique object identifier and it is assigned by Wheel Fudo PAM when object is created.



- Unsaved changes are marked with an icon.



4. Click *Save*.

Related topics:

- *Users synchronization*
- *Data model*
- *System initiation*
- *Servers*
- *Accounts*

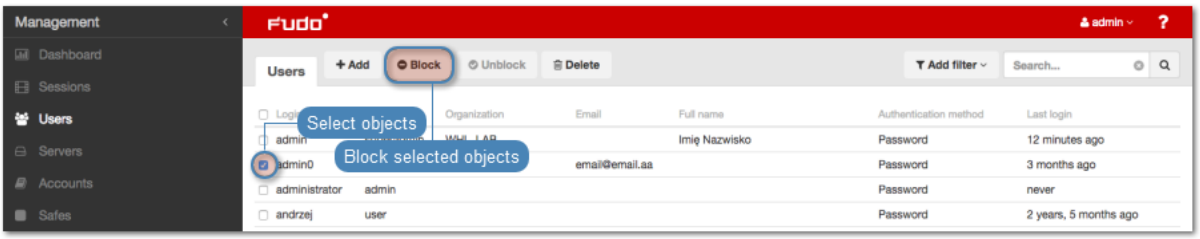
5.3 Blocking a user

Warning: Blocking a user will terminate its current connections.

1. Select *Management* > *Users*.
2. Find and select desired objects.

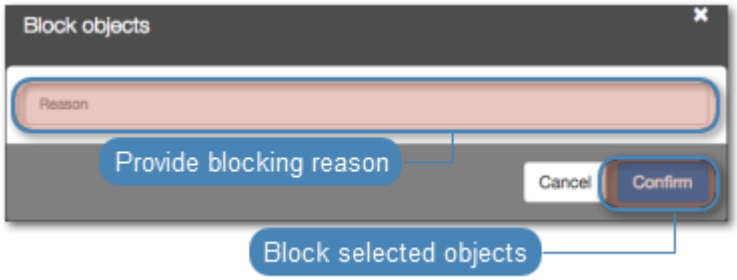
Note: Define filters to limit the number of objects displayed on the list.

3. Click *Block*.



4. Optionally, provide blocking reason and click *Confirm*.

Note: To view the blocking reason, place the cursor over the icon on the accounts list.



Note: Users can also be blocked by accessing the user object configuration form.

- Select the *Blocked* option.
- Provide an optional blocking reason.
- Click *Save*.

Related topics:

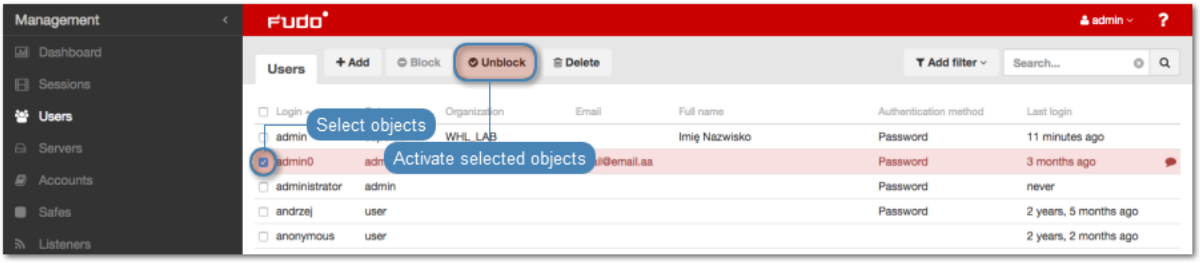
- *Users synchronization*
- *Data model*
- *System initiation*
- *Servers*
- *Accounts*

5.4 Unblcoking a user

1. Select *Management* > *Users*.
2. Find and select desired objects.

Note: Define filters to limit the number of objects displayed on the list.

3. Click *Unblock*.



4. Click *Confirm* to unblock selected objects.

Related topics:

- *Users synchronization*
- *Data model*
- *System initiation*
- *Servers*
- *Accounts*

5.5 Deleting a user

Warning: Deleting a user definition will terminate its current connections.

1. Select *Management* > *Users*.
2. Find and select desired object.

Note: Define filters to limit the number of objects displayed on the list.

3. Click *Delete*.

4. Confirm deleting selected objects.

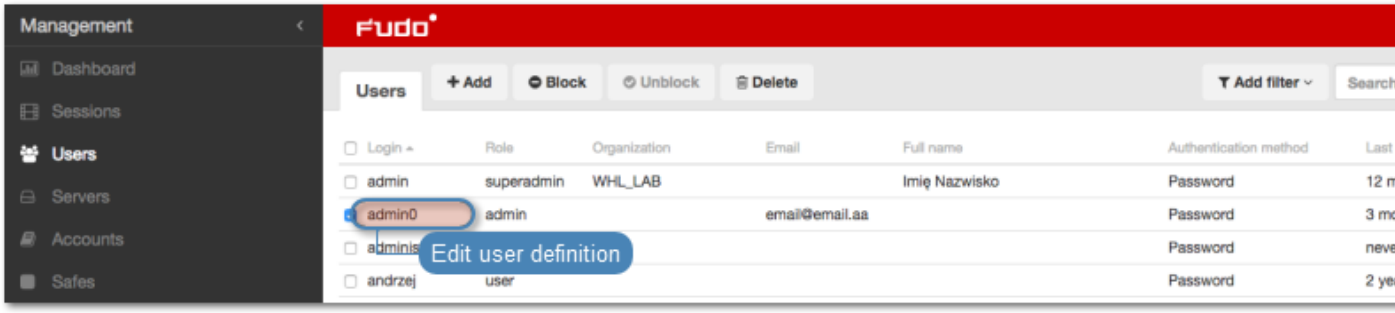
Related topics:

- *Users synchronization*
- *Data model*
- *System initiation*
- *Servers*
- *Accounts*

5.6 Time access policy

Wheel Fudo PAM can regulate access to safes based on time. To define time based safe access, proceed as follows.

1. Select *Management* > *Users*.
2. Find and click desired user to access its configuration parameters.



Note: Define filters to limit the number of objects displayed on the list.

3. Click desired safe object.

4. Select the *Enable time policy* option.
5. Select the *Reveal password* option to allow user to see the passwords to servers that are grouped in selected safe.
6. Click the weekly calendar to define time interval.

7. Click *OK*.

Related topics:

- *Creating a user*
- *ServiceNow - granting access*
- *Servers*
- *Accounts*

5.7 Roles

Role	Access rights
user	• Connecting to servers through assigned safes. • Loggin to the User Portal (requires adding the user to the `portal` safe) • Fetching servers' passwords (requires additional access right).
service	Accessing SNMP information.
operator	• Logging in to the administration panel. • Browsing objects: servers, users, safes, listeners, accounts, to which the user has been assigned sufficient access permisions. • Blocking/unblocking objects: servers, users, safes, listeners, accounts, to which the user has been assigned sufficient access permisions. • Generating reports on demand and subscribing to periodic reports. • Activating/deactivating email notifications. • Viewing live and archived sessions involving objects (user, safe, account, listener, server), to which the user has been assigned sufficient access permissions. • Converting sessions and downloading converted content involving objects (user, safe, account, listener, server), to which the user has been assigned sufficient access permissions.
admin	• Logging in to the administration panel. • Managing objects: servers, users, safes, listeners, accounts, to which the user has been assigned sufficient access permisions. • Blocking/unblocking objects: servers, users, safes, listeners, accounts, to which the user has been assigned sufficient access permisions. • Generating reports on demand and subscribing to periodic reports. • Activating/deactivating email notifications. • Viewing live and archived sessions involving objects (user, safe, account, listener, server), to which the user has been assigned management privileges. • Converting sessions and downloading converted content involving objects (user, safe, account, listener, server), to which the user has been assigned sufficient access permissions. • Managing policies.
superadmin	• Full access rights to objects management. • Full access rights to system configuration options.

Related topics:

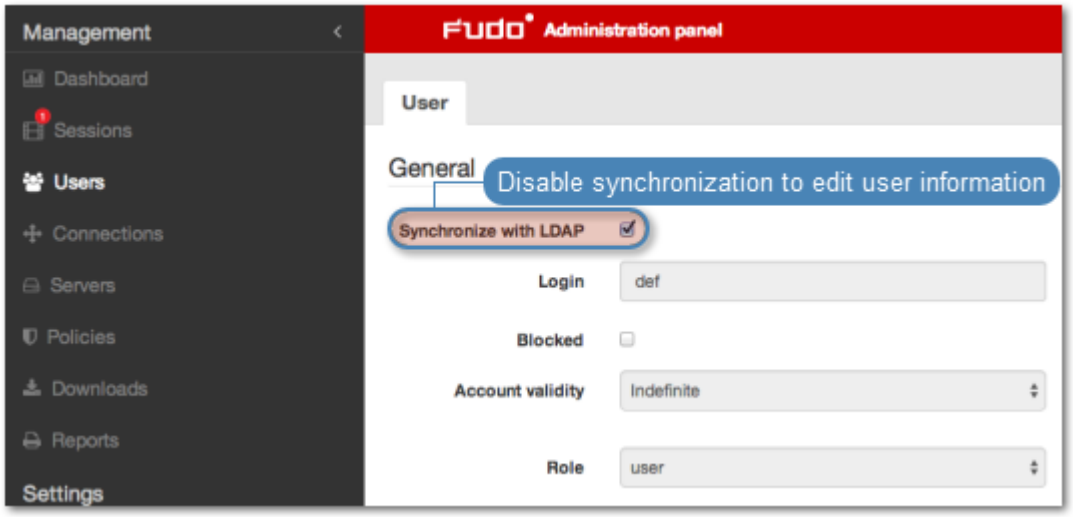
- *Users synchronization*
- *Data model*
- *System initiation*
- *Servers*
- *Accounts*

5.8 Users synchronization

User is one of the fundamental *data model* entity. Only defined users are allowed to connect to monitored servers. Wheel Fudo PAM features automatic users synchronization service which enables importing users information from Active Directory servers.

New users definitions and changes in existing objects are imported from the directory service periodically every 5 minutes. Deleting a user object from an AD or an LDAP server requires performing the full synchronization to reflect those changes on Wheel Fudo PAM. The full synchronization process is triggered automatically once a day at 00:00, or can be triggered manually.

Note: Users imported from the catalog service cannot be edited. To edit a user definition imported from an LDAP or an AD server, disable the `Synchronize with LDAP` option for the given user.



Configuring users synchronization service

To enable users synchronization feature, proceed as follows.

1. Select *Settings* > *LDAP synchronization*.
2. Select *Enabled*.
3. Select the data source type from the *Server type* drop-down list.
4. Provide the user authentication information to access user data on given server.
5. Enter domain name, to which imported users definition belong to.

6. In the *Base user* field, provide base DN for directory tree where users' definitions are stored (eg. `DC=tech,DC=whl`).
7. In the *Base group* field, provide base DN for directory tree where groups' definitions are stored (eg. `DC=tech,DC=whl`).

Note: DN parameter should not contain any white space characters.

---

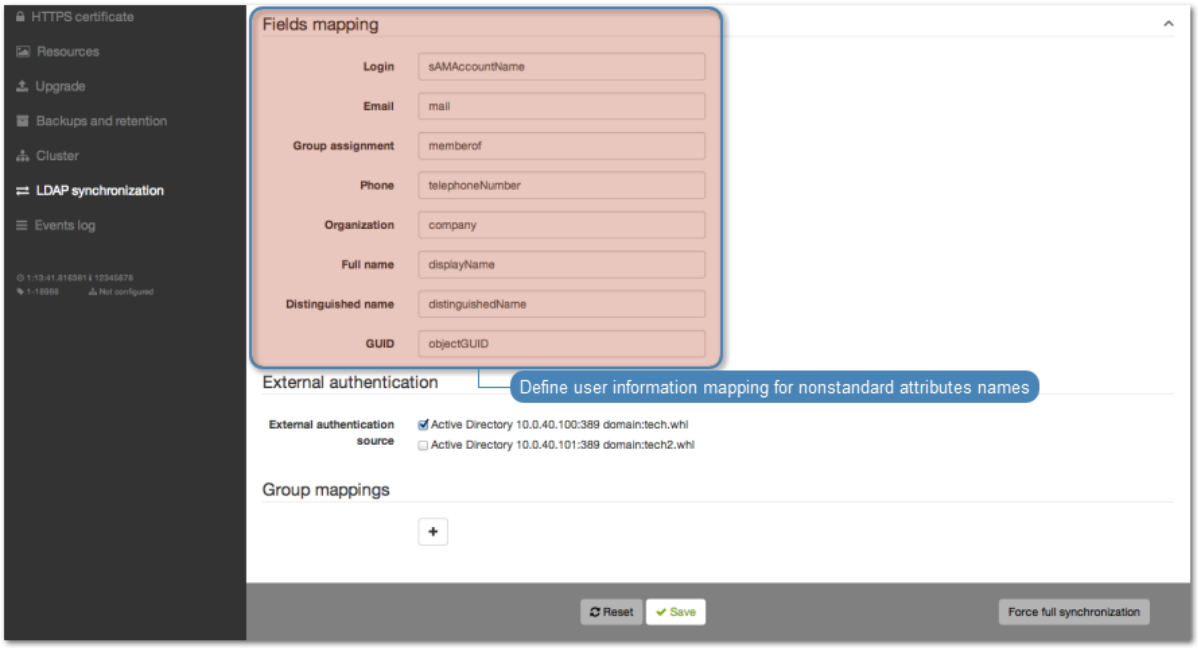
8. Define filter for user records, which are subject to synchronization.
9. Define filter for user groups, which are subject to synchronization.
10. In the *Servers* section, provide the directory server's IP address and port number.

Note: Click + to add more directory servers.

---

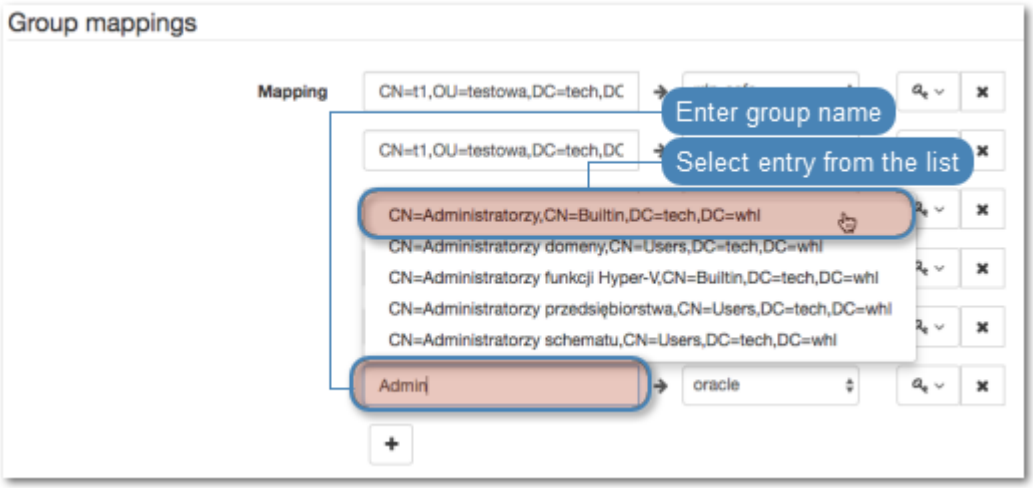
11. Select the *Page LDAP results* option to enable paging.
12. Select the *Encrypted connection* option to enable encryption.
13. Define user information mapping.

Note: Fields mapping enables importing users information from nonstandard attributes, e.g. telephone number defined in an attribute named *mobile* instead of the standard *telephoneNumber*.



---

14. Click + to add users group mapping.
15. Type in user group and select desired entry.

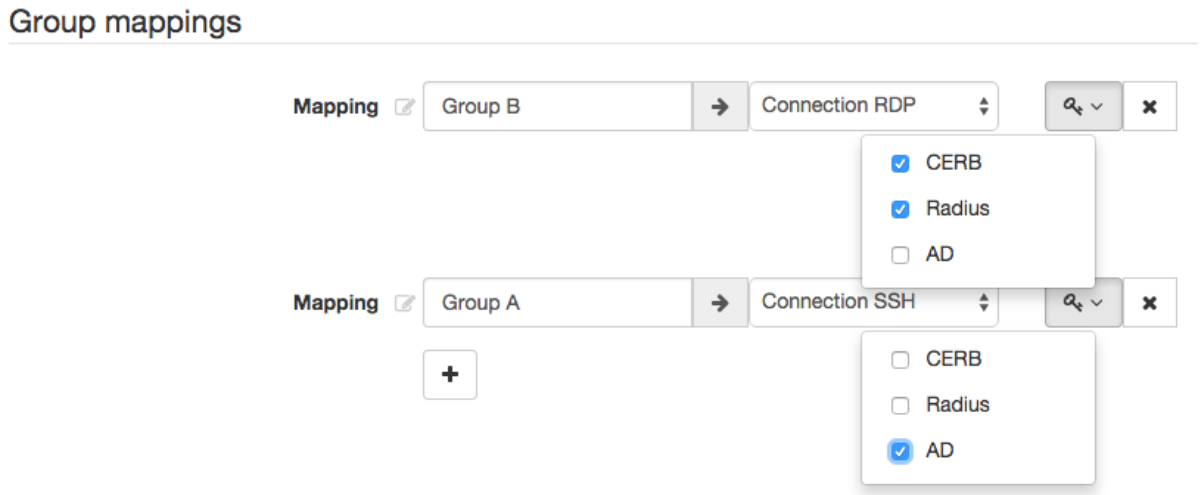


16. Assign safes to user groups.
17. Assign external authentication sources to user groups.

Note: External authentication sources are assigned to users in the exact sequence they are defined in groups mapping. Thus if the same user is present in more than one group, Wheel Fudo PAM will be authenticating him against external authentication sources starting from those defined in the first group mapping defined.

For example:

A user is assigned to groups A and B. Group B is mapped to `Safe RDP` and has `CERB` and `Radius` authentication sources assigned. Group A is second in order and it is mapped to `Safe SSH` and has `AD` authentication source assigned.



Authenticating a user, Wheel Fudo PAM will send requests to external authentication sources in the following order:

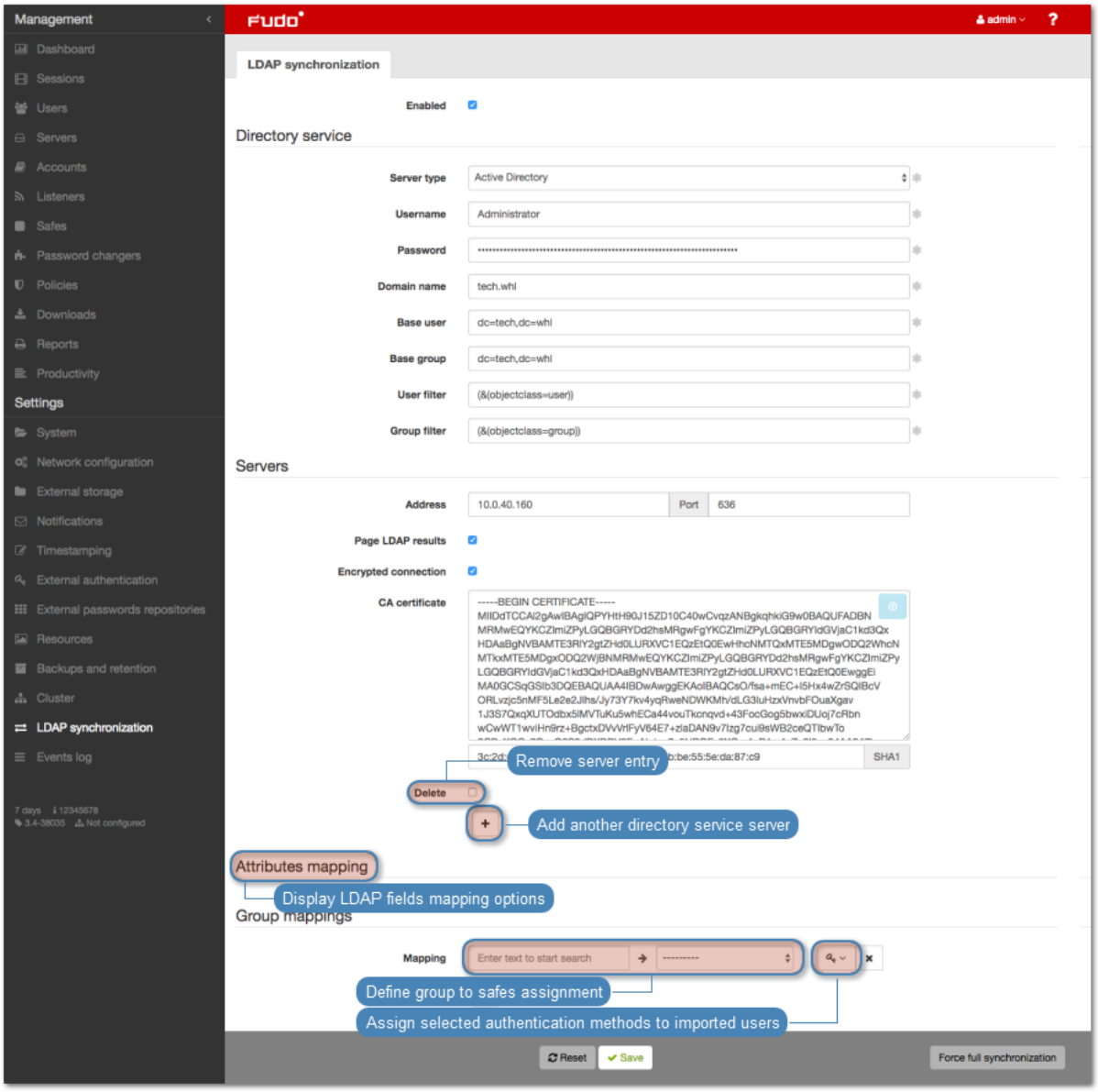
1. CERB.
2. Radius.
3. AD.

---

18. Click *Save*.

Note: The *Force full synchronization* option enables processing changes in directory structures which cannot be processed during periodical synchronization, eg. deleting a defined group or deleting a user.

The full synchronization process is triggered automatically once a day at 00:00, or can be triggered manually.



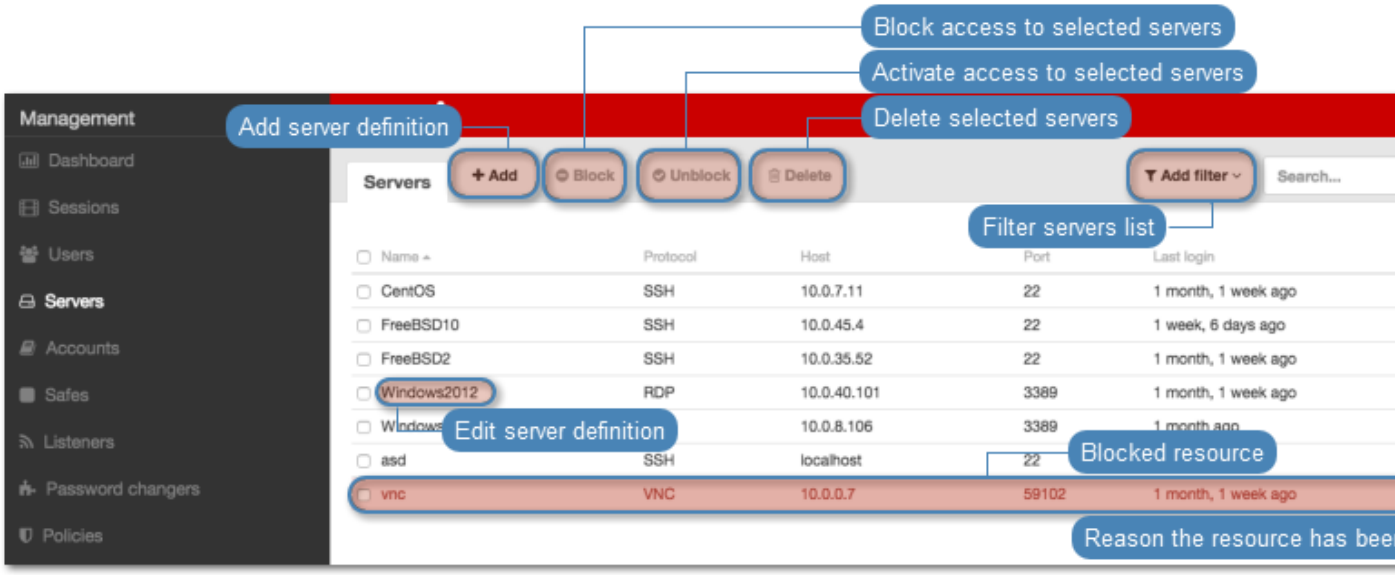
Related topics:

- *Data model*
- *Users management*
- *Servers management*
- *Accounts*

CHAPTER 6

Servers

Server is a definition of the IT infrastructure resource, which can be accessed over one of the specified protocols.



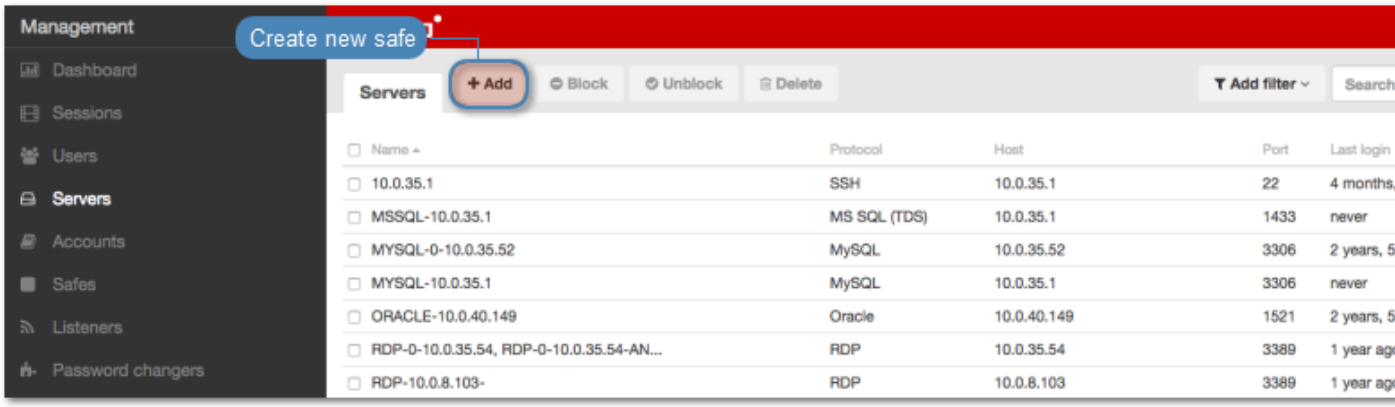
6.1 Creating a server

Warning: Data model objects: *safes*, *users*, *servers*, *accounts* and *listeners* are replicated within the cluster and object instances must not be added on each node. In case the replication mechanism fails to copy objects to other nodes, contact technical support department.

6.1.1 Static server

6.1.1.1 Creating a Citrix server

1. Select *Management* > *Servers*.
2. Click *+ Add*.

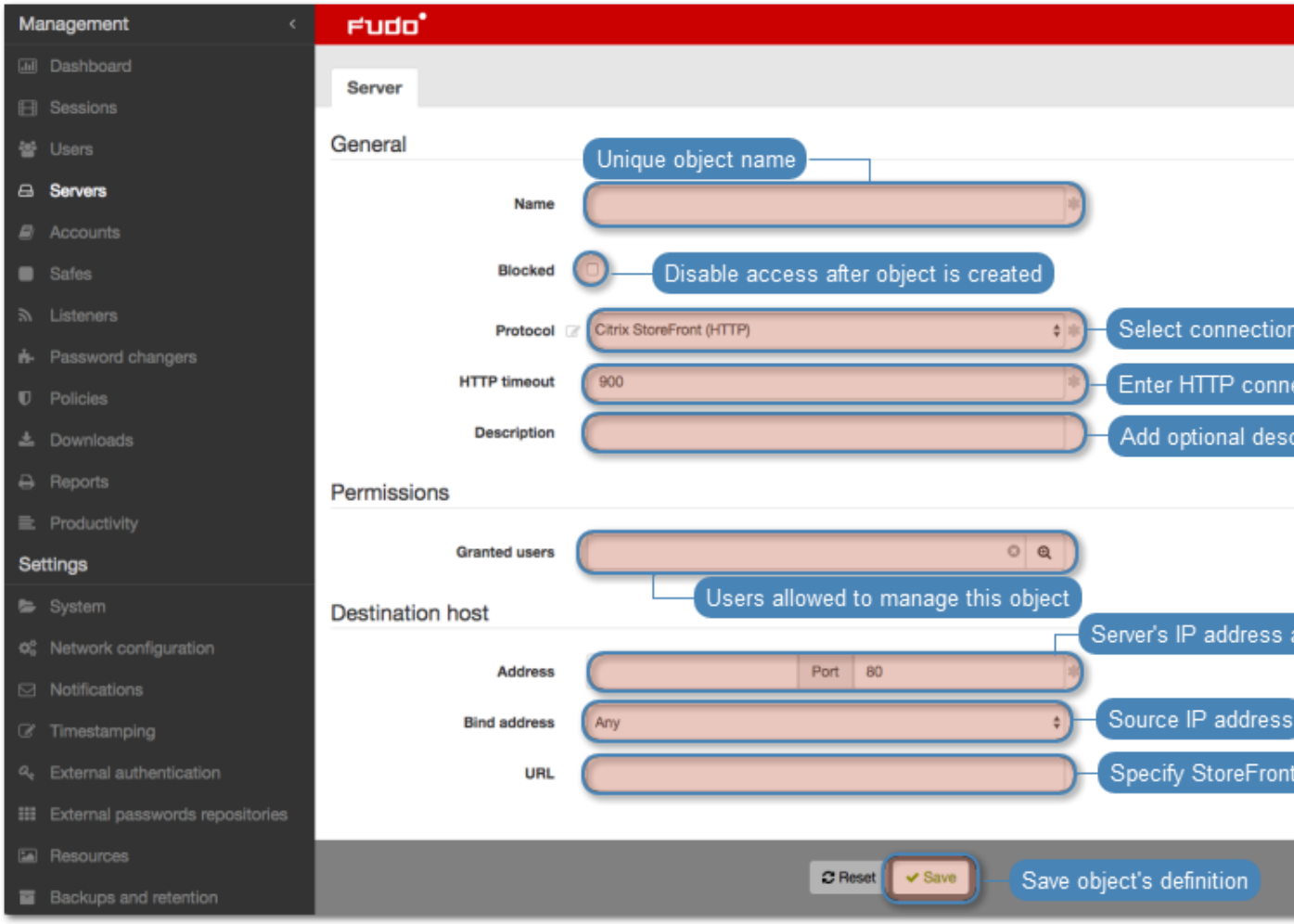


3. Enter server's unique name.
4. Select *Blocked* option to disable access to server after it's created.
5. Select `Citrix StoreFront (HTTP)` from the *Protocol* drop-down list.
6. Enter value of the *HTTP timeout* parameter, determining the time period of inactivity (expressed in seconds), after which the user will have to authenticate again.
7. Enter optional description, which will help identifying this server object.
8. In the *Permissions* section, add users allowed to manage this object.
9. In the *Destination host* section, enter server's IP address and port number.
10. From the *Bind address* drop-down list, select Wheel Fudo PAM IP address used for communicating with this server.

Note: The *Bind address* drop-down list elements are IP address defined in the *Network configuration* menu. Refer to *Network interfaces configuration* for more information on managing physical interfaces.

---

11. In the URL field, enter Citrix StoreFront base URL.
12. Click *Save*.



Related topics:

- *Data model*
- *Creating a Citrix listener*
- *ICA via Citrix StoreFront*
- *Citrix StoreFront (HTTP)*
- *ICA*
- *ICA configuration file*

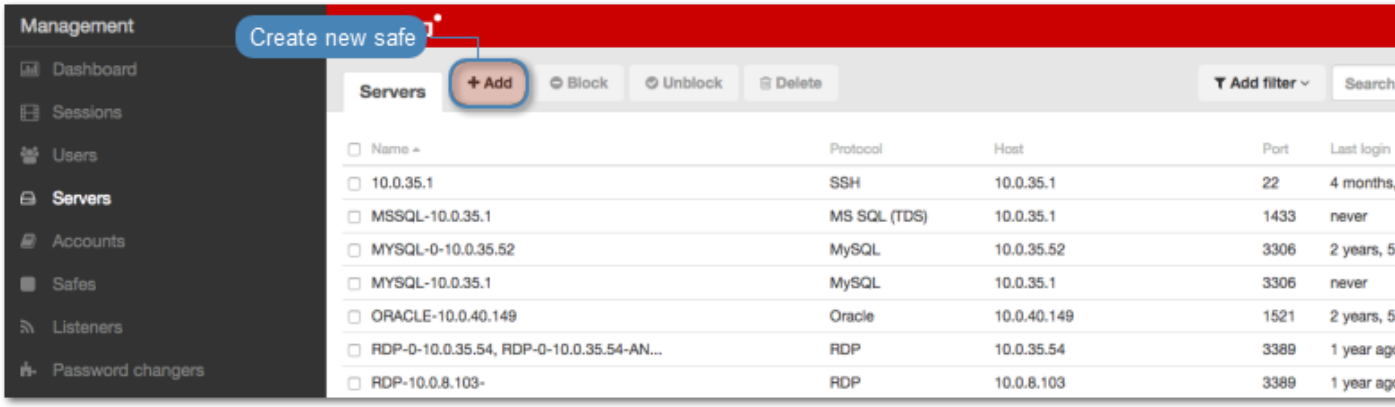
6.1.1.2 Creating an HTTP server

Note:

- A server object can be linked to only one *anonymous* account.
- A server object can be linked to only one *forward* account.

---

1. Select *Management* > *Servers*.
2. Click *+ Add*.

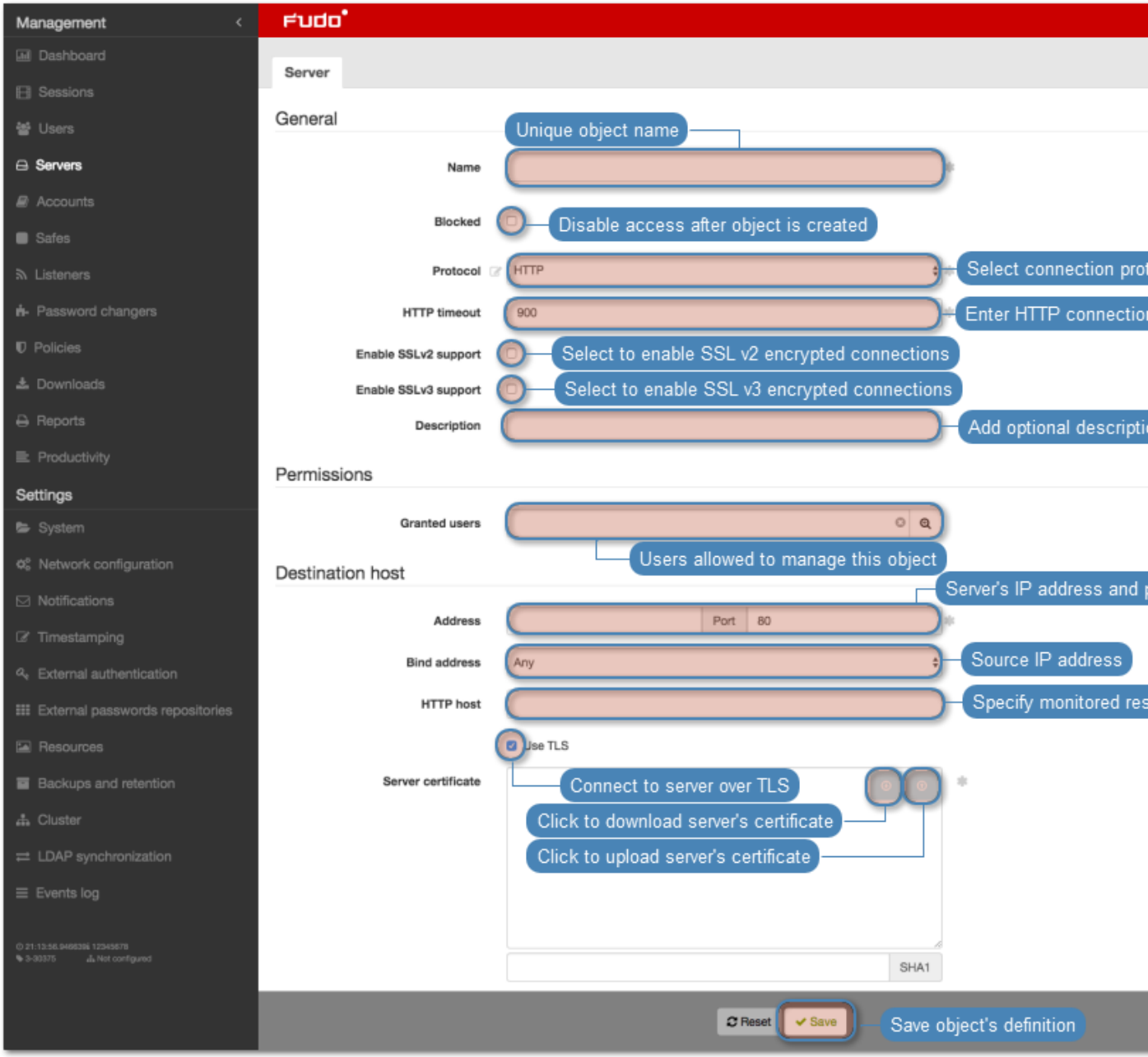


3. Enter server's unique name.
4. Select *Blocked* option to disable access to server after it's created.
5. Select `HTTP` from the *Protocol* drop-down list.
6. Enter value of the *HTTP timeout* parameter, determining the time period of inactivity (expressed in seconds), after which the user will have to authenticate again.
7. Select the *Enable SSLv2 support* to support SSL v2 encrypted connections.
8. Select the *Enable SSLv3 support* to support SSL v3 encrypted connections.
9. Enter optional description, which will help identifying this server object.
10. In the *Permissions* section, add users allowed to manage this object.
11. In the *Destination host* section, enter server's IP address and port number.
12. From the *Bind address* drop-down list, select Wheel Fudo PAM IP address used for communicating with this server.

Note: The *Bind address* drop-down list elements are IP address defined in the *Network configuration* menu. Refer to *Network interfaces configuration* for more information on managing physical interfaces.

---

13. Specify the monitored resource in the *HTTP host* field.
14. Select the *Use TLS* options to connect to monitored server over TLS.
15. Click the certificate download icon to fetch server's certificate, or the certificate upload icon to upload a certificate.
16. Click *Save*.



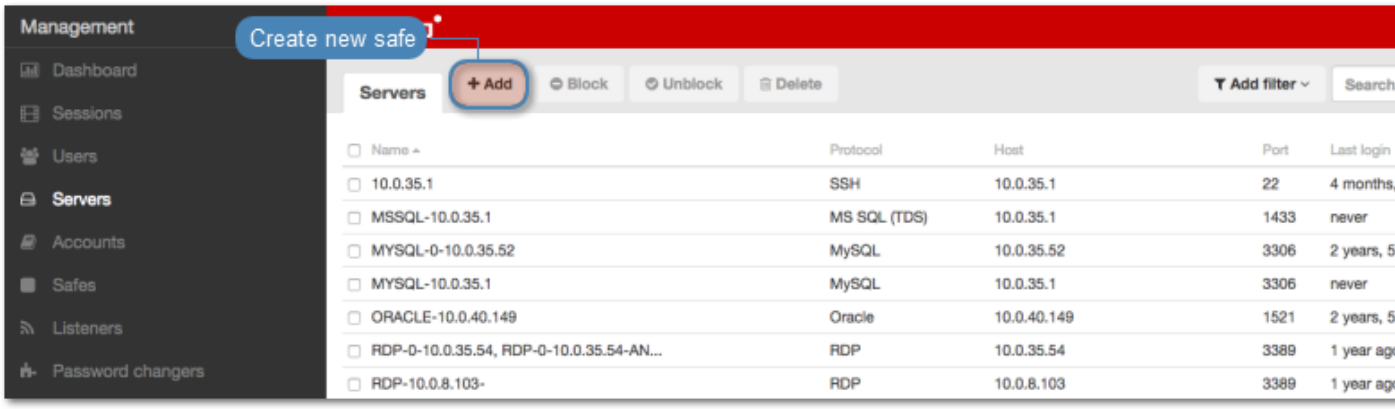
Related topics:

- *Data model*
- *System initiation*
- *Users*
- *Listeners*
- *Safes*
- *Accounts*

6.1.1.3 Creating an ICA server

1. Select *Management* > *Servers*.

2. Click *+ Add*.

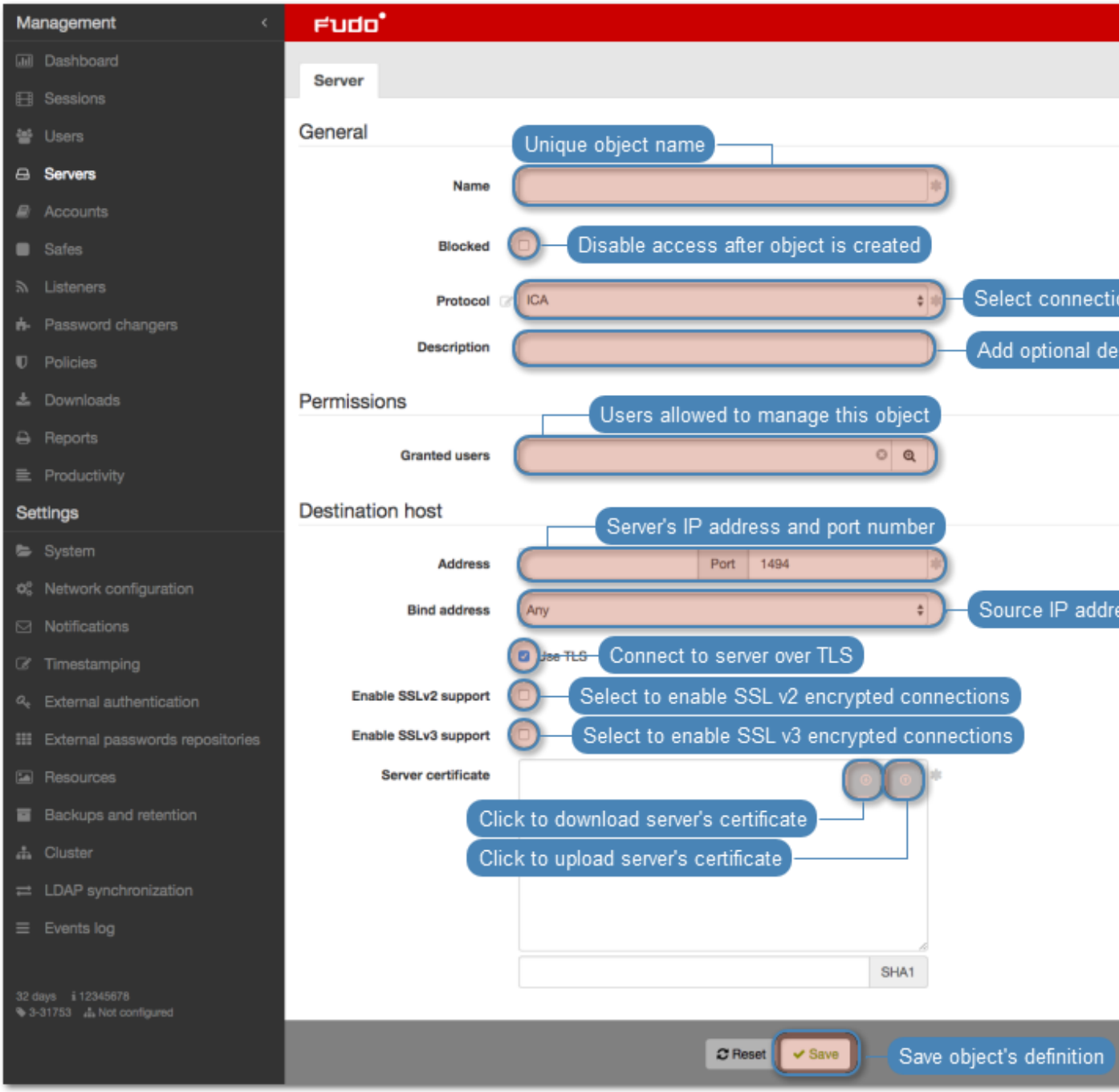


3. Enter server's unique name.
4. Select *Blocked* option to disable access to server after it's created.
5. Select `ICA` from the *Protocol* drop-down list.
6. Enter optional description, which will help identifying this server object.
7. In the *Permissions* section, add users allowed to manage this object.
8. In the *Destination host* section, enter server's IP address and port number.
9. From the *Bind address* drop-down list, select Wheel Fudo PAM IP address used for communicating with this server.

Note: The *Bind address* drop-down list elements are IP address defined in the *Network configuration* menu. Refer to *Network interfaces configuration* for more information on managing physical interfaces.

---

10. Select the *Use TLS* options to connect to monitored server over TLS.
11. Select the *Enable SSLv2 support* to support SSL v2 encrypted connections.
12. Select the *Enable SSLv3 support* to support SSL v3 encrypted connections.
13. Click the certificate download icon to fetch server's certificate, or the certificate upload icon to upload a certificate.
14. Click *Save*.



Related topics:

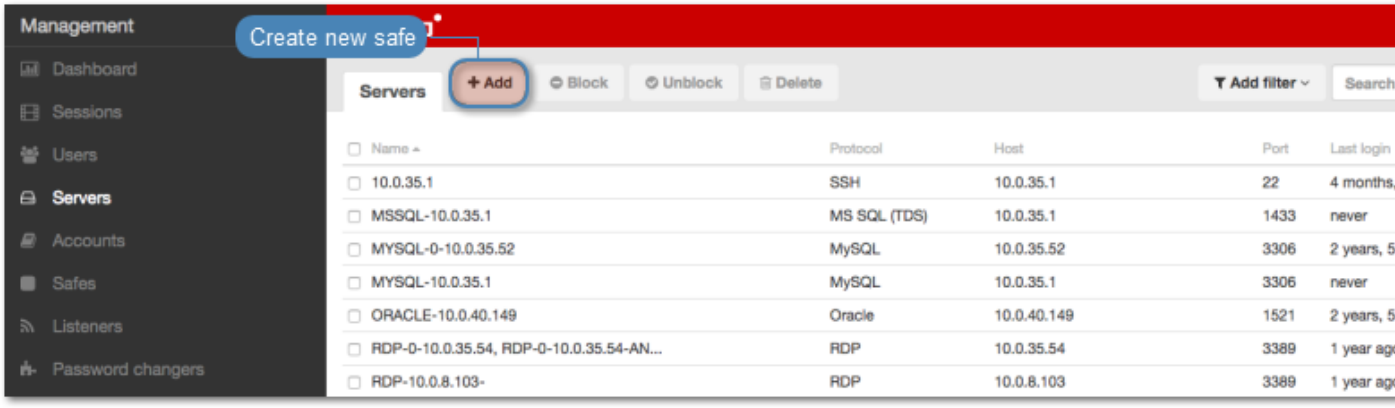
- *Data model*
- *ICA*
- *Creating an ICA listener*
- *ICA configuration file*
- *ICA*

6.1.1.4 Creating a Modbus server

Note:

- A server object can be linked to only one *anonymous* account.
- A server object can be linked to only one *forward* account.

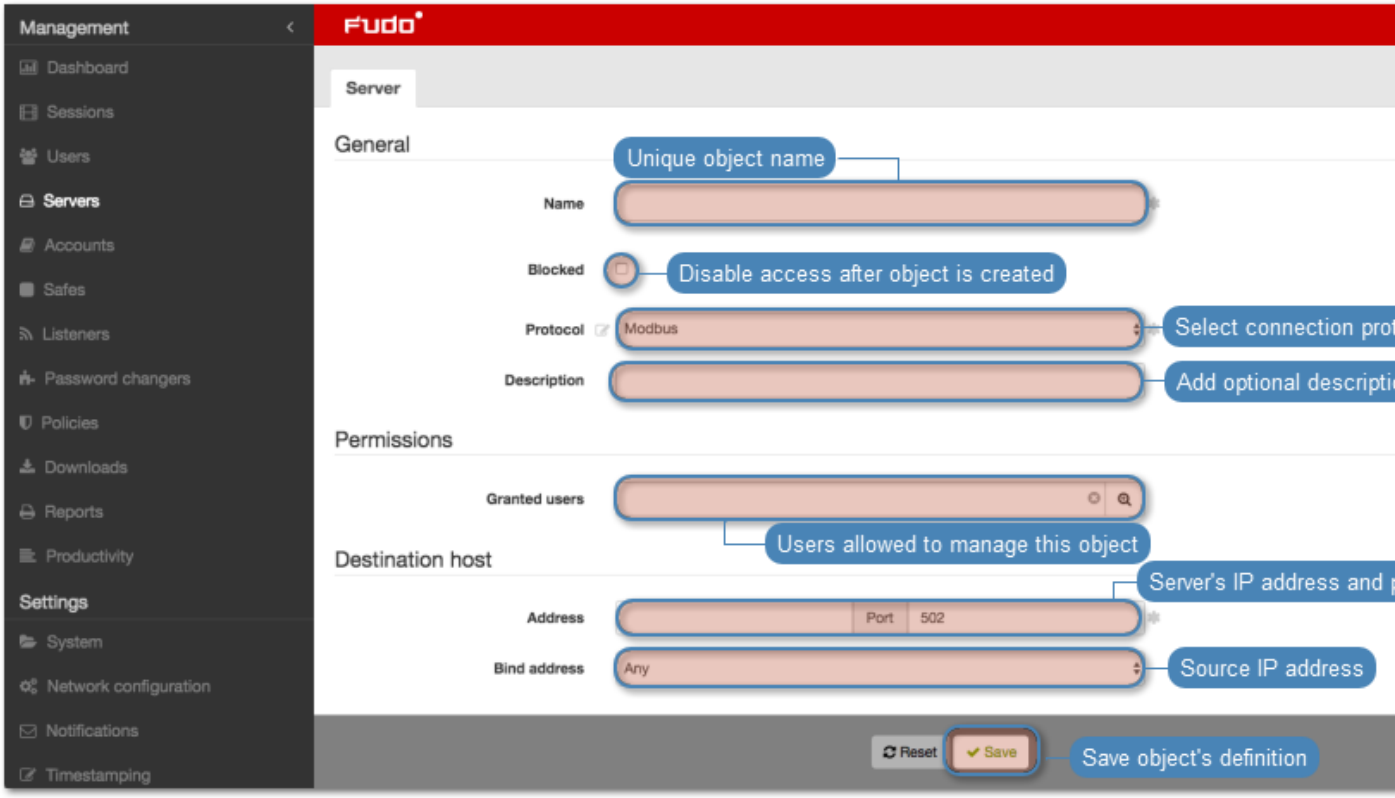
1. Select *Management* > *Servers*.
2. Click *+ Add*.



3. Enter server's unique name.
4. Select *Blocked* option to disable access to server after it's created.
5. Select `Modbus` from the *Protocol* drop-down list.
6. Enter optional description, which will help identifying this server object.
7. In the *Permissions* section, add users allowed to manage this object.
8. In the *Destination host* section, enter server's IP address and port number.
9. From the *Bind address* drop-down list, select Wheel Fudo PAM IP address used for communicating with this server.

Note: The *Bind address* drop-down list elements are IP address defined in the *Network configuration* menu. Refer to *Network interfaces configuration* for more information on managing physical interfaces.

10. Click *Save*.



Related topics:

- *Data model*
- *System initiation*
- *Users*
- *Listeners*
- *Safes*
- *Accounts*

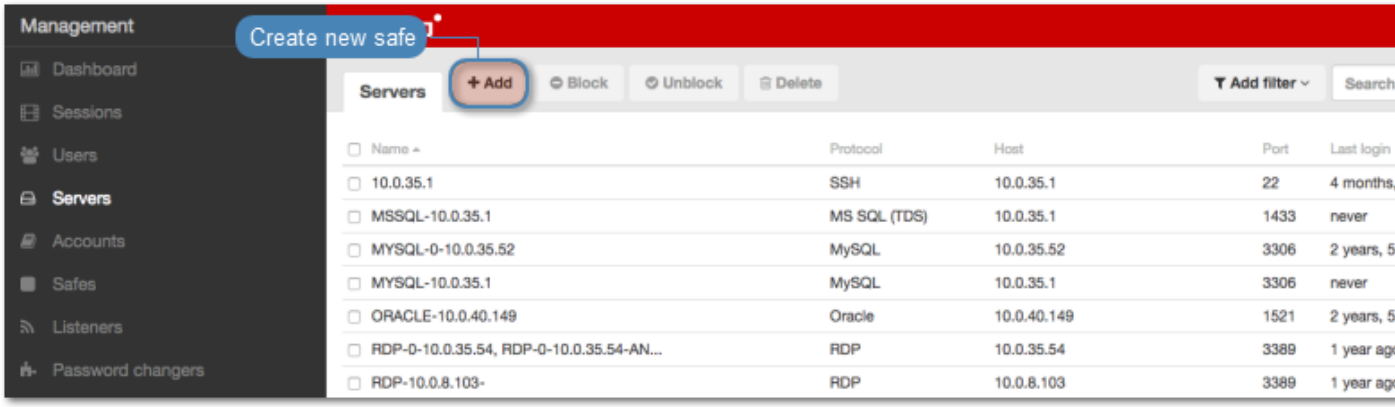
6.1.1.5 Creating a MS SQL server

Note:

- A server object can be linked to only one *anonymous* account.
- A server object can be linked to only one *forward* account.

---

1. Select *Management* > *Servers*.
2. Click + *Add*.

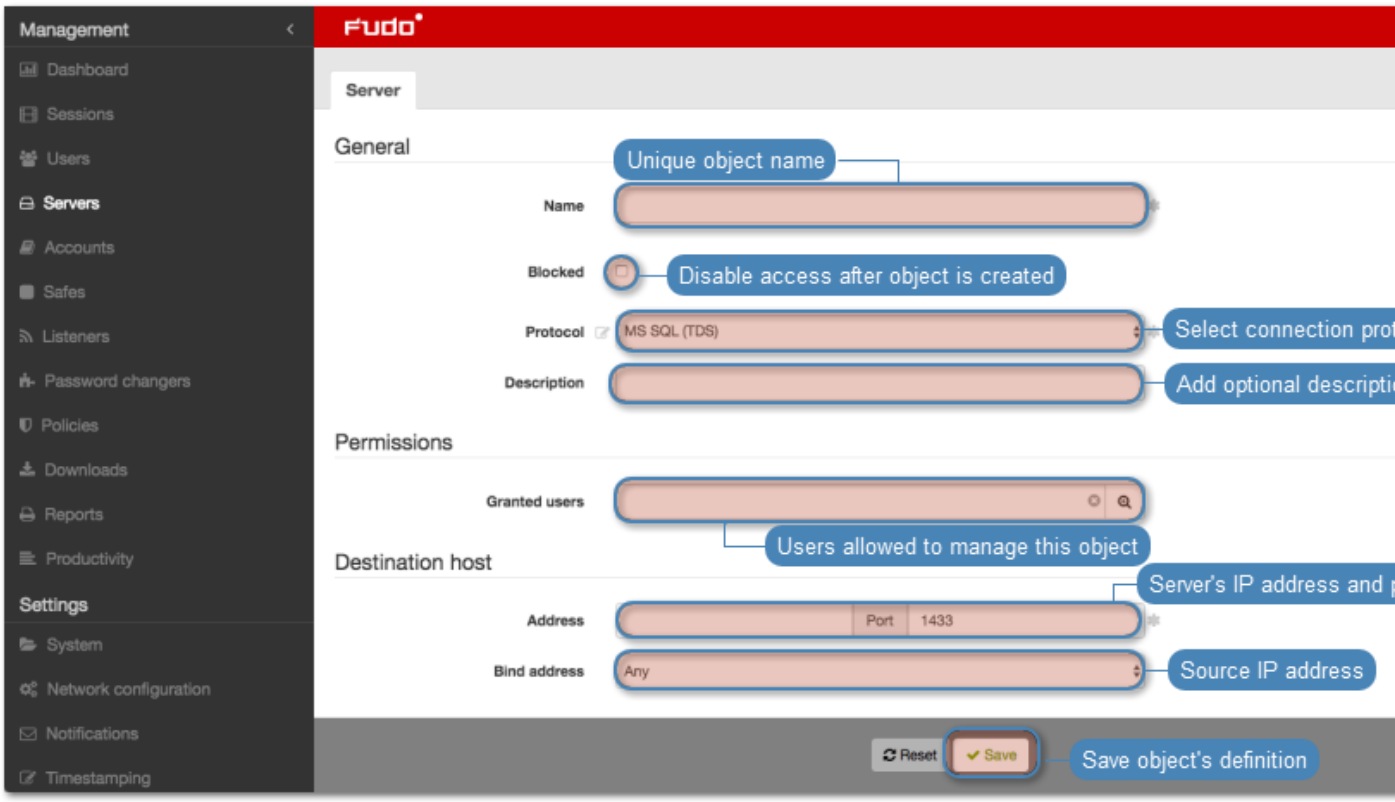


3. Enter server's unique name.
4. Select *Blocked* option to disable access to server after it's created.
5. Select `MS SQL (TDS)` from the *Protocol* drop-down list.
6. Enter optional description, which will help identifying this server object.
7. In the *Permissions* section, add users allowed to manage this object.
8. In the *Destination host* section, enter server's IP address and port number.
9. From the *Bind address* drop-down list, select Wheel Fudo PAM IP address used for communicating with this server.

Note: The *Bind address* drop-down list elements are IP address defined in the *Network configuration* menu. Refer to *Network interfaces configuration* for more information on managing physical interfaces.

---

10. Click *Save*.



Related topics:

- *Data model*
- *System initiation*
- *Users*
- *Listeners*
- *Safes*
- *Accounts*

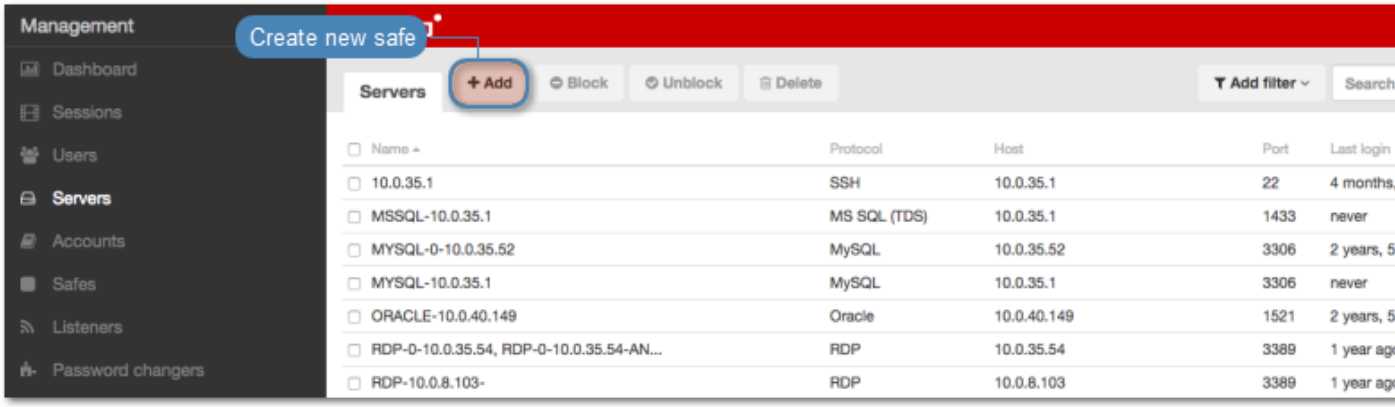
6.1.1.6 Creating a MySQL server

Note:

- A server object can be linked to only one *anonymous* account.
- A server object can be linked to only one *forward* account.

---

1. Select *Management* > *Servers*.
2. Click *+ Add*.

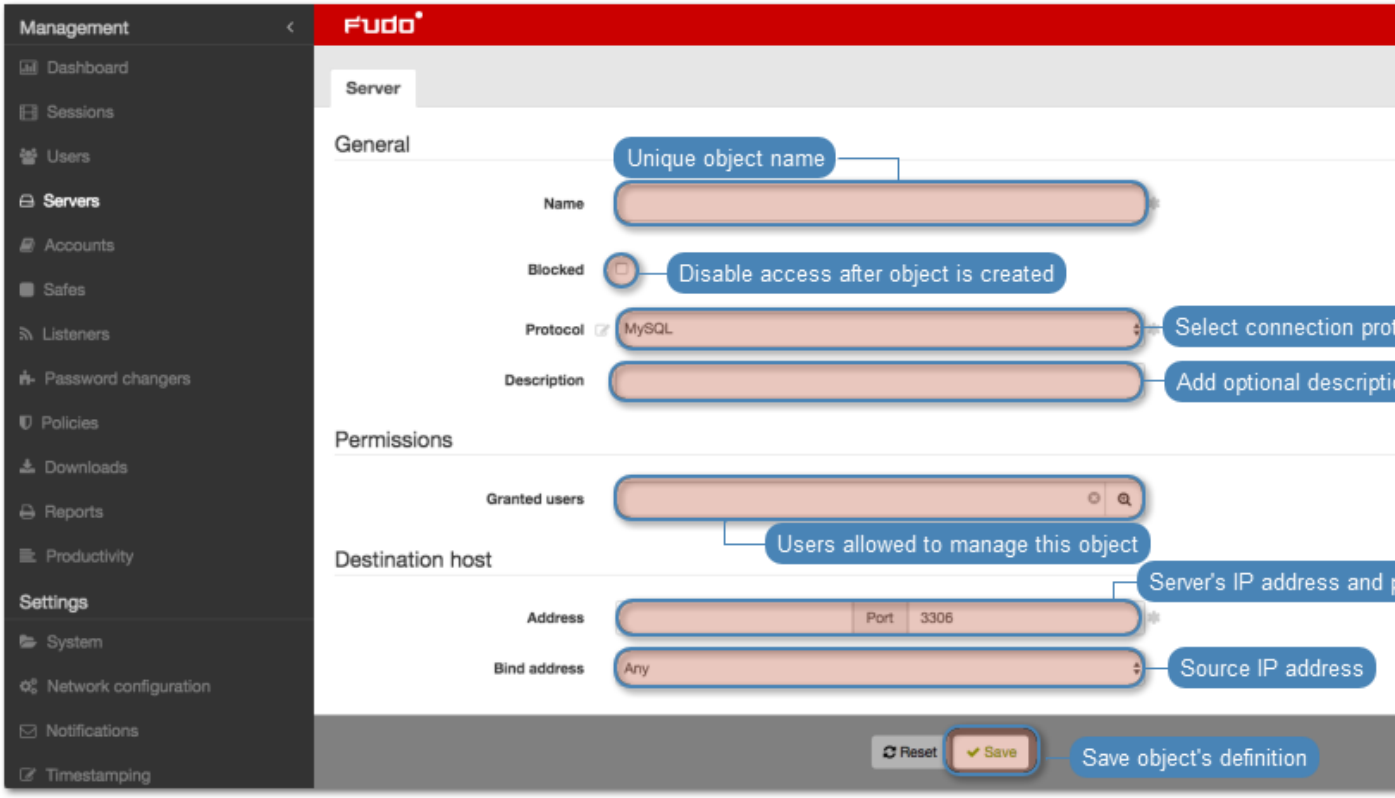


3. Enter server's unique name.
4. Select *Blocked* option to disable access to server after it's created.
5. Select `MySQL` from the *Protocol* drop-down list.
6. Enter optional description, which will help identifying this server object.
7. In the *Permissions* section, add users allowed to manage this object.
8. In the *Destination host* section, enter server's IP address and port number.
9. From the *Bind address* drop-down list, select Wheel Fudo PAM IP address used for communicating with this server.

Note: The *Bind address* drop-down list elements are IP address defined in the *Network configuration* menu. Refer to *Network interfaces configuration* for more information on managing physical interfaces.

---

10. Click *Save*.



Related topics:

- *Data model*
- *System initiation*
- *Users*
- *Listeners*
- *Safes*
- *Accounts*

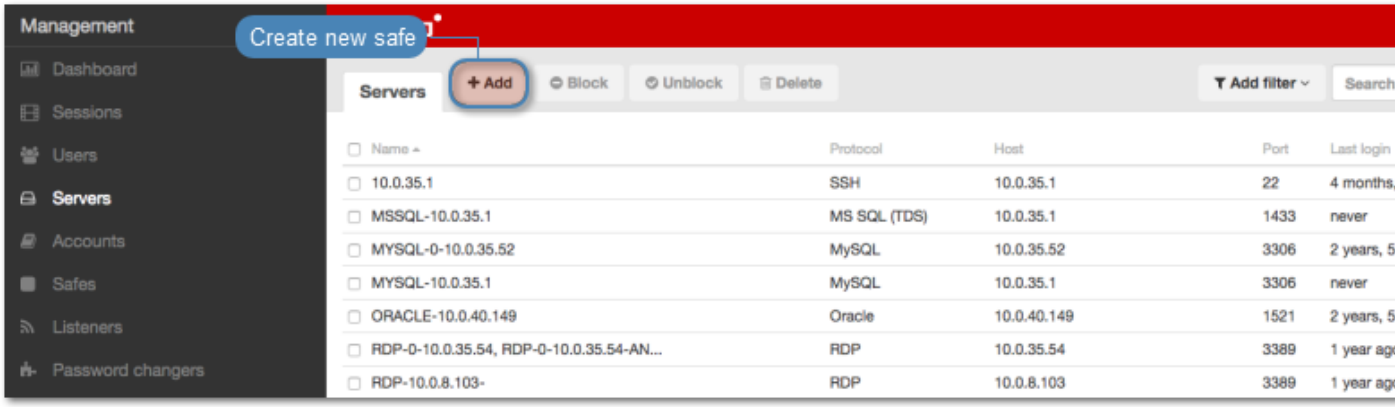
6.1.1.7 Creating an Oracle server

Note:

- A server object can be linked to only one *anonymous* account.
- A server object can be linked to only one *forward* account.

---

1. Select *Management* > *Servers*.
2. Click + *Add*.

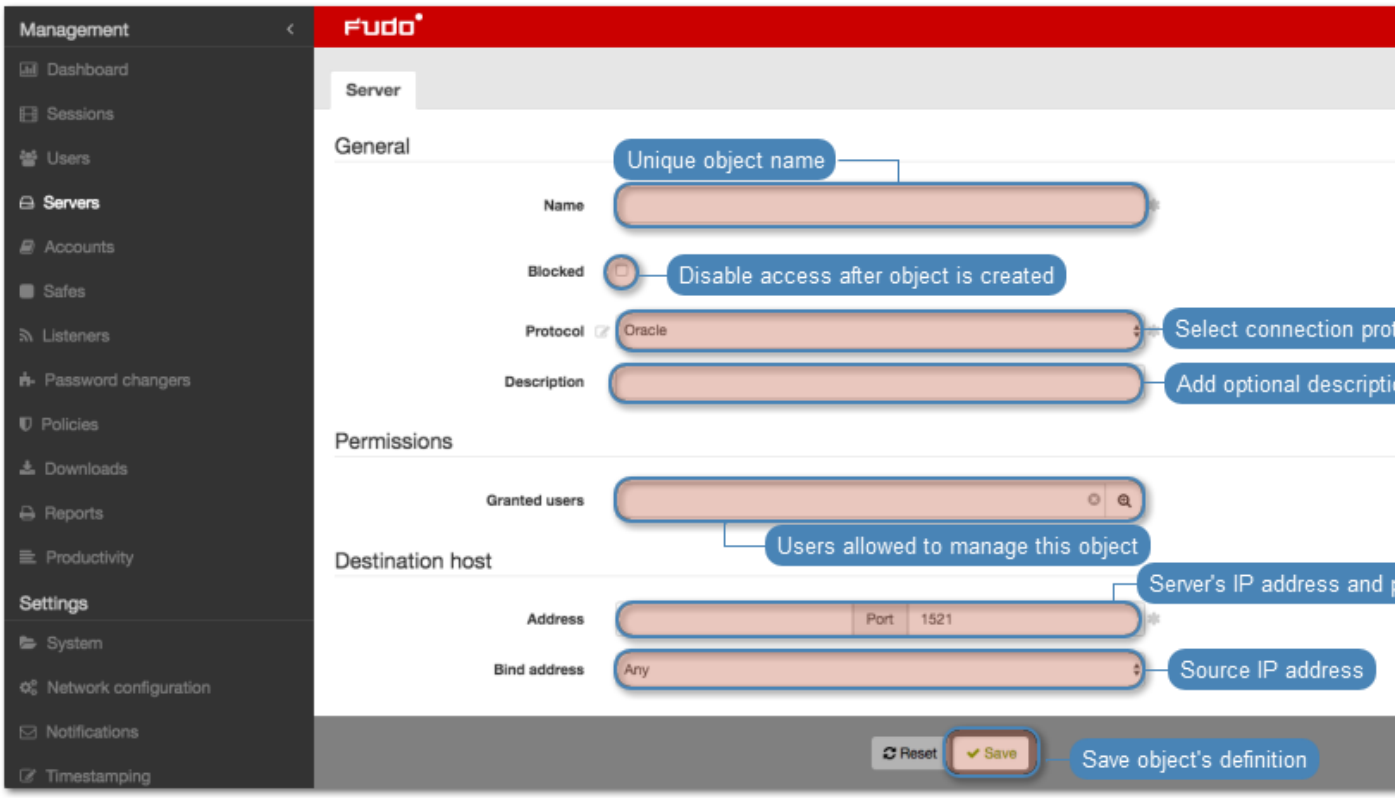


3. Enter server's unique name.
4. Select *Blocked* option to disable access to server after it's created.
5. Select `Oracle` from the *Protocol* drop-down list.
6. Enter optional description, which will help identifying this server object.
7. In the *Permissions* section, add users allowed to manage this object.
8. In the *Destination host* section, enter server's IP address and port number.
9. From the *Bind address* drop-down list, select Wheel Fudo PAM IP address used for communicating with this server.

Note: The *Bind address* drop-down list elements are IP address defined in the *Network configuration* menu. Refer to *Network interfaces configuration* for more information on managing physical interfaces.

---

10. Click *Save*.



Related topics:

- *Data model*
- *System initiation*
- *Users*
- *Listeners*
- *Safes*
- *Accounts*

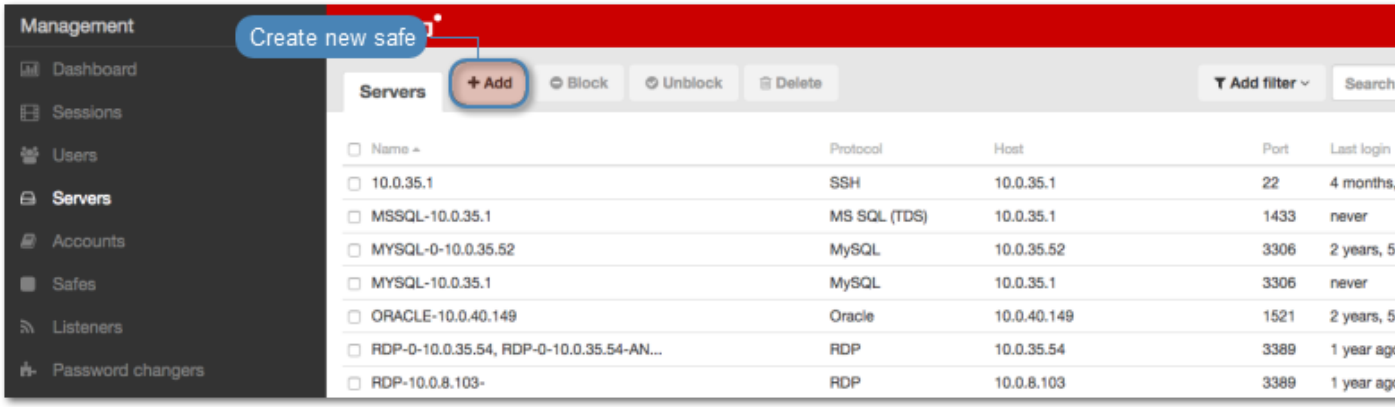
6.1.1.8 Creating an RDP server

Note:

- A server object can be linked to only one *anonymous* account.
- A server object can be linked to only one *forward* account.

---

1. Select *Management* > *Servers*.
2. Click *+ Add*.

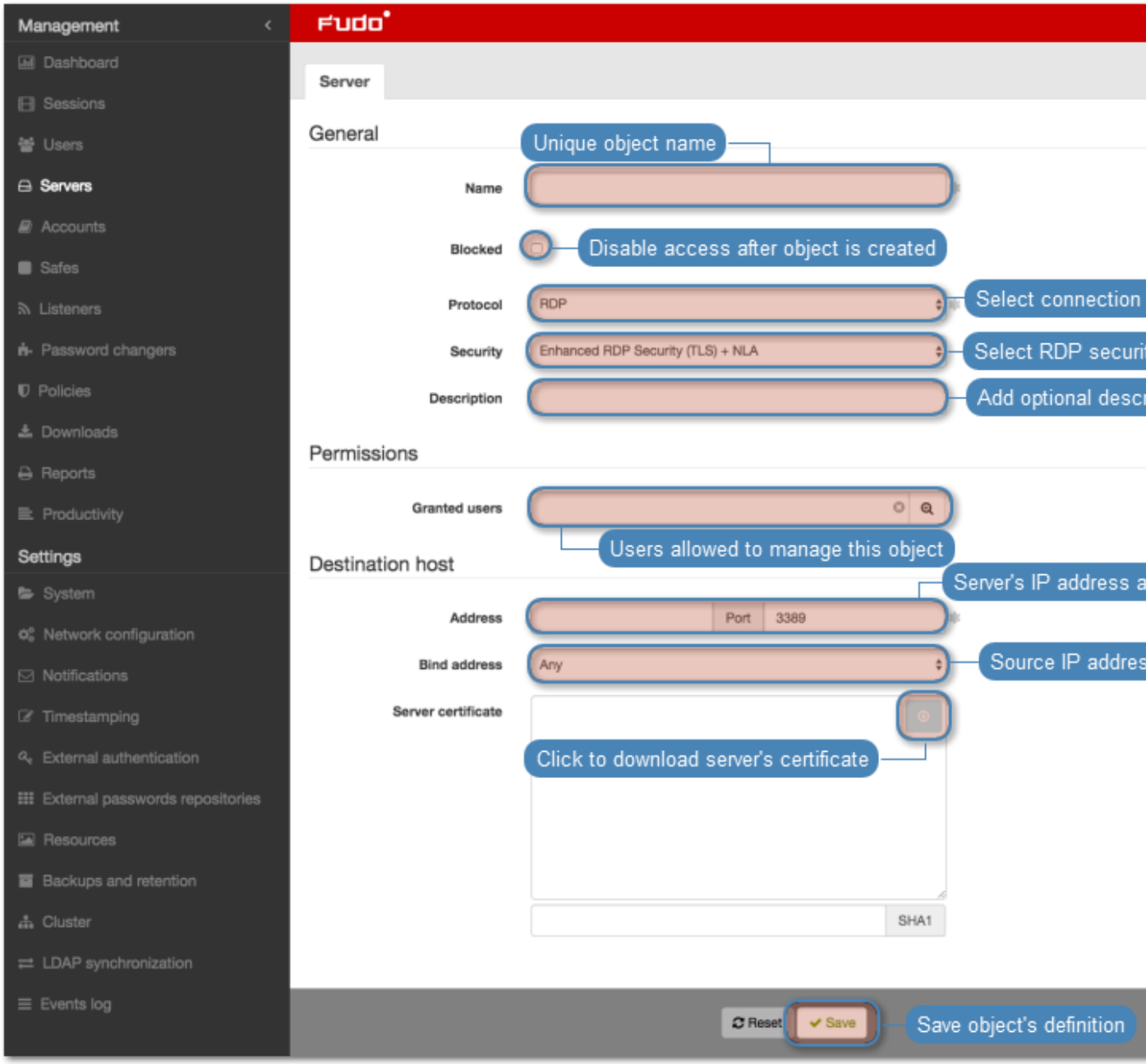


3. Enter server's unique name.
4. Select *Blocked* option to disable access to server after it's created.
5. Select `RDP` from the *Protocol* drop-down list.
6. From the `Security` drop-down list, select RDP connection security mode.
7. Enter optional description, which will help identifying this server object.
8. In the *Permissions* section, add users allowed to manage this object.
9. In the *Destination host* section, enter server's IP address and RDP service port number.
10. From the *Bind address* drop-down list, select Wheel Fudo PAM IP address used for communicating with this server.

Note: The *Bind address* drop-down list elements are IP address defined in the *Network configuration* menu. Refer to *Network interfaces configuration* for more information on managing physical interfaces.

---

10. Click the fetch key icon to download server's certificate.
11. Click *Save*.



Related topics:

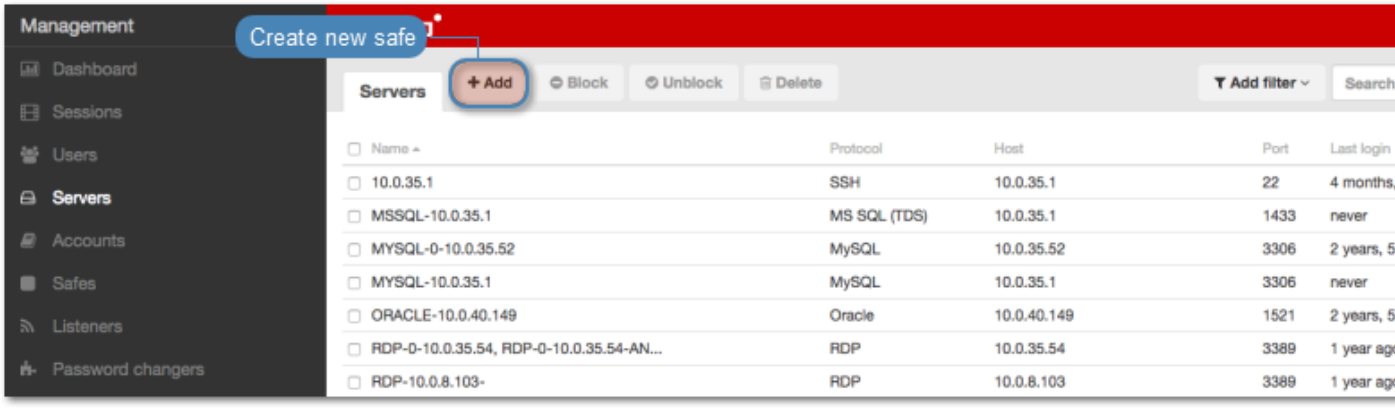
- *Data model*
- *System initiation*
- *Users*
- *Listeners*
- *Safes*
- *Accounts*

6.1.1.9 Creating an SSH server

Note:

- A server object can be linked to only one *anonymous* account.
- A server object can be linked to only one *forward* account.

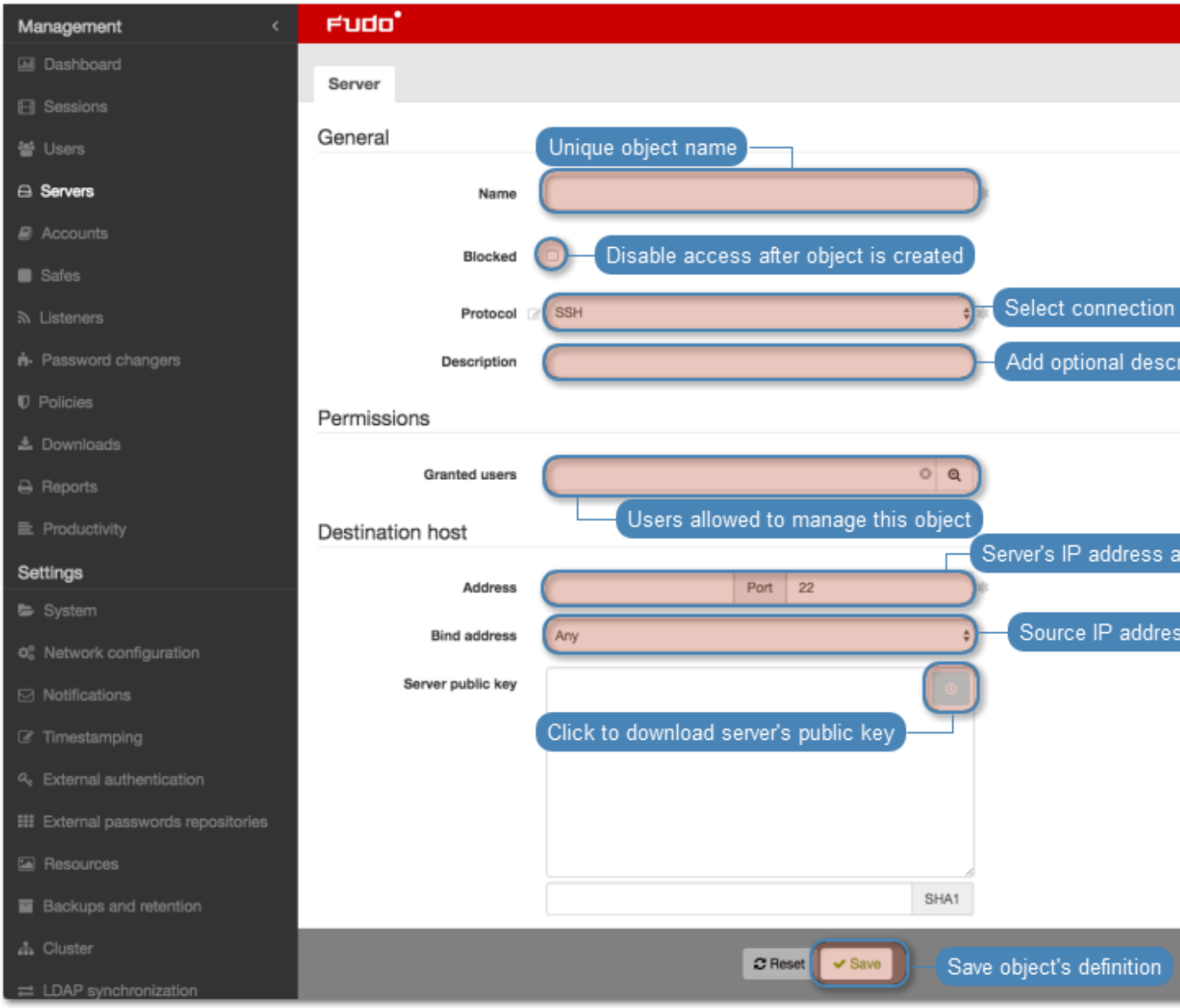
1. Select *Management* > *Servers*.
2. Click *+ Add*.



3. Enter server's unique name.
4. Select *Blocked* option to disable access to server after it's created.
5. Select `SSH` from the *Protocol* drop-down list.
6. Enter optional description, which will help identifying this server object.
7. In the *Permissions* section, add users allowed to manage this object.
8. In the *Destination host* section, enter server's IP address and SSH service port number.
9. From the *Bind address* drop-down list, select Wheel Fudo PAM IP address used for communicating with this server.

Note: The *Bind address* drop-down list elements are IP address defined in the *Network configuration* menu. Refer to *Network interfaces configuration* for more information on managing physical interfaces.

10. Click the fetch key icon to download server's public key.
11. Click *Save*.



Related topics:

- *Data model*
- *System initiation*
- *Users*
- *Listeners*
- *Safes*
- *Accounts*

6.1.1.10 Creating a Telnet server

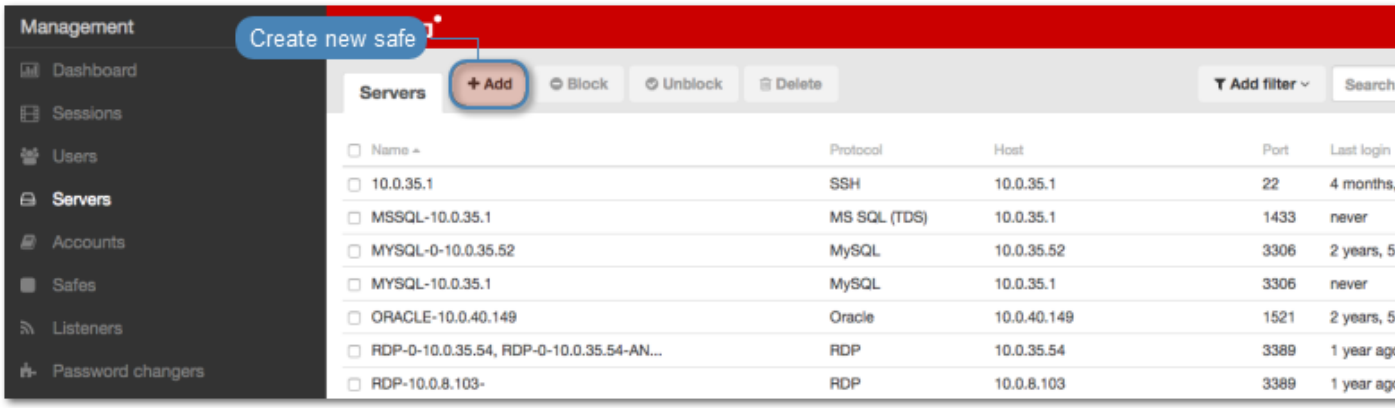
Note:

- A server object can be linked to only one *anonymous* account.

- A server object can be linked to only one *forward* account.
- In case of Telnet connections over *forward* and *regular* accounts, users are asked to provide their login credentials twice. First time to authenticate against Wheel Fudo PAM and then to connect to the target host.

---

1. Select *Management* > *Servers*.
2. Click *+ Add*.

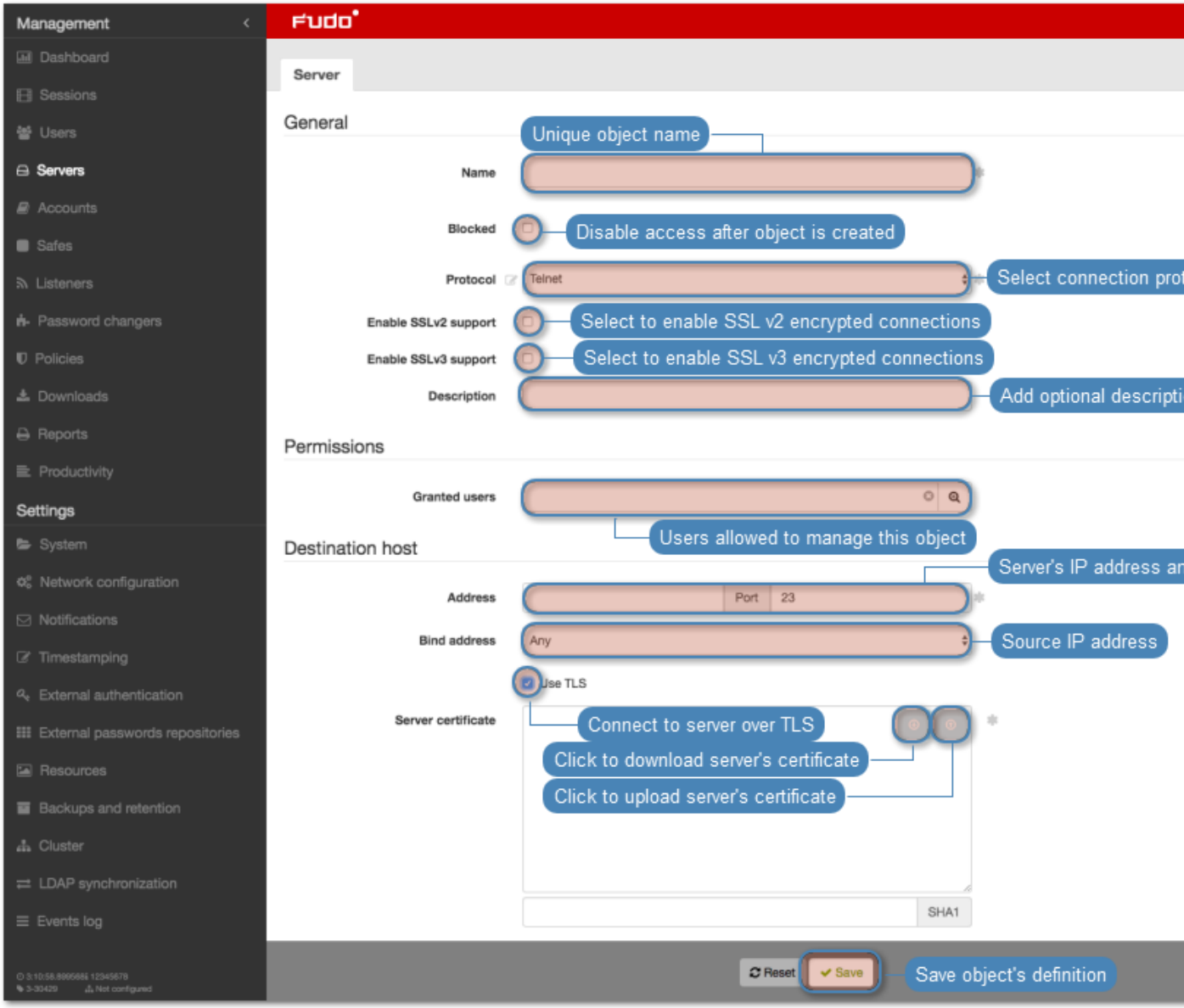


3. Enter server's unique name.
4. Select *Blocked* option to disable access to server after it's created.
5. Select `Telnet` from the *Protocol* drop-down list.
6. Select the *Enable SSLv2 support* to support SSL v2 encrypted connections.
7. Select the *Enable SSLv3 support* to support SSL v3 encrypted connections.
8. Enter optional description, which will help identifying this server object.
9. In the *Permissions* section, add users allowed to manage this object.
10. In the *Destination host* section, enter server's IP address and port number.
11. From the *Bind address* drop-down list, select Wheel Fudo PAM IP address used for communicating with this server.

Note: The *Bind address* drop-down list elements are IP address defined in the *Network configuration* menu. Refer to *Network interfaces configuration* for more information on managing physical interfaces.

---

12. Select the *Use TLS* options to connect to monitored server over TLS.
13. Click the certificate download icon to fetch server's certificate, or the certificate upload icon to upload a certificate.
14. Click *Save*.



Related topics:

- *Data model*
- *System initiation*
- *Users*
- *Listeners*
- *Safes*
- *Accounts*

6.1.1.11 Creating a Telnet 3270 server

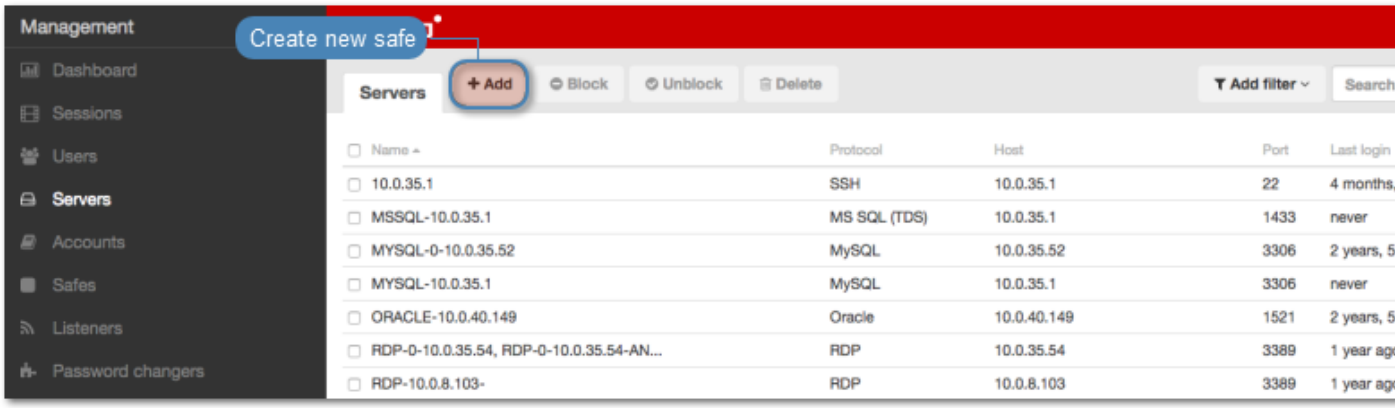
Note:

- A server object can be linked to only one *anonymous* account.

- A server object can be linked to only one *forward* account.
- In case of Telnet connections over *forward* and *regular* accounts, users are asked to provide their login credentials twice. First time to authenticate against Wheel Fudo PAM and then to connect to the target host.

---

1. Select *Management* > *Servers*.
2. Click *+ Add*.

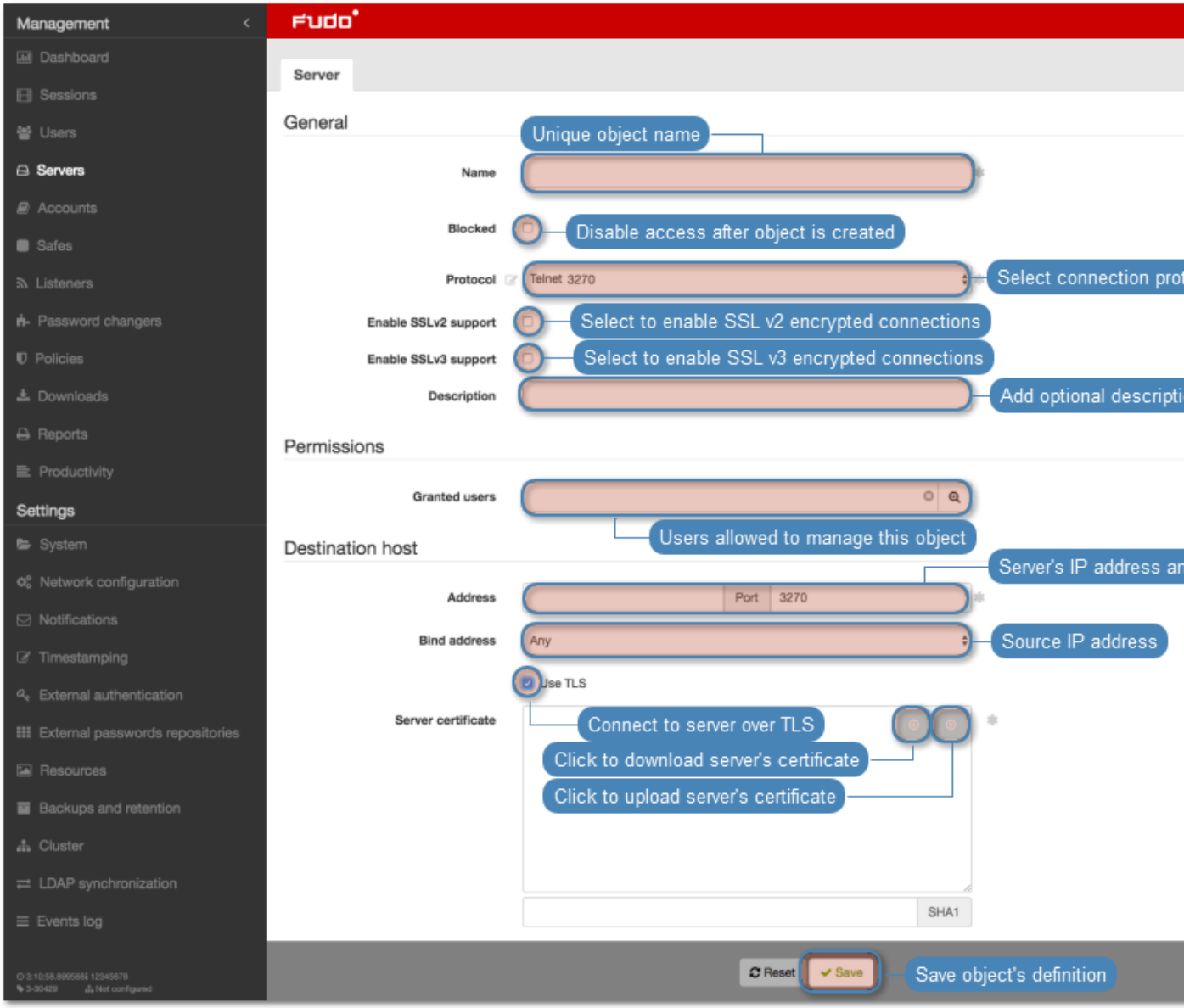


3. Enter server's unique name.
4. Select *Blocked* option to disable access to server after it's created.
5. Select `Telnet 3270` from the *Protocol* drop-down list.
6. Select the *Enable SSLv2 support* to support SSL v2 encrypted connections.
7. Select the *Enable SSLv3 support* to support SSL v3 encrypted connections.
8. Enter optional description, which will help identifying this server object.
9. In the *Permissions* section, add users allowed to manage this object.
10. In the *Destination host* section, enter server's IP address and port number.
11. From the *Bind address* drop-down list, select Wheel Fudo PAM IP address used for communicating with this server.

Note: The *Bind address* drop-down list elements are IP address defined in the *Network configuration* menu. Refer to *Network interfaces configuration* for more information on managing physical interfaces.

---

12. Select the *Use TLS* options to connect to monitored server over TLS.
13. Click the certificate download icon to fetch server's certificate, or the certificate upload icon to upload a certificate.
14. Click *Save*.



Related topics:

- *Data model*
- *System initiation*
- *Users*
- *Listeners*
- *Safes*
- *Accounts*

6.1.1.12 Telnet 5250 server

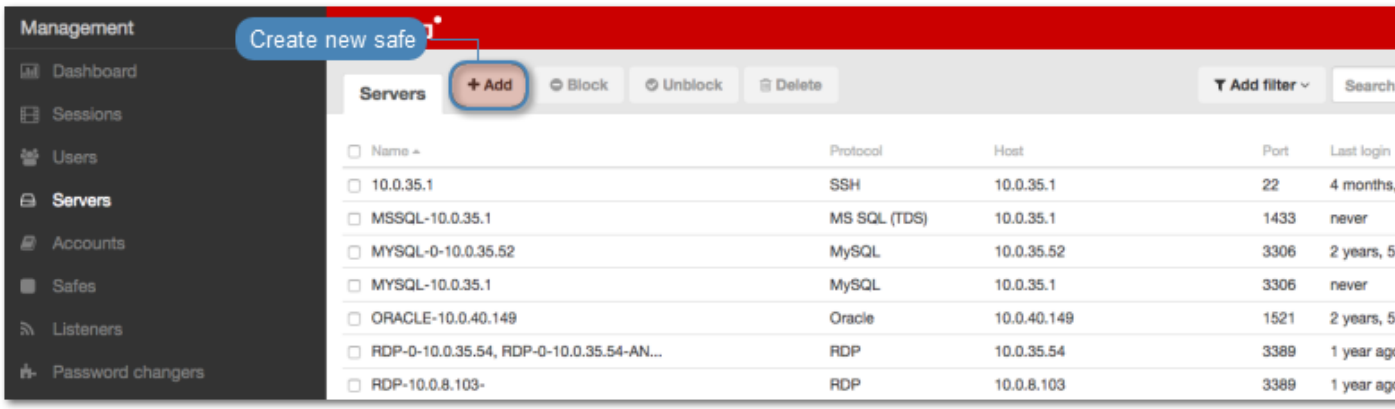
Adding an Telent 5250 server

Note:

- A server object can be linked to only one *anonymous* account.
- A server object can be linked to only one *forward* account.
- In case of Telnet connections over *forward* and *regular* accounts, users are asked to provide their login credentials twice. First time to authenticate against Wheel Fudo PAM and then to connect to the target host.

---

1. Select *Management* > *Servers*.
2. Click + *Add*.



3. Enter server's unique name.
4. Select *Blocked* option to disable access to server after it's created.
5. Select `Telnet 5250` from the *Protocol* drop-down list.
6. Select the *Enable SSLv2 support* to support SSL v2 encrypted connections.
7. Select the *Enable SSLv3 support* to support SSL v3 encrypted connections.
8. Enter optional description, which will help identifying this server object.
9. In the *Permissions* section, add users allowed to manage this object.
10. In the *Destination host* section, enter server's IP address and port number.
11. From the *Bind address* drop-down list, select Wheel Fudo PAM IP address used for communicating with this server.

Note: The *Bind address* drop-down list elements are IP address defined in the *Network configuration* menu. Refer to *Network interfaces configuration* for more information on managing physical interfaces.

---

12. Select the *Use TLS* options to connect to monitored server over TLS.
13. Click the certificate download icon to fetch server's certificate, or the certificate upload icon to upload a certificate.
14. Click *Save*.

Related topics:

- *Data model*

- *System initiation*
- *Users*
- *Listeners*
- *Safes*
- *Accounts*

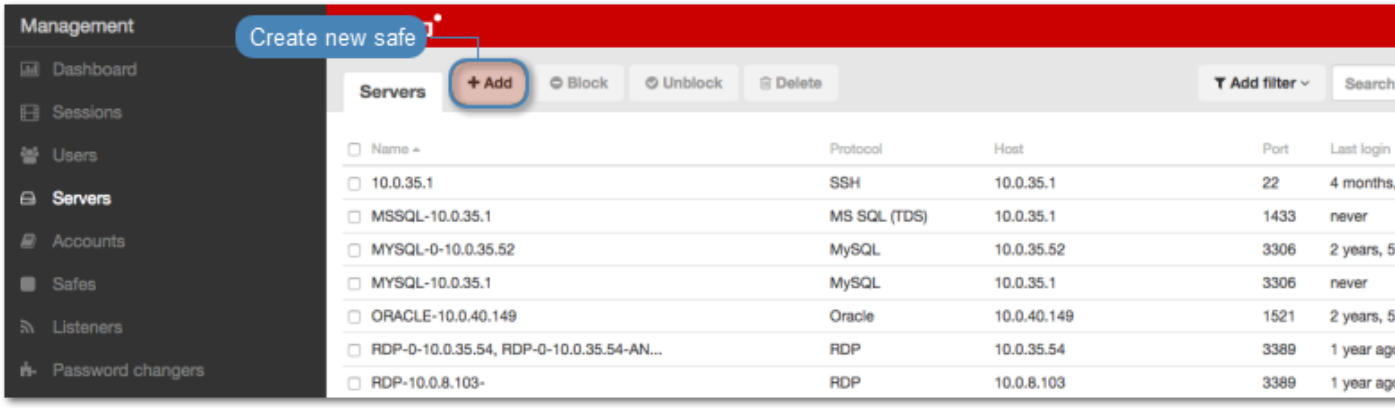
6.1.1.13 Creating a VNC server

Note:

- A server object can be linked to only one *anonymous* account.
- A server object can be linked to only one *forward* account.

---

1. Select *Management* > *Servers*.
2. Click + *Add*.

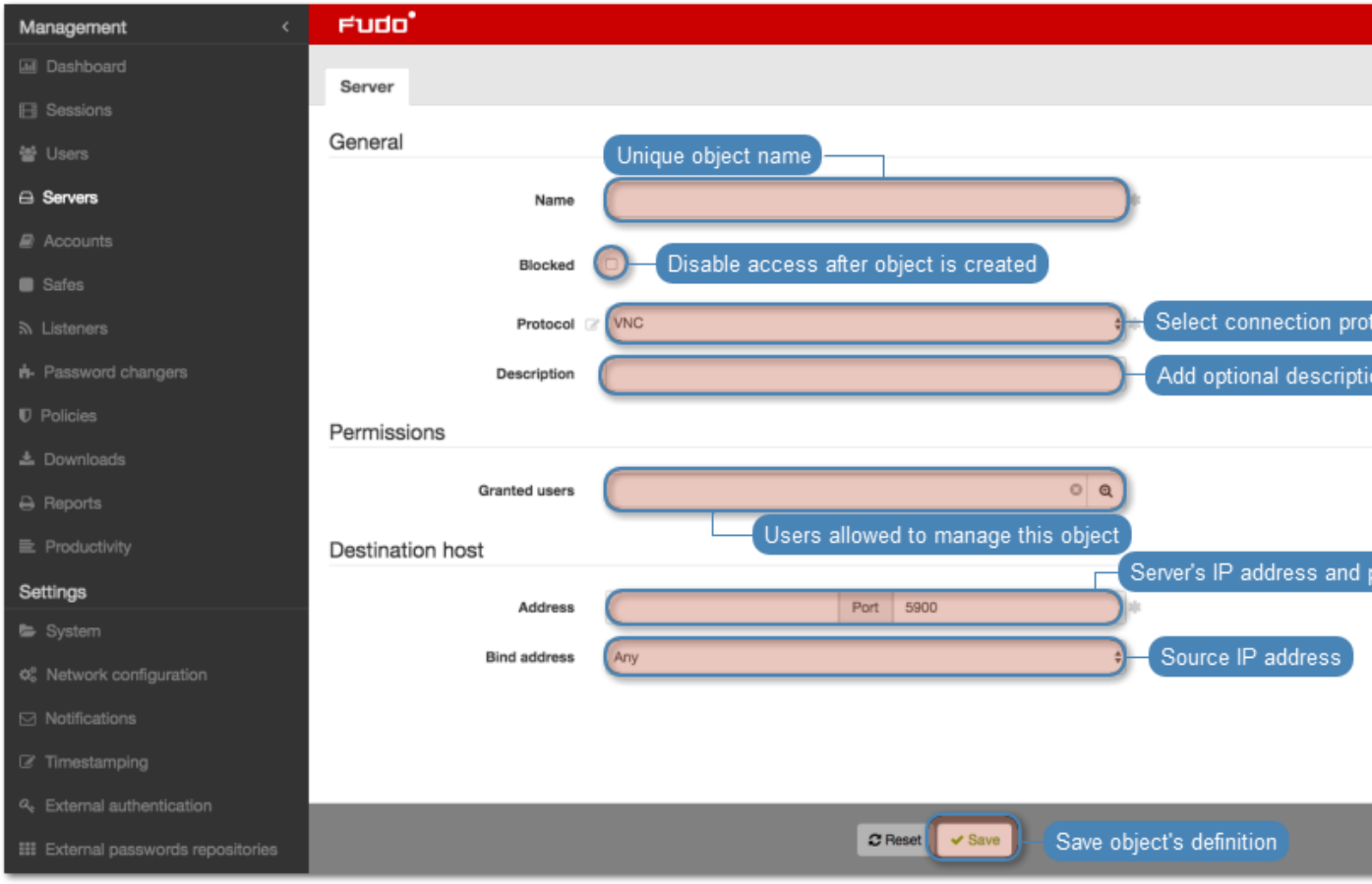


3. Enter server's unique name.
4. Select *Blocked* option to disable access to server after it's created.
5. Select `VNC` from the *Protocol* drop-down list.
6. Enter optional description, which will help identifying this server object.
7. In the *Permissions* section, add users allowed to manage this object.
8. In the *Destination host* section, enter server's IP address and port number.
9. From the *Bind address* drop-down list, select Wheel Fudo PAM IP address used for communicating with this server.

Note: The *Bind address* drop-down list elements are IP address defined in the *Network configuration* menu. Refer to *Network interfaces configuration* for more information on managing physical interfaces.

---

10. Click *Save*.



Related topics:

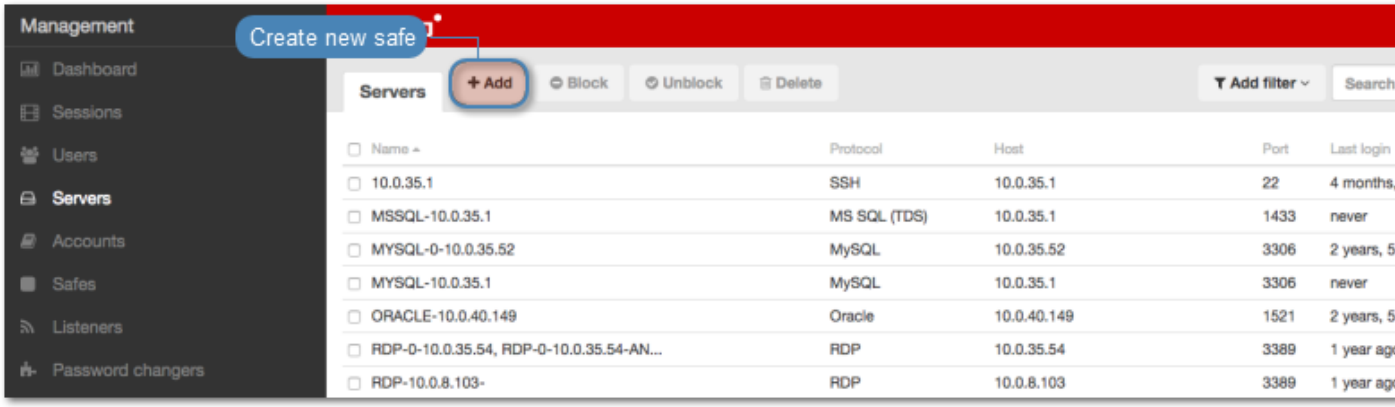
- *Data model*
- *System initiation*
- *Users*
- *Listeners*
- *Safes*
- *Accounts*

6.1.2 Dynamic server

Wheel Fudo PAM enables defining a group of automatically managed servers deployed within a specified network. When a user is trying to establish a connection with a specific resource that is within the defined network, Wheel Fudo PAM verifies whether he has sufficient privileges and automatically adds host within the existing dynamic servers object, downloads its certificate and establishes a monitored connection.

6.1.2.1 Creating a dynamic servers group

1. Select *Management* > *Servers*.
2. Click + *Add*.



3. Enter server's unique name.
4. Select *Blocked* option to disable access to server after it's created.
5. Select desired protocol and define corresponding configuration parameters.
6. In the *Destination host* section, enter server's IP address, subnet mask in CIDR format and port number.
7. From the *Bind address* drop-down list, select Wheel Fudo PAM IP address used for communicating with this server.

Note: The *Bind address* drop-down list elements are IP address defined in the *Network configuration* menu. Refer to *Network interfaces configuration* for more information on managing physical interfaces.

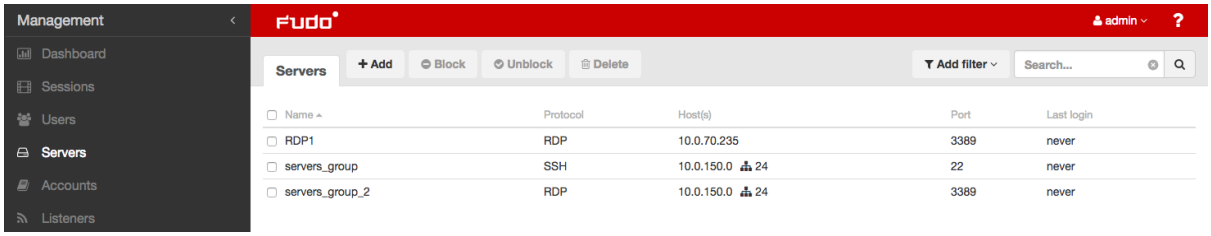
---

8. Click the  icon to upload the CA certificate used for generating certificates for dynamically added servers.
9. Fill in the rest of the parameters and click *Save*.

6.1.2.2 Adding a single host to a servers group

1. Select *Management* > *Servers*.
2. Find and click desired servers group object.

Note: Server group objects are marked with the icon.



---

3. Click *+ Add host*.
4. Provide server's IP address.

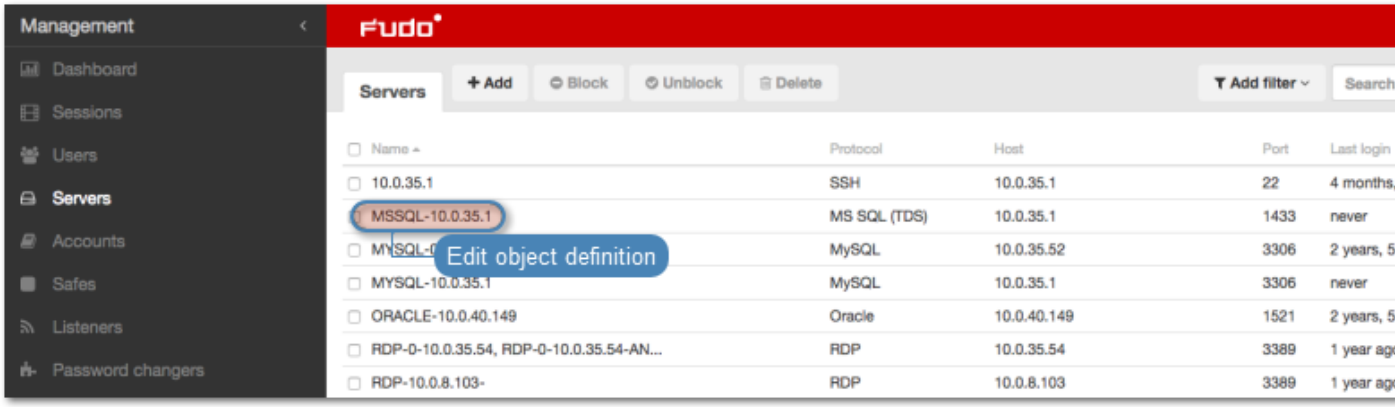
5. Click the  icon to download server's certificate.
6. Click *Save*.

Related topics:

- *Data model*
- *Static server*

6.2 Editing a server

1. Select *Management* > *Servers*.
2. Find and click desired object to open its configuration page.



Note: Define filters to limit the number of objects displayed on the list.

3. Modify configuration parameters as needed.

Note: Unsaved changes are marked with the icon.

4. Click *Save*.

Related topics:

- *Data model*
- *System initiation*

- *Users*
- *Listeners*
- *Safes*
- *Accounts*

6.3 Blocking a server

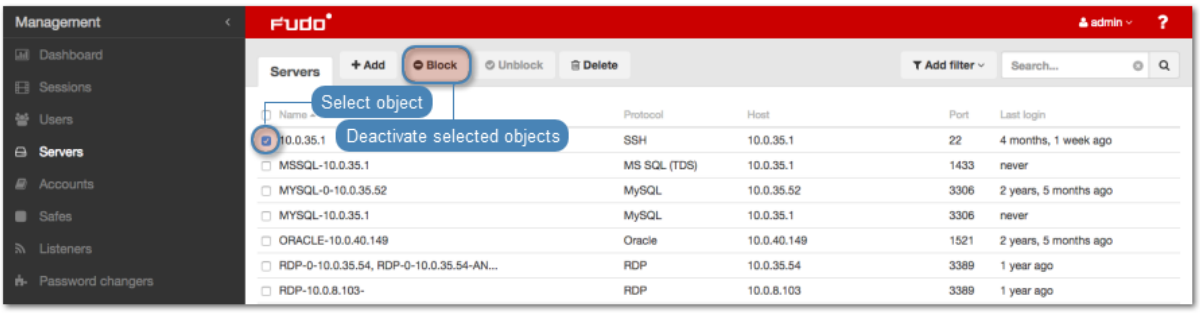
Wheel Fudo PAM allows blocking access to given server for all users.

Warning: Blocking a server will terminate current connections with the given server.

1. Select *Management* > *Servers*.
2. Find and select desired objects.

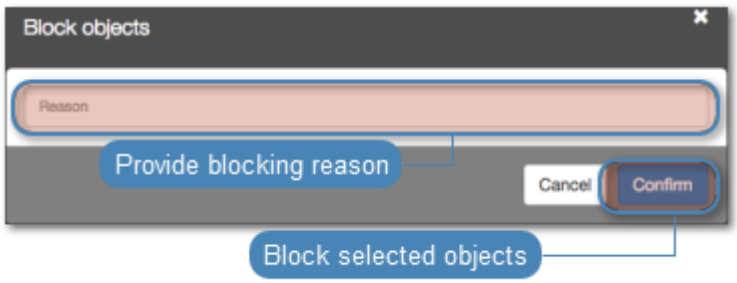
Note: Define filters to limit the number of objects displayed on the list.

3. Click *Block*.



4. Optionally, provide blocking reason and click *Confirm*.

Note: To view the blocking reason, place the cursor over the icon on the servers list.



Related topics:

- *Data model*
- *System initiation*
- *Users*

- *Listeners*
- *Safes*
- *Accounts*

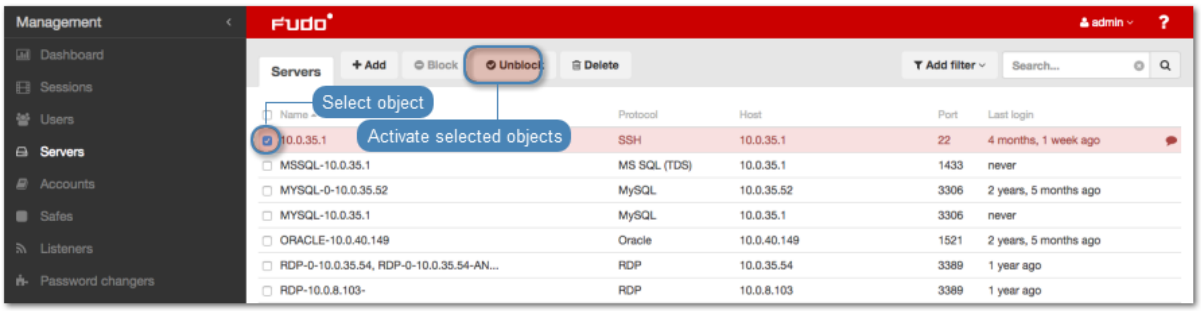
6.4 Unblocking a server

Warning: Blocking a server will terminate current connections with the given server.

1. Select *Management* > *Servers*.
2. Find and select desired objects.

Note: Define filters to limit the number of objects displayed on the list.

3. Click *Unblock*.



4. Click *Confirm* to unblock selected objects.

Related topics:

- *Data model*
- *System initiation*
- *Users*
- *Listeners*
- *Safes*
- *Accounts*

6.5 Deleting a server

Warning: Deleting a server definition will terminate current connections with the given server.

6.5.1 Deleting a static server definition

1. Select *Management* > *Servers*.
2. Find and select desired objects.

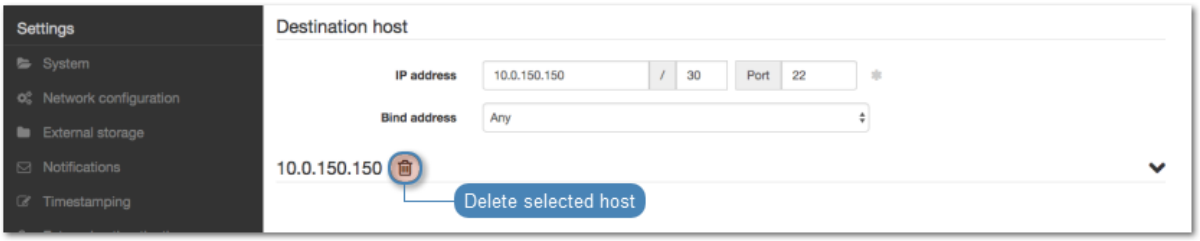
Note: Define filters to limit the number of objects displayed on the list.

3. Click *Delete*.

4. Confirm deletion of selected objects.

6.5.2 Deleting a dynamically added host

1. Select *Management* > *Servers*.
2. Find and click desired dynamic servers object.
3. In the *Destination host* section, find desired host and click the icon.



4. Click *Save*.

Related topics:

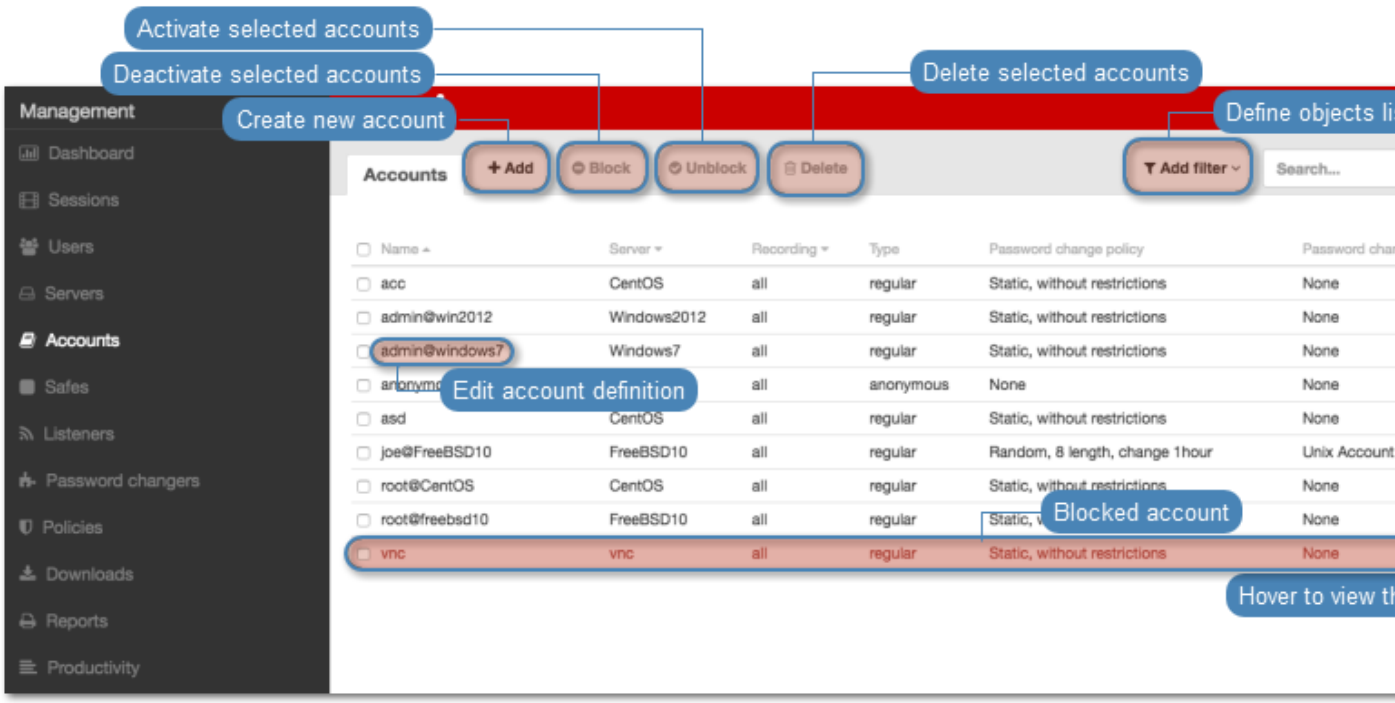
- *Data model*
- *System initiation*
- *Users*
- *Listeners*
- *Safes*
- *Accounts*

CHAPTER 7

Accounts

Account defines the privileged account existing on the monitored server. It specifies the actual login credentials, user authentication mode: anonymous (without user authentication), regular (with login credentials substitution) or forward (with login and password forwarding); password changing policy as well as the password changer itself.

Note: In case of Telnet connections, user has to go through authentication process twice. First time to authenticate against Wheel Fudo PAM and then to connect to the target host.

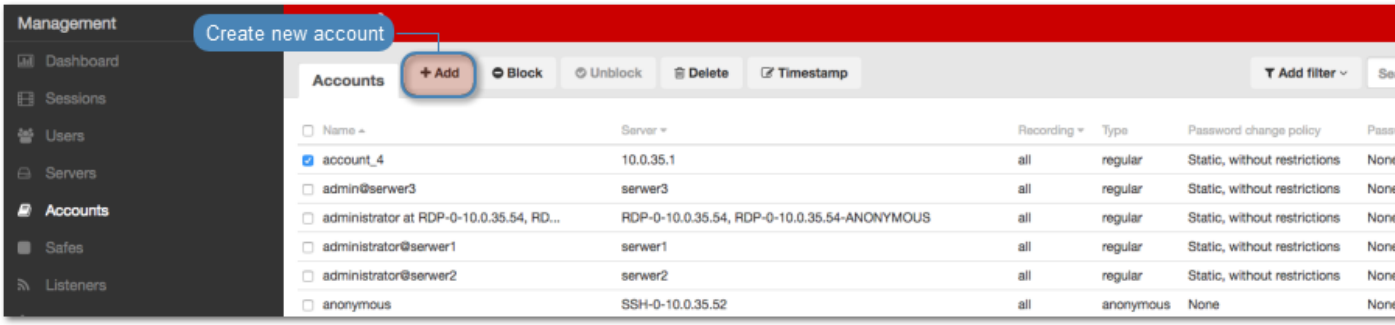


7.1 Creating an account

Warning: Data model objects: *safes*, *users*, *servers*, *accounts* and *listeners* are replicated within the cluster and object instances must not be added on each node. In case the replication mechanism fails to copy objects to other nodes, contact technical support department.

7.1.1 Creating an *anonymous* account

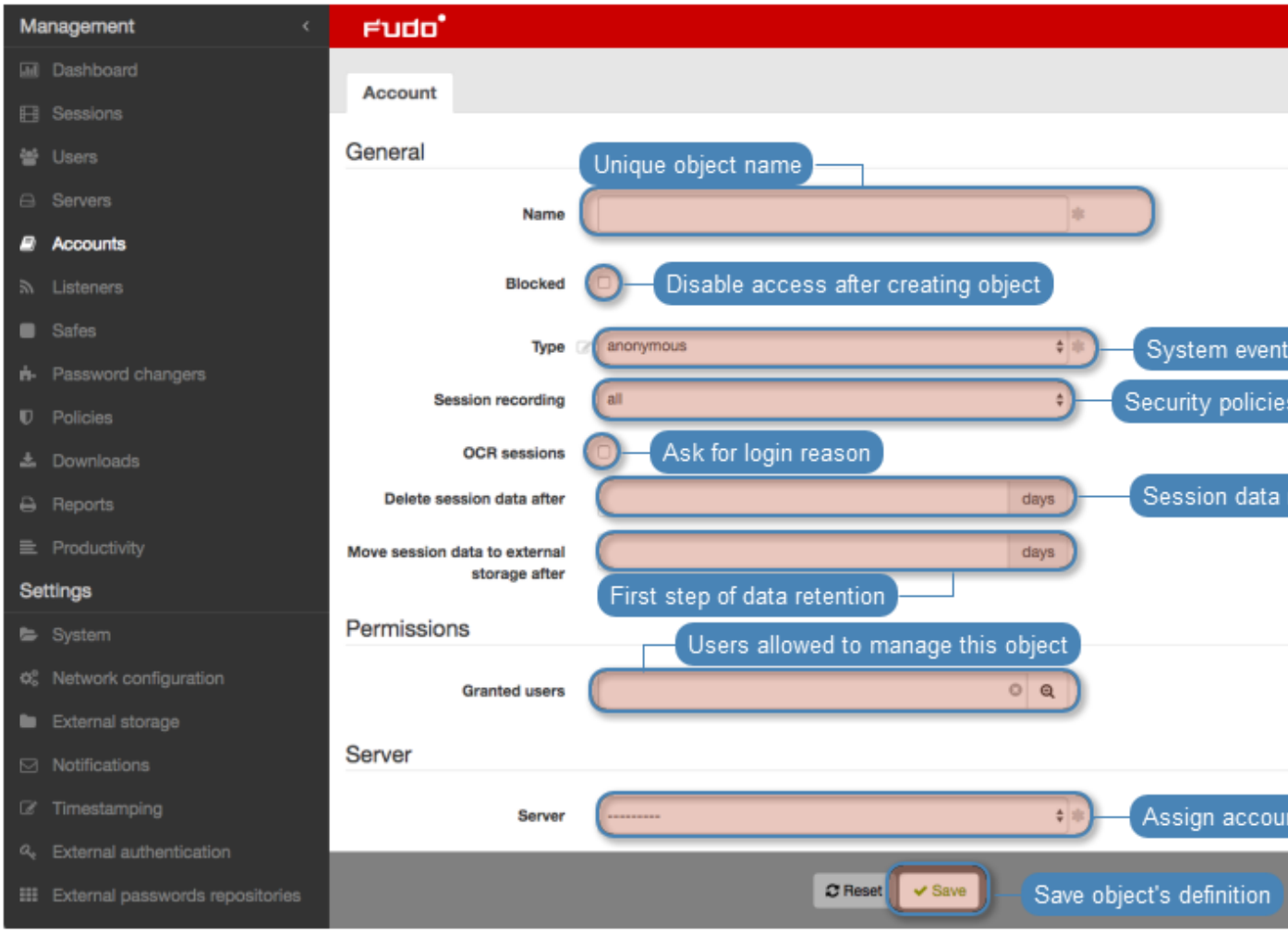
1. Select *Management* > *Accounts*.
2. Click *+ Add*.



3. Define object's name.
4. Select *Blocked* option to disable account after it's created.
5. Select `anonymous` from the *Type* drop-down list.
6. Select desired session recording option.

- `all` - Wheel Fudo PAM records network traffic allowing for future session playback, using the built in session player, as well as converting session material to a selection of video file formats.
- `raw` - Wheel Fudo PAM keeps records of the data exchanged between the user and the monitored server. The raw data can be downloaded later on but the session cannot be played back using the built in session player.
- `none` - Wheel Fudo PAM only takes note of the fact that the give session took place but does not record the data exchanged between the user and the server.

7. Select the *OCR sessions* option to fully index RDP and VNC sessions contents.
8. Select language used for processing recorded sessions.
9. In the *Move session data to external storage after*, define the number of days after which the session data will moved to external storage device.
10. In the *Delete session data after* field, define the number of days after which the session data will be deleted.
11. In the *Permissions* section, add users allowed to manage this object.
12. In the *Server* section, assign account to a specific server by selecting it from the *Server* drop-down list.
13. Click *Save*.

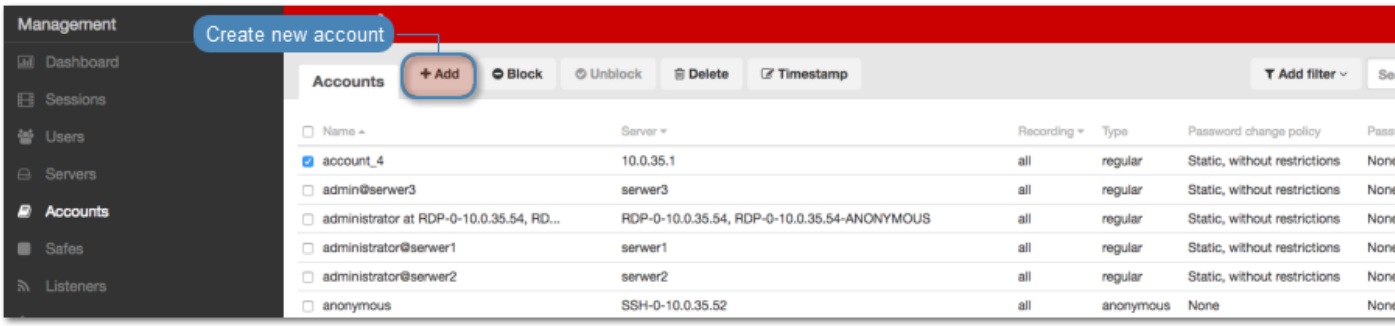


Related topics:

- *Data model*
- *Deleting an account*
- *Editing an account*
- *Unblocking an account*
- *Blocking an account*

7.1.2 Creating a *forward* account

1. Select *Management* > *Accounts*.
2. Click *+ Add*.



3. Define object's name.
4. Select *Blocked* option to disable account after it's created.
5. Select `forward` from the *Type* drop-down list.
6. Select desired session recording option.

- `all` - Wheel Fudo PAM records network traffic allowing for future session playback, using the built in session player, as well as converting session material to a selection of video file formats.
- `raw` - Wheel Fudo PAM keeps records of the data exchanged between the user and the monitored server. The raw data can be downloaded later on but the session cannot be played back using the built in session player.
- `none` - Wheel Fudo PAM only takes note of the fact that the give session took place but does not record the data exchanged between the user and the server.

7. Select the *OCR sessions* option to fully index RDP and VNC sessions contents.
8. Select language used for processing recorded sessions.
9. In the *Move session data to external storage after*, define the number of days after which the session data will moved to external storage device.
10. In the *Delete session data after* field, define the number of days after which the session data will be deleted.
11. In the *Permissions* section, add users allowed to manage this object.
12. In the *Server* section, assign the account to a server by selecting it from the *Server* drop-down list.
13. From the *Replace secret with* drop down list in the *Credentials*, select desired option.

`other account`

- From the *Account* drop-down list, select account object, whose credentials will be used to authenticate user when establishing connection with monitored server.

Note: The list contains only objects to which you have been given access permissions.

`key`

- Click the  icon and select the key type.

- Click the  and browse the file system to find the key definition file.
- Click the i icon and select the key type.
- Click the i icon and browse the file system to find the key definition file.

`password`

- Provide account password.
- Repeat account password.

Note: *Two-fold authentication*

With two-fold authentication enabled, user is being prompted twice for login credentials. Once for authenticating against Wheel Fudo PAM and once again for accessing target system.

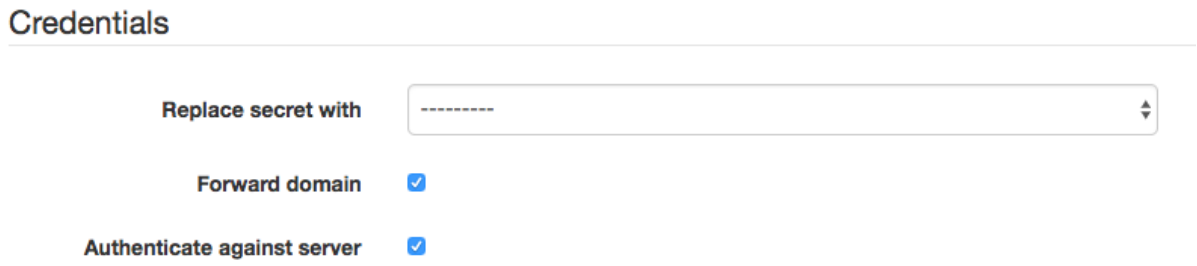
To enable two-fold authentication, select `password` from the *Replace secret with* drop-down list and leave the password and login fields empty.

`password from external repository`

- Select external repository.

Note: *Authentication by the server*

With the *Authentication against server* option enabled, Wheel Fudo PAM does not verify the correctness of user credentials. Login information is forwarded to the target host, which verifies whether the user is allowed to access it. Verification status is returned to Fudo, which establishes monitored connection. To enable this authentication scenario, select the *Authenticate against server* option in the *Credentials* section (available only for SSH servers and RDP hosts with the *Enhanced RDP Security (TLS) + NLA* security option selected).



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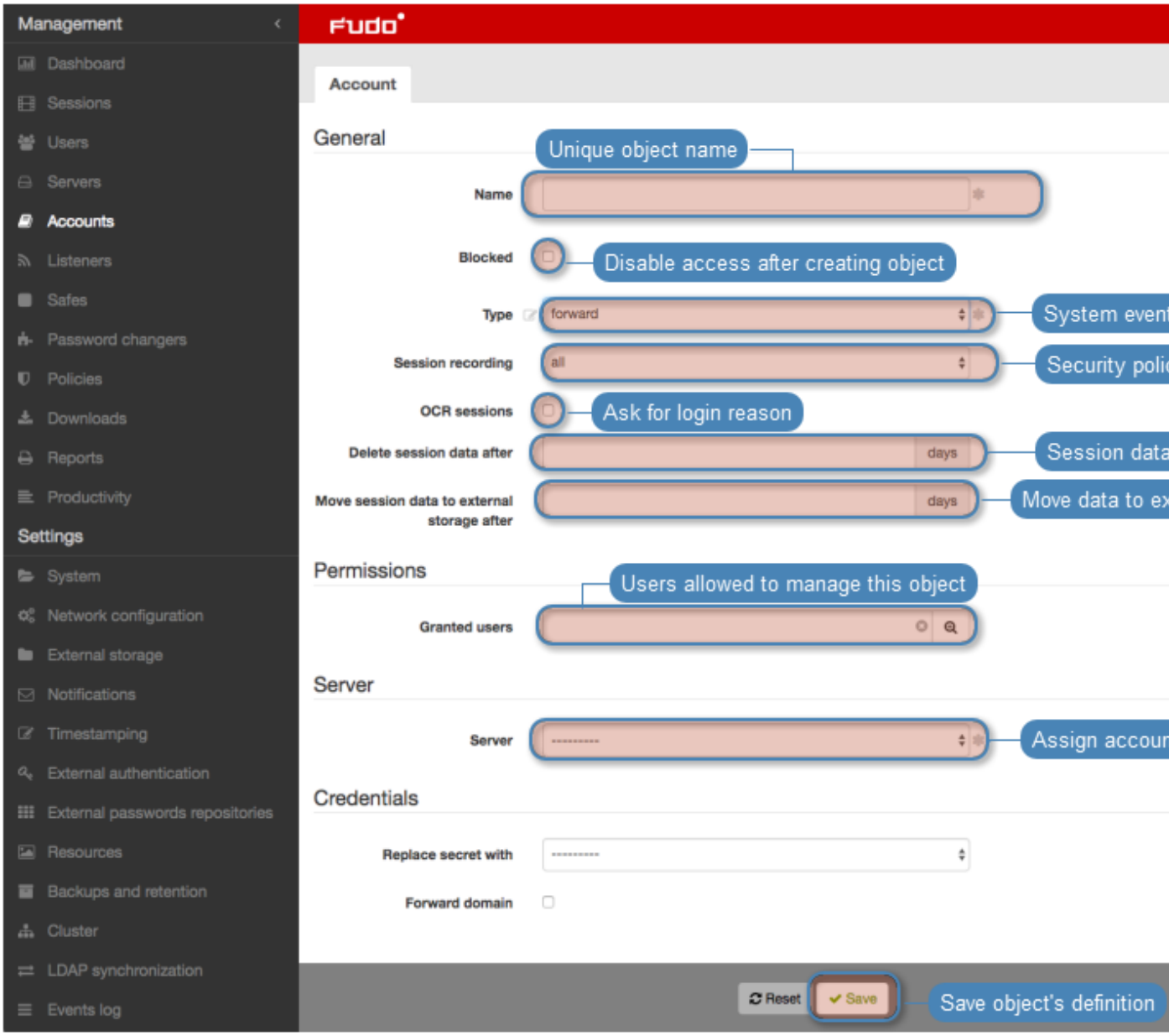
14. Select *Forward domain* option to have the domain name included in the string identifying the user.
15. Click *Save*.

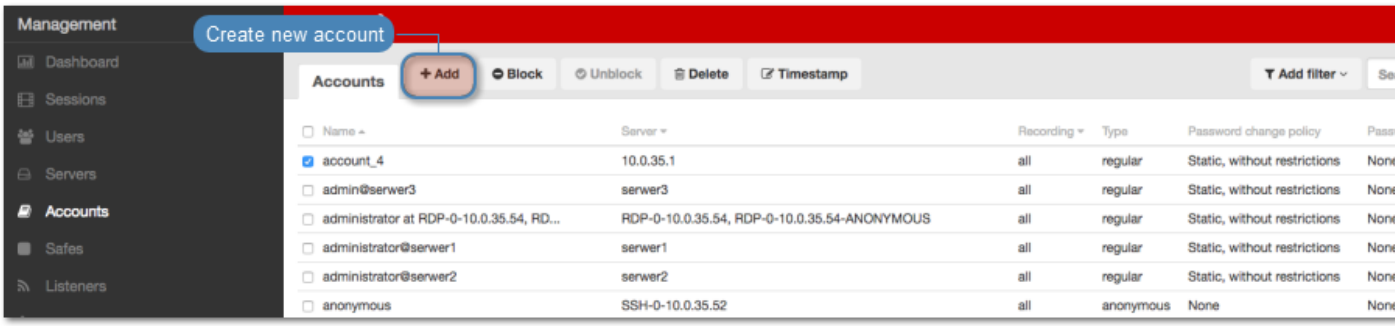


Related topics:

- *Data model*
- *Deleting an account*
- *Editing an account*
- *Unblocking an account*
- *Blocking an account*

7.1.3 Creating a *regular* account

1. Select *Management* > *Accounts*.
2. Click *+ Add*.



3. Define object's name.
4. Select *Blocked* option to disable account after it's created.
5. Select `regular` from the *Type* drop-down list.
6. Select desired session recording option.

- `all` - Wheel Fudo PAM records network traffic allowing for future session playback, using the built in session player, as well as converting session material to a selection of video file formats.
- `raw` - Wheel Fudo PAM keeps records of the data exchanged between the user and the monitored server. The raw data can be downloaded later on but the session cannot be played back using the built in session player.
- `none` - Wheel Fudo PAM only takes note of the fact that the give session took place but does not record the data exchanged between the user and the server.

7. Select the *OCR sessions* option to fully index RDP and VNC sessions contents.

Note: Indexing sessions enables full-text content searching.

---

8. Select language used for processing recorded sessions.
9. In the *Move session data to external storage after*, define the number of days after which the session data will moved to external storage device.
10. In the *Delete session data after* field, define the number of days after which the session data will be deleted.
11. In the *Permissions* section, add users allowed to manage this object.
12. In the *Server* section, assign account to a specific server by selecting it from the *Server* drop-down list.
13. In the *Credentials* section, enter privileged account domain.
14. Type in login to the privileged account.
15. From the *Replace secret with* drop down list, select desired option.

`other account`

- From the *Account* drop-down list, select account object, whose credentials will be used to authenticate user when establishing connection with monitored server.

`key`

- Click the  icon and select the key type.
- Click the  icon and browse the file system to find the file with a non-passphrase protected private key.

`password`

- Provide account password.
- Repeat account password.

Note: *Two-fold authentication*

With two-fold authentication enabled, user is being prompted twice for login credentials. Once for authenticating against Wheel Fudo PAM and once again for accessing target system.

To enable two-fold authentication, select `password` from the *Replace secret with* drop-down list and leave the password and login fields empty.

`password from external repository`

- Select external repository.

16. Select the defined password changing policy from the *Password change policy* drop-down list.
17. In the *Password changer* section, from the *Password changer* drop-down list select password changer specific for given account.

Unix Account over SSH

- Enter privileged user name.
- Enter privileged user password.

Windows Account over WMI

- Enter privileged user name.
- Enter privileged user password.

MySQL User Account on Unix Server over SSH

- Provide SSH user name.
- Provide SSH account password.
- Enter SSH server address.
- Provide SSH service port.
- Enter privileged user name.
- Enter privileged user password.

Cisco Account over Telnet

- Provide privileged mode password.
- Enter privileged user name.

- Enter privileged user password.

Cisco Enable Password over Telnet

- Provide privileged mode password.
- Enter privileged user name.
- Enter privileged user password.

Cisco Account over SSH

- Provide privileged mode password.
- Enter privileged user name.
- Enter privileged user password.

Cisco Enable Password poprzez SSH

- Provide privileged mode password.
- Enter privileged user name.
- Enter privileged user password.

LDAP

- Enter privileged user name.
- Enter privileged user password.
- Wprowadź parametr bazowy LDAP (LDAP base).
- Wgraj certyfikat CA serwera LDAP.

Note: Privileged user account is used for changing the password when system detects that password has been changed in an unauthorized way.

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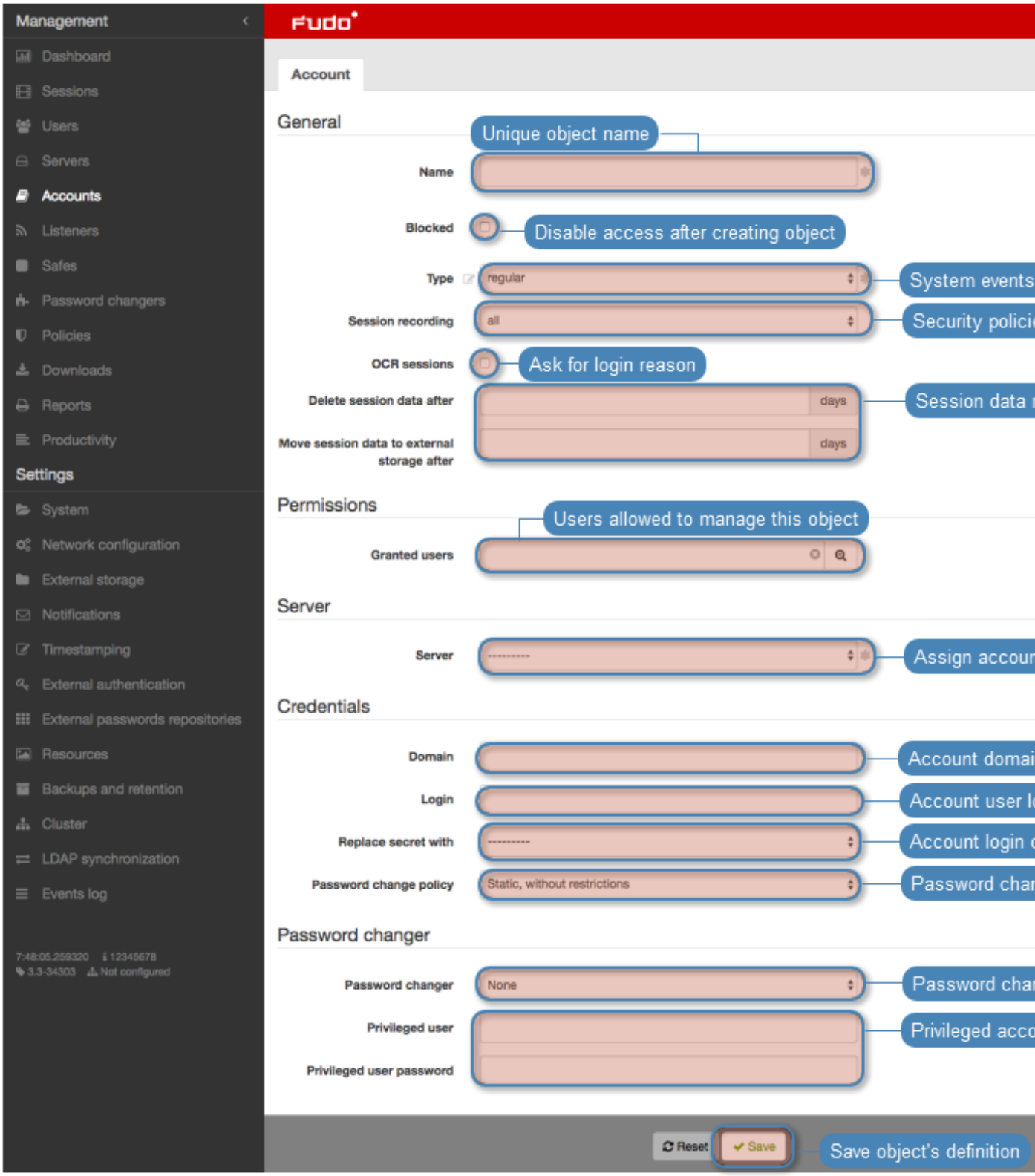
18. Click *Save*.



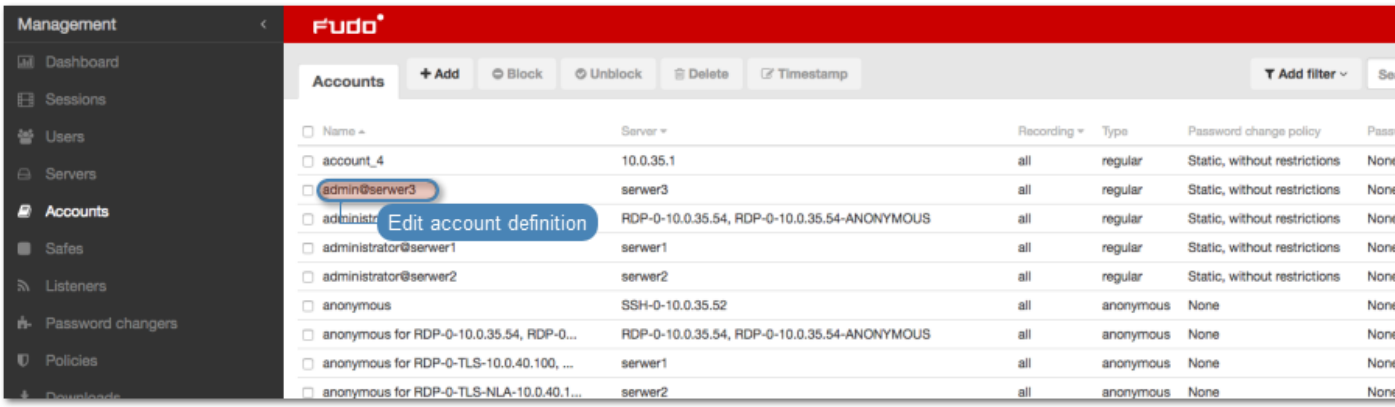
Related topics:

- *Data model*
- *Editing an account*
- *Blocking an account*

- *Unblocking an account*
- *Deleting an account*

7.2 Editing an account

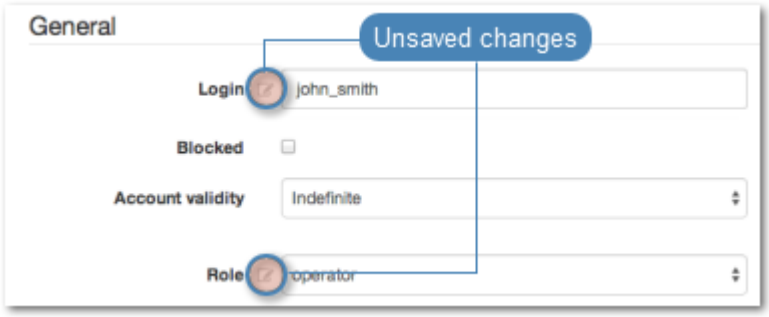
1. Select *Management* > *Accounts*.
2. Find and click desired object to open its configuration page.



Note: Define filters to limit the number of objects displayed on the list.

3. Modify configuration parameters as needed.

Note: Unsaved changes are marked with the icon.



4. Click *Save*.

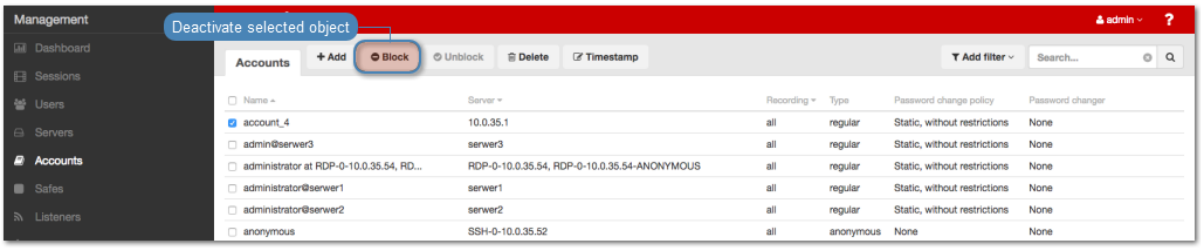
Related topics:

- *Creating an account*
- *Blocking an account*
- *Unblocking an account*
- *Deleting an account*

7.3 Blocking an account

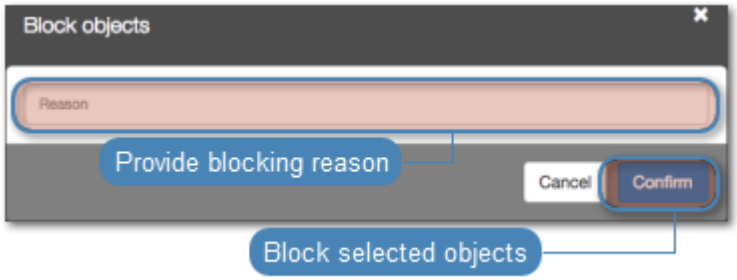
Warning: Blocking an accout definition will terminate all current connections to servers which use selected account for accessing those servers.

1. Select *Management* > *Accounts*.
2. Find and select desired objects.
3. Click *Block*.



4. Optionally, provide blocking reason and click *Confirm*.

Note: To view the blocking reason, place the cursor over the icon on the accounts list.

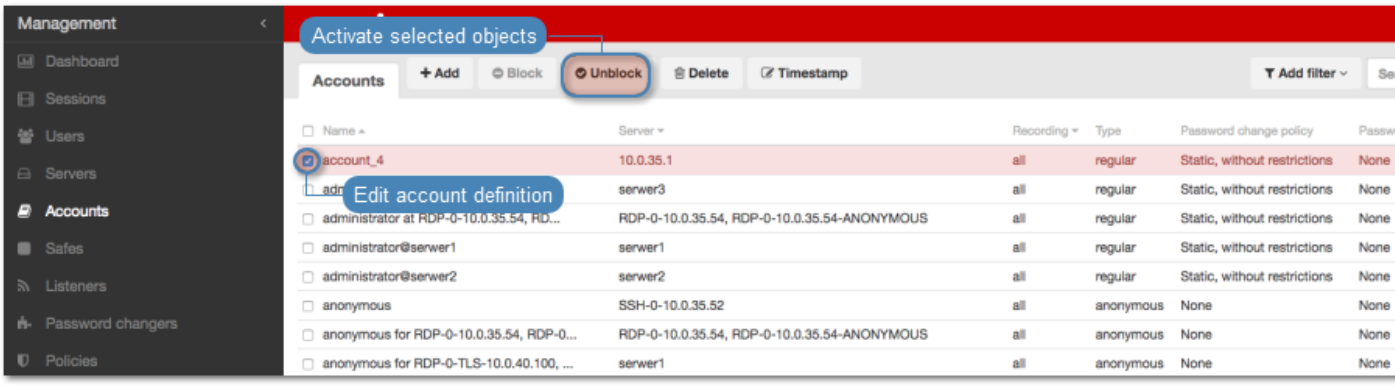


Related topics:

- *Creating an account*
- *Editing an account*
- *Unblocking an account*
- *Deleting an account*

7.4 Unblocking an account

1. Select *Management* > *Accounts*.
2. Find and select desired objects.
3. Click *Unblock*.



4. Confirm unblocking selected objects.

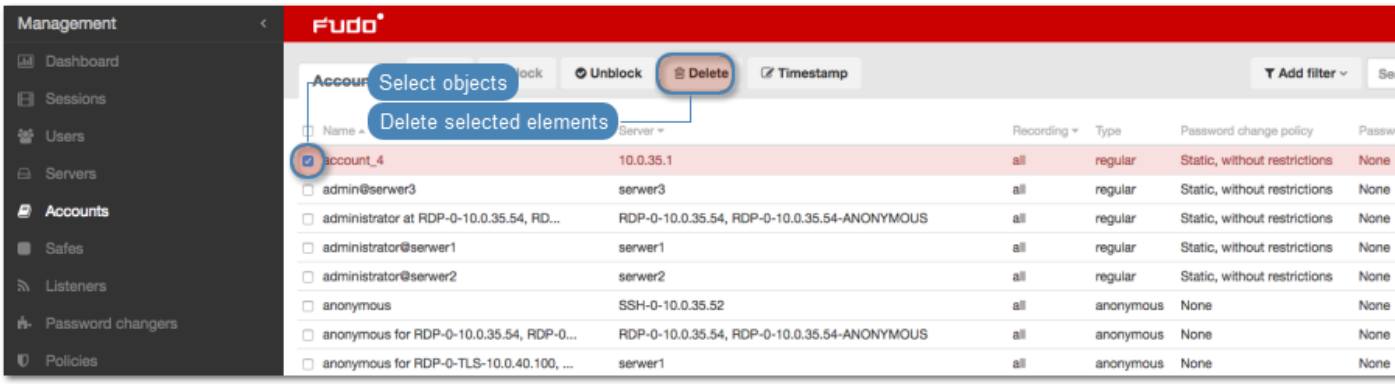
Related topics:

- *Blocking an account*
- *Creating an account*
- *Editing an account*
- *Deleting an account*

7.5 Deleting an account

Warning: Deleting an accout definition will terminate all current connections to servers which use selected account for accessing those servers.

1. Select *Management* > *Accounts*.
2. Find and select desired objects.
3. Click *Delete*.



4. Confirm deletion of selected objects.

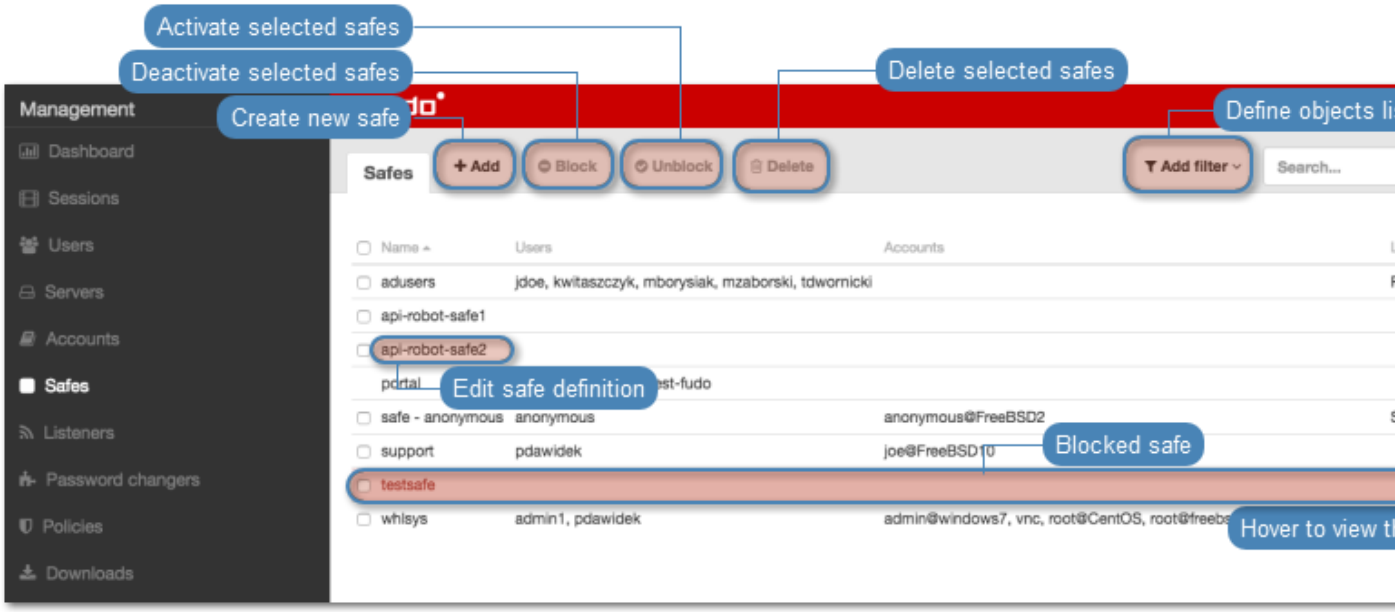
Related topics:

- *Creating an account*
- *Editing an account*
- *Blocking an account*
- *Unblocking an account*

CHAPTER 8

Safes

Safe directly regulates user access to monitored servers. It specifies available protocols' features, policies and other details concerning users and servers relations.



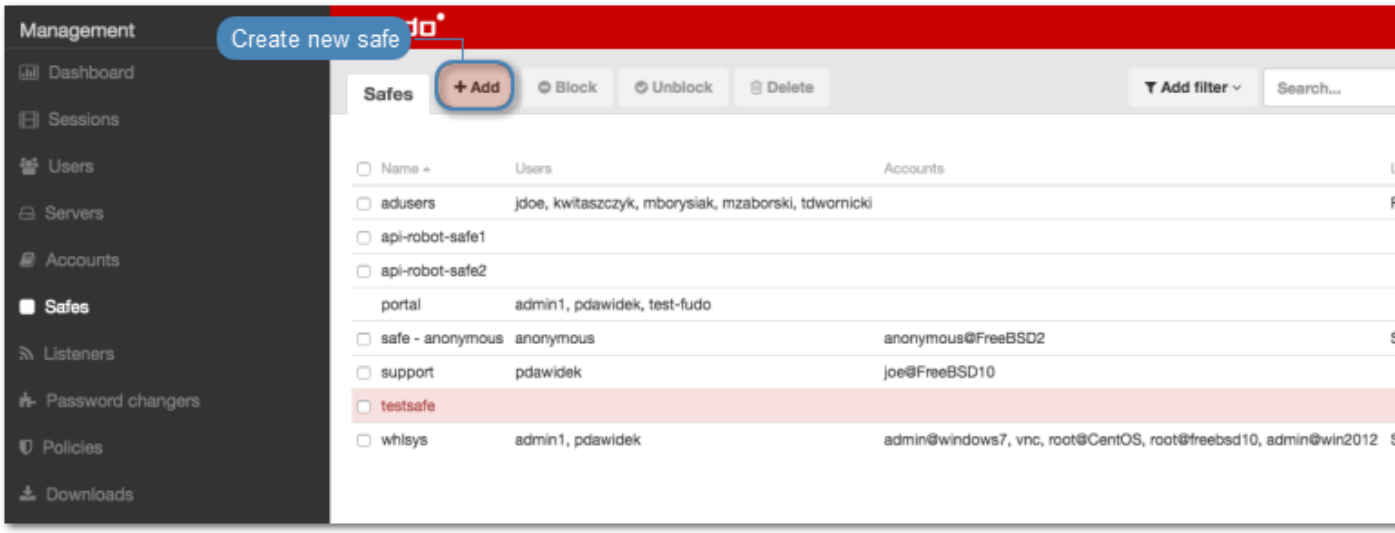
Note:

- The `system` safe can only contain `system` account.
- The `portal` safe can only contain the `portal` account.
- `Operator`, `admin` and `superadmin` users always have access to the `system` safe.
- `User` type users cannot have access to the `system` safe.
- Anonymous user must have access to safes containing anonymous accounts.

8.1 Creating a safe

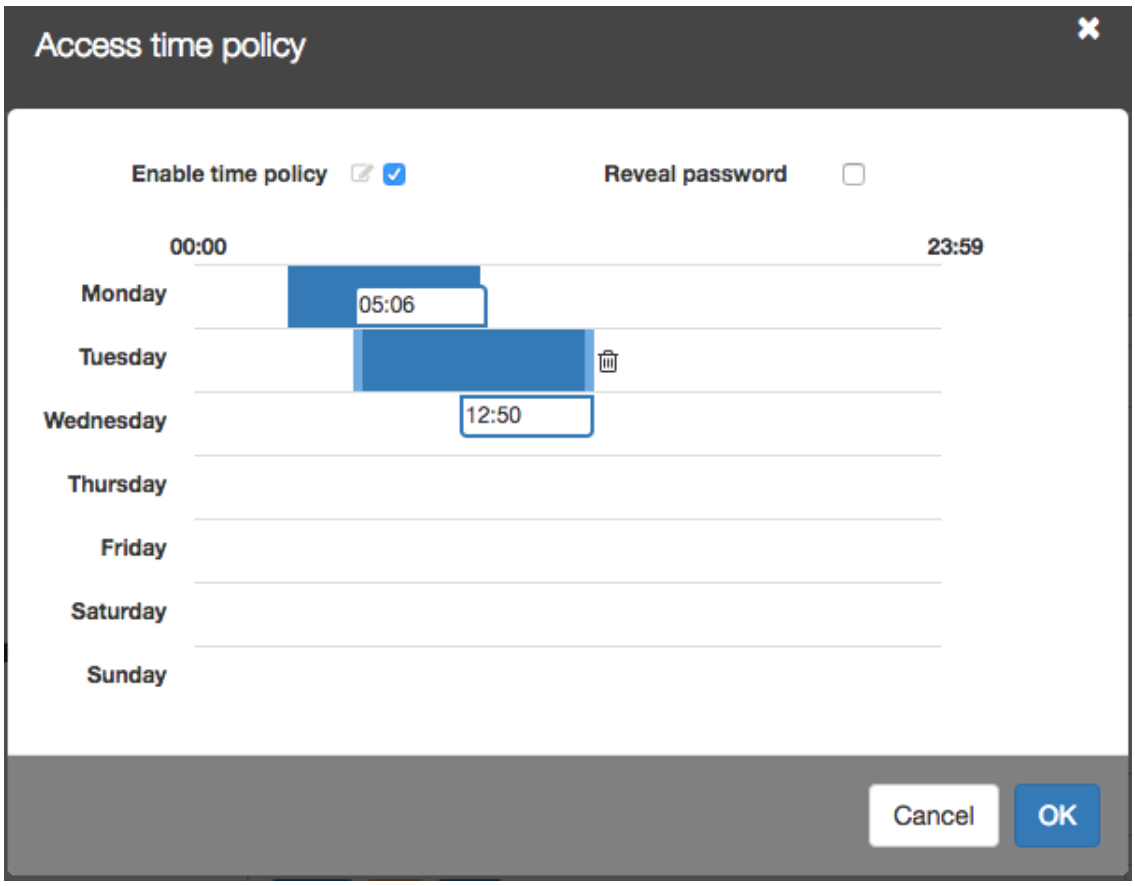
Warning: Data model objects: *safes*, *users*, *servers*, *accounts* and *listeners* are replicated within the cluster and object instances must not be added on each node. In case the replication mechanism fails to copy objects to other nodes, contact technical support department.

1. Select *Management* > *Safes*.
2. Click + *Add*.

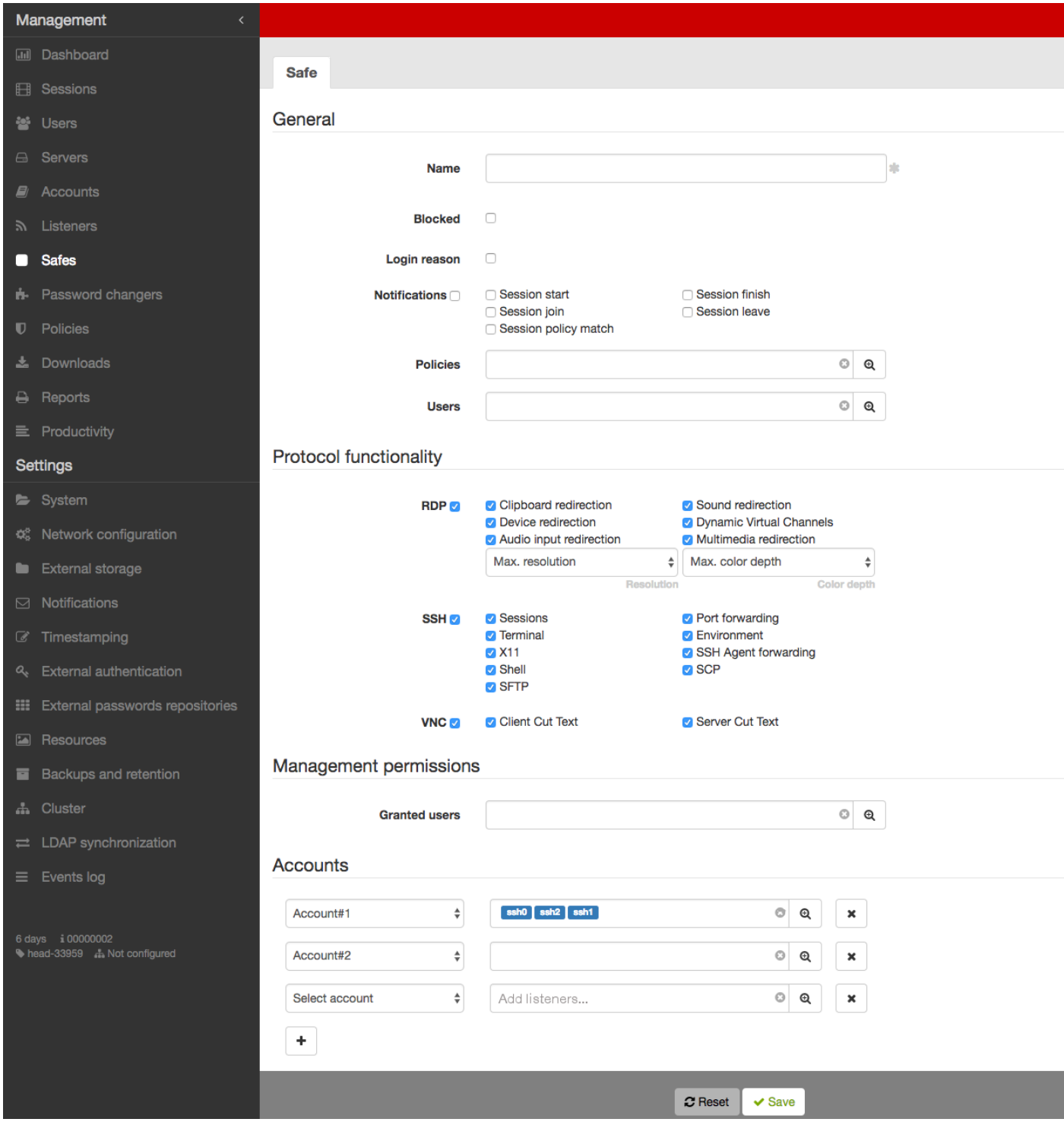


3. Enter object's name.
4. Select *Blocked* option to disable access to object after it's created.
5. Select *Login reason* option, to display prompt upon logging in, asking user to enter login reason.
6. Select *Notifications* option and choose notifications sent out to Wheel Fudo PAM administrator.
7. Assign *security policies* in the *Policies* field.
8. Add users allowed to connect to servers using accounts assigned to this safe.

Note: Click a specific user element to define time policy and allow him to see passwords in the User Portal.



9. In the *Protocol functionality* section, select allowed protocols' features.
10. In the *Permissions* section, add users (administrators, operators) allowed to manage this object.
11. In the *Accounts* section, click the + icon.
12. Select privileged account from the drop-down list and assign listeners allowed to initiate connections to hosts using selected account.
13. Click *Save*.

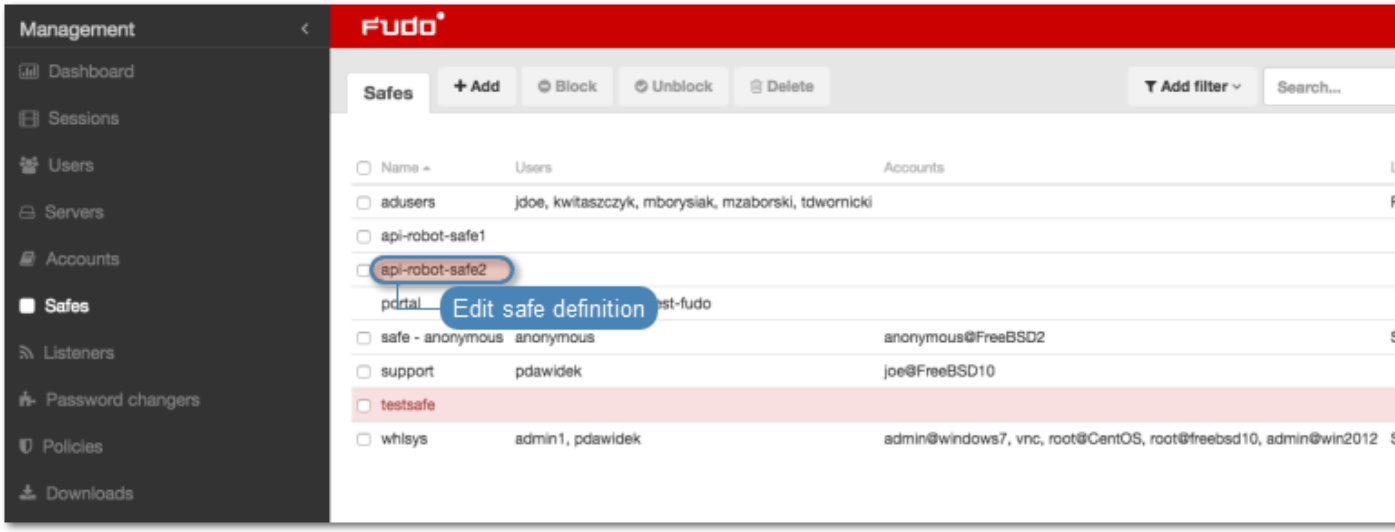


Related topics:

- *Data model*
- *Editing a safe*
- *Blocking a safe*
- *Deleting a safe*

8.2 Editing a safe

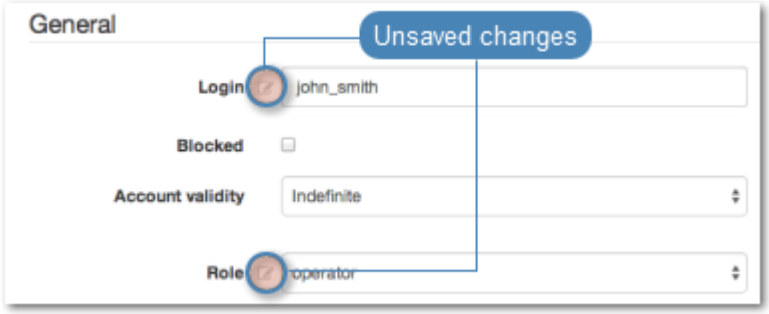
1. Select *Management* > *Safes*.
2. Find and click desired object to open its configuration page.



Note: Define filters to limit the number of objects displayed on the list.

3. Modify configuration parameters as needed.

Note: Unsaved changes are marked with the icon.



4. Click *Save*.

Related topics:

- *Data model*
- *Creating a safe*
- *Blocking a safe*
- *Unblocking a safe*

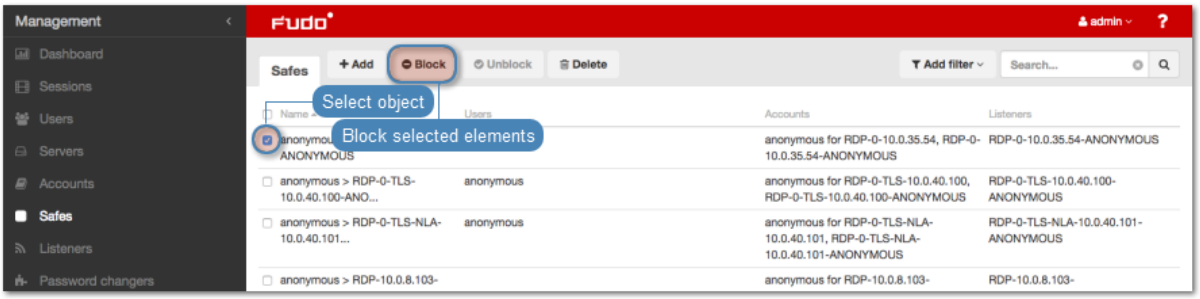
8.3 Blocking a safe

Warning: Blocking a safe definition will terminate all current connections that use accounts assigned to this safe to connect to servers.

1. Select *Management* > *Safes*.
2. Find and select desired objects.

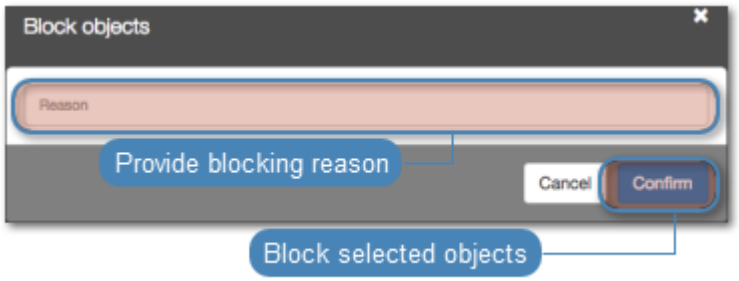
Note: Define filters to limit the number of objects displayed on the list.

3. Click *Block*.



4. Optionally, provide blocking reason and click *Confirm*.

Note: To view the blocking reason, place the cursor over the icon on the safes list.



Related topics:

- *Unblocking a safe*
- *Data model*
- *Creating a safe*
- *Blocking a safe*

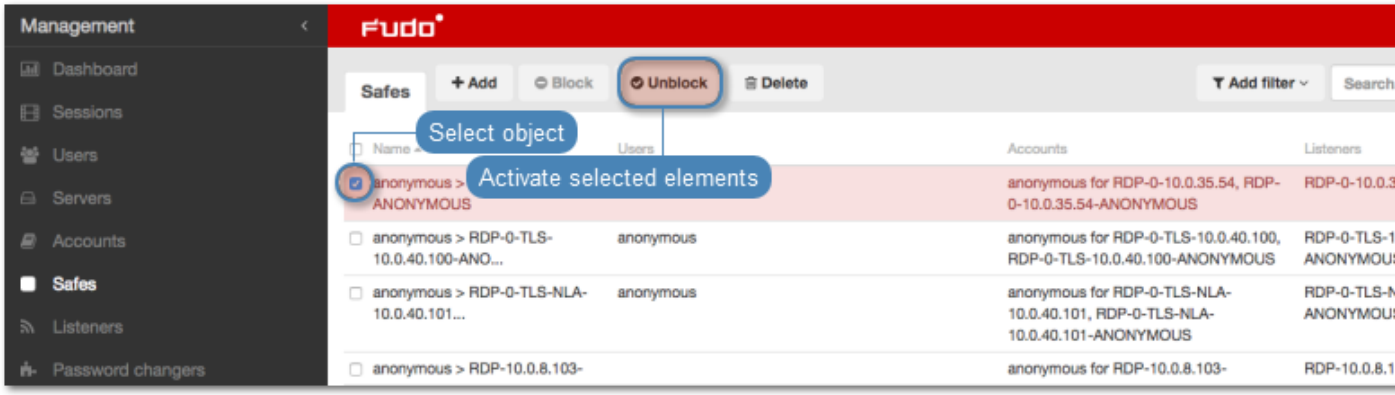
8.4 Unblocking a safe

1. Select *Management* > *Safes*.

2. Find and select desired objects.

Note: Define filters to limit the number of objects displayed on the list.

3. Click *Unblock*.



4. Click *Confirm* to unblock selected objects.

Related topics:

- *Blocking a safe*
- *Data model*
- *Creating a safe*
- *Deleting a safe*

8.5 Deleting a safe

Warning: Deleting a safe definition will terminate all current connections that use accounts assigned to this safe to connect to servers.

1. Select *Management* > *Safes*.
2. Find and select desired objects.

Note: Define filters to limit the number of objects displayed on the list.

3. Click *Delete*.

4. Confirm deletion of selected objects.

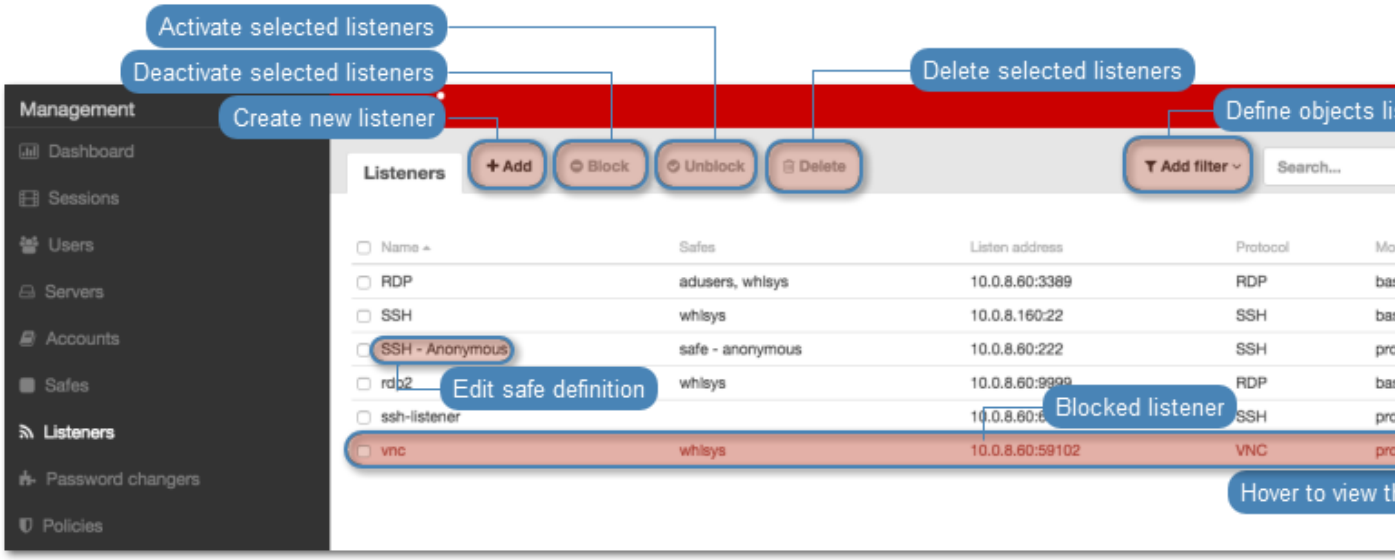
Related topics:

- *Data model*
- *Creating a safe*
- *Editing a safe*
- *Blocking a safe*
- *Unblocking a safe*

CHAPTER 9

Listeners

Listener determines server connection mode (proxy, gateway, transparent, bastion) as well as its specifics.



Note:

- A listener cannot link to an account that is assigned to a server with a different protocol then the one defined in the listener.
- A *proxy* type listener can link to only one server.
- A *bastion* type listener cannot link to an anonymous account.
- A listener cannot link to the same anonymous account through two different safes.
- A listener cannot link to an *anonymous* and a *regular* or *forward* account to the same server with the same protocol as the listener's protocol.

- A listener cannot link to two *regular* or *forward* type accounts to the same server with the same protocol as the listener's protocol, to which a single user has access.
- For a given linked RDP listener and RDP server, both have to use either *Standard RDP Security* or *TLS* or *NLA*.

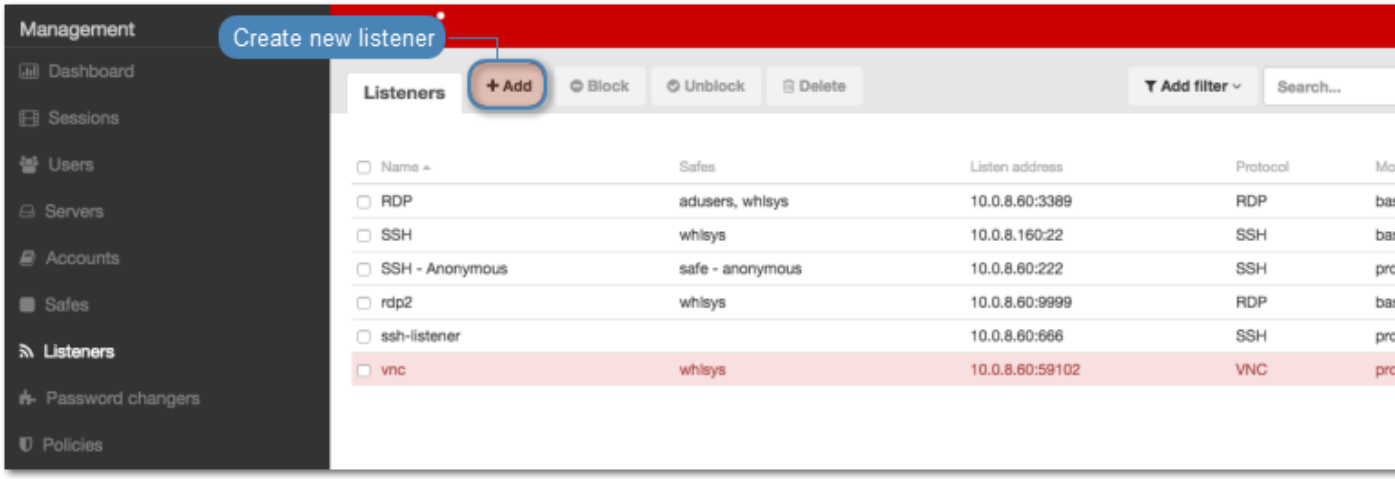
9.1 Creating a listener

Listener determines server connection mode (proxy, gateway, transparent, bastion) as well as its specifics.

Warning: Data model objects: *safes*, *users*, *servers*, *accounts* and *listeners* are replicated within the cluster and object instances must not be added on each node. In case the replication mechanism fails to copy objects to other nodes, contact technical support department.

9.1.1 Creating a Citrix listener

1. Select *Management* > *Listeners*.
2. Click + *Add*.



3. Select `Citrix StoreFront (HTTP)` from the *Protocol* drop-down list.
4. In the *Permissions* section, add users allowed to manage this object.
5. In the *Connection* section, select desired connection mode.

`gateway`

Note: User connects to the target host by providing its actual IP address. Wheel Fudo PAM moderates the connection with the remote host using own IP address. This option requires deploying Wheel Fudo PAM in the *bridge mode*.

- Select `gateway` from the *Mode* drop-down list.

- Select the network interface used for handling connections over this listener.

`proxy`

Note:

- User connects to the target host by providing Wheel Fudo PAM IP address and port number which unambiguously identifies target host.
- Proxy mode is not supported by *dynamically added hosts*.

- Select `proxy` from the *Mode* drop-down list.
- Select the the IP address from the *Local address* drop-down list and enter port number.

`transparent`

Note: User connects to the target host by providing its actual IP address. Wheel Fudo PAM moderates the connection with the remote host using user's IP address. This option requires deploying Wheel Fudo PAM in the *bridge mode*.

- Select `transparent` from the *Mode* drop-down list.
- Select the network interface used for handling connections over this listener.

7. Select *Use TLS* option to enable encryption.
8. Upload or generate TLS certificate.

Note: In case of TLS encrypted connections, Fudo returns an *.ica configuration file* to the Citrix client, which has the *FQDN* server address (*Address*) set to the common name defined in the TLS certificate.

---

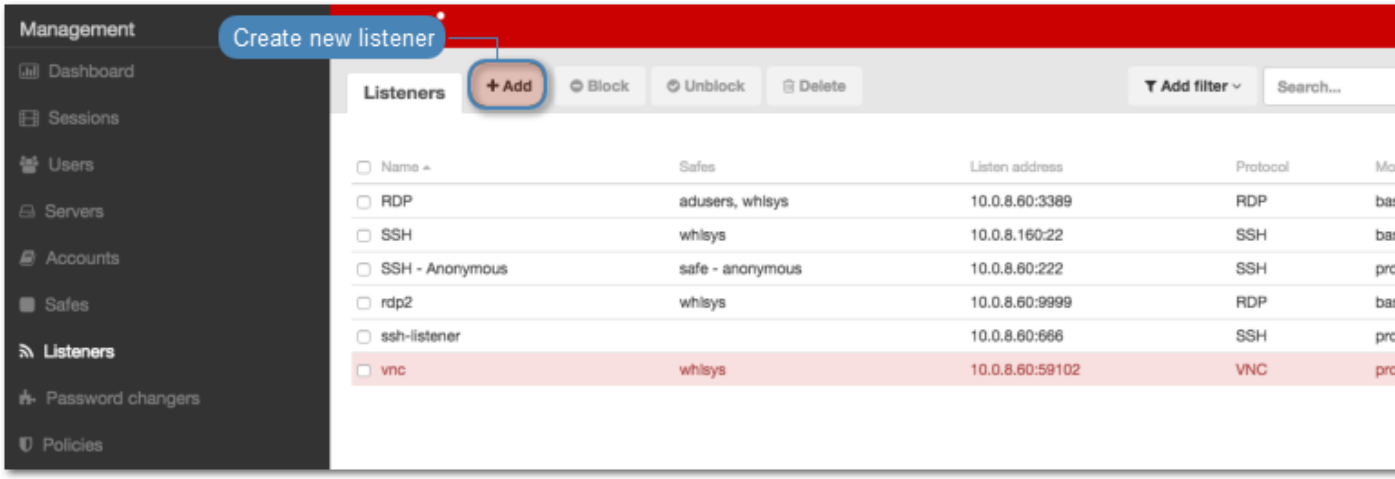
9. Click *Save*.

Related topics:

- *Data model*
- *ICA via Citrix StoreFront*
- *Creating a Citrix server*

9.1.2 Creating a HTTP listener

1. Select *Management* > *Listeners*.
2. Click + *Add*.



3. Select `HTTP` from the *Protocol* drop-down list.
4. In the *Permissions* section, add users allowed to manage this object.
5. In the *Connection* section, select desired connection mode.

`gateway`

Note: User connects to the target host by providing its actual IP address. Wheel Fudo PAM moderates the connection with the remote host using own IP address. This option requires deploying Wheel Fudo PAM in the *bridge mode*.

- Select `gateway` from the *Mode* drop-down list.
- Select the network interface used for handling connections over this listener.

`proxy`

Note:

- User connects to the target host by providing Wheel Fudo PAM IP address and port number which unambiguously identifies target host.
- Proxy mode is not supported by *dynamically added hosts*.

- Select `proxy` from the *Mode* drop-down list.
- Select the the IP address from the *Local address* drop-down list and enter port number.

`transparent`

Note: User connects to the target host by providing its actual IP address. Wheel Fudo PAM moderates the connection with the remote host using user's IP address. This option requires deploying Wheel Fudo PAM in the *bridge mode*.

- Select `transparent` from the *Mode* drop-down list.
- Select the network interface used for handling connections over this listener.

6. Select the *Use TLS* option to enable encryption.

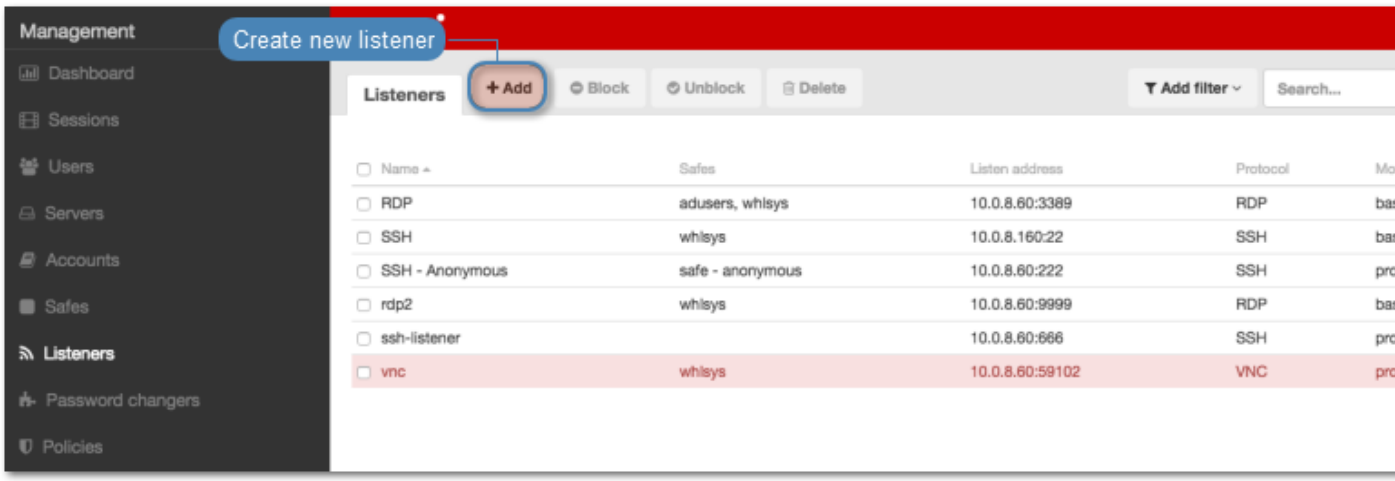
7. Select the *Enable SSLv2 support* to support SSL v2 encrypted connections.
8. Select the *Enable SSLv3 support* to support SSL v3 encrypted connections.
9. Click the generate certificate icon to generate certificate, or the certificate upload icon to upload a certificate.
10. Click *Save*.

Related topics:

- *Data model*
- *Editing a listener*
- *Deleting a listener*
- *Blocking a listener*
- *Unblocking a listener*

9.1.3 Creating an ICA listener

1. Select *Management* > *Listeners*.
2. Click *+ Add*.



3. Select `ICA` from the *Protocol* drop-down list.
4. In the *Permissions* section, add users allowed to manage this object.
5. In the *Connection* section, select desired connection mode.

`bastion`

Note: User connects to the target host by including its name in the login string, e.g. `john_smith#mail_server`.

- Select `bastion` from the *Mode* drop-down list.
- Select the the IP address from the *Local address* drop-down list and enter port number.

`gateway`

Note: User connects to the target host by providing its actual IP address. Wheel Fudo PAM moderates the connection with the remote host using own IP address. This option requires deploying Wheel Fudo PAM in the *bridge mode*.

- Select `gateway` from the *Mode* drop-down list.
- Select the network interface used for handling connections over this listener.

`proxy`

Note:

- User connects to the target host by providing Wheel Fudo PAM IP address and port number which unambiguously identifies target host.
- Proxy mode is not supported by *dynamically added hosts*.

- Select `proxy` from the *Mode* drop-down list.
- Select the the IP address from the *Local address* drop-down list and enter port number.

`transparent`

Note: User connects to the target host by providing its actual IP address. Wheel Fudo PAM moderates the connection with the remote host using user's IP address. This option requires deploying Wheel Fudo PAM in the *bridge mode*.

- Select `transparent` from the *Mode* drop-down list.
- Select the network interface used for handling connections over this listener.

7. Select *Use TLS* option to enable encryption.
8. Upload or generate TLS certificate.

Note: In case of TLS encrypted connections, Fudo returns an *.ica configuration file* to the Citrix client, which has the *FQDN* server address (*Address*) set to the common name defined in the TLS certificate.

---

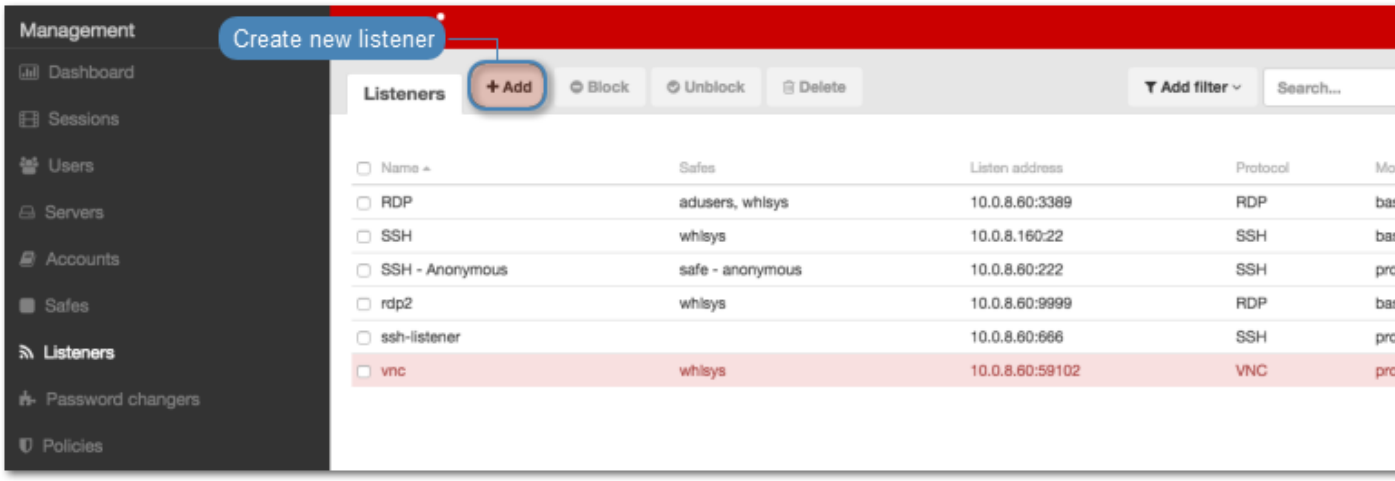
9. Click *Save*.

Related topics:

- *Data model*
- *ICA via Citrix StoreFront*
- *ICA*
- *Creating an ICA server*
- *ICA configuration file*

9.1.4 Creating a Modbus listener

1. Select *Management* > *Listeners*.
2. Click + *Add*.



3. Select `Modbus` from the *Protocol* drop-down list.
4. In the *Permissions* section, add users allowed to manage this object.
5. In the *Connection* section, select desired connection mode.

`gateway`

Note: User connects to the target host by providing its actual IP address. Wheel Fudo PAM moderates the connection with the remote host using own IP address. This option requires deploying Wheel Fudo PAM in the *bridge mode*.

- Select `gateway` from the *Mode* drop-down list.
- Select the network interface used for handling connections over this listener.

`proxy`

Note:

- User connects to the target host by providing Wheel Fudo PAM IP address and port number which unambiguously identifies target host.
- Proxy mode is not supported by *dynamically added hosts*.

- Select `proxy` from the *Mode* drop-down list.
- Select the the IP address from the *Local address* drop-down list and enter port number.

`transparent`

Note: User connects to the target host by providing its actual IP address. Wheel Fudo PAM moderates the connection with the remote host using user's IP address. This option requires

deploying Wheel Fudo PAM in the *bridge mode*.

- Select `transparent` from the *Mode* drop-down list.
- Select the network interface used for handling connections over this listener.

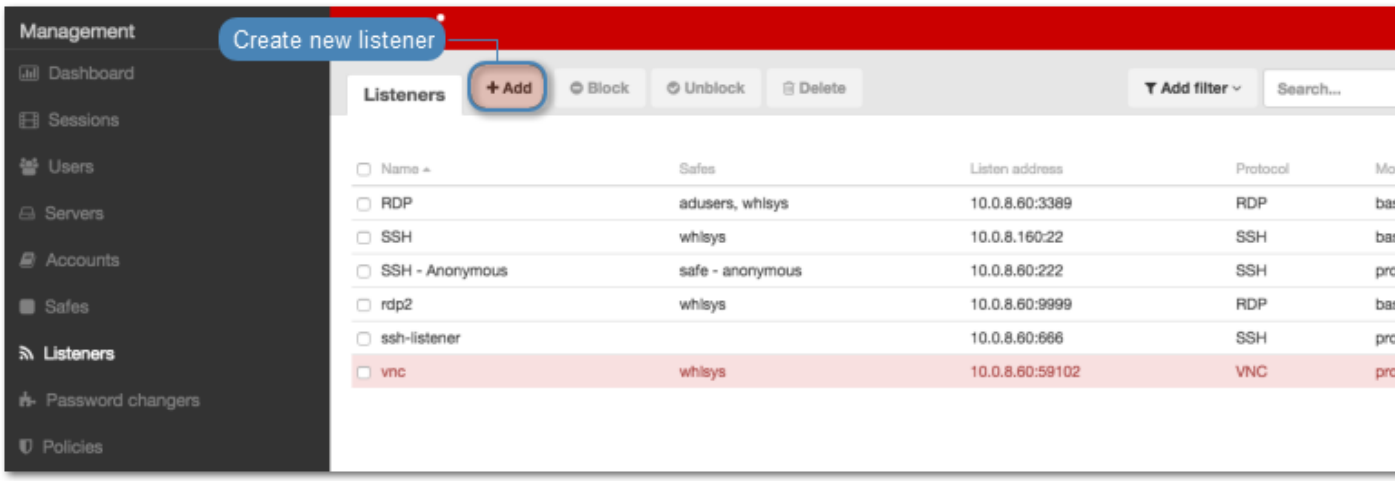
6. Click *Save*.

Related topics:

- *Data model*
- *Editing a listener*
- *Deleting a listener*
- *Blocking a listener*
- *Unblocking a listener*

9.1.5 Creating a MySQL listener

1. Select *Management* > *Listeners*.
2. Click *+ Add*.



3. Select `MySQL` from the *Protocol* drop-down list.
4. In the *Permissions* section, add users allowed to manage this object.
5. In the *Connection* section, select desired connection mode.

`gateway`

Note: User connects to the target host by providing its actual IP address. Wheel Fudo PAM moderates the connection with the remote host using own IP address. This option requires deploying Wheel Fudo PAM in the *bridge mode*.

- Select `gateway` from the *Mode* drop-down list.
- Select the network interface used for handling connections over this listener.

`proxy`

Note:

- User connects to the target host by providing Wheel Fudo PAM IP address and port number which unambiguously identifies target host.
- Proxy mode is not supported by *dynamically added hosts*.

- Select `proxy` from the *Mode* drop-down list.
- Select the the IP address from the *Local address* drop-down list and enter port number.

`transparent`

Note: User connects to the target host by providing its actual IP address. Wheel Fudo PAM moderates the connection with the remote host using user's IP address. This option requires deploying Wheel Fudo PAM in the *bridge mode*.

- Select `transparent` from the *Mode* drop-down list.
- Select the network interface used for handling connections over this listener.

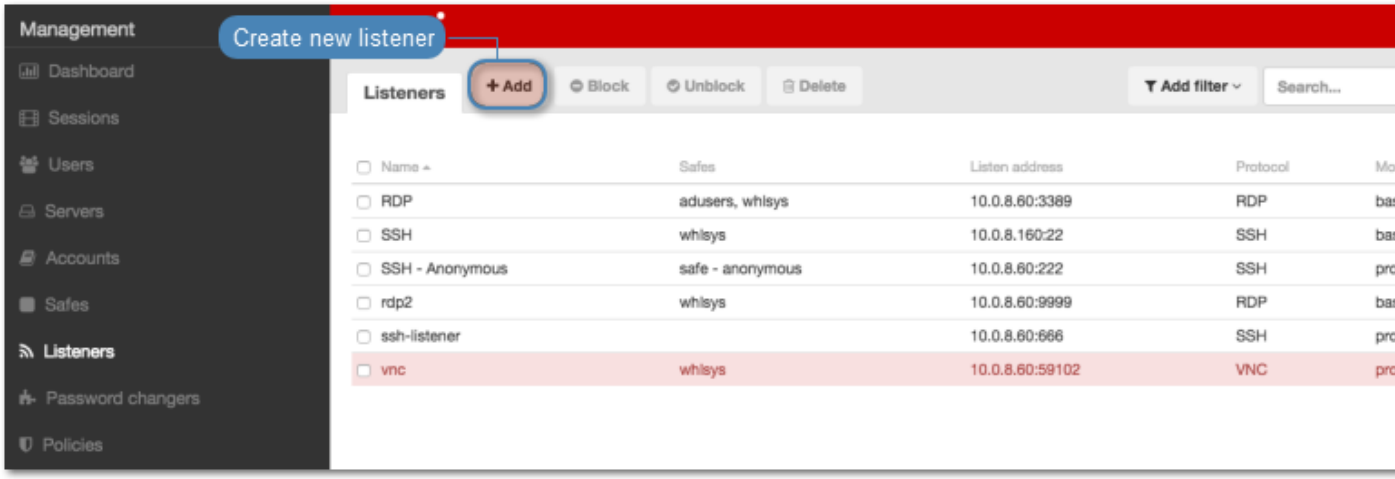
6. Click *Save*.

Related topics:

- *Data model*
- *Editing a listener*
- *Deleting a listener*
- *Blocking a listener*
- *Unblocking a listener*

9.1.6 Creating an Oracle listener

1. Select *Management* > *Listeners*.
2. Click + *Add*.



3. Select `MySQL` from the *Protocol* drop-down list.
4. In the *Permissions* section, add users allowed to manage this object.
5. In the *Connection* section, select desired connection mode.

`gateway`

Note: User connects to the target host by providing its actual IP address. Wheel Fudo PAM moderates the connection with the remote host using own IP address. This option requires deploying Wheel Fudo PAM in the *bridge mode*.

- Select `gateway` from the *Mode* drop-down list.
- Select the network interface used for handling connections over this listener.

`proxy`

Note:

- User connects to the target host by providing Wheel Fudo PAM IP address and port number which unambiguously identifies target host.
- Proxy mode is not supported by *dynamically added hosts*.

- Select `proxy` from the *Mode* drop-down list.
- Select the the IP address from the *Local address* drop-down list and enter port number.

`transparent`

Note: User connects to the target host by providing its actual IP address. Wheel Fudo PAM moderates the connection with the remote host using user's IP address. This option requires deploying Wheel Fudo PAM in the *bridge mode*.

- Select `transparent` from the *Mode* drop-down list.
- Select the network interface used for handling connections over this listener.

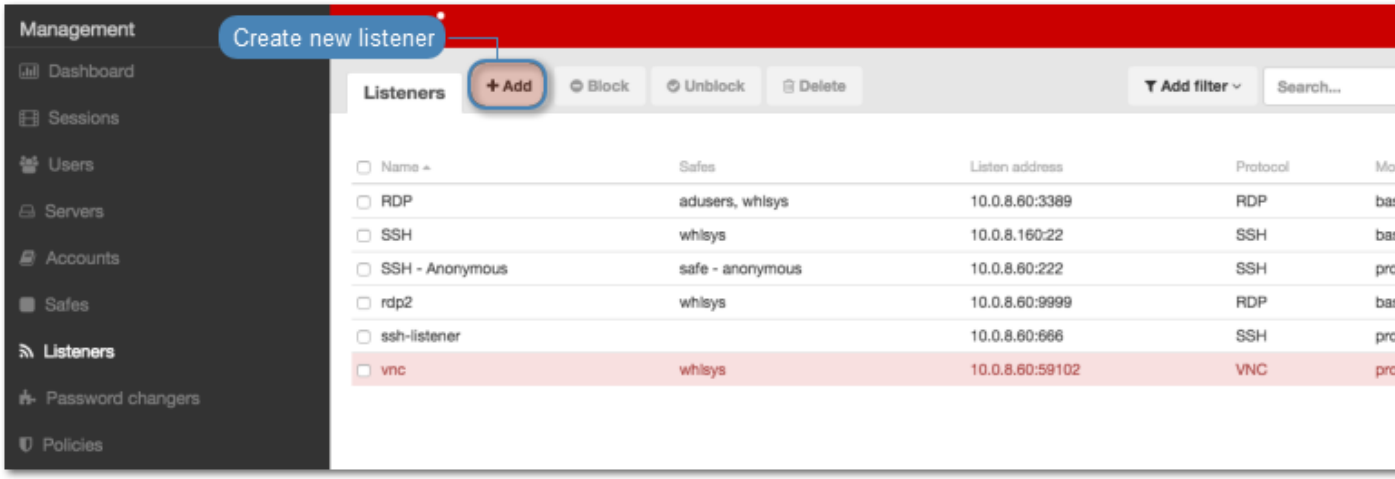
6. Click *Save*.

Related topics:

- *Data model*
- *Editing a listener*
- *Deleting a listener*
- *Blocking a listener*
- *Unblocking a listener*

9.1.7 Creating an RDP listener

1. Select *Management* > *Listeners*.
2. Click *+ Add*.



3. Select `RDP` from the *Protocol* drop-down list.
4. From the `Security` drop-down list, select RDP connection security mode.
5. In the *Announcement* field, type in the announcement that will be presented to the user on the login screen.
6. In the *Permissions* section, add users allowed to manage this object.
7. In the *Connection* section, select desired connection mode.

`bastion`

Note: User connects to the target host by including its name in the login string, e.g. `john_smith#mail_server`.

- Select `bastion` from the *Mode* drop-down list.
- Select the the IP address from the *Local address* drop-down list and enter port number.

`gateway`

Note: User connects to the target host by providing its actual IP address. Wheel Fudo PAM moderates the connection with the remote host using own IP address. This option requires

deploying Wheel Fudo PAM in the *bridge mode*.

- Select `gateway` from the *Mode* drop-down list.
- Select the network interface used for handling connections over this listener.

`proxy`

Note:

- User connects to the target host by providing Wheel Fudo PAM IP address and port number which unambiguously identifies target host.
- Proxy mode is not supported by *dynamically added hosts*.

- Select `proxy` from the *Mode* drop-down list.
- Select the the IP address from the *Local address* drop-down list and enter port number.

`transparent`

Note: User connects to the target host by providing its actual IP address. Wheel Fudo PAM moderates the connection with the remote host using user's IP address. This option requires deploying Wheel Fudo PAM in the *bridge mode*.

- Select `transparent` from the *Mode* drop-down list.
- Select the network interface used for handling connections over this listener.

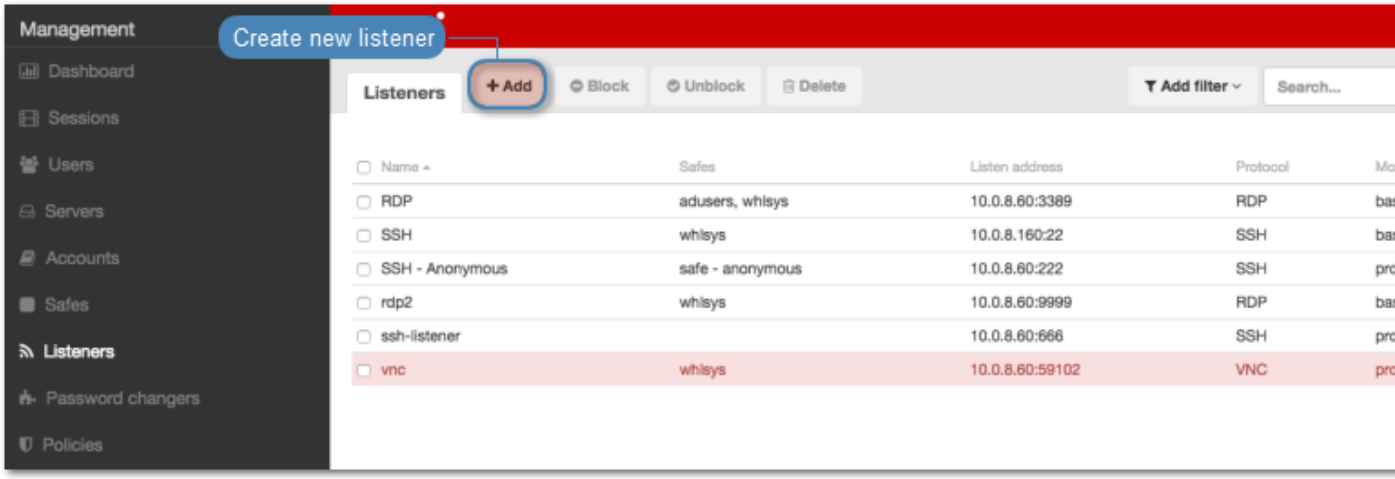
8. In the *TLS certificate* field, click the generate certificate icon to generate certificate, or the certificate upload icon to upload a certificate.
9. Click *Save*.

Related topics:

- *Data model*
- *Editing a listener*
- *Deleting a listener*
- *Blocking a listener*
- *Unblocking a listener*

9.1.8 Creating an SSH listener

1. Select *Management* > *Listeners*.
2. Click *+ Add*.



3. Select `SSH` from the *Protocol* drop-down list.
4. In the *Permissions* section, add users allowed to manage this object.
5. In the *Connection* section, select desired connection mode.

`bastion`

Note: User connects to the target host by including its name in the login string, e.g. `john_smith#mail_server`.

- Select `bastion` from the *Mode* drop-down list.
- Select the the IP address from the *Local address* drop-down list and enter port number.

`gateway`

Note: User connects to the target host by providing its actual IP address. Wheel Fudo PAM moderates the connection with the remote host using own IP address. This option requires deploying Wheel Fudo PAM in the *bridge mode*.

- Select `gateway` from the *Mode* drop-down list.
- Select the network interface used for handling connections over this listener.

`proxy`

Note:

- User connects to the target host by providing Wheel Fudo PAM IP address and port number which unambiguously identifies target host.
- Proxy mode is not supported by *dynamically added hosts*.

- Select `proxy` from the *Mode* drop-down list.
- Select the the IP address from the *Local address* drop-down list and enter port number.

`transparent`

Note: User connects to the target host by providing its actual IP address. Wheel Fudo PAM moderates the connection with the remote host using user's IP address. This option requires deploying Wheel Fudo PAM in the *bridge mode*.

- Select `transparent` from the *Mode* drop-down list.
- Select the network interface used for handling connections over this listener.

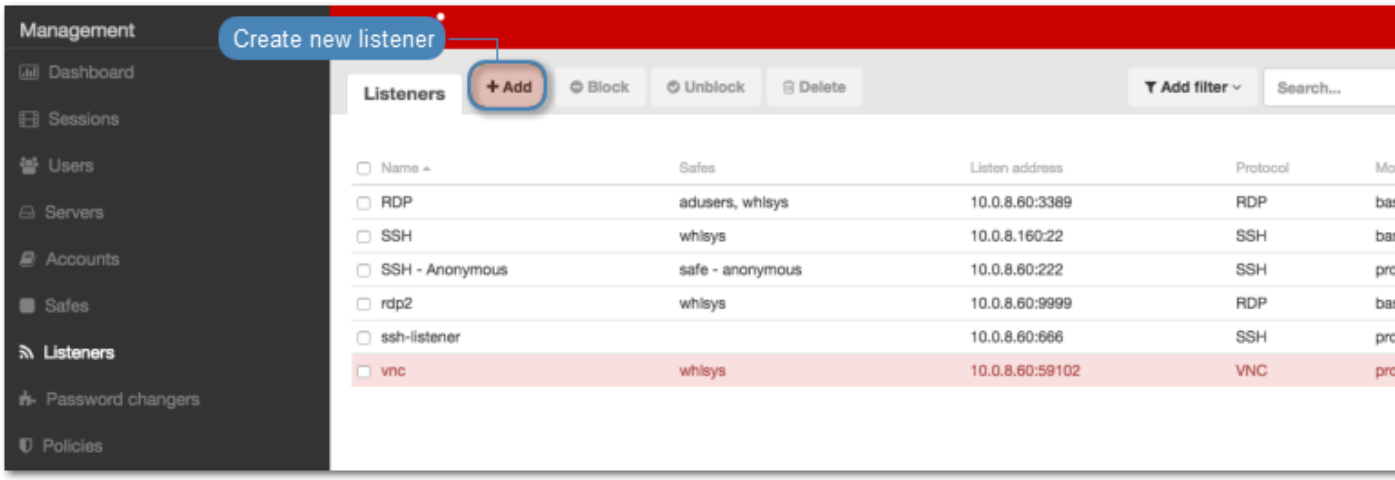
6. In the *Fudo public key* field, click the generate certificate icon to generate certificate, or the certificate upload icon to upload a certificate.
7. Click *Save*.

Related topics:

- *Data model*
- *Editing a listener*
- *Deleting a listener*
- *Blocking a listener*
- *Unblocking a listener*

9.1.9 Creating a MS SQL listener

1. Select *Management* > *Listeners*.
2. Click *+ Add*.



3. Select `MS SQL (TDS)` from the *Protocol* drop-down list.
4. In the *Permissions* section, add users allowed to manage this object.
5. In the *Connection* section, select desired connection mode.

`gateway`

Note: User connects to the target host by providing its actual IP address. Wheel Fudo PAM moderates the connection with the remote host using own IP address. This option requires

deploying Wheel Fudo PAM in the *bridge mode*.

- Select `gateway` from the *Mode* drop-down list.
- Select the network interface used for handling connections over this listener.

`proxy`

Note:

- User connects to the target host by providing Wheel Fudo PAM IP address and port number which unambiguously identifies target host.
- Proxy mode is not supported by *dynamically added hosts*.

- Select `proxy` from the *Mode* drop-down list.
- Select the the IP address from the *Local address* drop-down list and enter port number.

`transparent`

Note: User connects to the target host by providing its actual IP address. Wheel Fudo PAM moderates the connection with the remote host using user's IP address. This option requires deploying Wheel Fudo PAM in the *bridge mode*.

- Select `transparent` from the *Mode* drop-down list.
- Select the network interface used for handling connections over this listener.

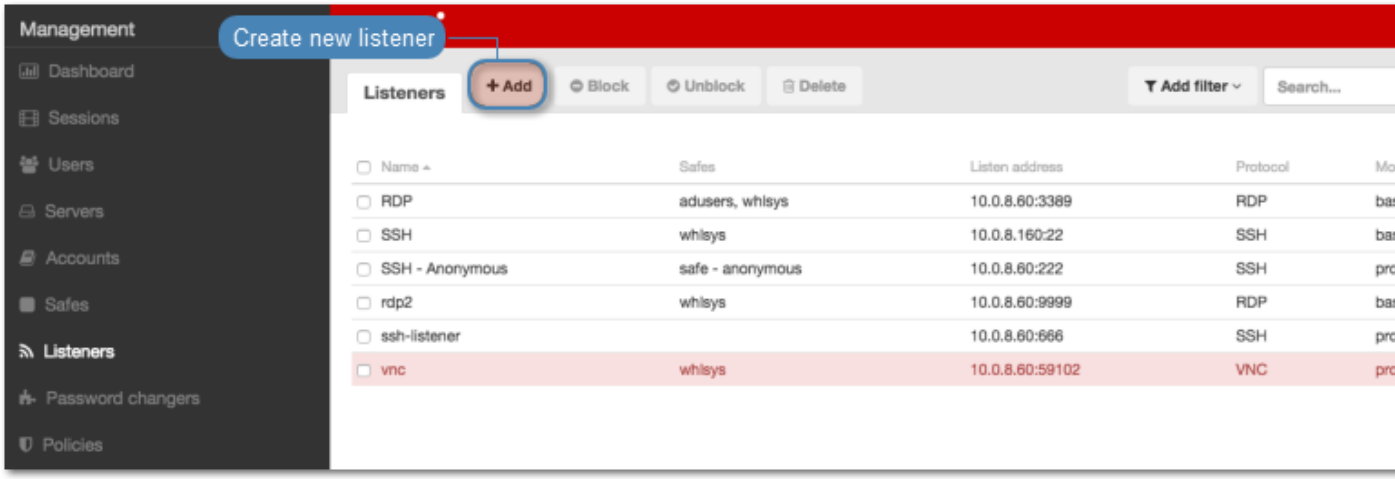
6. Click *Save*.

Related topics:

- *Data model*
- *Editing a listener*
- *Deleting a listener*
- *Blocking a listener*
- *Unblocking a listener*

9.1.10 Creating a Telnet listener

1. Select *Management* > *Listeners*.
2. Click *+ Add*.



3. Select `Telnet` from the *Protocol* drop-down list.
4. In the *Permissions* section, add users allowed to manage this object.
5. In the *Connection* section, select desired connection mode.

`gateway`

Note: User connects to the target host by providing its actual IP address. Wheel Fudo PAM moderates the connection with the remote host using own IP address. This option requires deploying Wheel Fudo PAM in the *bridge mode*.

- Select `gateway` from the *Mode* drop-down list.
- Select the network interface used for handling connections over this listener.

`proxy`

Note:

- User connects to the target host by providing Wheel Fudo PAM IP address and port number which unambiguously identifies target host.
- Proxy mode is not supported by *dynamically added hosts*.

- Select `proxy` from the *Mode* drop-down list.
- Select the the IP address from the *Local address* drop-down list and enter port number.

`transparent`

Note: User connects to the target host by providing its actual IP address. Wheel Fudo PAM moderates the connection with the remote host using user's IP address. This option requires deploying Wheel Fudo PAM in the *bridge mode*.

- Select `transparent` from the *Mode* drop-down list.
- Select the network interface used for handling connections over this listener.

6. Select the *Use TLS* option to enable encryption.

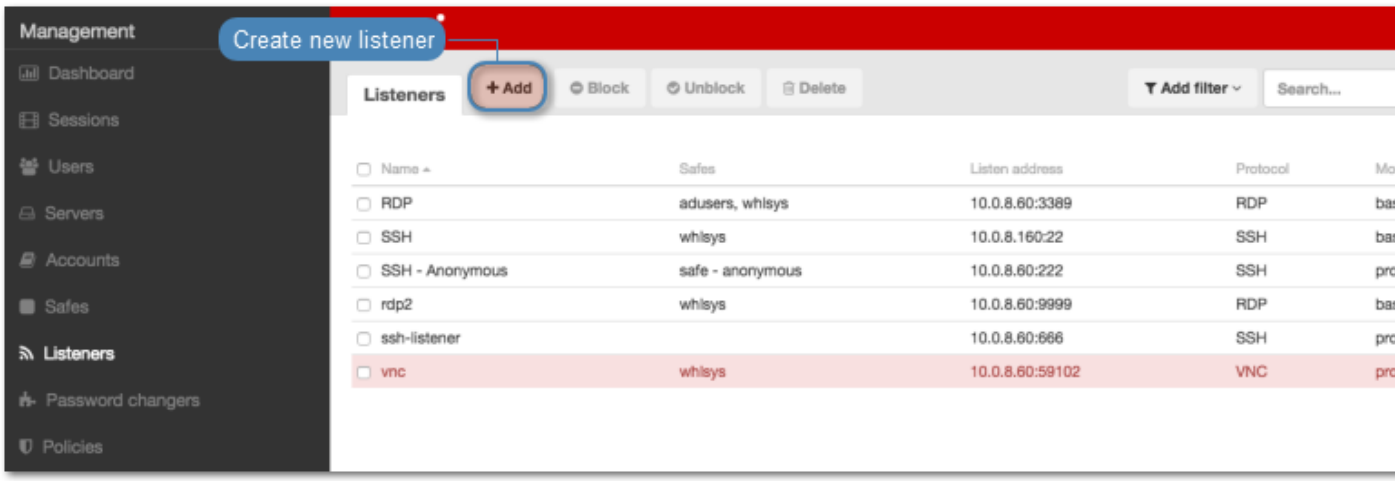
7. Select the *Enable SSLv2 support* to support SSL v2 encrypted connections.
8. Select the *Enable SSLv3 support* to support SSL v3 encrypted connections.
9. Click the generate certificate icon to generate certificate, or the certificate upload icon to upload a certificate.
10. Click *Save*.

Related topics:

- *Data model*
- *Editing a listener*
- *Deleting a listener*
- *Blocking a listener*
- *Unblocking a listener*

9.1.11 Creating a Telnet 3270 listener

1. Select *Management* > *Listeners*.
2. Click *+ Add*.



3. Select `Telnet 3270` from the *Protocol* drop-down list.
4. In the *Permissions* section, add users allowed to manage this object.
5. In the *Connection* section, select desired connection mode.

`gateway`

Note: User connects to the target host by providing its actual IP address. Wheel Fudo PAM moderates the connection with the remote host using own IP address. This option requires deploying Wheel Fudo PAM in the *bridge mode*.

- Select `gateway` from the *Mode* drop-down list.
- Select the network interface used for handling connections over this listener.

`proxy`

Note:

- User connects to the target host by providing Wheel Fudo PAM IP address and port number which unambiguously identifies target host.
- Proxy mode is not supported by *dynamically added hosts*.

- Select `proxy` from the *Mode* drop-down list.
- Select the the IP address from the *Local address* drop-down list and enter port number.

`transparent`

Note: User connects to the target host by providing its actual IP address. Wheel Fudo PAM moderates the connection with the remote host using user's IP address. This option requires deploying Wheel Fudo PAM in the *bridge mode*.

- Select `transparent` from the *Mode* drop-down list.
- Select the network interface used for handling connections over this listener.

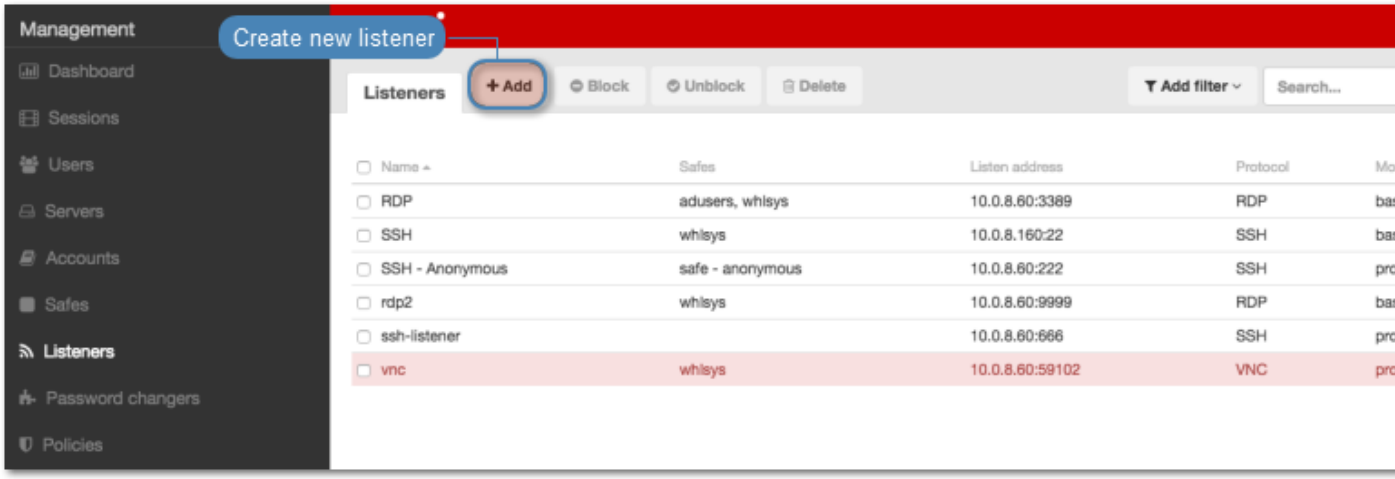
6. Select the *Use TLS* option to enable encryption.
7. Select the *Enable SSLv2 support* to support SSL v2 encrypted connections.
8. Select the *Enable SSLv3 support* to support SSL v3 encrypted connections.
9. Click the generate certificate icon to generate certificate, or the certificate upload icon to upload a certificate.
10. Click *Save*.

Related topics:

- *Data model*
- *Editing a listener*
- *Deleting a listener*
- *Blocking a listener*
- *Unblocking a listener*

9.1.12 Creating a VNC listener

1. Select *Management* > *Listeners*.
2. Click + *Add*.



3. Select `VNC` from the *Protocol* drop-down list.
4. In the *Announcement* field, type in the announcement that will be presented to the user on the login screen.
5. In the *Permissions* section, add users allowed to manage this object.
6. In the *Connection* section, select desired connection mode.

`bastion`

Note: User connects to the target host by including its name in the login string, e.g. `john_smith#mail_server`.

- Select `bastion` from the *Mode* drop-down list.
- Select the the IP address from the *Local address* drop-down list and enter port number.

`gateway`

Note: User connects to the target host by providing its actual IP address. Wheel Fudo PAM moderates the connection with the remote host using own IP address. This option requires deploying Wheel Fudo PAM in the *bridge mode*.

- Select `gateway` from the *Mode* drop-down list.
- Select the network interface used for handling connections over this listener.

`proxy`

Note:

- User connects to the target host by providing Wheel Fudo PAM IP address and port number which unambiguously identifies target host.
- Proxy mode is not supported by *dynamically added hosts*.

- Select `proxy` from the *Mode* drop-down list.
- Select the the IP address from the *Local address* drop-down list and enter port number.

`transparent`

Note: User connects to the target host by providing its actual IP address. Wheel Fudo PAM moderates the connection with the remote host using user's IP address. This option requires deploying Wheel Fudo PAM in the *bridge mode*.

- Select `transparent` from the *Mode* drop-down list.
- Select the network interface used for handling connections over this listener.

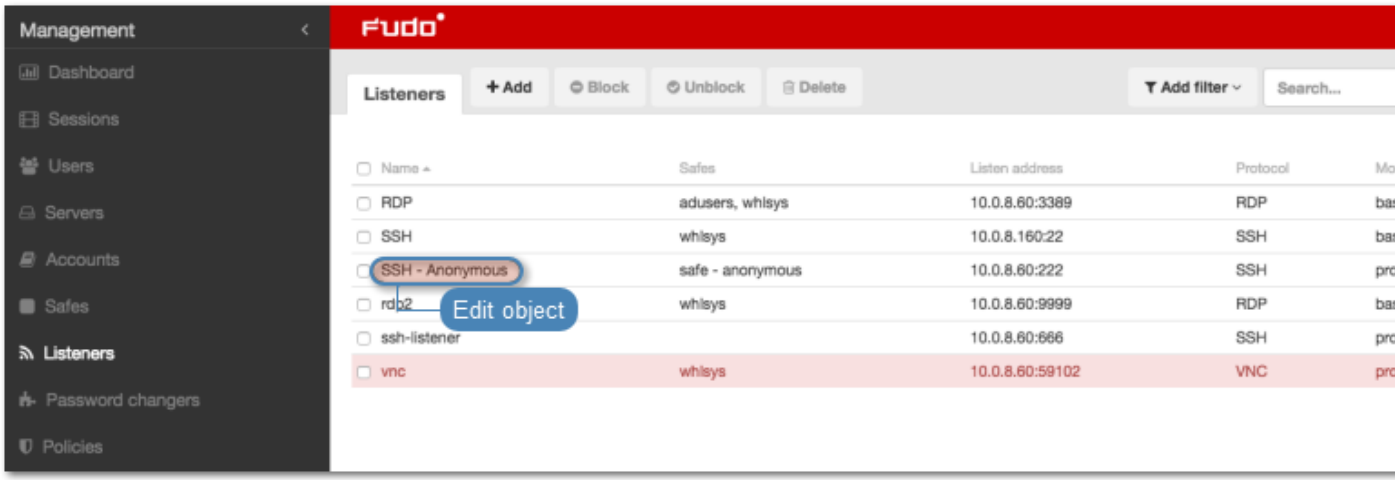
7. Click *Save*.

Related topics:

- *Data model*
- *Editing a listener*
- *Deleting a listener*
- *Blocking a listener*
- *Unblocking a listener*

9.2 Editing a listener

1. Select *Management* > *Listeners*.
2. Find and click desired listener to access its configuration parameters.



Note: Define filters to limit the number of objects displayed on the list.

---

3. Modify configuration values as needed.

Note: Unsaved changes are marked with an icon.

4. Click *Save*.

Related topics:

- *Data model*
- *System initiation*
- *Servers*

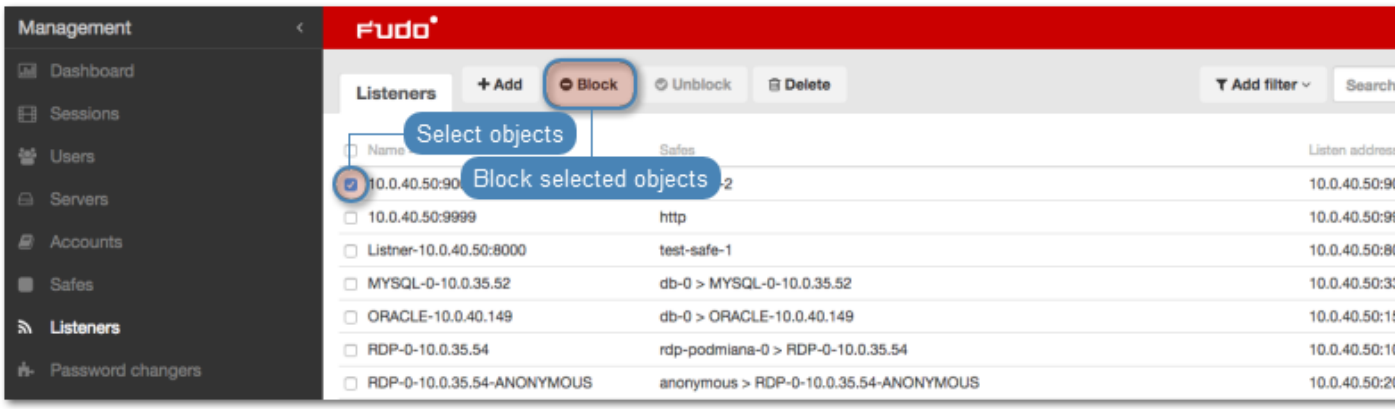
9.3 Blocking a listener

Warning: Blocking a listener will terminate current connections with server which uses it.

1. Select *Management* > *Listeners*.
2. Find and select desired listener.

Note: Define filters to limit the number of objects displayed on the list.

3. Click *Block* to disable access to hosts over selected listeners.



4. Optionally, provide descriptive reason for blocking given resource and click *Confirm*.

Related topics:

- *Data model*
- *System initiation*

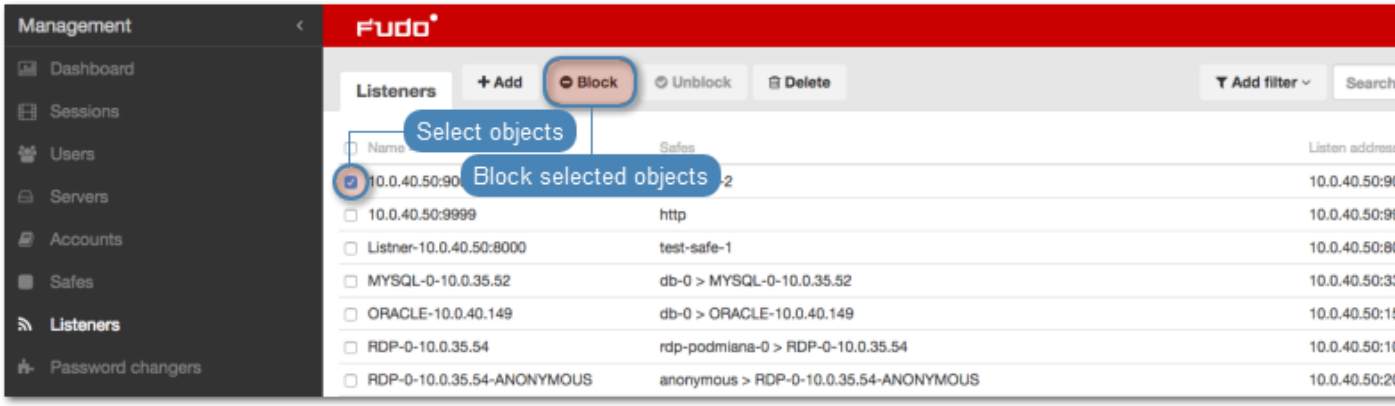
- *Servers*

9.4 Unblocking a listener

1. Select *Management* > *Listeners*.
2. Find and select desired listener.

Note: Define filters to limit the number of objects displayed on the list.

3. Click *Unblock* to enable access to hosts over selected listeners.



4. Click *Confirm* to unblock selected objects.

Related topics:

- *Data model*
- *System initiation*
- *Servers*

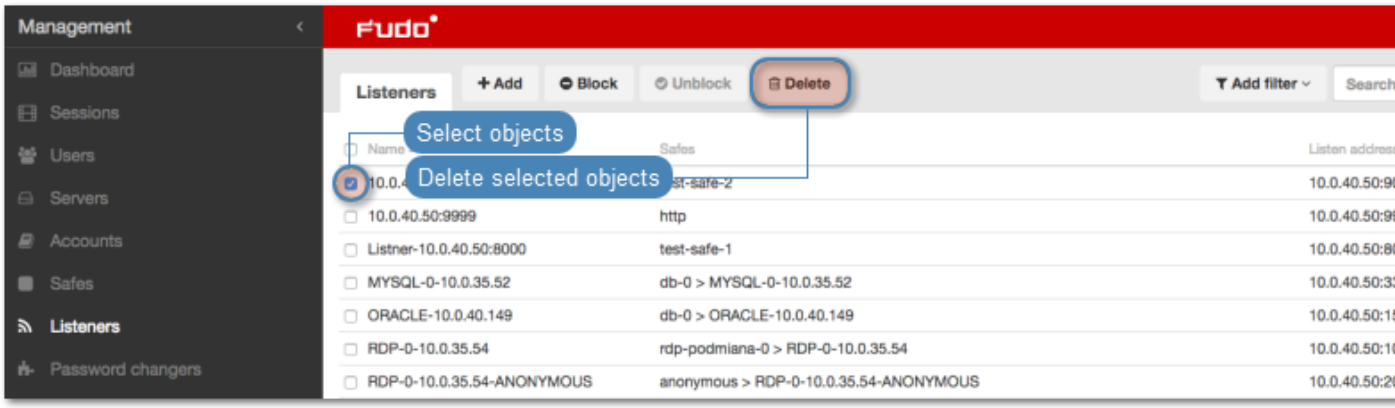
9.5 Deleting a listener

Warning: Deleting a listener will terminate current connections with server which uses it.

1. Select *Management* > *Listeners*.
2. Find and select desired listener.

Note: Define filters to limit the number of objects displayed on the list.

3. Click *Delete*.



4. Confirm deleting selected objects.

Related topics:

- *Data model*
- *System initiation*
- *Servers*

CHAPTER 10

Password changers

Wheel Fudo PAM uses proprietary *password changers* to manage credentials to privileged accounts defined on monitored servers. Password changer feature supports the following password management scenarios:

- Unix over SSH
- MySQL over SSH
- Cisco over SSH and Telnet
- Cisco Enable Password over SSH and Telnet
- MS Windows over WMI

10.1 Password changer policy

Password changer policy defines specifics of how frequently the password should be changed and password complexity requirements.

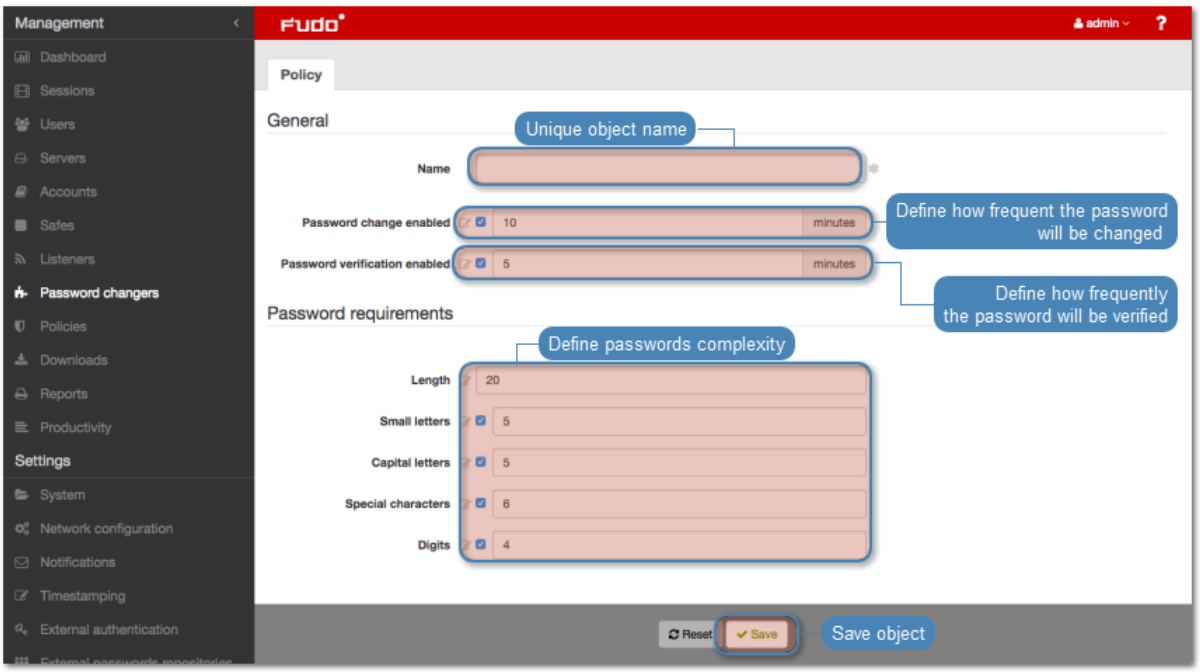
10.1.1 Defining a password changer policy

1. Select *Management* > *Password changers*.
2. Click *+ Add*.
3. Enter object name.
4. Select the *Password change enabled* option and specify the time interval between each password change.
5. Select the *Password verification enabled* option and specify the time interval between each password verification.
6. Define password complexity.

Parameter	Description
Length	Provide the number of characters comprising the password.
Small letters	Select to include lowercase characters, define their minimal number.
Capital letters	Select to include uppercase characters, define their minimal number.
Special characters	Select to include special characters, define their minimal number.
Digits	Select to include digits, define their minimal number.

Note: The sum of the enforced password requirements cannot be greater than the specified password length.

7. Click *Save*.



10.1.2 Editing a password changer policy

1. Select *Management* > *Password changers*.
2. Find and click desired object to open its configuration page.
3. Modify configuration parameters as needed.

Note: Unsaved changes are marked with an icon.

4. Click *Save*.

10.1.3 Deleting a password changer policy

1. Select *Management* > *Password changers*.
2. Find and select desired objects.
3. Click *Delete*.
4. Confirm deletion of selected objects.

Related topics:

- *Data model*
- *Accounts*
- *Custom password changers*
- *Setting up password changing on a Unix system*

10.2 Custom password changers

Custom password changers enable defining a set of commands executed on a remote host in order to change the password.

10.2.1 Defining a custom password changer

1. Select *Management* > *Password changers*.
2. Select *Custom changers* tab.
3. Click *+ Add*.
4. Define the password changer's name.
5. Click *+* to add a command.
6. Enter command.

Note: Commands allow usage of variables listed in the *List of available variables* section. Variables encapsulated in %% charachters will be replaced in all commands (e.g. `%%host%%`).

- *host* - IP address or hostname of the target system (using hostname requires configuring *DNS server*)
- *port* - port number
- *login* - user login
- *secret* - current user password
- *new_secret* - new password

7. Provide optional comments.
8. Repeat steps 5 through 7 to add additional commands.

Note: Drag and drop each command to change the execution order.

9. Repeat steps 5 through 8 and define a password verification commands in the *Password verification commands list* section.
10. Click *Save*.
11. *Define password change policy* and *assign the password changer to account*.

Note: Example

In this password changer example, the password is changed is triggered with the `passwd` command, followed by the current password string `secret` and the new secret repeated twice `new_secret`. The last command creates a file, which is later used to verify that the password has been changed successfully.

Password change

1. passwd
2. %%secret%%
3. %%new_secret%%
4. %%new_secret%%
5. touch /tmp/%%login%%.passwd-changed

Password verification

1. stat /tmp/%%login%%.passwd-changed | | exit 1
2. touch /tmp/%%login%%.passwd-verified

10.2.2 Editing a custom password changer

1. Select *Management* > *Password changers*.
2. Select *Custom changers* tab.
3. Click the name of desired password changer.
4. Edit selected commands.

5. Click *X* to remove selected command.
6. Click *Save*.

10.2.3 Deleting a custom password changer

1. Select *Management* > *Password changers*.
2. Select *Custom changers* tab.
3. Select desired elements and click *Delete*.
4. Confirm deleting selected objects.

Related topics:

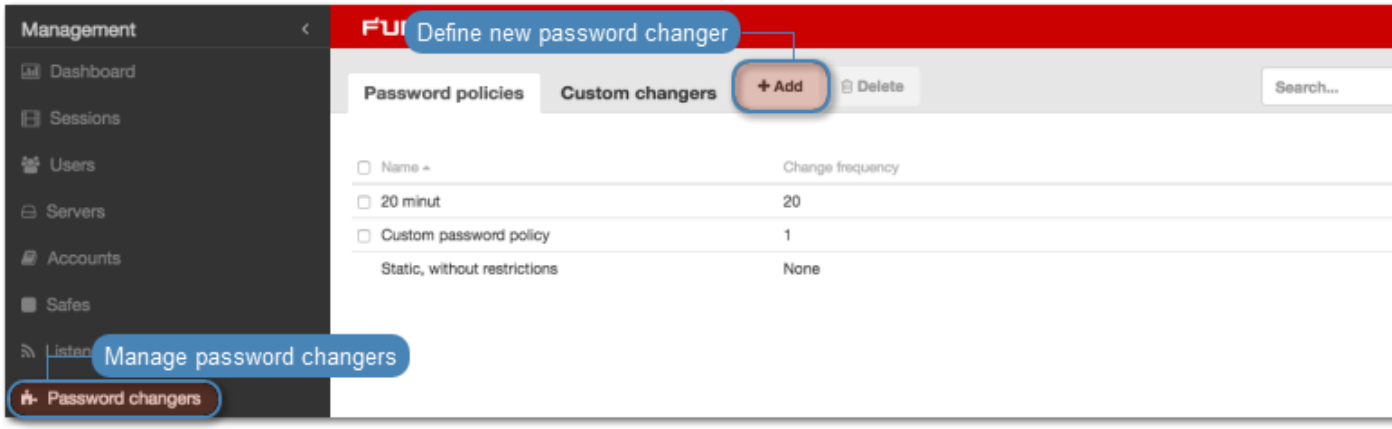
- *Data model*
- *Accounts*
- *Password changer policy*
- *Setting up password changing on a Unix system*

10.3 Setting up password changing on a Unix system

This topic contains an example of setting up password changing on a Unix system.

Adding a password change policy

1. Select *Management* > *Password changers*.
2. Click + *Add* to create a new password changing policy.



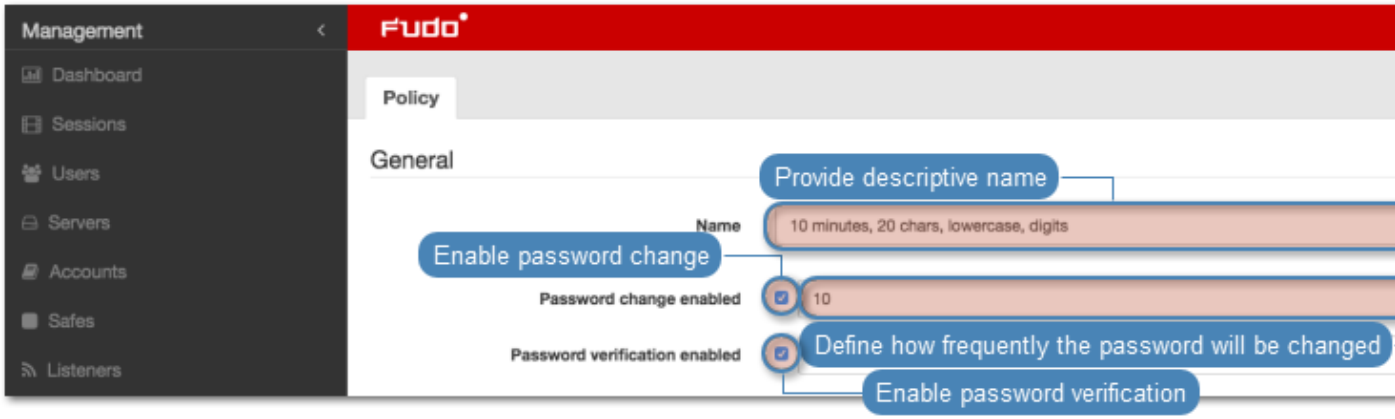
3. Provide password change policy name.

Note: Provide a descriptive name so that anyone administrating Wheel Fudo PAM can tell what the policy does at a glance. E.g. `10 minutes, 20 characters, special characters, uppercase`.

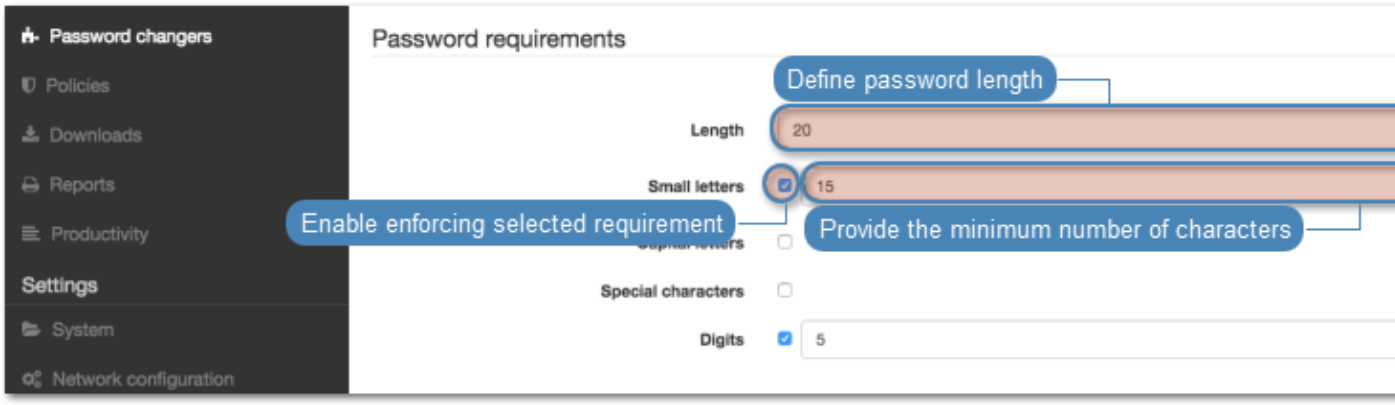
---

4. Select the *Password change enabled* option and define how frequently the password will be changed.

5. Select the *Password verification enabled* option and define how frequently the Secret Manager should verify whether the password has not been changed in any outher way but the Secret Manager itself.



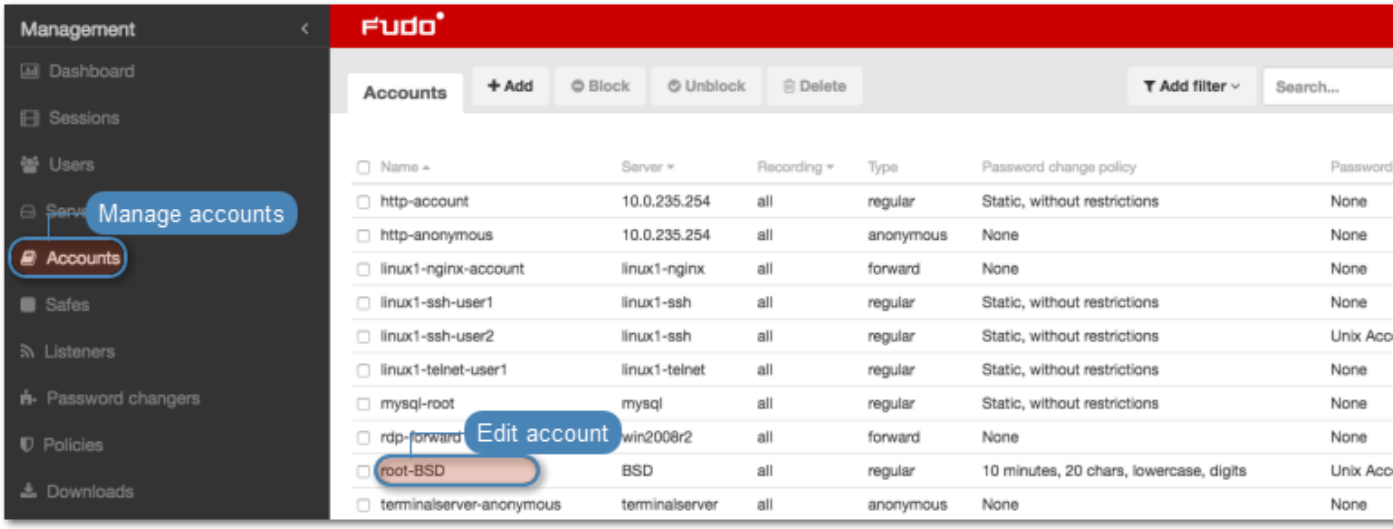
6. Provide the number of characters comprising the password.
7. Select desired password complexity options and provide the minimal number of characters for each.



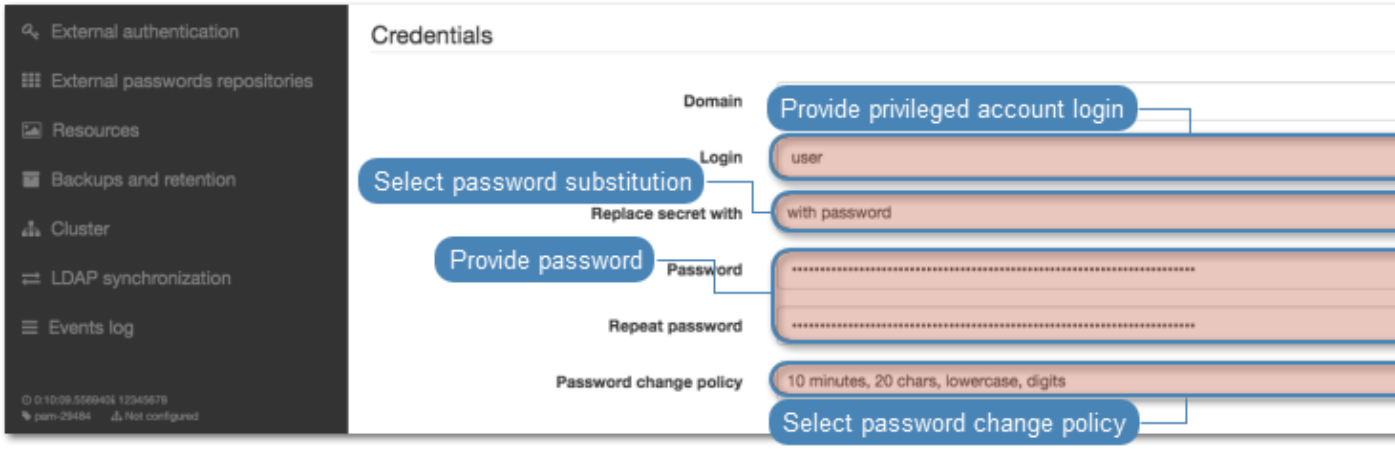
8. Click *Save* to store password changer policy.

Assigning password changer to the privileged account

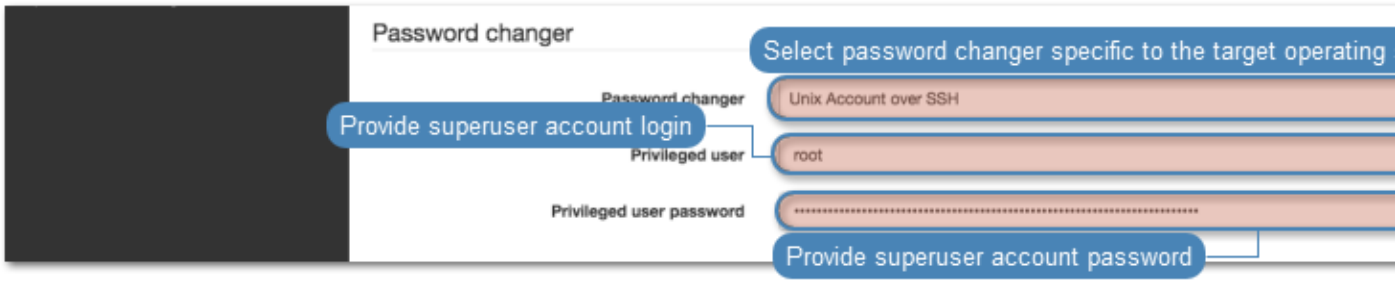
1. Select *Management* > *Accounts*.
2. Find and click desired account object.



3. Provide the privileged account login in the *Credentials* section.
4. Select `with password` from the *Replace secret* drop-down list.
5. Provide privileged account password.
6. Select your policy from the *Password change policy* drop-down list.



7. In the *Password changer* section, select the `Unix Account over SSH` from the *Password changer* drop-down list.
8. Provide superuser login credentials.



Note: Superuser account enables resetting the password in case the *Secret manager* detects

that it has been changed by someone else.

9. Click *Save*.

Related topics:

- *Requirements*
- *Data model*
- Configuration

10.4 Setting up password changing on Michrosoft Windows system

This topic contains an example of setting up password changing to Microsoft Windows account over WMI.

Note: Windows WMI password changer

Using Windows WMI password changers requires granting sufficient permissions to regular users.

- Run the `winrm quickconfig` command to detect any potential issues, turn on the *LocalAccountTokenFilterPolicy* option and unblock ports on internal firewall.
- In case the *winrm* is unavailable, execute the following command `cmd /c reg add HKLM\SOFTWARE\Microsoft\Windows\CurrentVersion\Policies\system /v LocalAccountTokenFilterPolicy /t REG_DWORD /d 1 /f`

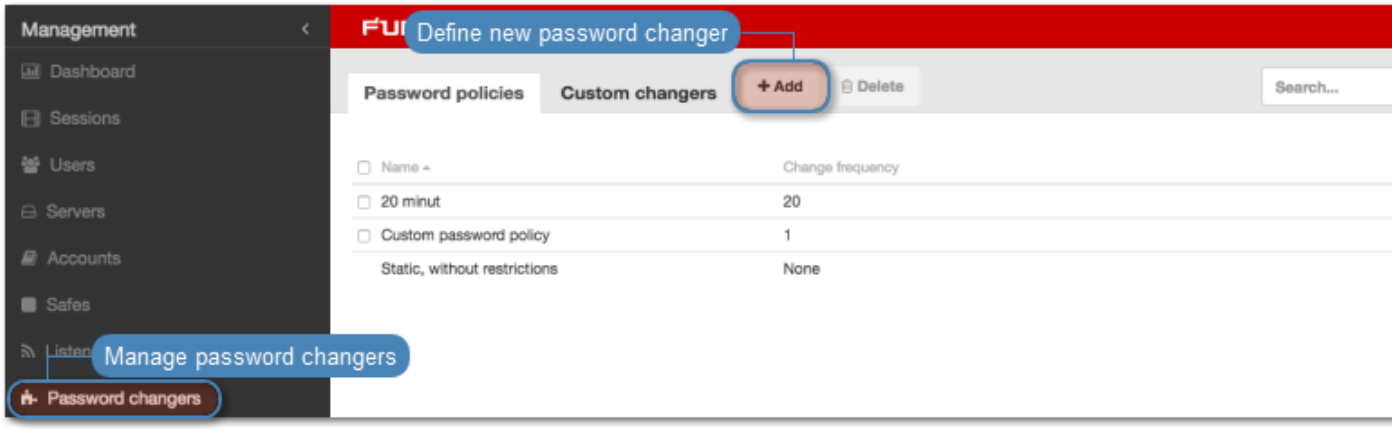
  Additionally, unblock WMI and DCOM ports and change the network interface type to *Office network*.

If neither of the above has brought expected results, the administrator must explicitely asign users and groups priviledges to WMI or DCOM using *wmimgmt.msc* and *dcomcnfg*:

- http://www-01.ibm.com/support/docview.wss?uid=swg21681046
- https://technet.microsoft.com/en-us/library/cc771551(v=ws.11).aspx

Adding a password change policy

1. Select *Management* > *Password changers*.
2. Click *+ Add* to create a new password changing policy.

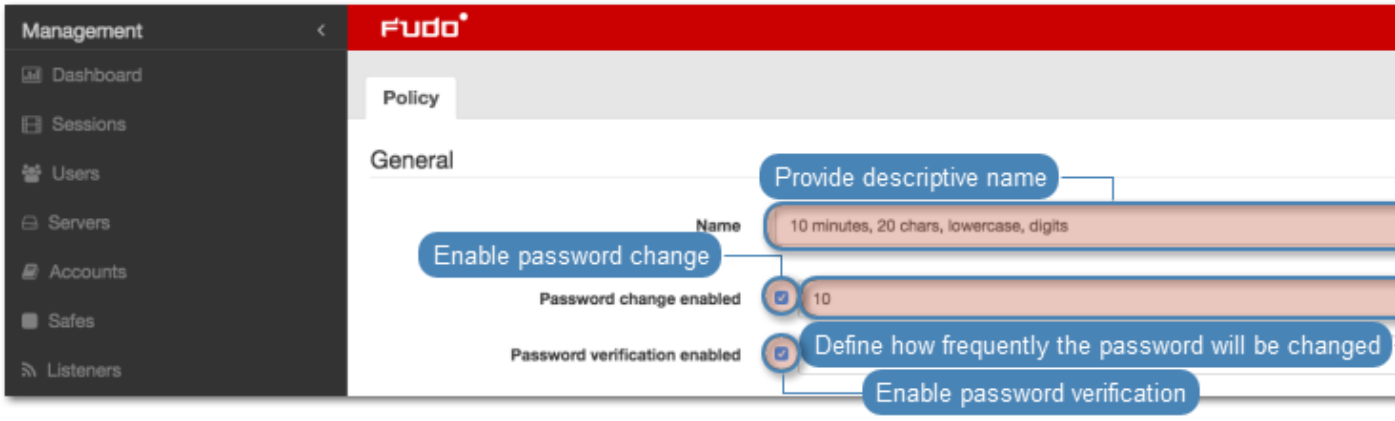


3. Provide password change policy name.

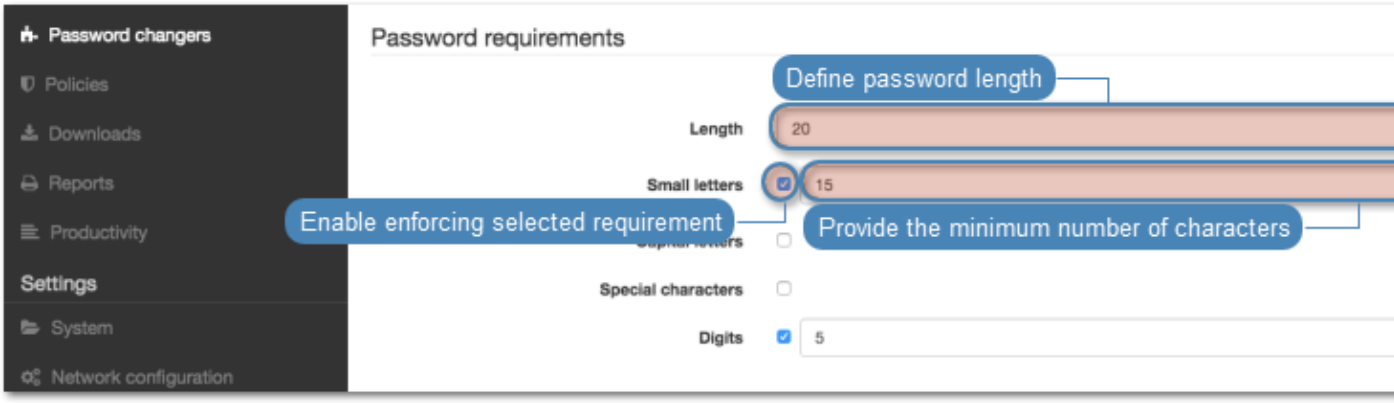
Note: Provide a descriptive name so that anyone administrating Wheel Fudo PAM can tell what the policy does at a glance. E.g. `10 minutes, 20 characters, special characters, uppercase`.

---

4. Select the *Password change enabled* option and define how frequently the password will be changed.
5. Select the *Password verification enabled* option and define how frequently the Secret Manager should verify whether the password has not been changed in any outher way but the Secret Manager itself.



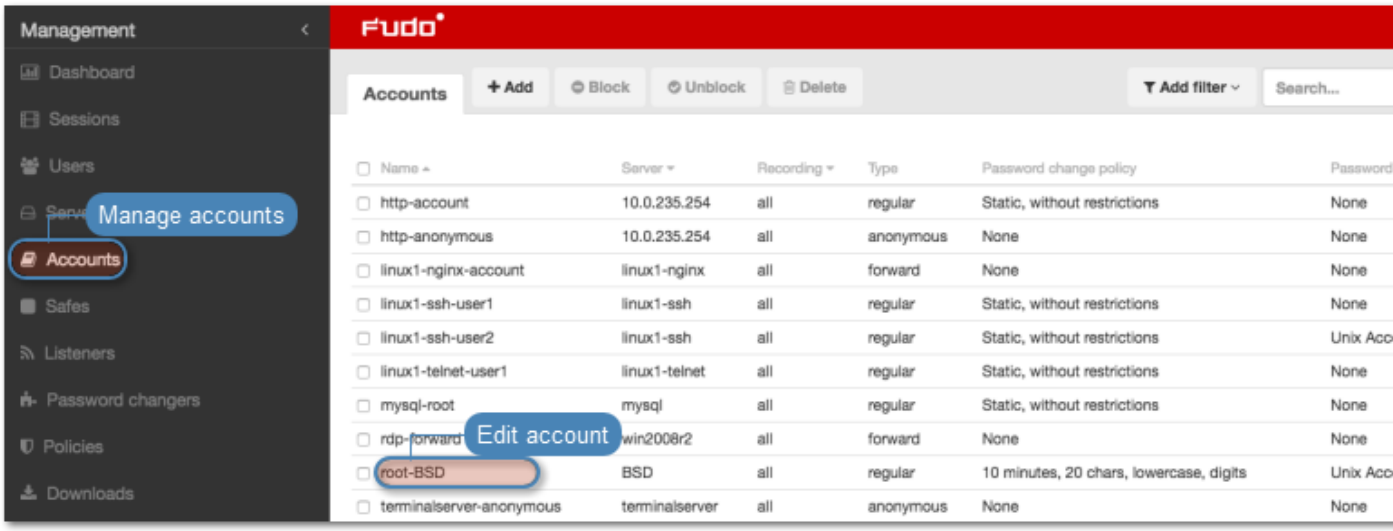
6. Provide the number of characters comprising the password.
7. Select desired password complexity options and provide the minimal number of characters for each.



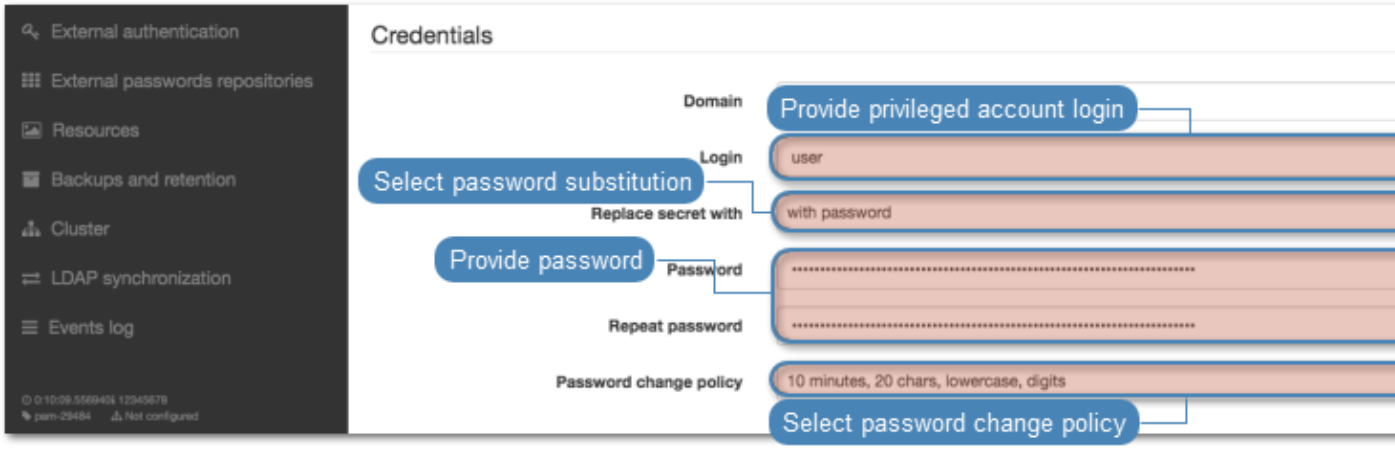
8. Click *Save* to store password changer policy.

Assigning password changer to the privileged account

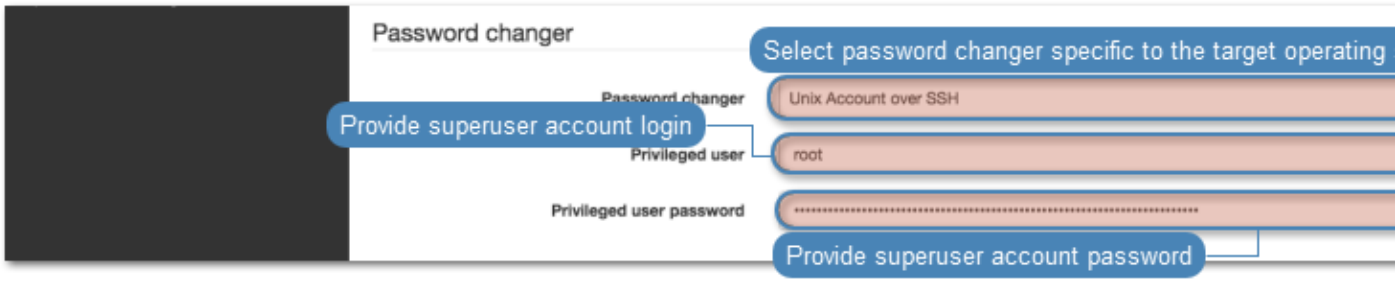
1. Select *Management* > *Accounts*.
2. Find and click desired account object.



3. Provide the privileged account login in the *Credentials* section.
4. Select `with password` from the *Replace secret* drop-down list.
5. Provide privileged account password.
6. Select your policy from the *Password change policy* drop-down list.



7. In the *Password changer* section, select the `Unix Account over SSH` from the *Password changer* drop-down list.
8. Provide superuser login credentials.



Note: Superuser account enables resetting the password in case the *Secret manager* detects that it has been changed by someone else.

---

9. Click *Save*.

Related topics:

- *Requirements*
- *Data model*
- Configuration

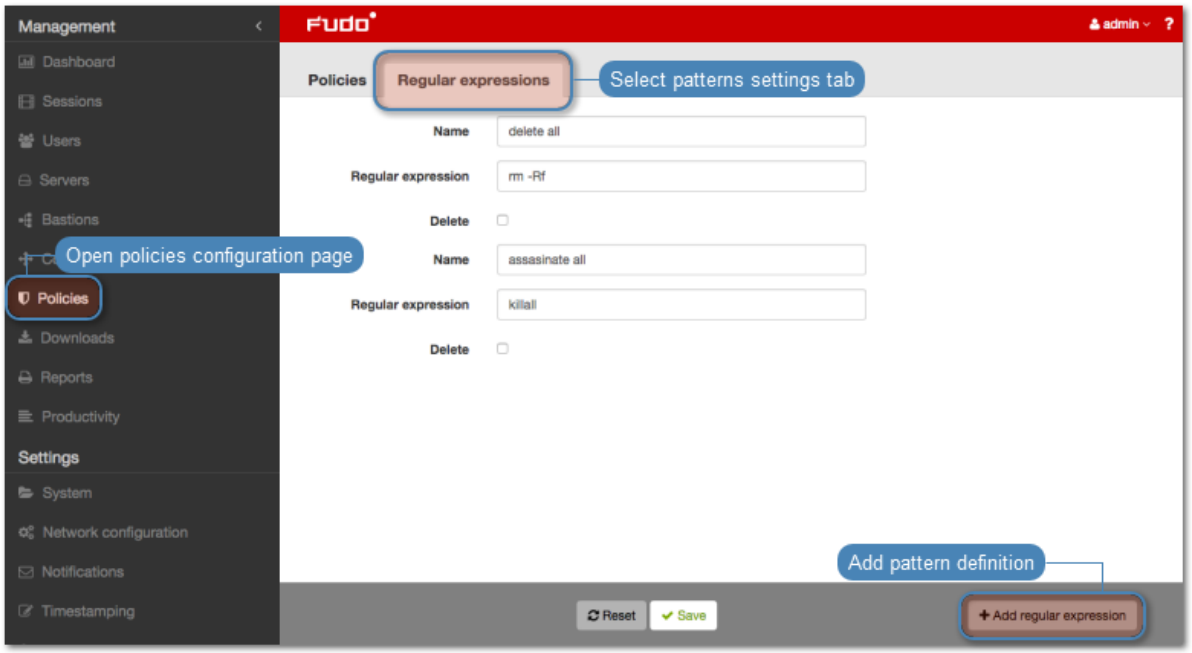
CHAPTER 11

Policies

Policies are patterns definitions facilitating proactive session monitoring. In case a defined pattern is detected, Wheel Fudo PAM can automatically pause or terminate given connection, block the user and send notification to Wheel Fudo PAM administrator.

Defining patterns

1. Select *Management* > *Policies*.
2. Select *Regular expressions* tab.
3. Click + *Add regular expression*.

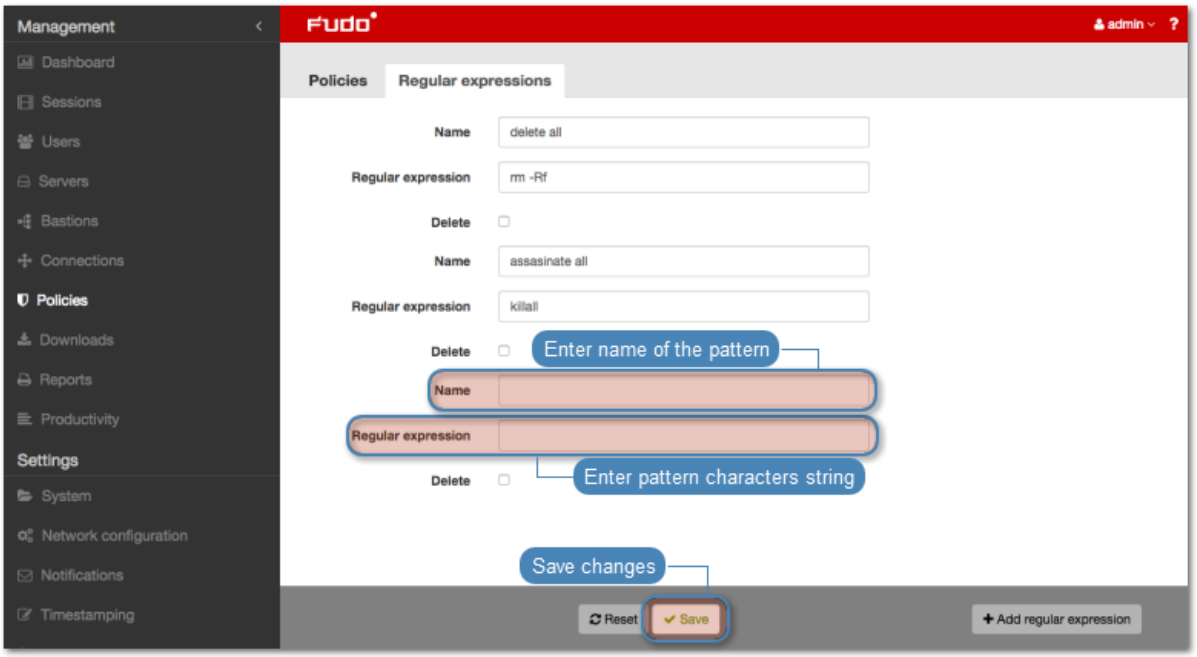


4. Enter pattern name.
5. Define the pattern itself.

Note: Patterns can be defined as regular expressions.

Wheel Fudo PAM does not recognize expressions which use backslash character, e.g. `\d`, `\D`, `\w`, `\W`.

6. Repeat steps 3-5 to define additional patterns.
7. Click Save.



Note: Regular expressions examples

Command `rm`

`(^|[^a-zA-Z])rm[[:space:]]`

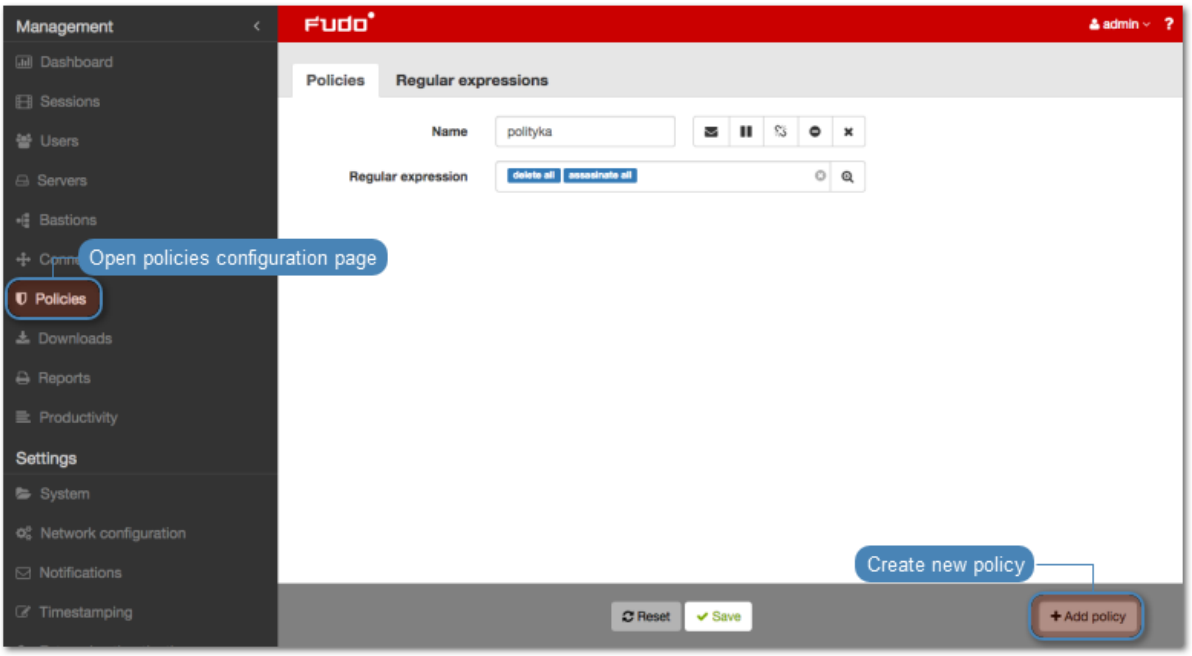
Command `rm -rf` (*also* `-fr`; `-Rf`; `-fR`)

`(^|[^a-zA-Z])rm[[:space:]]+-([rR]f|f[rR])`

Command `rm file` `(^|[^a-zA-Z])rm[[:space:]]+([^[:space:]]+[[:space:]]*)?/full/path/to/a/file([[:space:]]|\;|$)` `(^|[^a-zA-Z])rm[[:space:]]+.*justafilename`

Defining policies

1. Select *Management* > *Policies*.
2. Click Add policy.

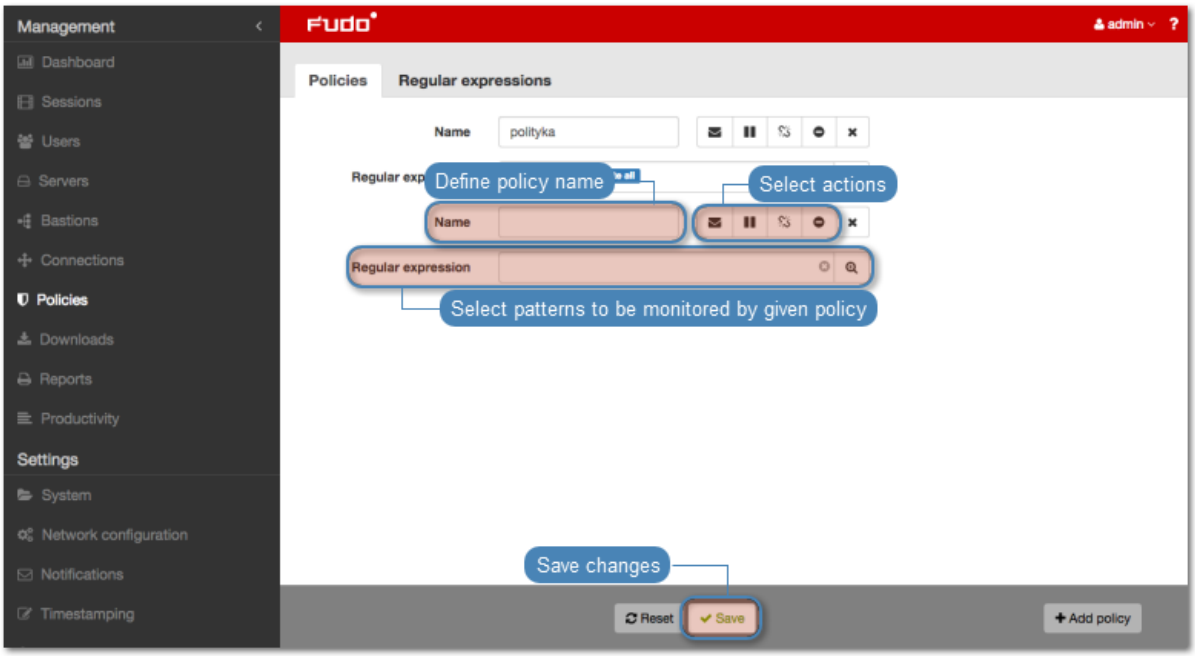


3. Enter policy name.
4. Select actions.

	Send email notification to system administrator.
	Pause connection.
	Terminate connection.
	Block user.

Note: Note that terminating connection also blocks the user account and vice versa - blocking user automatically terminates user's connections.

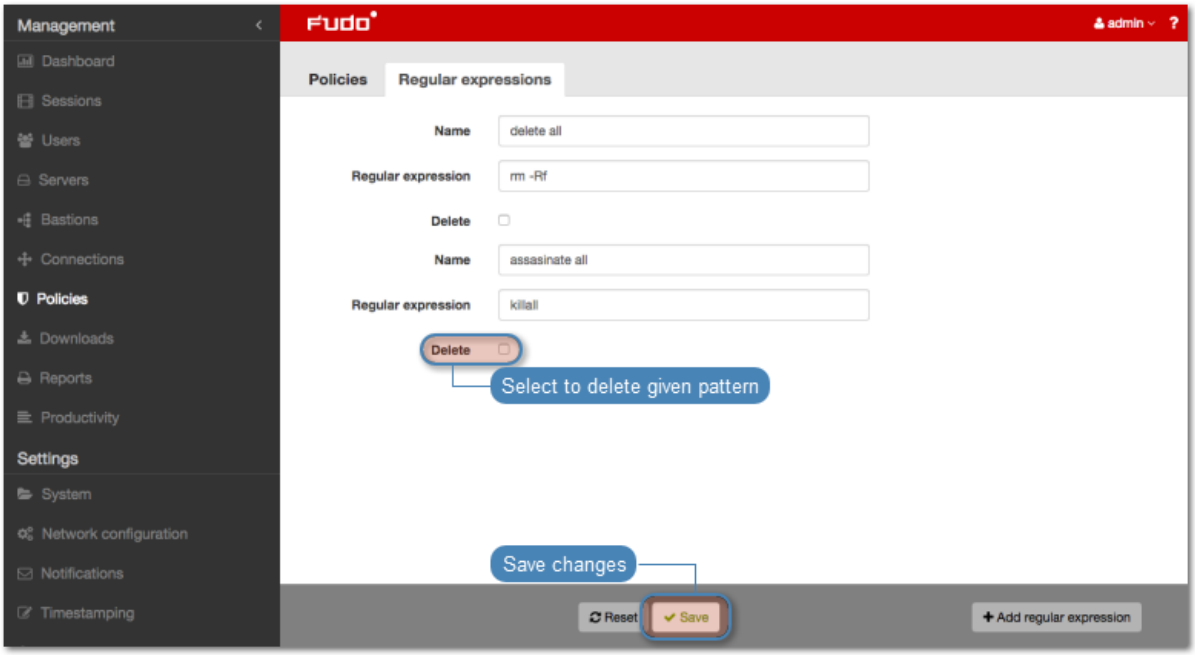
5. Select monitored patterns.
6. Click Save.



Note: After defining a policy, you can assign it to a particular server configured in connection.

Deleting patterns

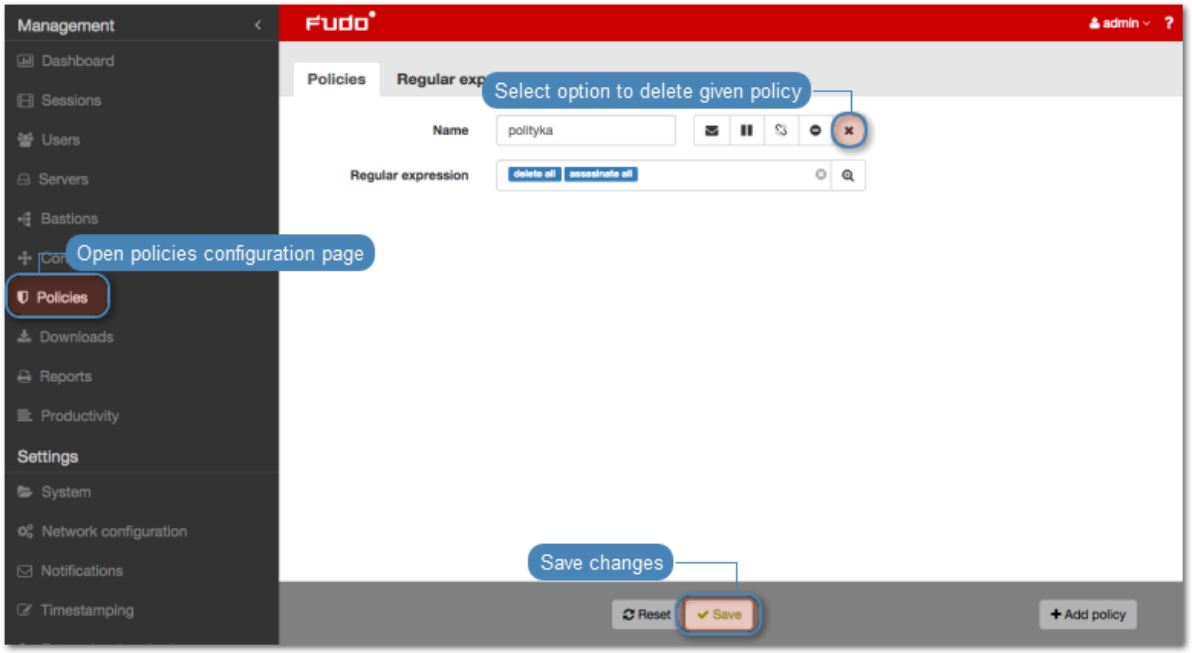
1. Select *Management* > *Policies*.
2. Select the *Regular expressions* tab.
3. Find desired pattern definition and select the *Delete* option.
4. Click *Save*.



Deleting policies

To delete policy definition, proceed as follows.

1. Select *Management* > *Policies*.
2. Find desired policy definition and select corresponding Delete option.
3. Click Save.



Related topics:

- *Terminating connection*
- *Notifications*
- *Accounts*
- *Security*

CHAPTER 12

Sessions

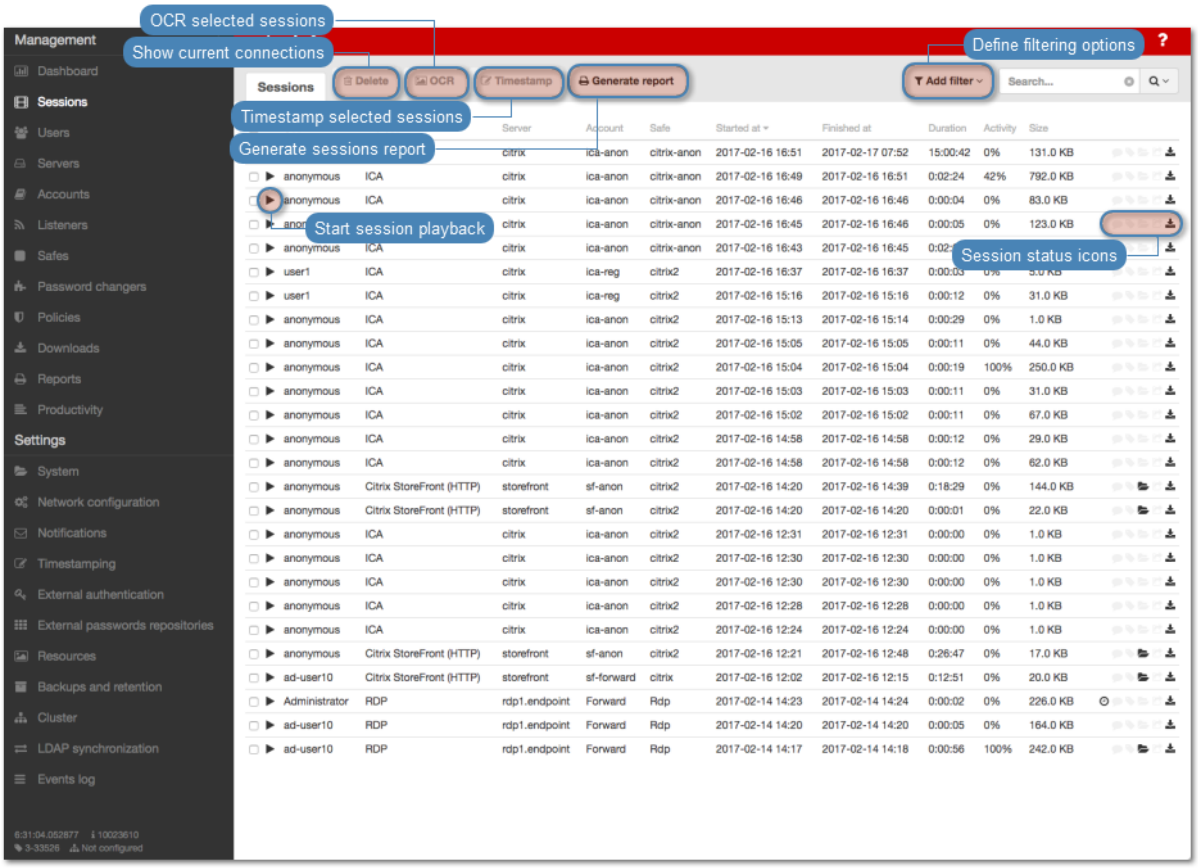
Wheel Fudo PAM stores all recorded servers access sessions, allowing to playback, review, delete and export to one of supported video format.

Sessions management page allows filtering stored user sessions, accessing current users connections and downloading stored sessions. It also provides status information on each session and enables access to session sharing options.

Icon	Description
▶	Start session playback (*applicable to sessions with the entire traffic recording option selected in connection properties*).
	Icon indicating that session has been timestamped.
	Purpose why the user has connected to the server.
	Session has been commented.
	Session has been processed for full-text search purposes.
	Access session sharing management options.
	Download session material i selected file format (*applicable to sessions with either complete or raw traffic recording option selected in connection properties*).
	User activity monitor (*applicable to live sessions*).

To open sessions management page, select *Management* > *Sessions*.

Note: Wheel Fudo PAM stores compressed session material which may result in differences between the displayed and the actual session size.

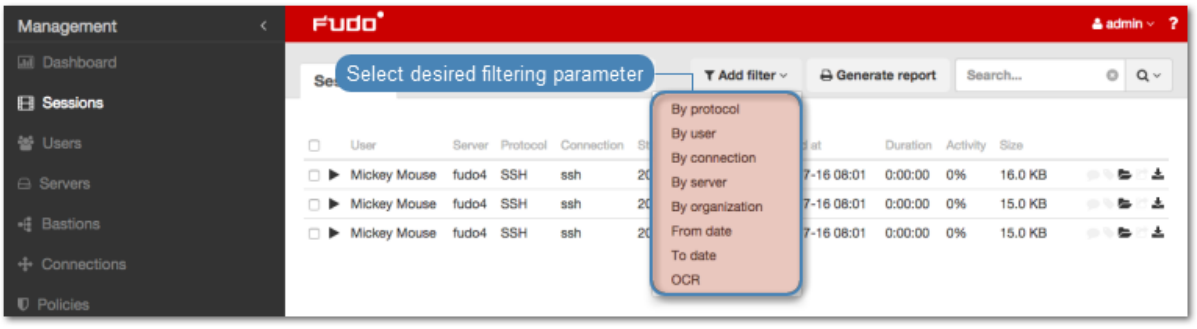


12.1 Filtering sessions

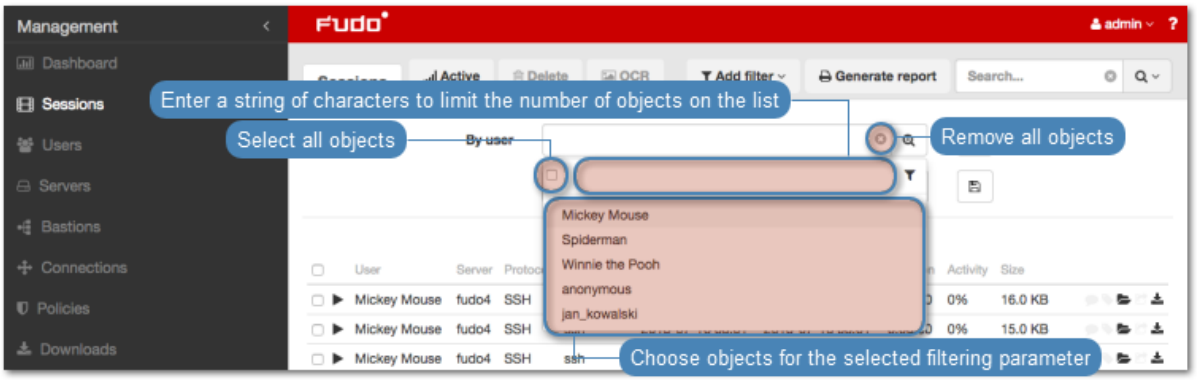
Sessions filtering allows to find desired sessions easily by limiting the number of displayed sessions on the sessions management page.

12.1.1 Defining filters

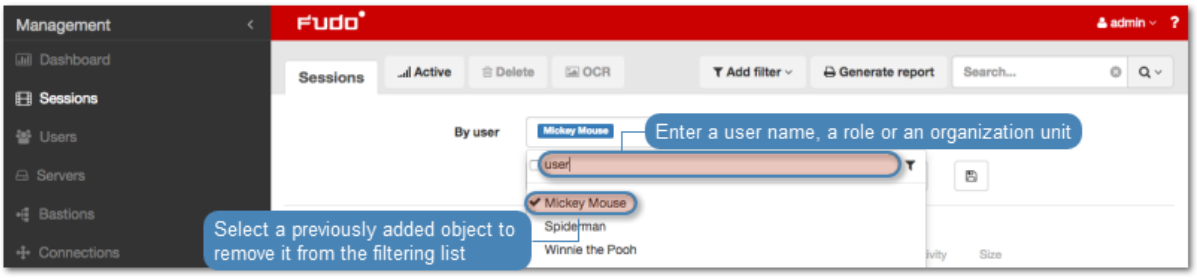
1. Click *Add Filters* and select desired data type from the drop-down list.



2. Select desired values for the given filtering type parameter.

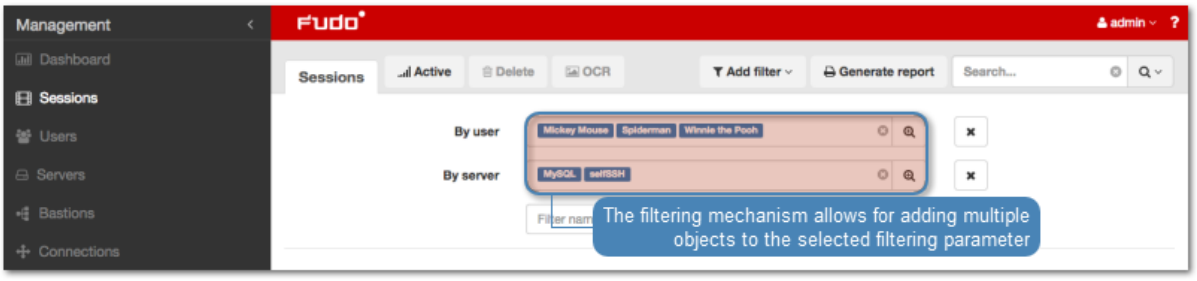


Note: Enter a string of characters to limit the number of the elements on the list. In case of users, the elements on the list can be limited to those who have a given user role assigned or belong to the given organization unit.



Select a previously added object to remove it from the filter.

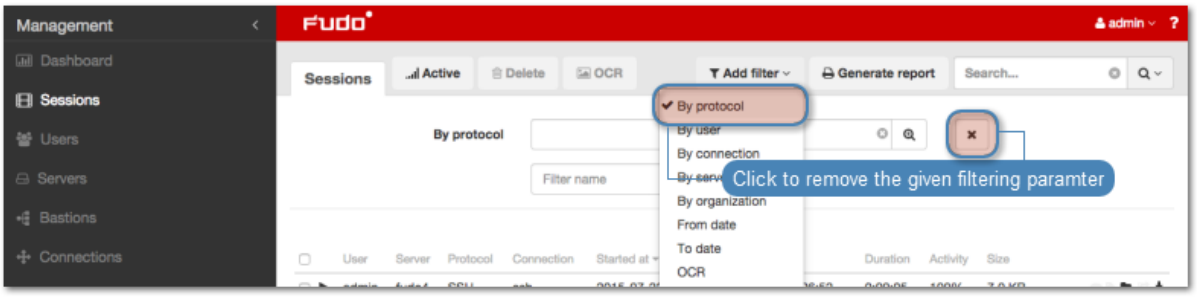
Protocol, user, connection, server and organization parameters allow for selecting multiple objects of the given type.



3. Repeat steps 2 and 3 to define additional filters.

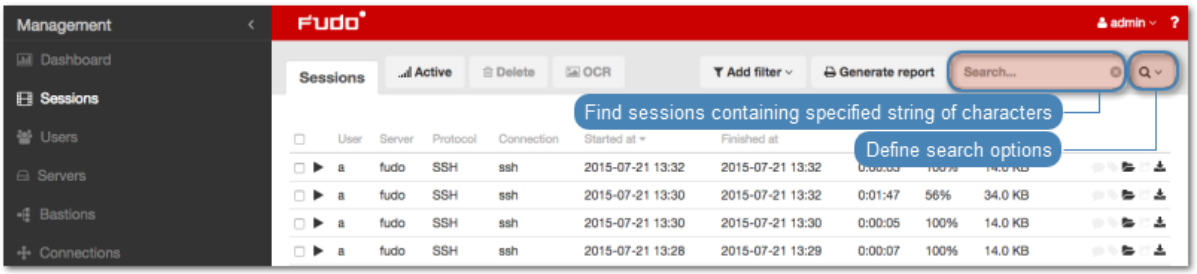
Note: Only sessions which match all defined filtering parameters will be displayed.

4. Click *Add Filter* and select previously added filtering parameter to disable given filter.



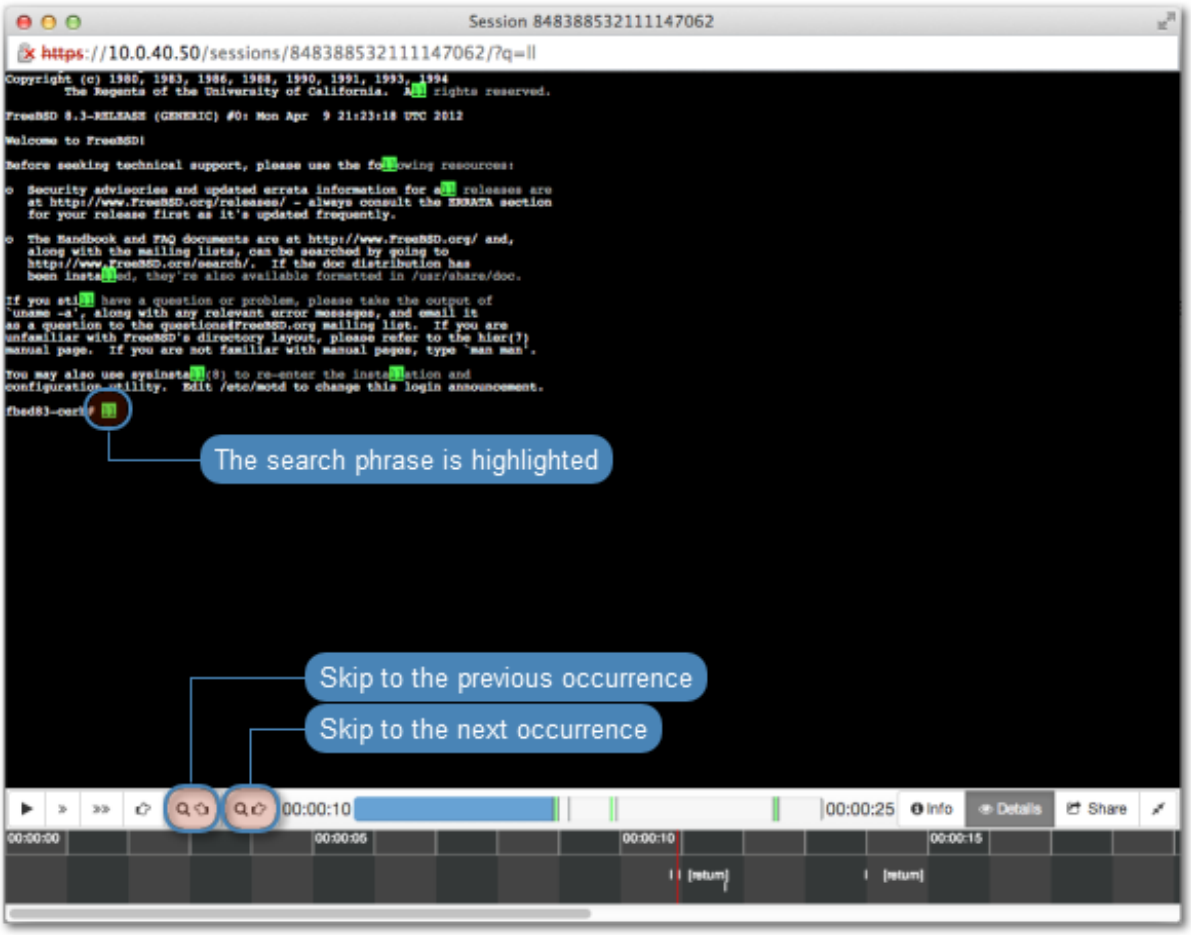
12.1.2 Full text search

Wheel Fudo PAM enables searching stored data to limit the number of elements on the sessions list only to those containing the specified phrase.



Note: Playing a session containing the specified phrase starts from the moment of its first occurrence.

The player allows for skipping between each occurrence of the specified phrase.

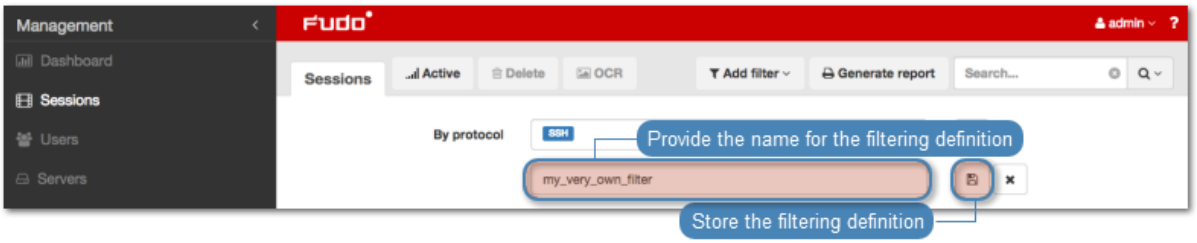


12.1.3 Managing user defined filter definitions

Current filtering settings can be stored as a user defined filtering preset for the convinience of the system's operator.

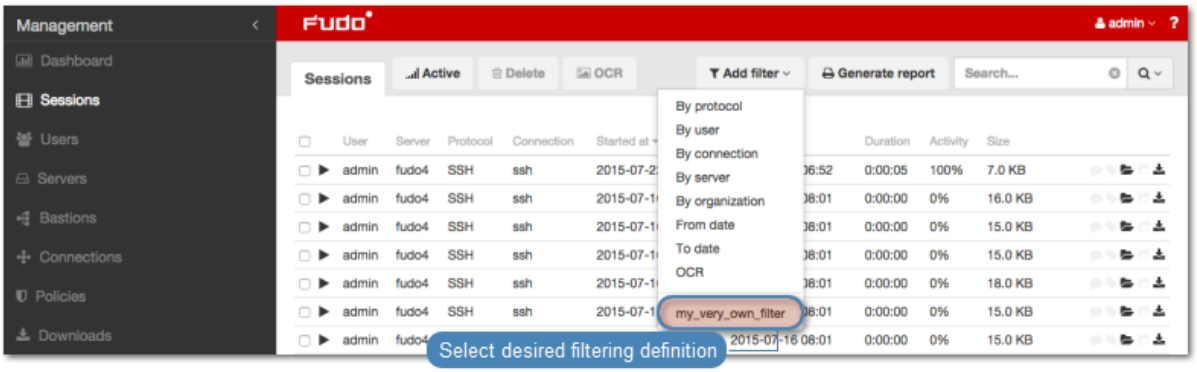
Storing a user defined filter definition

1. Define filtering options as described in the *Filtering sessions* section.
2. Provide the name for the filter definition.
3. Click the save icon to store the filter definition.



Editing a user defined filter definition

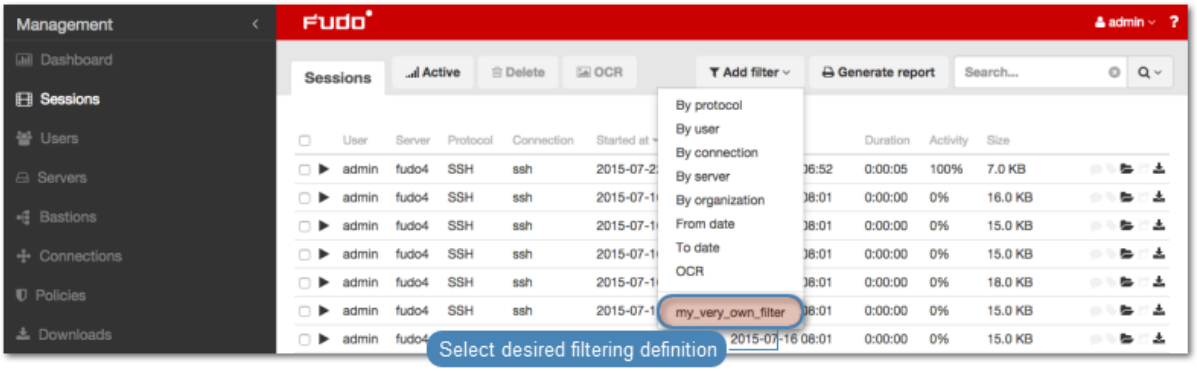
1. Click *Add filter* and select the desired filter definition.



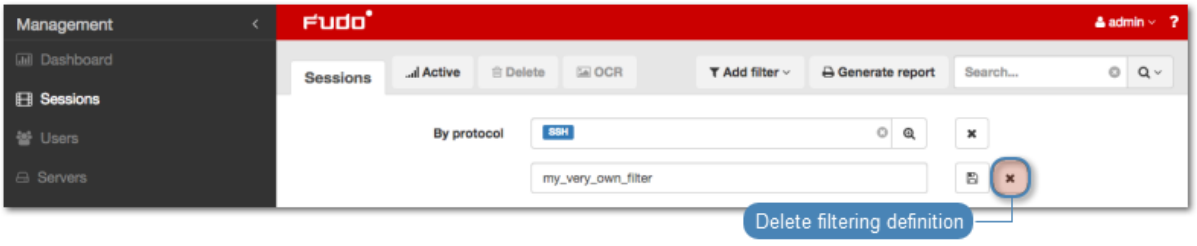
2. Change the filtering parameters as desired.
3. Click the save icon to store changes in the filter definition.

Deleting a user defined filter definition

1. Click *Add filter* and select the desired filter definition.



2. Click the delete icon to remove the filtering definition.



3. Confirm deleting the selected filtering definition.

Related topics:

- *System overview*
- *Reports*

12.2 Viewing sessions

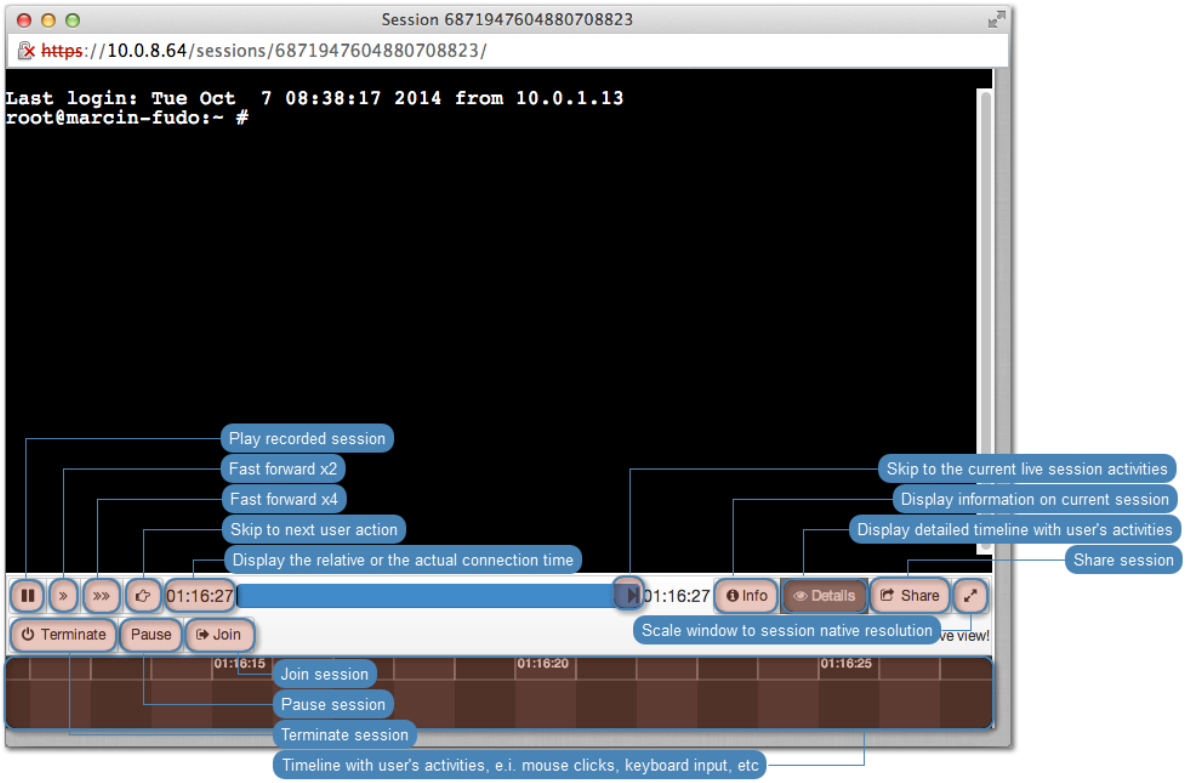
Wheel Fudo PAM allows viewing recorded sessions as well as current user connections.

To view a session, proceed as follows.

1. Select *Management* > *Sessions*.
2. Find desired session and click the play icon next to it.

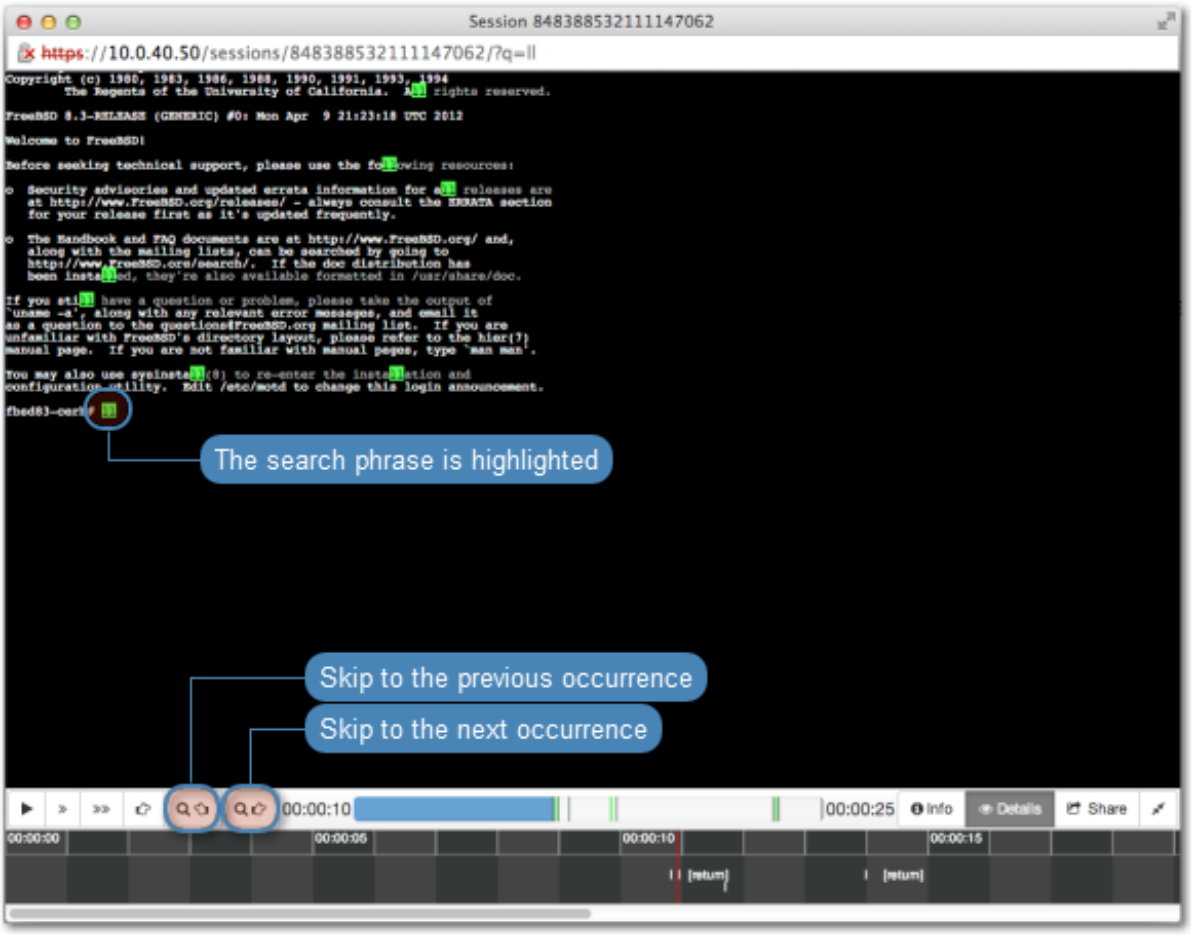
Session player options

Note: Some options are available for live sessions only.

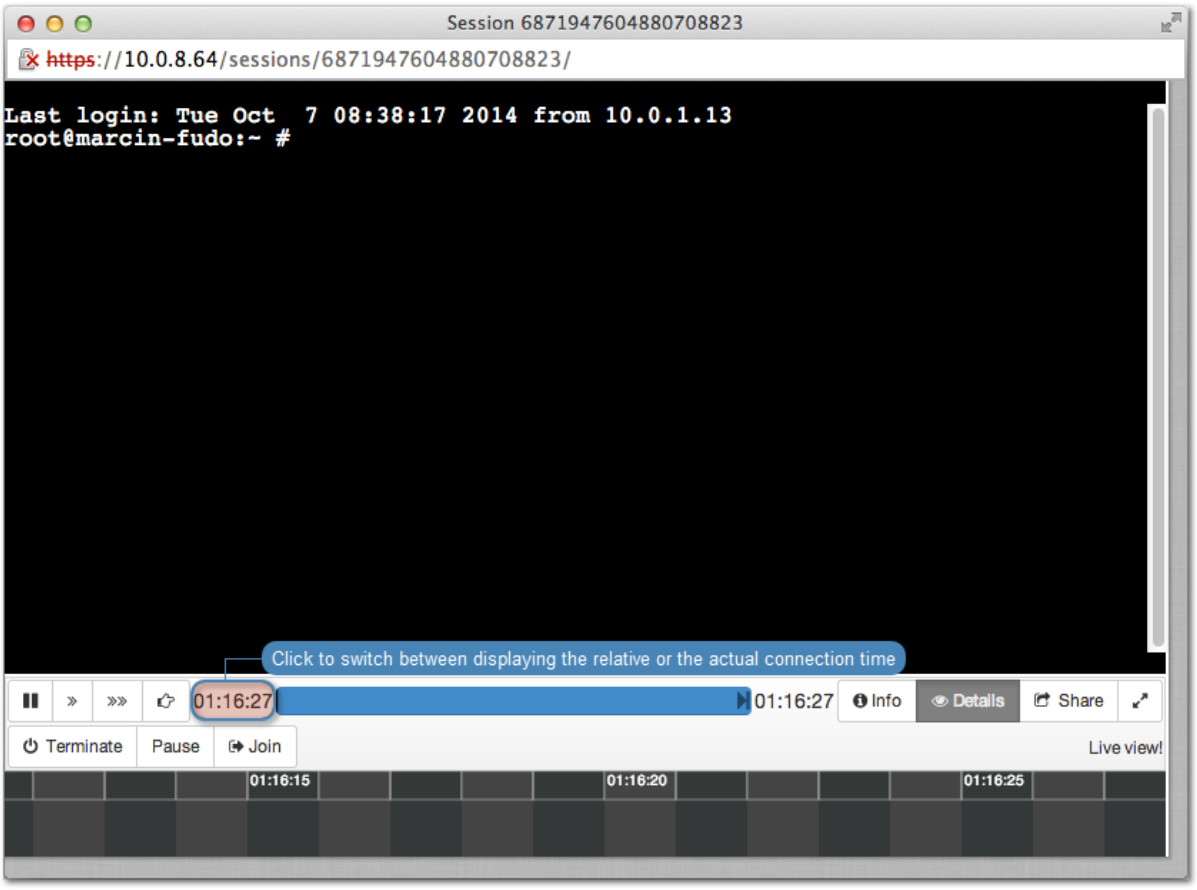


Note: Playing a session containing the specified phrase starts from the moment of its first occurrence.

The player enables skipping between each occurrence of the specified phrase.



Note: Click the displayed elapsed time to switch between the connections's actual and relative time.



Related topics:

- *Sensitive features*

12.3 Viewing live sessions

Wheel Fudo PAM enables viewing current connection sessions, allowing to supervise user's activities.

1. Select *Management* > *Sessions*.
2. Click *Add filter* and select *Active*.
3. Select *Yes* from the drop-down list.
4. Find desired session and click the play icon to start playback.

Related topics:

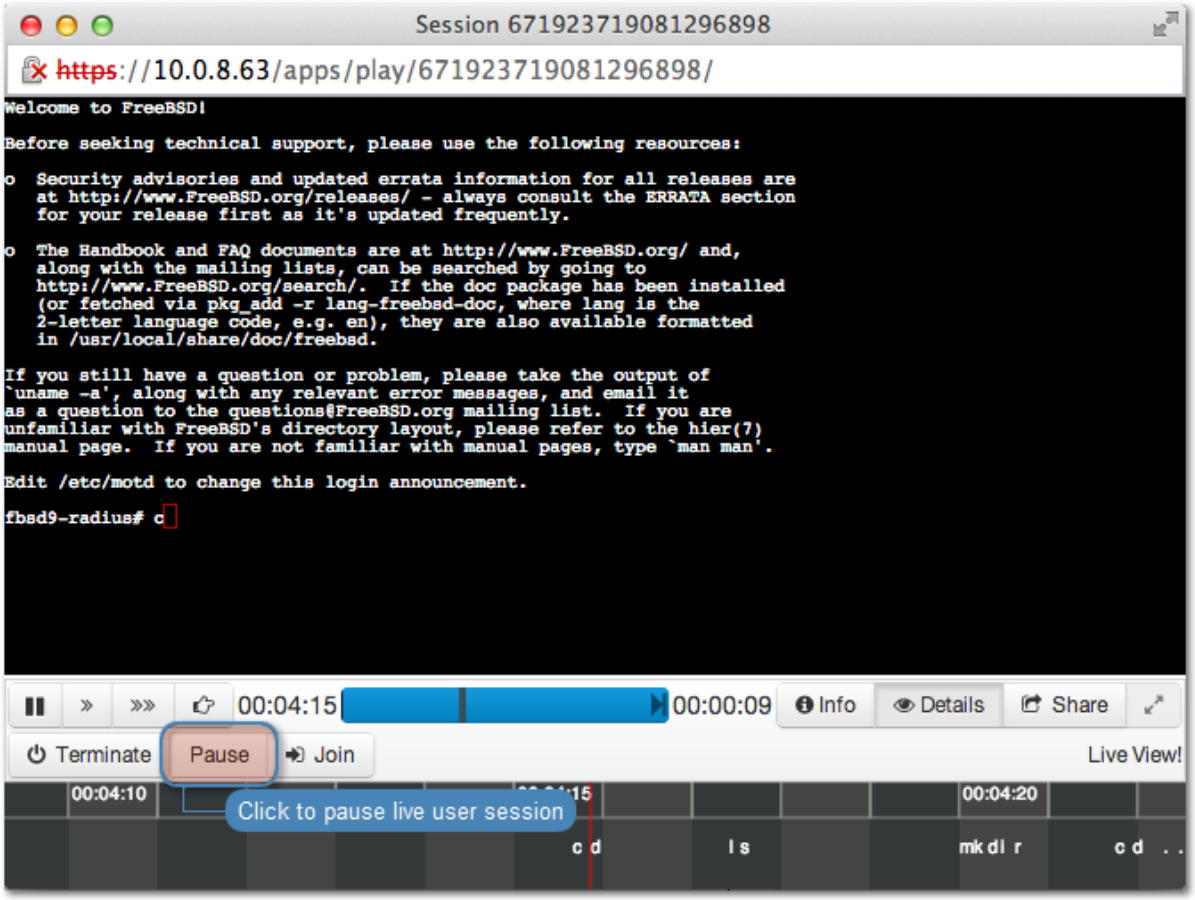
- *Viewing sessions*
- *Terminating connection*

12.4 Pausing connection

In case a current user action requires analysis, the connection to the server can be paused.

Note: Pausing connection temporarily suspends data transmission. After resuming connection, buffered user's actions are forwarded to the server.

1. Select *Management* > *Sessions*.
2. Click *Add filter* and select *Active*.
3. Select *Yes* from the drop-down list.
4. Find desired session and and click the play icon to start playback.
5. Click *Pause*.



Related topics:

- *Replaying session*
- *Joining session*
- *Filtering session*

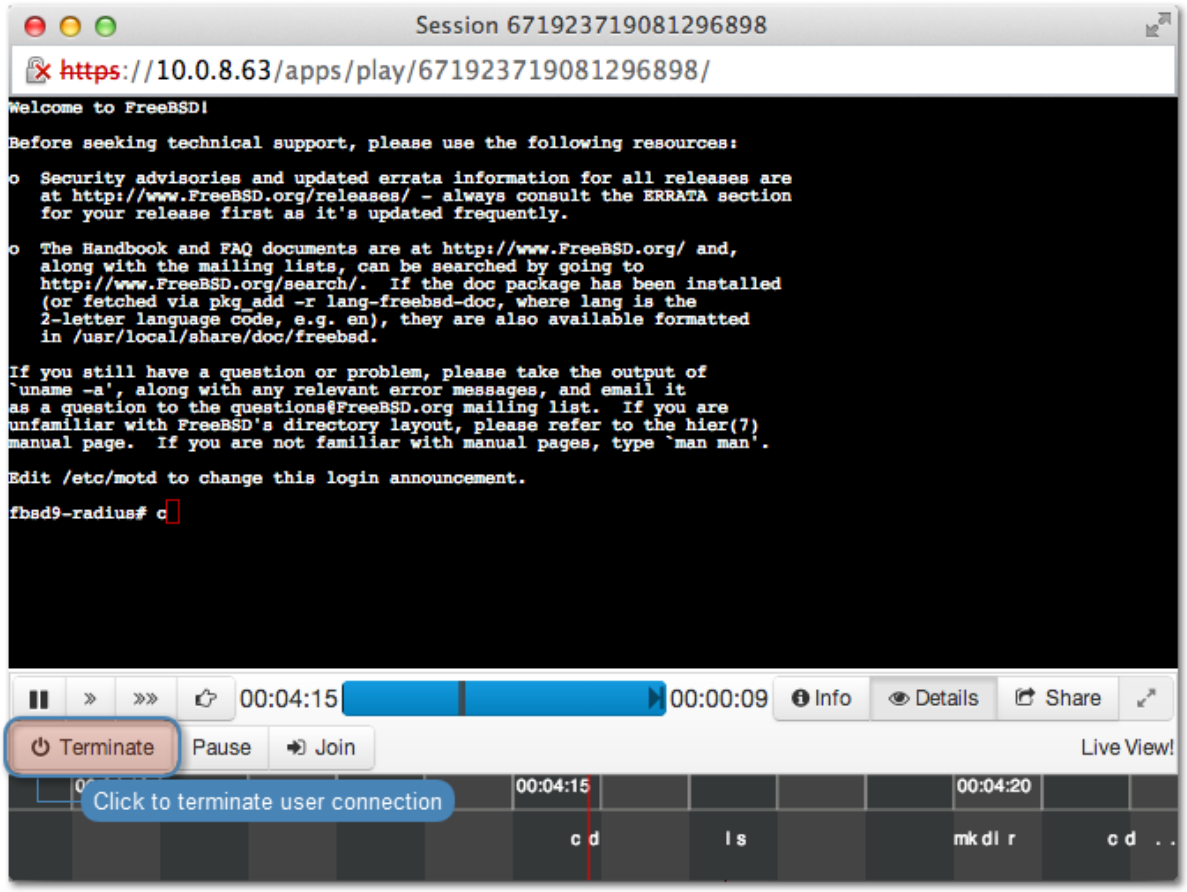
12.5 Terminating connection

In case the administrator notices access rights misuse, Wheel Fudo PAM allows to terminate the session and automatically block given user.

Note: Wheel Fudo PAM can automatically block user account upon detecting a defined pattern. For more information refer to *Policies*.

1. Select *Management* > *Sessions*.
2. Click *Add filter* and select *Active*.
3. Select *Yes* from the drop-down list.
4. Find desired session and click the playback icon to start playback.
5. Click *Terminate*.

Note: Terminating connection automatically blocks given user.



6. Decide whether the user should remain blocked or not.

Related topics:

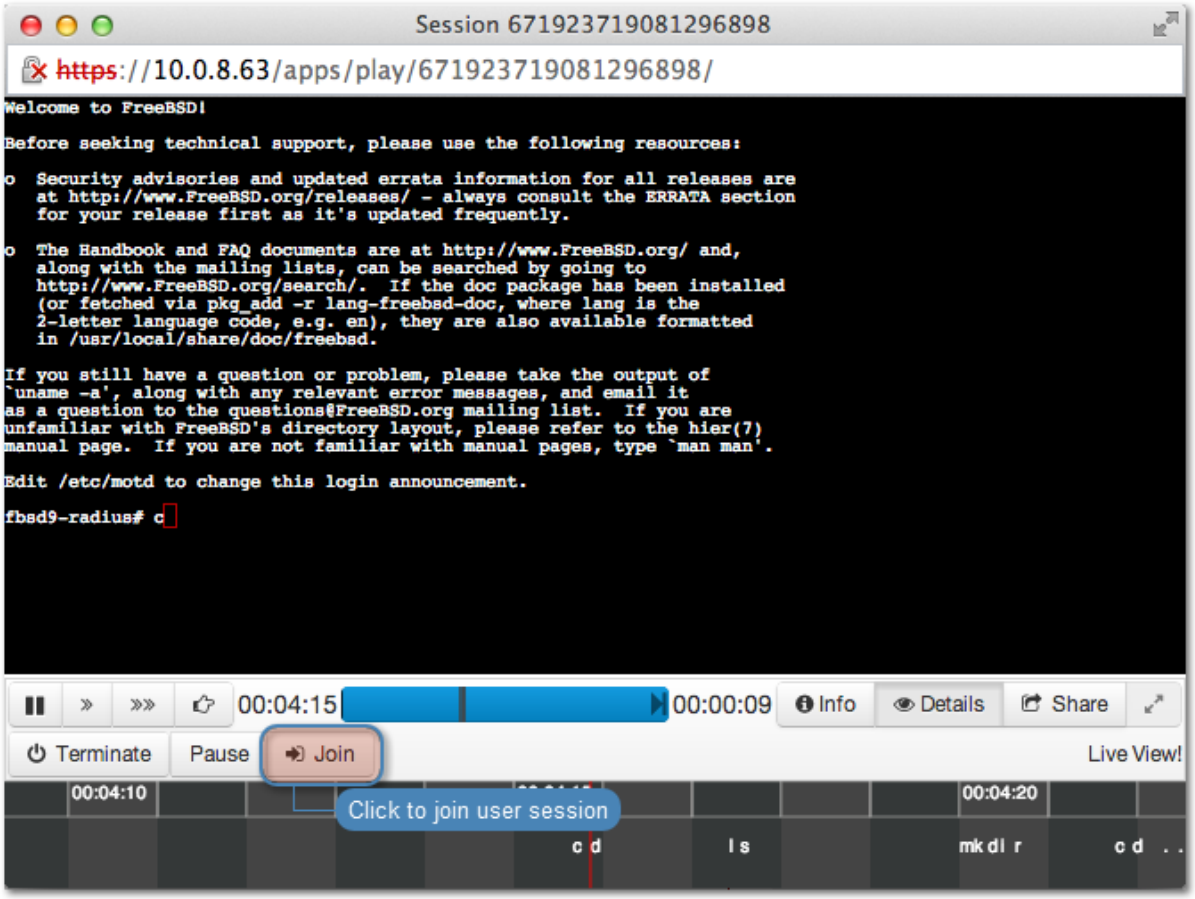
- *Policies*
- *Security measures*
- *Joining live session*
- *Sharing sessions*
- *Filtering sessions*

12.6 Joining live session

Wheel Fudo PAM allows joining an ongoing session to work simultaneously with the remote user.

To join currently established session, proceed as follows.

1. Select *Management* > *Sessions*.
2. Click *Add filter* and select *Active*.
3. Select *Yes* from the drop-down list.
4. Find desired session and and click the play icon to start playback.
5. Click *Join*.



Related topics:

- *Replaying sessions*
- *Sharing sessions*
- *Filtering sessions*

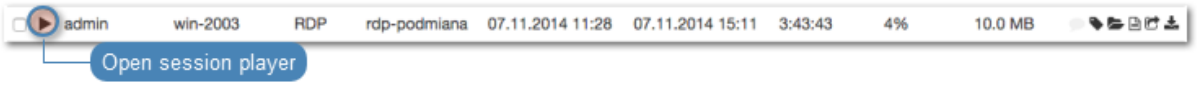
12.7 Sharing sessions

Wheel Fudo PAM enables sharing given session with another user.

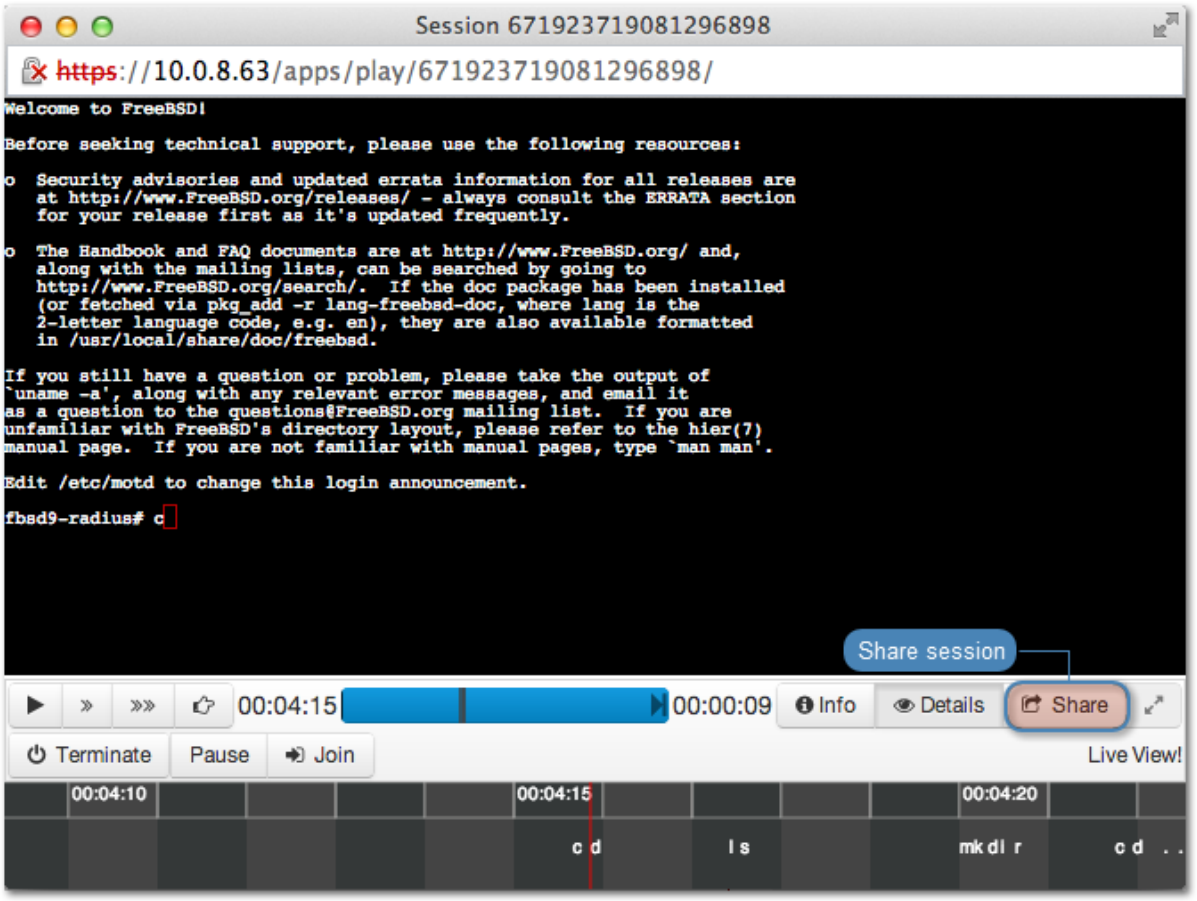
Sharing a session

To share a session, proceed as follows.

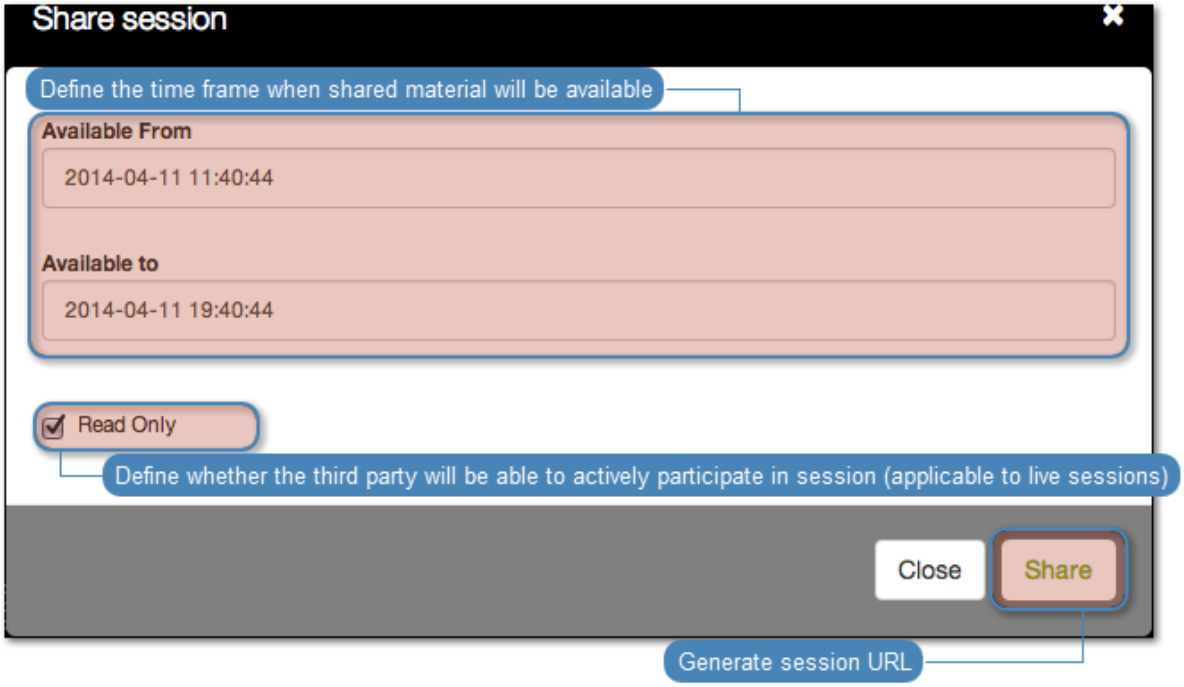
1. Select *Management* > *Sessions*.
2. Find desired session and and click the play icon to start playback.



3. Click *Share*.



4. Provide session availability time frame and click *Confirm* to generate URL.

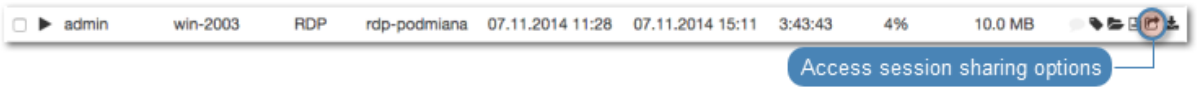


5. Copy the system generated URL and click *Close*.

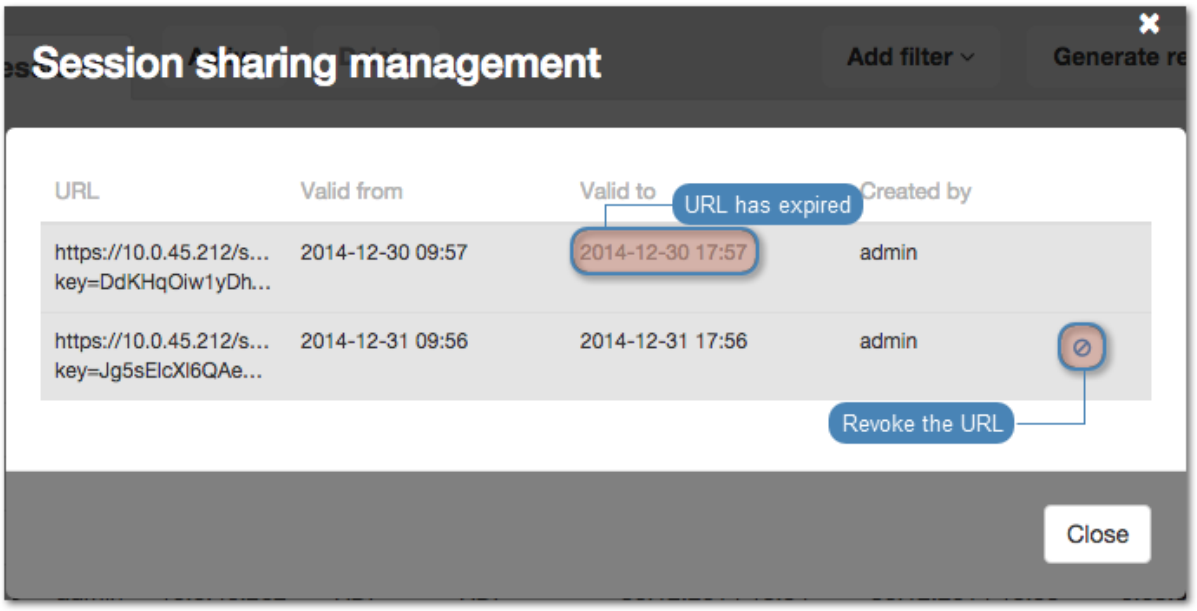
Revoking session URL

To revoke a session URL, proceed as follows:

1. Select *Management* > *Sessions*.
2. Find desired session and click the *share* icon to display sessions sharing management options.



3. Click the *revoke* icon to deactivate given URL.



Related topics:

- *Replaying sessions*
- *Joining sessions*
- *Filtering sessions*

12.8 Commenting sessions

Wheel Fudo PAM enables adding comments and tags to recorded sessions.

Adding a comment

1. Select *Management* > *Sessions*.
2. Find desired session and click the playback icon to start playback.
3. Click *Details*.
4. Click the lower part of the timeline to add a comment.
5. Define time interval which applies to this comment.

Note: Click and drag either side of the tag to change the starting/ending time.

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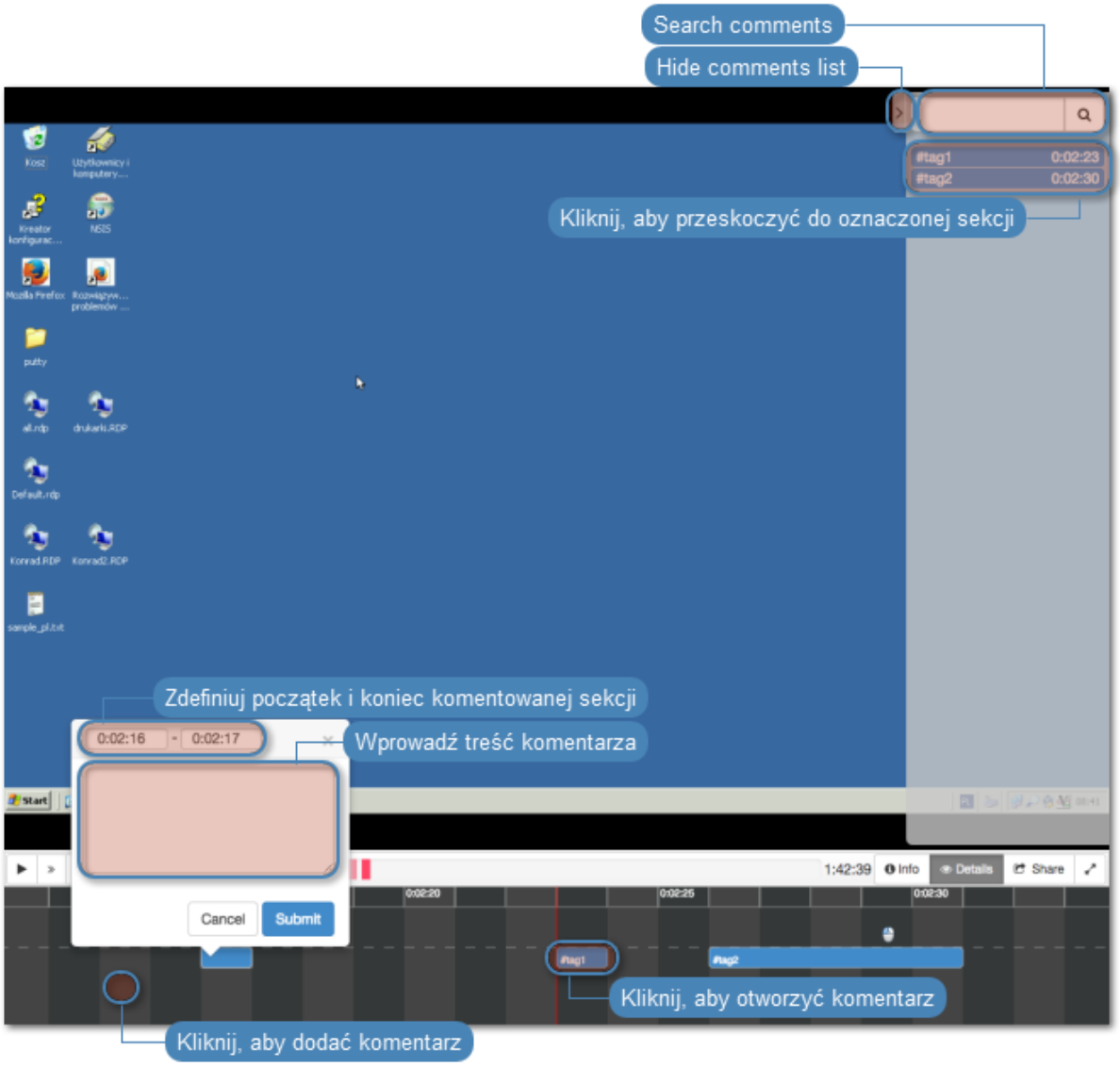
6. Add comment.
7. Click *Submit*.



Editing a comment

1. Select *Management* > *Sessions*.
2. Find desired session and click the playback icon to start playback.
3. Click *Details*.
4. Find and click desired comment.
5. Click the edit icon.
6. Change the comment and *Submit*.

Deleting a comment

1. Select *Management* > *Sessions*.
2. Find desired session and click the playback icon to start playback.
3. Click *Details*.
4. Find and click desired comment.

5. Click the trashcan icon.
6. Click *Delete* to delete the comment.

Replying to a comment

1. Select *Management* > *Sessions*.
2. Find desired session and click the playback icon to start playback.
3. Click *Details*.
4. Find and click desired comment.
5. Click *Reply*.
6. Enter message and click *Submit*.

Related topics:

- *Sensitive features*

12.9 Exporting sessions

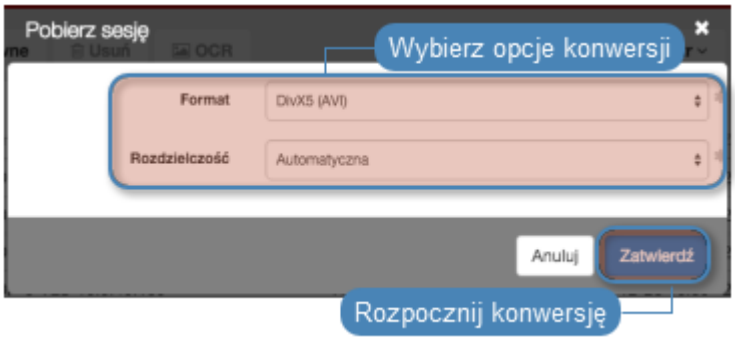
Wheel Fudo PAM allows converting stored session data to one of supported video formats.

To export a session, proceed as follows.

1. Select *Management* > *Sessions*.
2. Find desired session and click the session export icon.

3. Select the output file format.

Note: The output file format and the resolution determine conversion time and the size of the output file.



4. Select the video resolution (*not applicable to the text log file format*).

Note: *Autodetect* option will export video in the native user's screen resolution.

---

5. Click *Confirm* to start conversion and open the downloads page.

Note: The *Downloads* page enables monitoring conversion progress.

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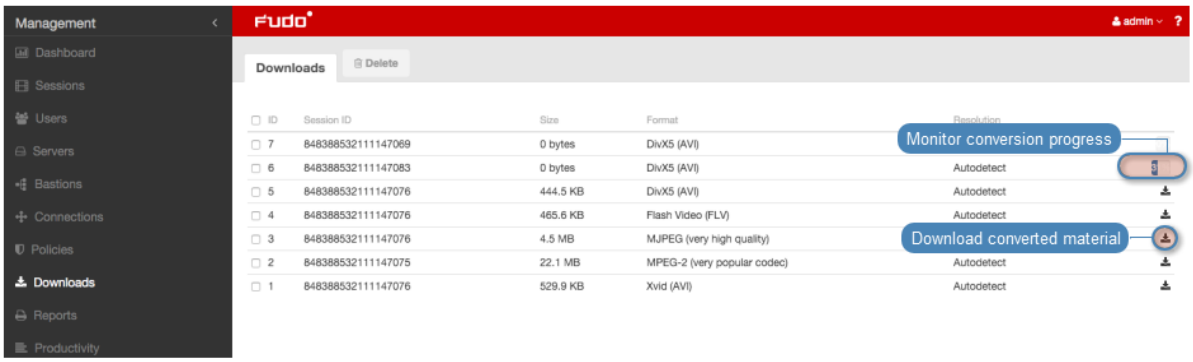
6. Find desired session and click the *Download* icon to download converted session material.



Related topics:

- *Filtering sessions*
- *Sharing sessions*
- *Viewing sessions*

- *Joining sessions*

12.10 Deleting sessions

To delete a recorded session, proceed as follows.

1. Select *Management* > *Sessions*.
2. Find and select desired session.
3. Click *Delete*.
4. Confirm deleting selected sessions.

Note: Wheel Fudo PAM can automatically delete sessions after certain time, specified by the retention parameter. Refer to the *Backups and retention* topic for more on data retention.

Related topics:

- *Filtering sessions*
- *Sharing sessions*
- *Replaying sessions*
- *Exporting sessions*

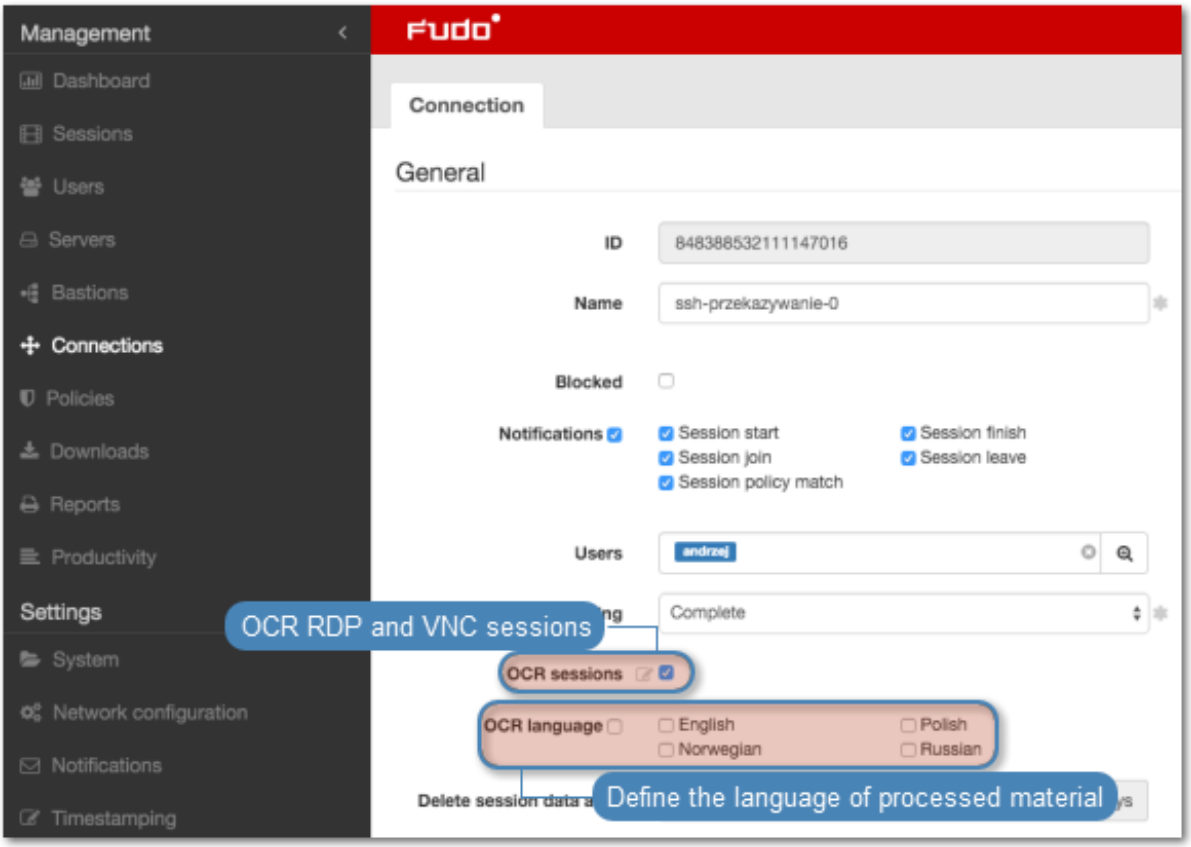
12.11 OCR processing sessions

Recorded RDP and VNC sessions can be processed and indexed for full-text search purposes.

Automated sessions processing

To have RDP and VNC sessions automatically processed, proceed as follows.

1. Select *Management* > *Connections*.
2. Find and click desired connection.
3. Select *OCR sessions* option.
4. Select the language of processed material.

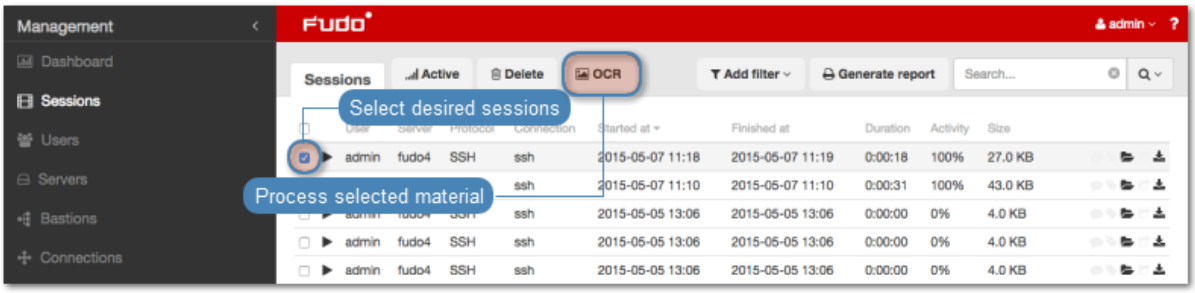


4. Click *Save*.

Processing selected sessions

To process selected sessions, proceed as follows.

1. Select *Management* > *Sessions*.
2. Select desired RDP or VNC sessions and click *OCR*.



Note: Filtering options allows for selecting processed or unprocessed objects.

3. Confirm processing selected sessions.

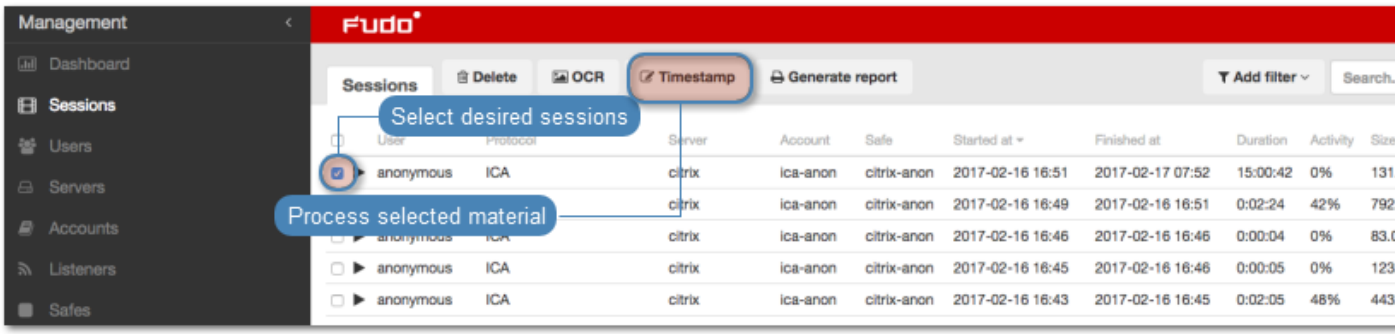
Related topics:

- *Filtering sessions*
- *Accounts*

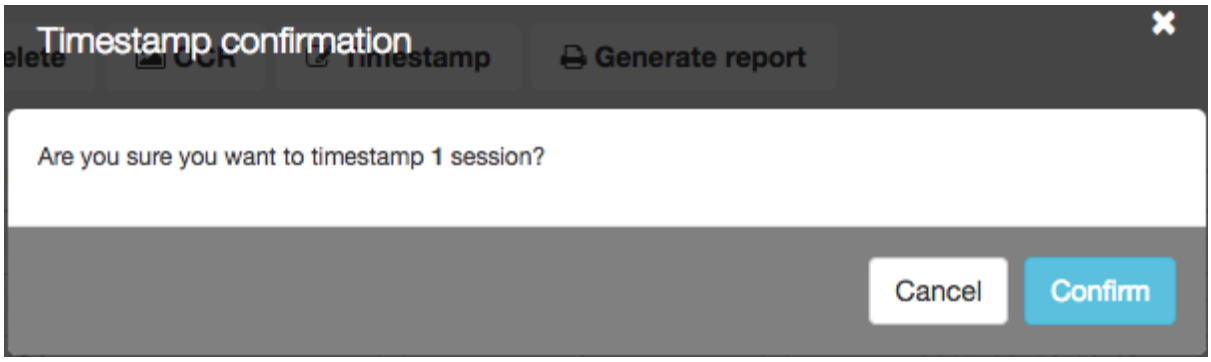
12.12 Timestamping selected sessions

To timestamp selected sessions, proceed as follows.

1. Select *Management* > *Sessions*.
2. Select desired sessions and click *Timestamp*.



3. Click *Confirm*.



Note: Click the ⏲ to view the timestamp data.

Related topics:

- *Filtering sessions*
- *Accounts*

CHAPTER 13

Reports

Reporting service generates detailed statistics of users access sessions.

Full reports are generated periodically (daily, weekly, monthly, quarterly) by the system and can be accessed by users with the `superadmin` role assigned. Reports generated periodically upon users with `admin` or `operator` requests, will include only information regarding sessions objects which they have access permission assigned to.

In addition to the system default settings, cyclic reports can be also generated based on the user defined *filtering definition*.

Report can also be generated on demand and include data related to specified user sessions.

Subscribing to a periodic report

To enable automatic periodic report generation for the logged in user, proceed as follows.

Note: Periodic reports, generated upon specific user's request, include only sessions, to which given user has sufficient access rights.

---

1. Select *Management* > *Reports*.
2. Click *Manage subscriptions*.
3. Select the report definition from the drop-down list.

Note: The list contains system default options and user defined *filtering definitions*.

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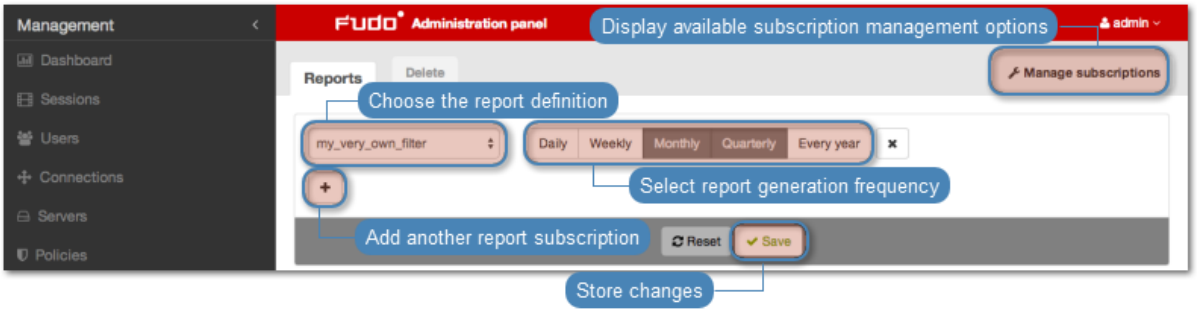
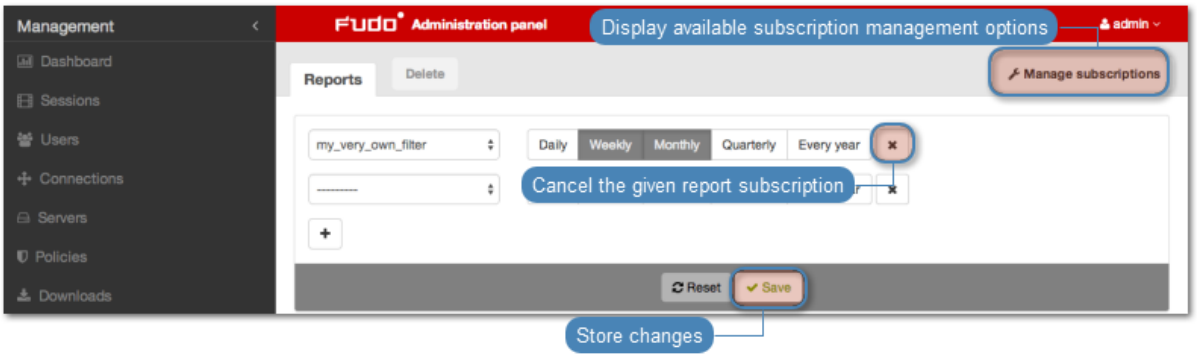
4. Choose how often the given report should be generated.
5. Click *Save*.



Cancelling a periodic report subscription

To cancel a subscription to a cyclic report, proceed as follows.

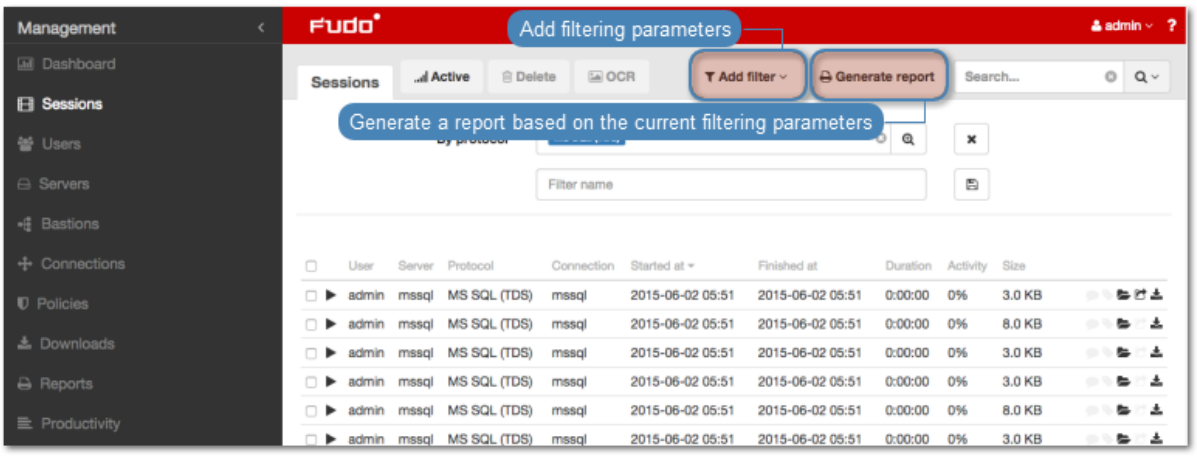
1. Select *Management* > *Reports*.
2. Click *Manage subscriptions*.
3. Click the report definition removal icon.
4. Click *Save*.



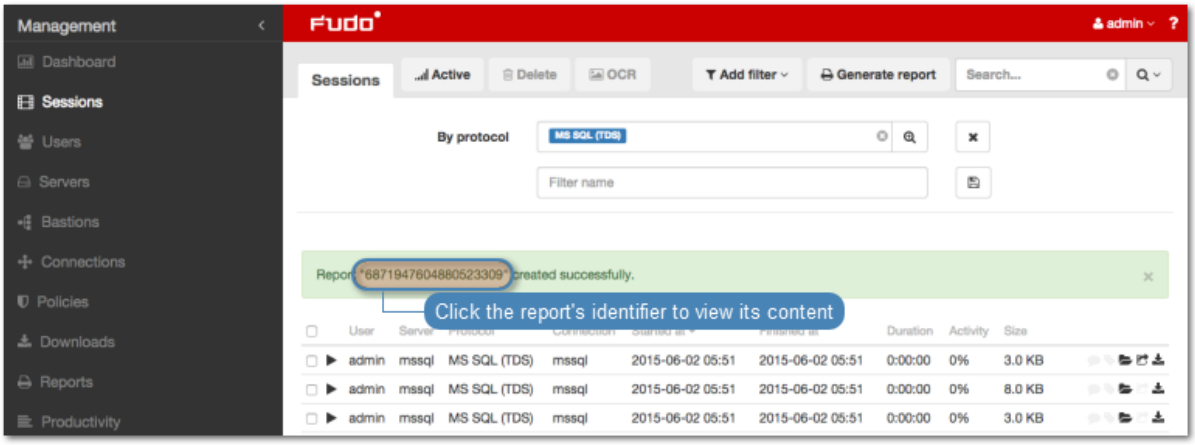
Generating reports on demand

A report can be prepared for a specified subset of user sessions, determined by filtering options.

1. Select *Management* > *Sessions*.
2. Click *Add filters* and define filtering parameters (for more information on sessions filtering, refer to the *Sessions: Sessions filtering* topic).
3. Click *Generate report*, to have the report generated based on the current filtering criteria.



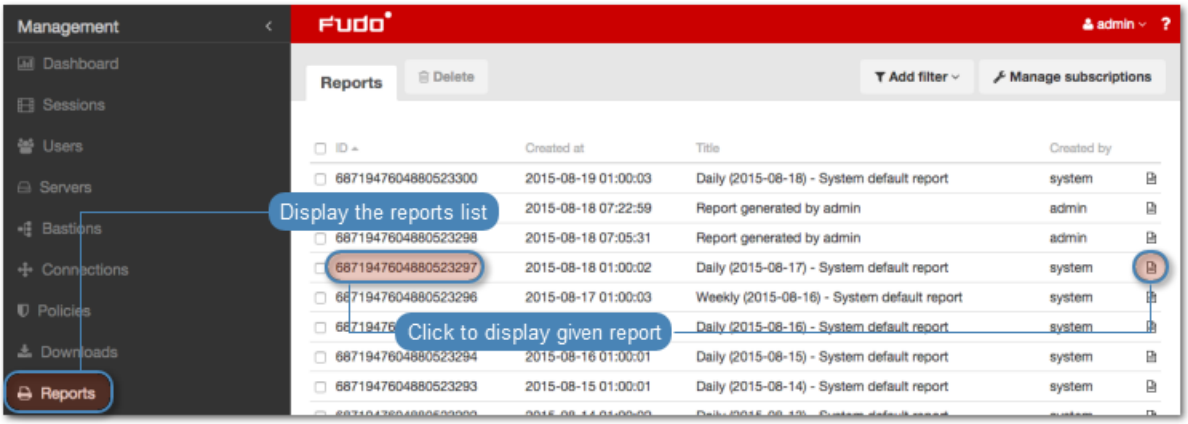
4. Note your report's identifier or click it to display the report.



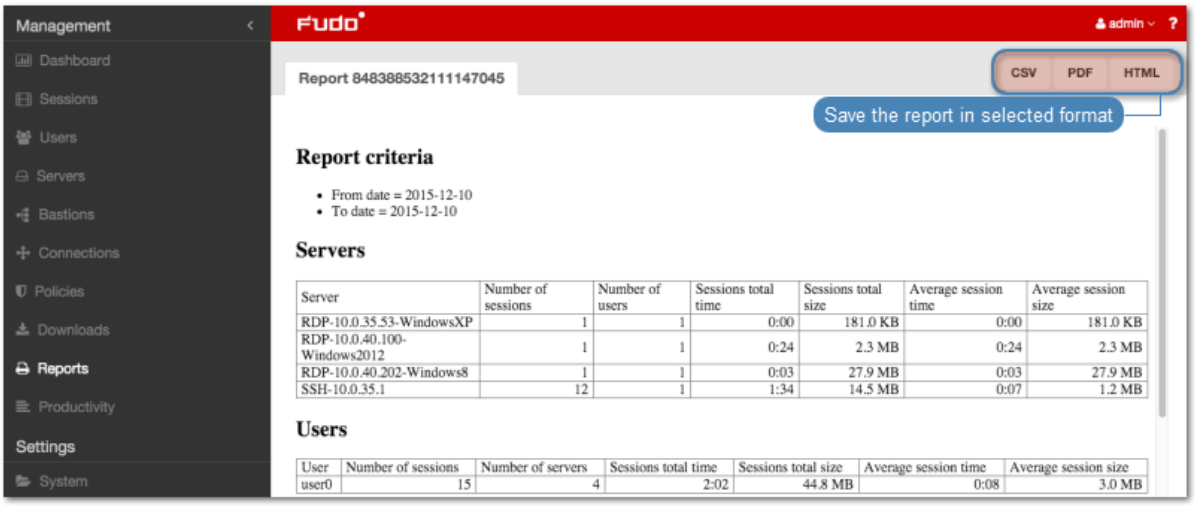
5. Select *Management* > *Reports*.
6. Find desired report and click the view icon.
7. Click the corresponding button to save the report in selected format.

Opening and downloading reports

1. Select *Management* > *Reports*.
2. Find desired report and click the view icon.



3. Click the corresponding button to save the report in selected format.



Deleting reports

1. Select *Management* > *Reports*.
2. Find, select desired reports and click *Delete*.
3. Confirm deleting selected reports.

Related topics:

- *Notifications*
- *Filtering sessions*

CHAPTER 14

Efficiency analyzer

Wheel Fudo PAM features a productivity analysis component which tracks users' activities and can provide precise information on activity and idle times.

14.1 Overview

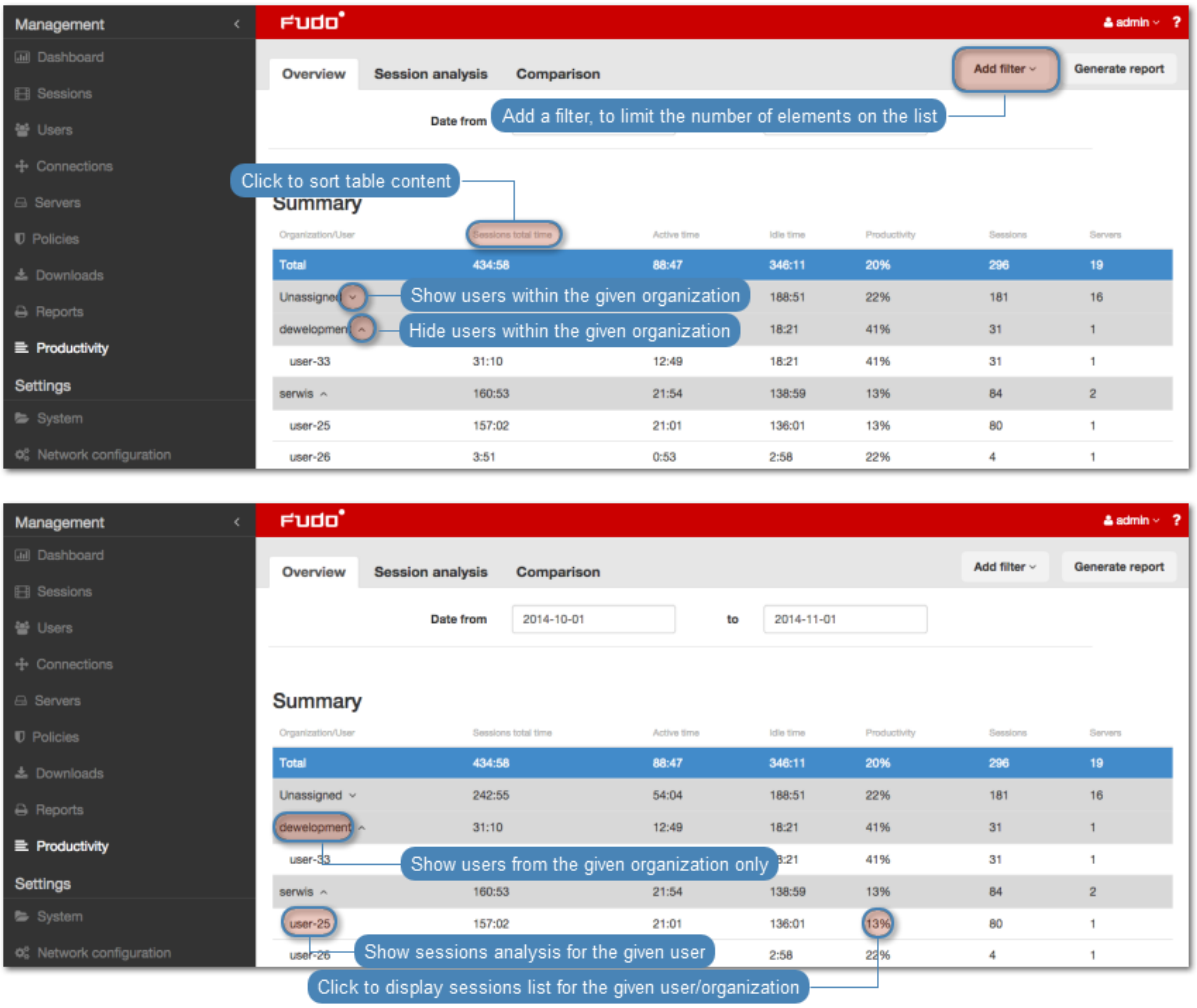
Overview displays data on users' activity in selected time interval.

Note: Activity rating is based on the user's interaction with the monitored system. Wheel Fudo PAM divides the time into 60 seconds long time intervals and monitors the activity within the interval. Lack of any actions in a given time period accounts such as a non-productive time.

To view the users' activity rundown, proceed as follows.

1. Select *Management* > *Productivity*.
2. Select the *Overview* tab.
3. Define the users' list filtering.
4. Click *Generate report* to generate rundown of the displayed data in HTML, CSV or PDF format.

Note: The report can be accessed in the *Reports* section.



Related topics:

- *Productivity analysis - Sessions analysis*
- *Productivity analysis - Comparison*
- *Sessions*

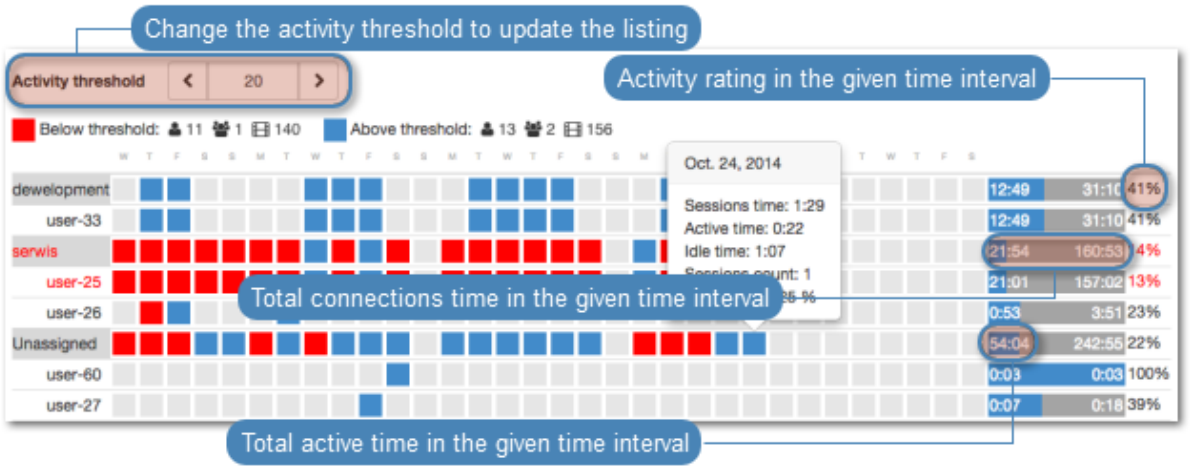
14.2 Sessions analysis

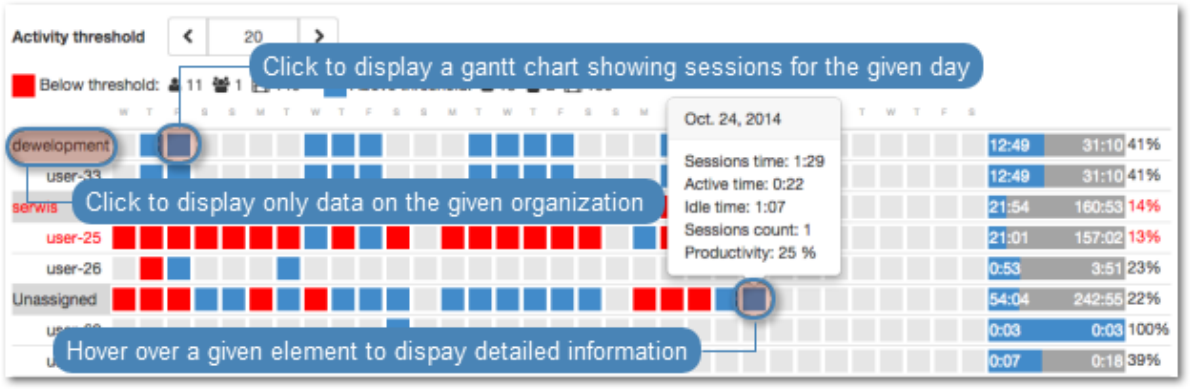
Sessions analysis shows in detail users/organizations productivity in the given time period. The activity threshold parameter allows identifying sessions, users and organisations which do not exceed the required user activity rating and helps establishing the threshold value attainable for a given number of users or sessions.

Users activity rating

Users activity rating allows identifying sessions which do not exceed the required user activity level. Further material analysis helps determining the reason for low activity in the given session and draw relevant conclusions.

Note: The listing does not cover time periods longer than 31 days. In case the defined time interval is longer than that, only data from the first 31 days is presented.





Related topics:

- *Productivity analysis - Overview*
- *Productivity analysis - Comparison*

14.3 Activity comparison

Efficiency analyzer module enables comparing users/organizations activity in given time periods.

To compare users/organizations, proceed as follows.

1. Select *Management* > *Productivity*.
2. Select the *Comparison* tab.
3. Select object types being compared.
4. Select the time interval.
5. Add objects to the comparison and define starting date for each object.
6. Click *Confirm* to compare selected objects.

Related topics:

- *Productivity analysis - Sessions analysis*
- *Productivity analysis - Overview*
- *Sessions*

CHAPTER 15

Administration

This section covers Wheel Fudo PAM administration topics.

15.1 System

15.1.1 Date and time

System events registered by Wheel Fudo PAM (sessions, system log events, etc.) are timestamped. Wheel Fudo PAM can obtain the time information either from an NTP server or the system clock.

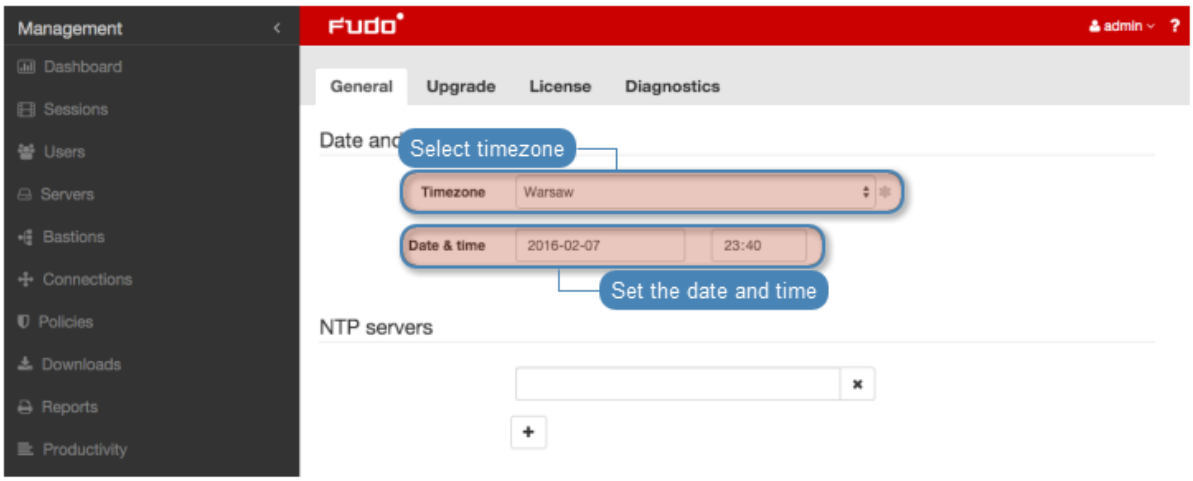
Warning: It is strongly advised for the date and time settings to be obtained from a reliable NTP server. Changing date and time settings manually may result in system malfunction.

Changing date and time settings

Note: Manual time setting is disabled if there are NTP servers configured.

To change the Wheel Fudo PAM's system clock settings, proceed as follows.

1. Select *Settings* > *System*.
2. Change date and time parameters in the *Date and time* section.



3. Click *Save*.

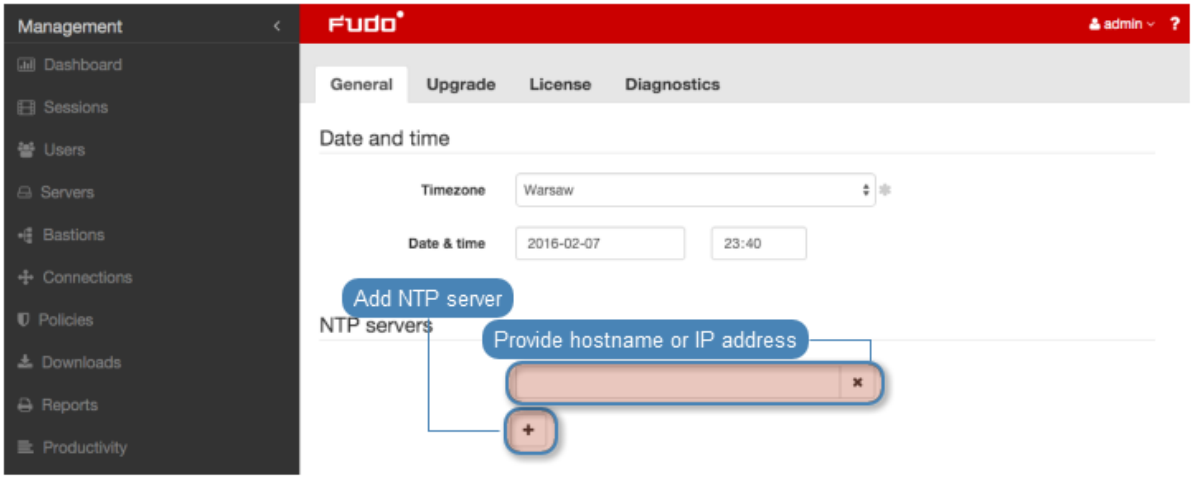
Time servers configuration

Note: NTP servers ensure that the system time on all IT infrastructure devices is synchronized. Using NTP servers guarantees that the timestamp of the recorded session matches the time settings on the monitored server.

Adding an NTP server definition

To add an NTP server definition, proceed as follows.

1. Select *Settings* > *System*.
2. Click + in the *NTP servers* section to add an NTP server.
3. Enter NTP server IP address or host name.



4. Click *Save*.

Editing an NTP server definition

To edit an NTP server definition, proceed as follows.

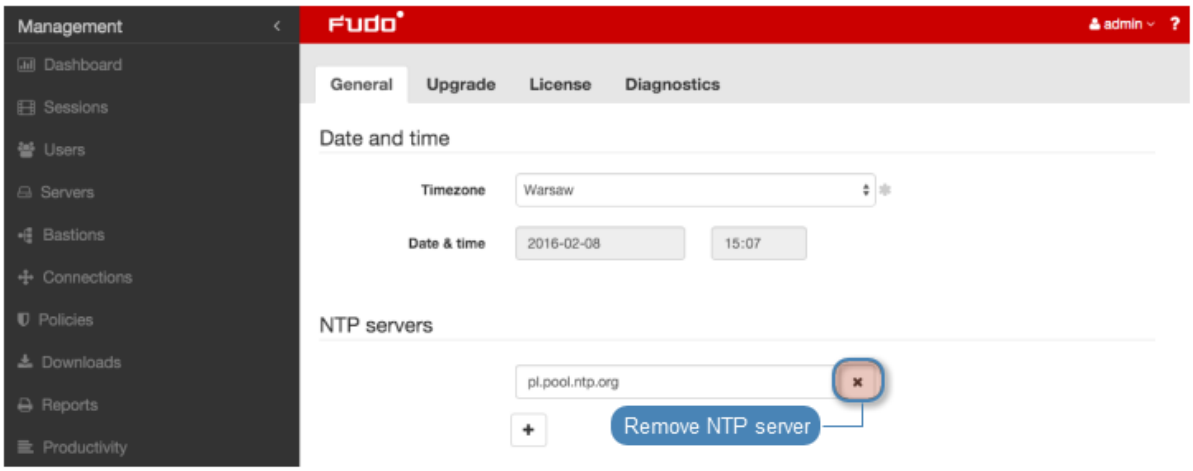
1. Select *Settings* > *System*.
2. Find and change desired NTP server configuration parameters in the *NTP servers* section.

3. Click *Save*.

Deleting an NTP server definition

To remove and NTP server definition, proceed as follows.

1. Select *Settings* > *System*.
2. Find desired NTP server definition in the *NTP servers* section and click the *X* icon.



3. Click *Save*.

Related topics:

- *Timestamping*

15.1.2 SSL certificate

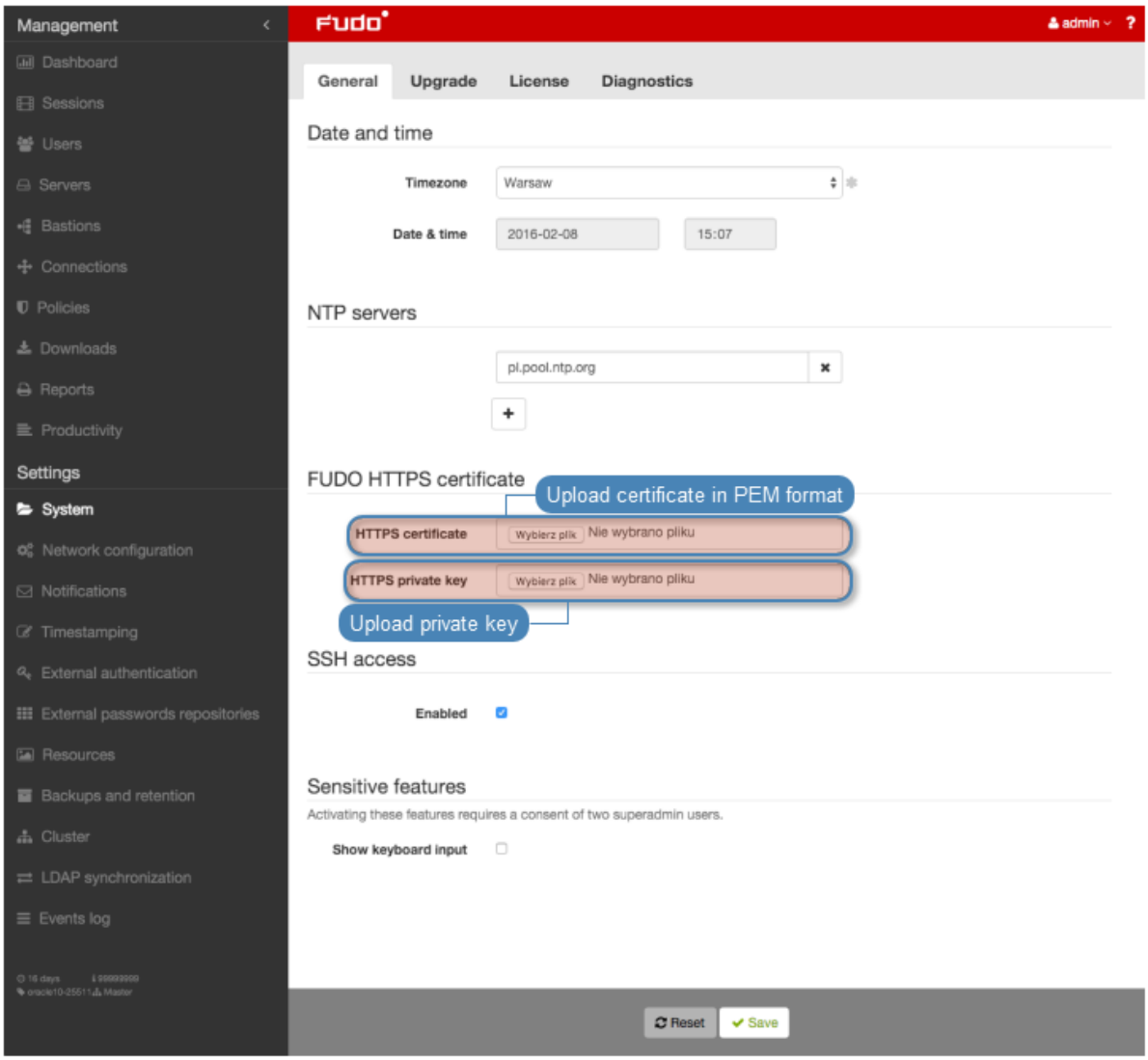
SSL certificate allows prevent phishing attacks.

Configuring SSL certificate

To configure SSL certificate, proceed as follows.

1. Select *Settings* > *System*.
2. Click the *Browse* button next to the *HTTPS Certificate* field in the *FUDO HTTPS certificate* section and point to the location of the SSL certificate file in PEM format.

3. Click the *Browse* button next to the *HTTPS Private Key* field and point to the location of the SSL key definition.



4. Click *Save*.

Related topics:

- *Security measures*
- *Servers*

15.1.3 Deny new connections

Enabling this option results in a denial of all new connections requests.

Blocking new connections

1. Select *Settings* > *System*.
2. Select *Deny new connections* option in the *Session* section.
3. Click *Save* button.

Related topics:

- *Network interfaces configuration*

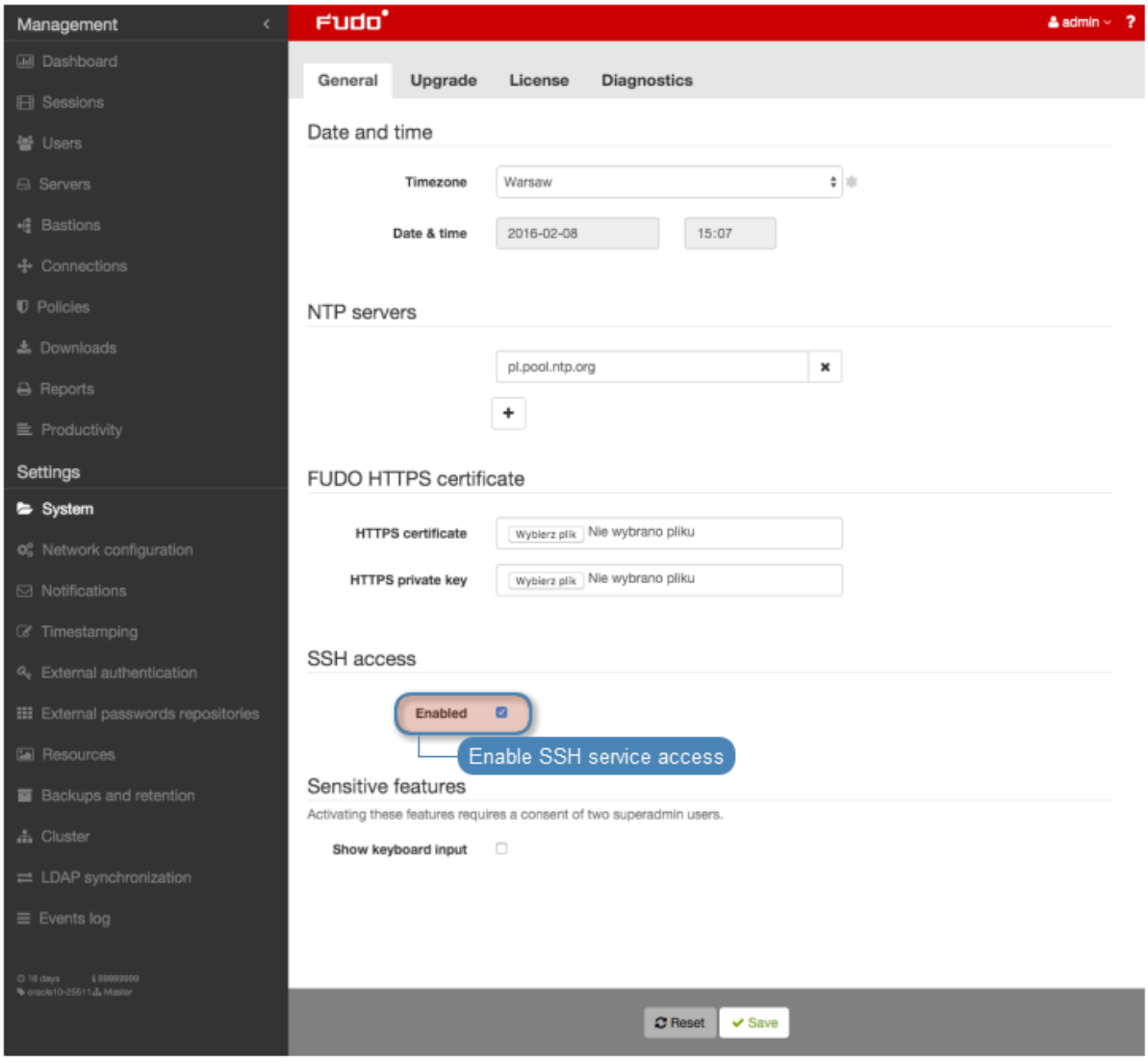
15.1.4 SSH access

SSH access option enables remote access to Wheel Fudo PAM for servicing and maintenance purposes.

Enabling SSH access

To enable SSH access, proceed as follows.

1. Select *Settings* > *System*.
2. Select *Enabled* option in the *SSH access* section.



3. Click *Save* button.

Related topics:

- *Network interfaces configuration*

15.1.5 Reset account

Reset account enables resetting Wheel Fudo PAM to factory settings.

Enabling reset account

To enable reset account, proceed as follows.

1. Select *Settings* > *System*.
2. Select *Enabled* option in the *Reset account* section.
3. Click *Save* button.

Related topics:

- *Network interfaces configuration*

15.1.6 Sensitive features

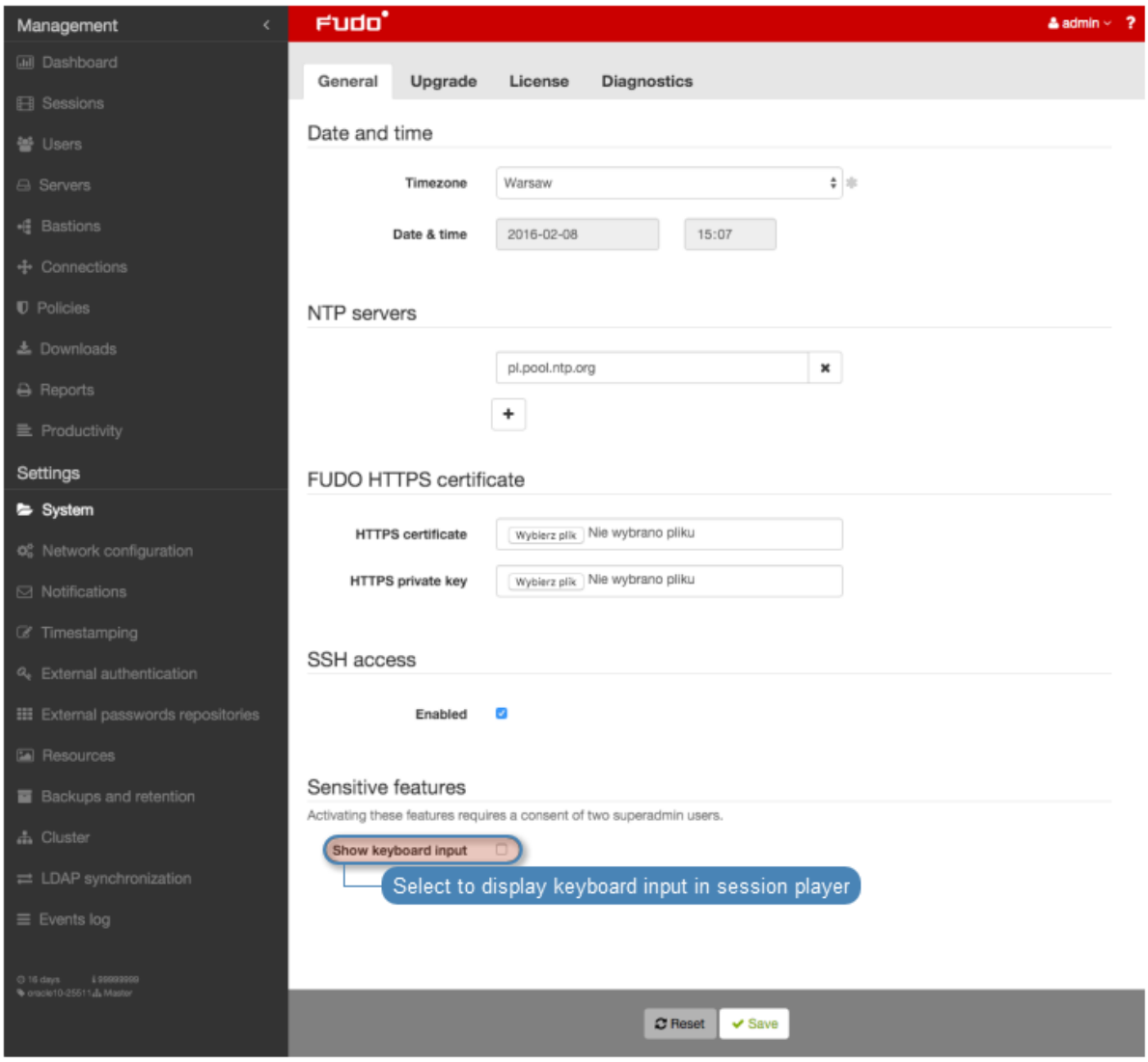
Sensitive features is a set of options enabling which requires a consent from two `superadmin` users.

Enabling displaying keyboard input

Note: Keystrokes are not displayed in the session player by default. Enabling keystrokes display requires a consent from two `superadmin` users.

To enable keyboard input display, proceed as follows.

1. Select *Settings* > *System*.
2. Select *Show user input* in the *Sensitive features* section to initiate the feature.
3. Click *Save*.



4. Notify another system administrator that the keyboard input showing feature has been initiated and requires a confirmation.

Related topics:

- *Viewing sessions*

15.1.7 System update

Note:

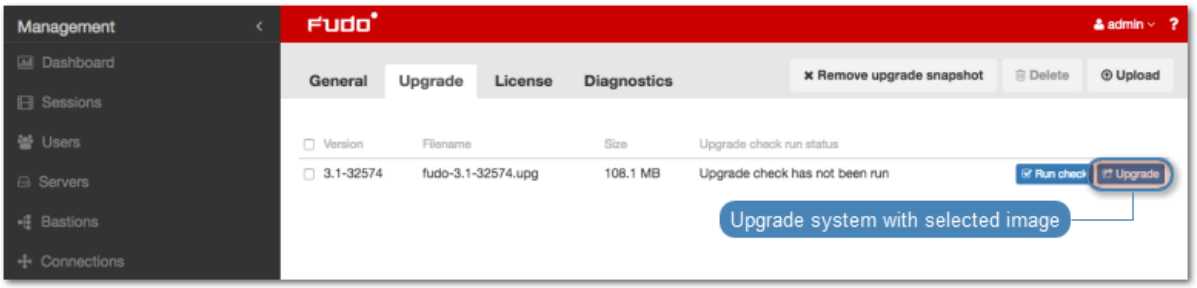
- In addition to the current system version, Wheel Fudo PAM stores the previous revision, allowing for restoring the system to its previous state.
- The system update process does not influence the system configuration or the session data stored on Wheel Fudo PAM.
- The storage usage may temporarily increase during system update.

15.1.7.1 Updating system

Warning:

- Before updating the system it is advised to run a preliminary check to ensure that the current system configuration can be successfully upgraded to new version.
- If the storage usage on the system being updated exceeds 85%, contact Wheel System technical support before proceeding with upgrading the system.
- During the system update, all current users' connections will be terminated.
- Use the *Deny new connections* option in the *Sessions* section in the system settings menu.

1. Select *Settings* > *System*.
2. Select the *Upgrade* tab.
3. Click *Upload*.
4. Browse the file system to find and upload the update image file (`.upg`).
5. Click *Upgrade*.



Warning: After running system update, Wheel Fudo PAM will restart automatically.

Rebooting Wheel Fudo PAM requires the encryption key. Connect the USB flash drive containing the encryption key to the USB port before proceeding.

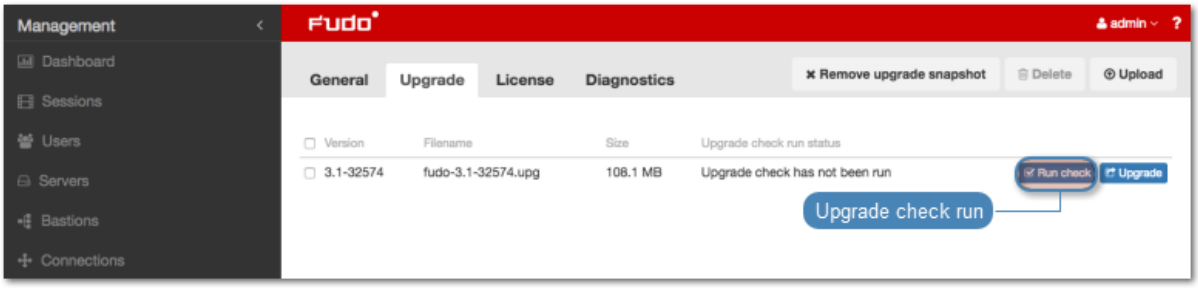
Note: In the event of an unsuccessful system update, Wheel Fudo PAM detects the problem during system restart and restarts itself using the previous system revision.

15.1.7.2 Running update check

Before updating the system it is advised to run a preliminary check to ensure that the current system configuration can be successfully upgraded to new version. The preliminary upgrade check also estimates the time it will take to perform the upgrade.

1. Select *Settings* > *System*.
2. Select the *Upgrade* tab.

3. Click *Upload*.
4. Browse the file system to find and upload the update image file (`.upg`).
5. Click *Run check*.



Note:

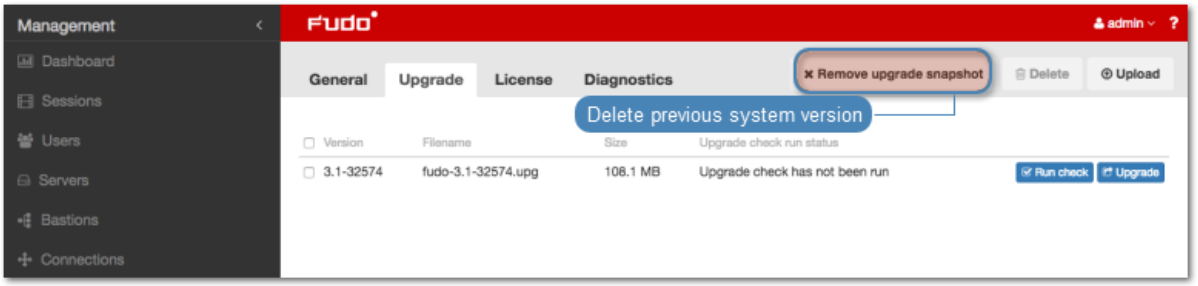
- Click *Cancel check* to stop the preliminary upgrade check.
- Click *Download log* to view the upgrade procedure log along with the information on how long it will take to perform the upgrade.

15.1.7.3 Deleting upgrade snapshot

Deleting upgrade snapshot will free the storage space occupied by previous system version.

Warning: After deleting the upgrade snapshot it will not be possible to restore the system to previous version.

1. Select *Settings* > *System*.
2. Select the *Upgrade* tab.
3. Click *Remove upgrade snapshot*.



4. Confirm deleting previous system version.

Related topics:

- *System version restore*
- *Restarting system*

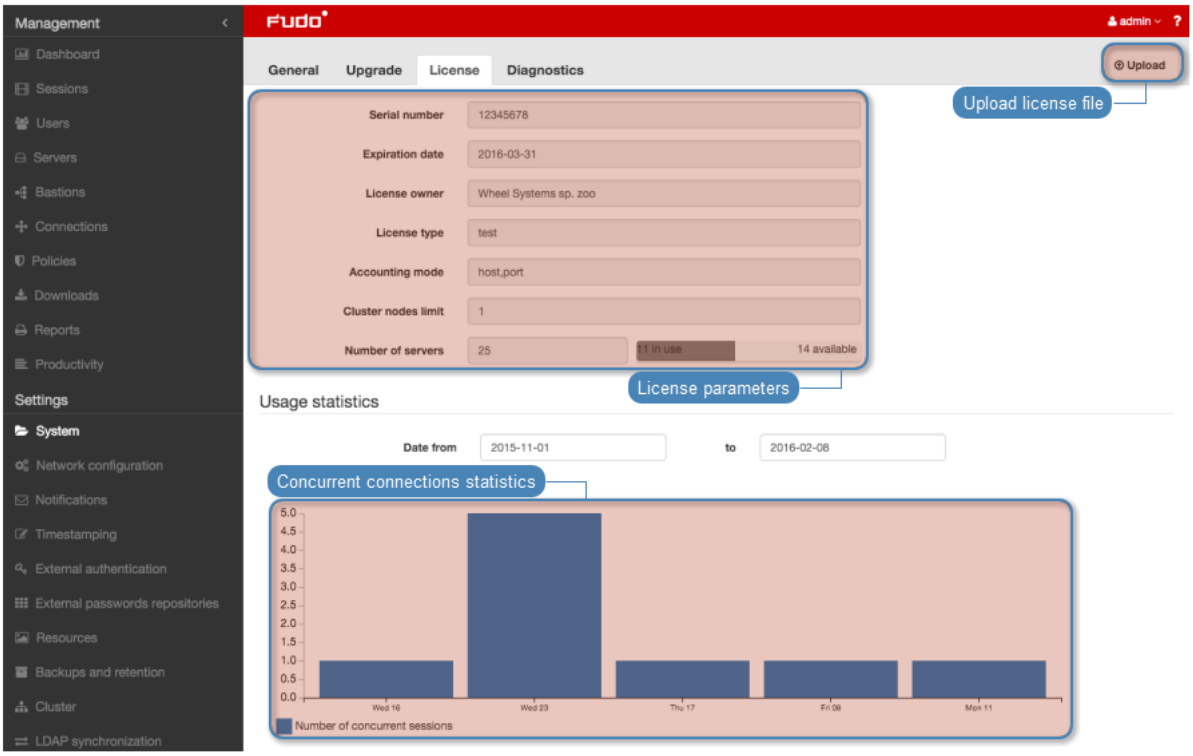
15.1.8 License

Uploading new license

To upload a new license file, proceed as follows.

Note: New license will replace existing one.

1. Select *Settings* > *System*.
2. Select the *License* tab.
3. Click *Upload*.



4. Browse the file system to find the license file and click *OK* to upload and replace current license definition.

Related topics:

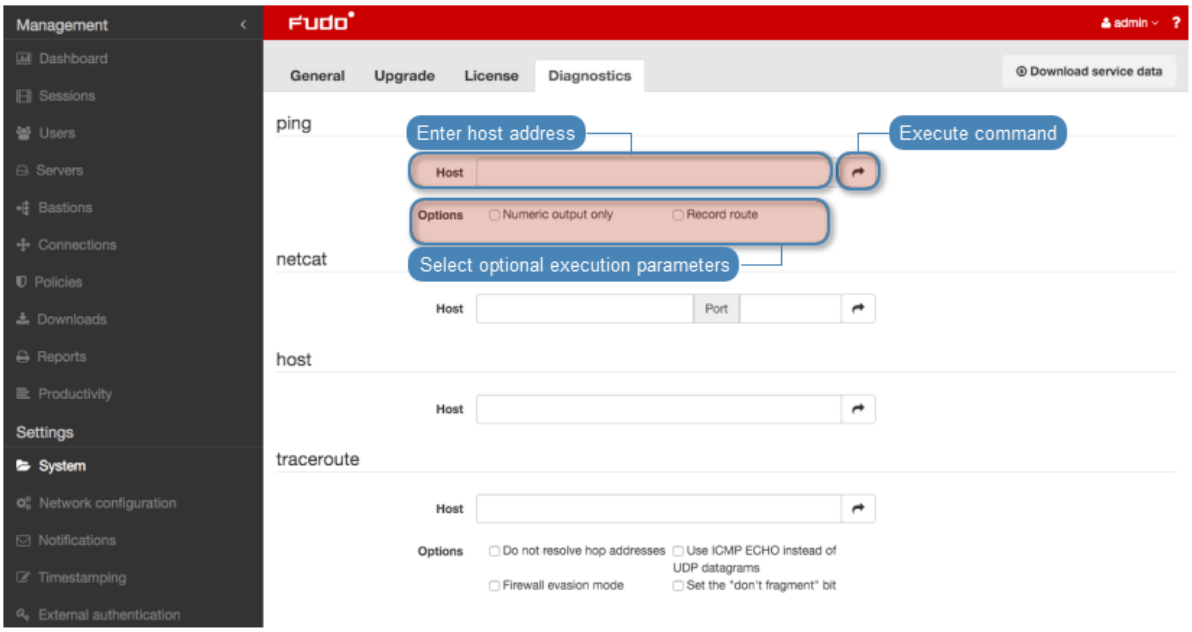
- *System*

15.1.9 Diagnostics

System diagnostics module enables executing basic system command, such as ping, netcat or tracerout.

To run a diagnostic utility, proceed as follows.

1. Select *Settings* > *System*.
2. Select the Diagnostics tab.
3. Find desired utility, provide necessary parameters and execute the command.



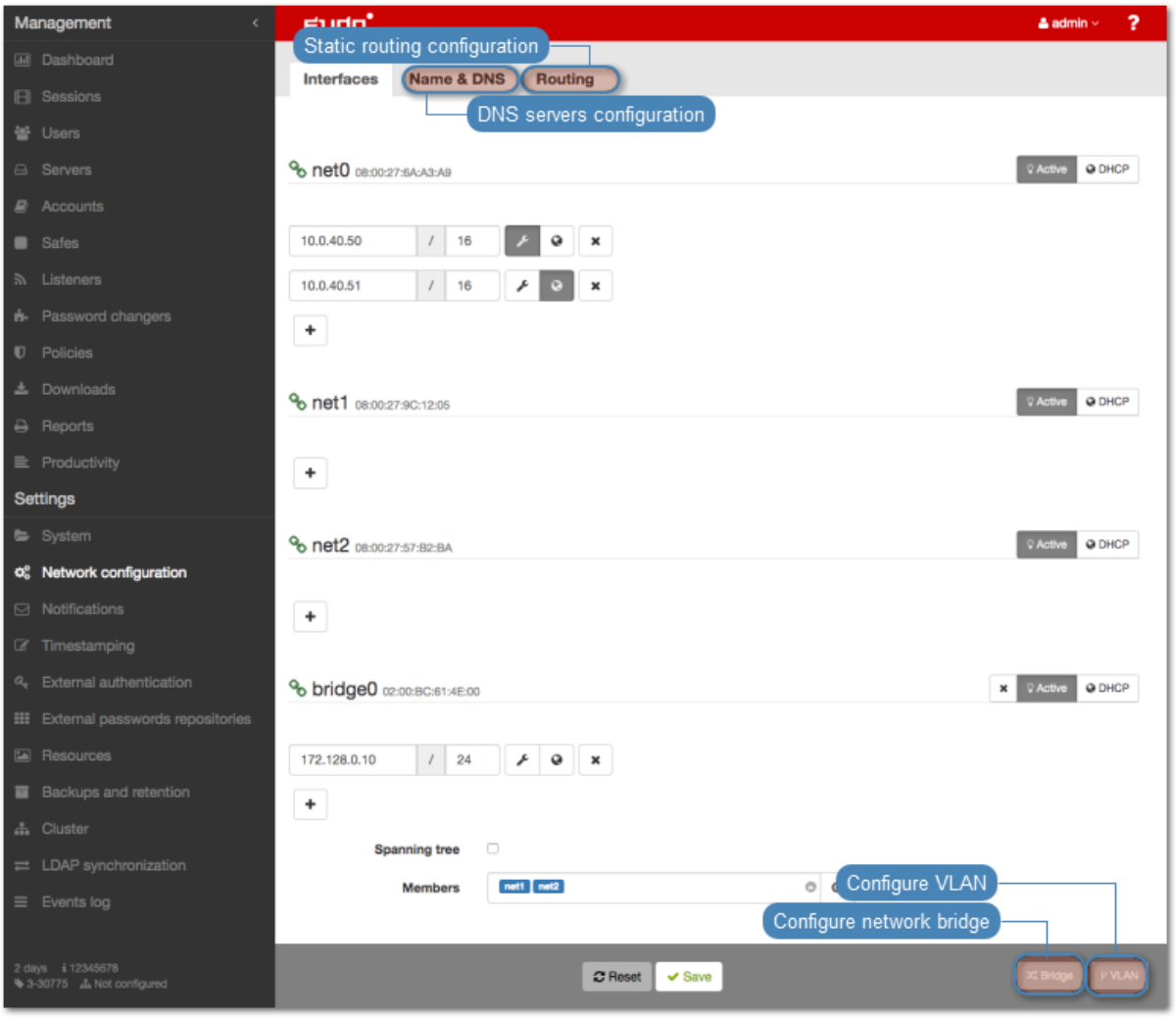
Command/parameter	Description
Ping	Ping sends a sequence of 10 ICMP packets to selected host.
Numeric output only	Does not resolve host's IP address to its mnemonic name.
Record route	Enables tracking packets' route.
netcat	`etcat` allows establishing connection with remote host on specified port number.
host	`host` is used to determine if the DNS server correctly resolves mnemonic hostnames.
traceroute	`traceroute` allows for determining packets' route between Wheel Fudo PAM and the specified host.
Do not resolve hop addresses	Subsequent hop IP addresses are not resolved to mnemonic names.
Use ICMP ECHO instead of UDP datagrams	Enforces `traceroute` to use UDP packets instead of ICMP.
Firewall evasion mode	Enforces the same port numbers for UDP and TCP packets. Target port is not incremented with each packet sent.
Set the "don't fragment" bit	Disables packet fragmentation in case the packet exceeds defined MTU (Maximum Transmission Unit) value defined for the network. Exceeding the MTU value results in an error.

Related topics:

- *Troubleshooting*

15.2 Network settings

To change network settings select *Settings* > *Network configuration*.



15.2.1 Network interfaces configuration

15.2.1.1 Managing physical interfaces

Defining IP address

Defined IP addresses are physical interface's aliases, which are used in server's *configuration procedures* (*Local address* field in proxy configuration).

Note: If the list of the assigned IP addresses is empty and the is no option to define an IP address, check if given interface is a member of a bridge.

To define an IP of a physical network interface, proceed as follows.

1. Select *Settings* > *Network configuration*.
2. Click + and provide IP address and subnet mask in CIDR format.

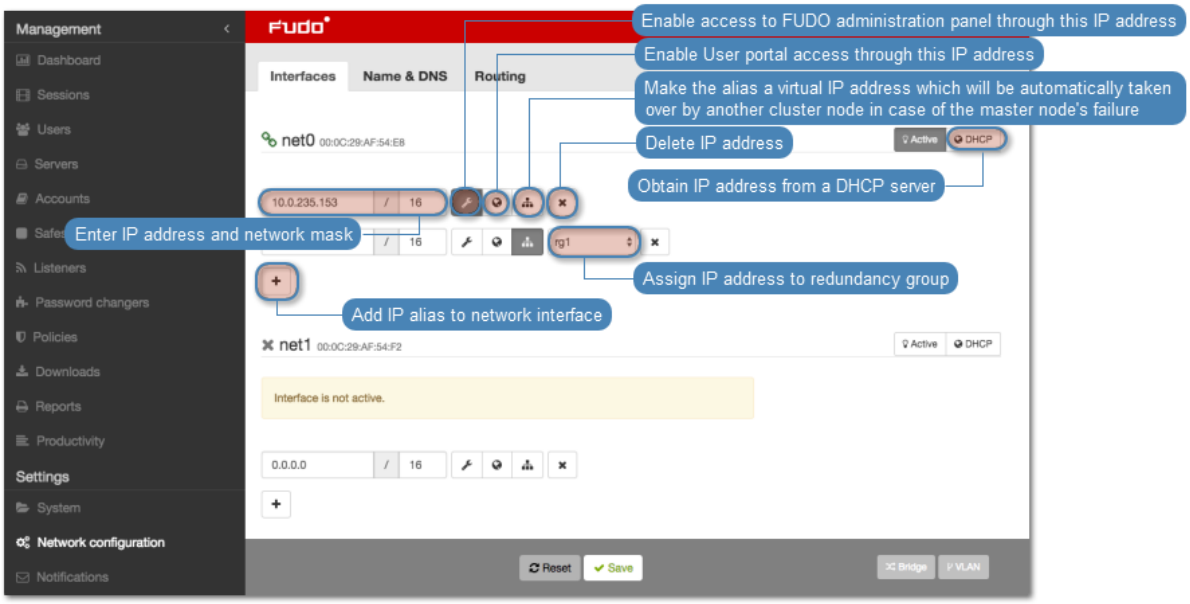
Note: + will be inactive if the *DHCP* option is enabled on the given interface.

---

3. Choose additional options for the IP address being defined.

	Enable access to administration panel on given IP address. Note that the management IP address is also used for replicating data between cluster nodes.
	Make the alias a virtual IP address which will be take over by another cluster node in case of the master node's failure. **Note:** Cluster IP address must be added manually on every cluster node, with the  option enabled.
	Enable access to *User portal* on given IP address.

4. Click *Save*.



Note: Current state of each network interface is represented with an icon.

	Interface active and connected.
	Interface active but disconnected.
	Interface disabled.

Removing defined IP addresses

Warning: Deleting an IP address will disable access to servers which had this IP configured in the *Local address* of the proxy server.

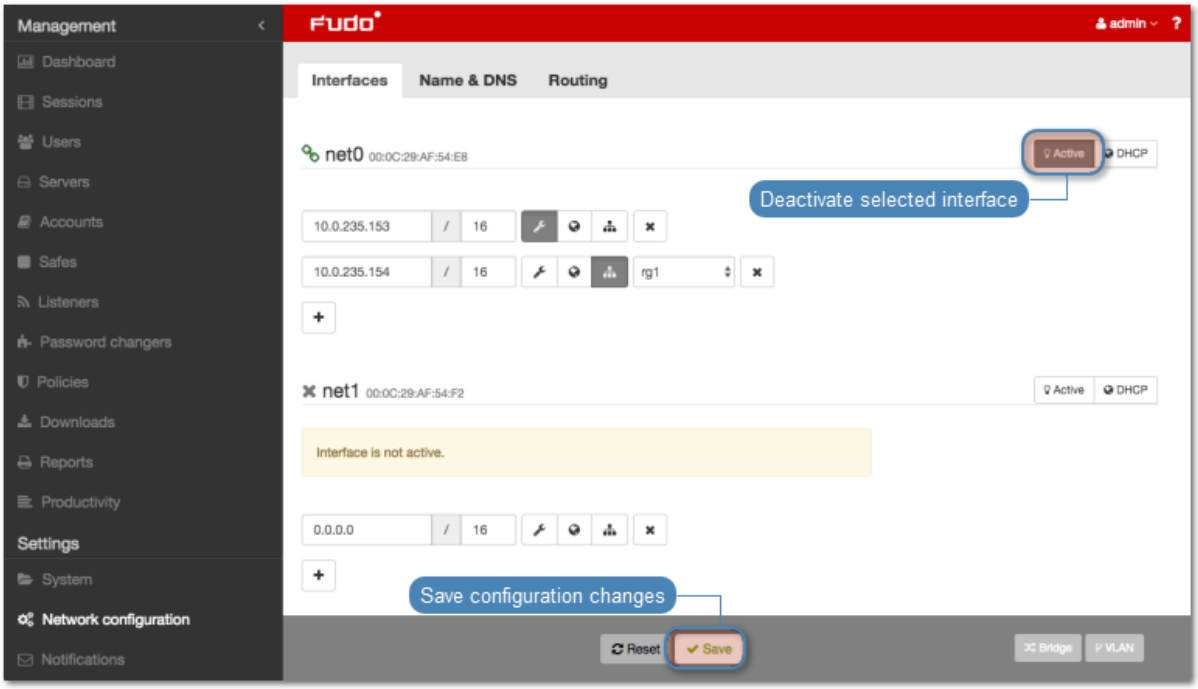
To delete an IP address assigned to a given network interface, proceed as follows.

1. Select *Settings* > *Network configuration*.
2. Select desired IP address assigned to given network interface and click *x*.
3. Click *Save*.

Disabling network interface

To disable a network interface, proceed as follows.

1. Select *Settings* > *Network configuration*
2. Click the *Active* icon next to given interface to deactivate it.

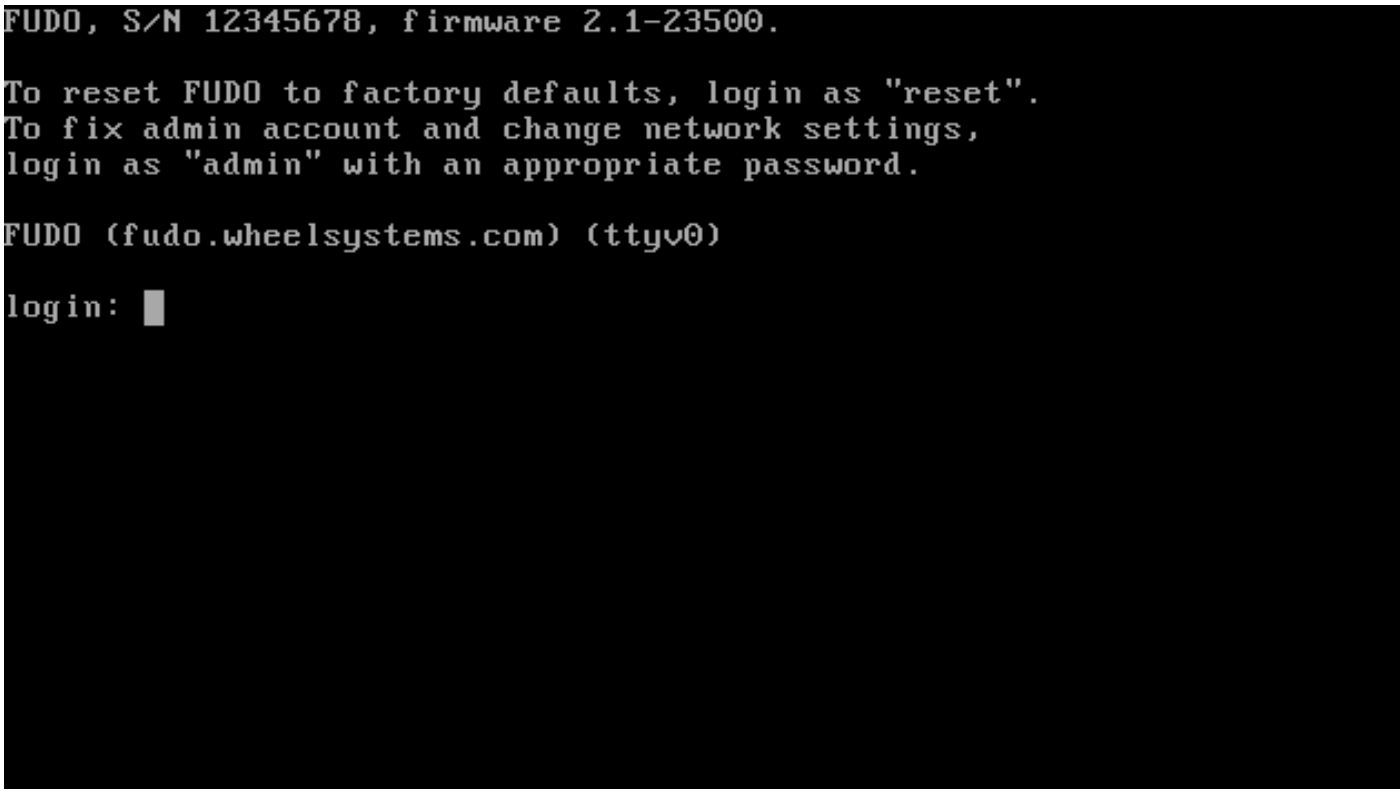


3. Click *Save*.

15.2.1.2 Defining IP address using system console

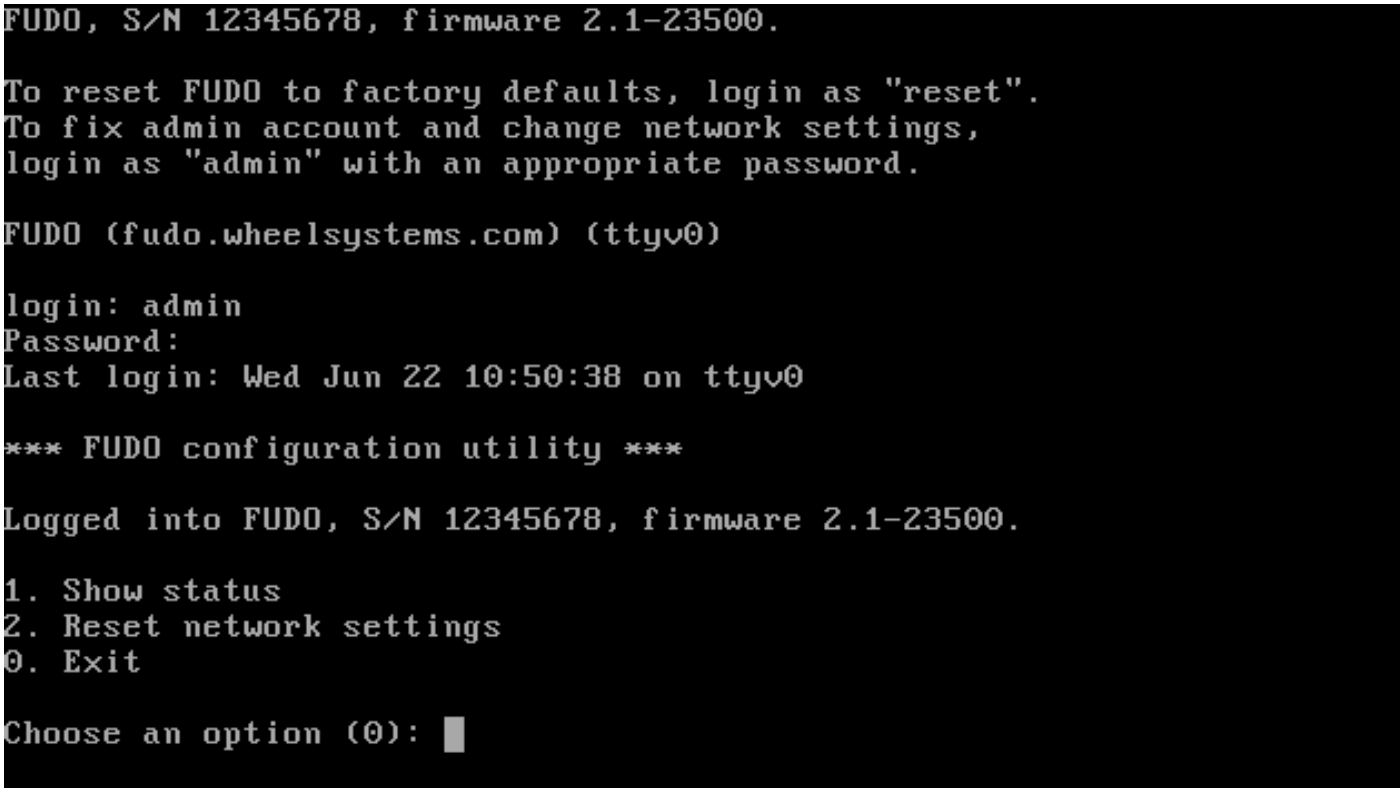
In case the web administration interface cannot be accessed, IP address can be defined using console connection.

1. Connect monitor and keyboard to the device.
2. Enter administrator account login and press *Enter*.



3. Enter administrator account password and press *Enter*.

4. Enter `2` and press *Enter* to change network configuration.



5. Enter `y` and press *Enter* to proceed with resetting network configuration.

```
FUDO, S/N 12345678, firmware 2.1-23500.

To reset FUDO to factory defaults, login as "reset".
To fix admin account and change network settings,
login as "admin" with an appropriate password.

FUDO (fudo.wheelsystems.com) (ttyv0)

login: admin
Password:
Last login: Wed Jun 22 10:50:38 on ttyv0

*** FUDO configuration utility ***

Logged into FUDO, S/N 12345678, firmware 2.1-23500.

1. Show status
2. Reset network settings
0. Exit

Choose an option (0): 2
Are you sure you want to continue? [y/N] (n):
```

6. Enter the name of the new management interface (Wheel Fudo PAM web interface is accessible through the management interface).

```
FUDO, S/N 12345678, firmware 2.1-23500.

To reset FUDO to factory defaults, login as "reset".
To fix admin account and change network settings,
login as "admin" with an appropriate password.

FUDO (fudo.wheelsystems.com) (ttyv0)

login: admin
Password:
Last login: Wed Jun 22 10:50:38 on ttyv0

*** FUDO configuration utility ***

Logged into FUDO, S/N 12345678, firmware 2.1-23500.

1. Show status
2. Reset network settings
0. Exit

Choose an option (0): 2
Are you sure you want to continue? [y/N] (n): y
Choose new management interface (net1 net0):
```

7. Enter IP address along with the network subnet mask separated with / (e.g. `10.0.0.8/24`) and press *Enter*.

```
FUDO, S/N 12345678, firmware 2.1-23500.

To reset FUDO to factory defaults, login as "reset".
To fix admin account and change network settings,
login as "admin" with an appropriate password.

FUDO (fudo.wheelsystems.com) (ttyv0)

login: admin
Password:
Last login: Wed Jun 22 10:56:52 on ttyv0

*** FUDO configuration utility ***

Logged into FUDO, S/N 12345678, firmware 2.1-23500.

1. Show status
2. Reset network settings
0. Exit

Choose an option (0): 2
Are you sure you want to continue? [y/N] (n): y
Choose new management interface (net1 net0): net0
Enter new net0 address (10.0.150.150/16): 10.0.150.150/16
```

8. Enter network gate and press *Enter*.

```
FUDO, S/N 12345678, firmware 2.1-23500.

To reset FUDO to factory defaults, login as "reset".
To fix admin account and change network settings,
login as "admin" with an appropriate password.

FUDO (fudo.wheelsystems.com) (ttyv0)

login: admin
Password:
Last login: Wed Jun 22 10:56:52 on ttyv0

*** FUDO configuration utility ***

Logged into FUDO, S/N 12345678, firmware 2.1-23500.

1. Show status
2. Reset network settings
0. Exit

Choose an option (0): 2
Are you sure you want to continue? [y/N] (n): y
Choose new management interface (net1 net0): net0
Enter new net0 address (10.0.150.150/16): 10.0.150.150/16
Enter new default gateway IP address (10.0.0.1):
```

15.2.1.3 Setting up a network bridge

Bridge deployment scenario requires setting up a network bridge.

To configure a network bridge, proceed as follows.

1. Select *Settings* > *Network configuration*.
2. Click *Bridge*.
3. Assign network interfaces or VLANs to the bridge.

Note: Setting up a network bridge requires removing all IP addresses directly assigned to interfaces which are selected as bridge members.

---

4. Enter IP address and network subnet in CIDR notation.
5. Select *Spanning tree* option to enable bridge loops prevention.
6. Select the *Management* option if the administration interface should be available under assigned IP addresses and click *Active*.
7. Click *Save*.

15.2.1.4 Setting up virtual networks (VLANs)

VLAN networks allow separating broadcast domains.

To configure a VLAN on , proceed as follows.

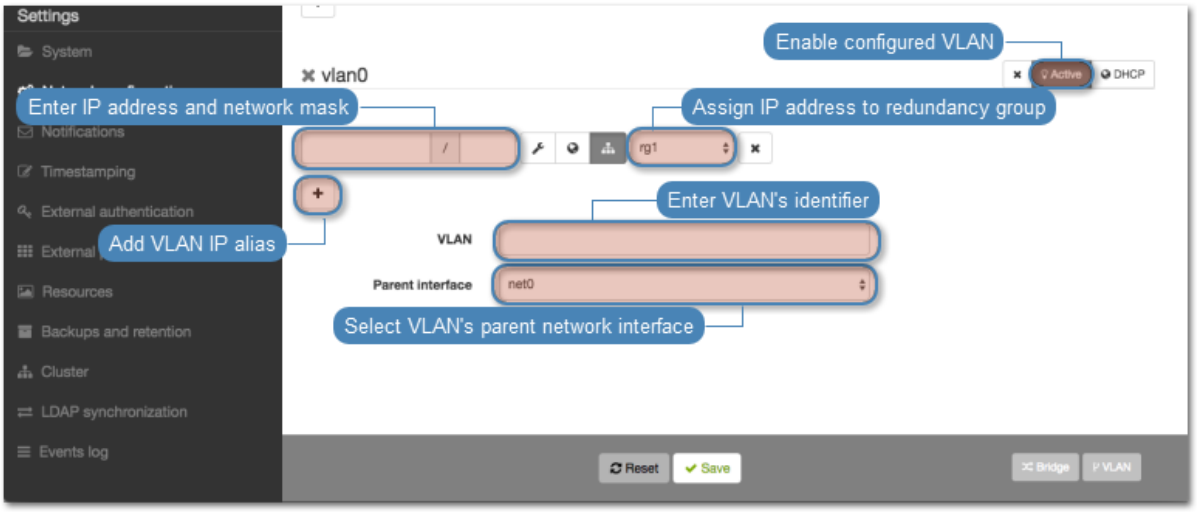
1. Select *Settings* > *Network configuration*
2. Click *VLAN*.
3. Select the physical interface and define VLAN ID.

4. Add IP addresses to given VLAN.

Note: Select *DHCP* option, to obtain IP address from a DHCP server.

Note: The IP addresses are aliases to the physical interface and are used in *servers configuration* as proxy server address.

5. Click *Active* to activate defined VLAN.
6. Click *Save*.

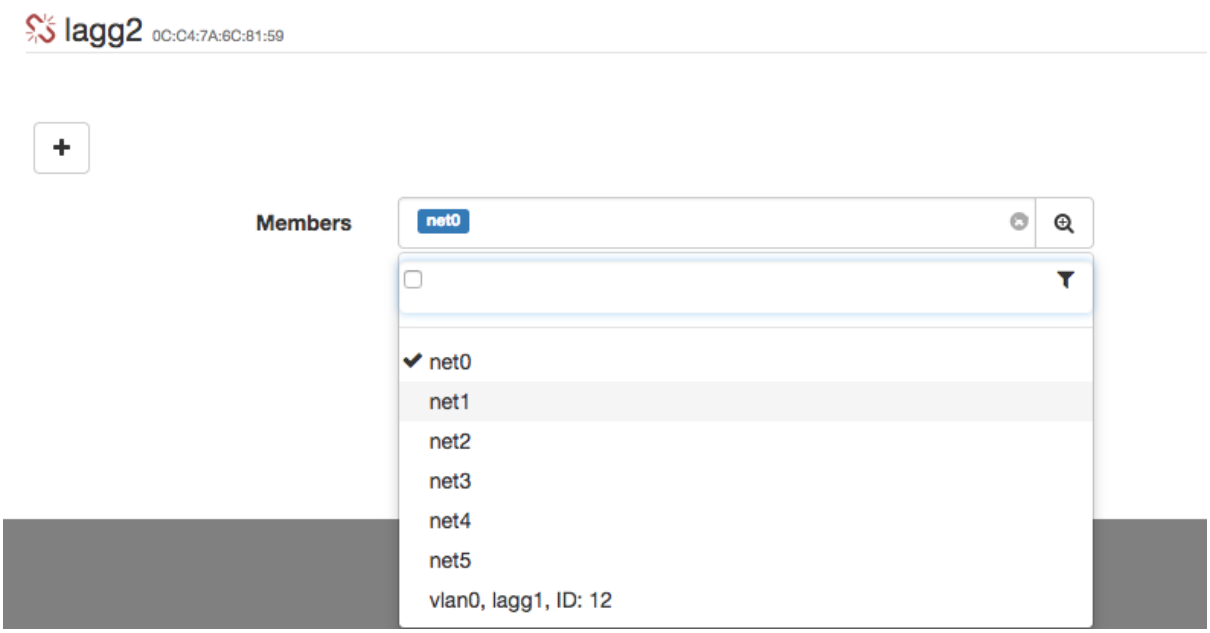


15.2.1.5 Setting up LACP link aggregation

Link aggregation enables combining a number of network interfaces for improved transfer rates and implementation of failover scenarios in which the services remain available in case of a network switch failure.

To configure a network link aggregation, proceed as follows.

1. Select *Settings* > *Network configuration*.
2. Click *Link aggregation*.
3. Assign network interfaces.



Note: Setting up a network bridge requires removing all IP addresses directly assigned to interfaces which are selected as bridge members.

4. Enter IP address and network subnet in CIDR notation.
5. Choose additional options for the IP address being defined.

	Enable access to administration panel on given IP address. Note that the management IP address is also used for replicating data between cluster nodes.
	Make the alias a virtual IP address which will be take over by another cluster node in case of the master node's failure.
	Enable access to *User portal* on given IP address.

6. Click *Save*.

Related topics:

- *Servers management*
- *Accounts*

15.2.2 Labeled IP addresses

IP address labels are global configuration parameters and thus are replicated throughout cluster's nodes. Labels enable ensuring constant access to LDAP authentication services in case of a node failure and allow for implementing load balancing scenarios.

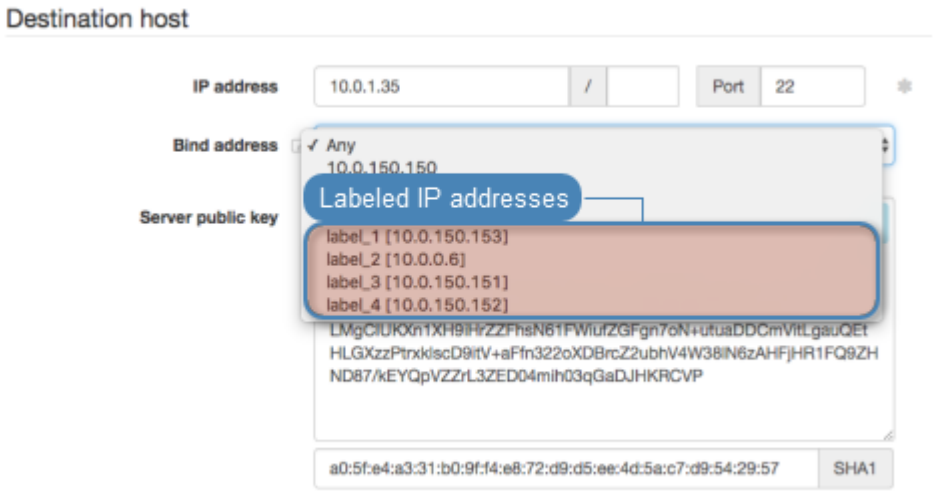
Defining a labeled IP address

1. Select *Settings* > *Network configuration*.
2. Select the *IP labels* tab.

3. Click +.
4. Provide IP address and enter label name.

Note: Label name can comprise small letters, digits, _ and - characters.

5. Click *Save*.
6. Use labeled IP address in listener, server or external authentication source configuration.



Related topics:

- *Network interfaces configuration*
- *External authentication*
- *Servers*
- *Listeners*

15.2.3 Bypasses configuration

Bypasses enable to physically re-route network packages in case of a system failure.

Note: Bypasses configuration is not available if Wheel Fudo PAM is running in virtualized environment.

1. Select *Settings* > *Network configuration*.
2. Select *Bypasses* tab.
3. Select bypass mode.
   - Bypass mode permanently enabled - this option enforces bypass mode on the network interface card. This mode may be used for maintenance purposes or when troubleshooting network issues.

- Bypass mode enabled only in case of system failure - network packets are re-routed only in case of a system failure or in case the Wheel Fudo PAM is powered off.
- Bypass mode disabled - in case of system failure, the network packets will not be routed to the next network appliance.

4. Click *Save*.

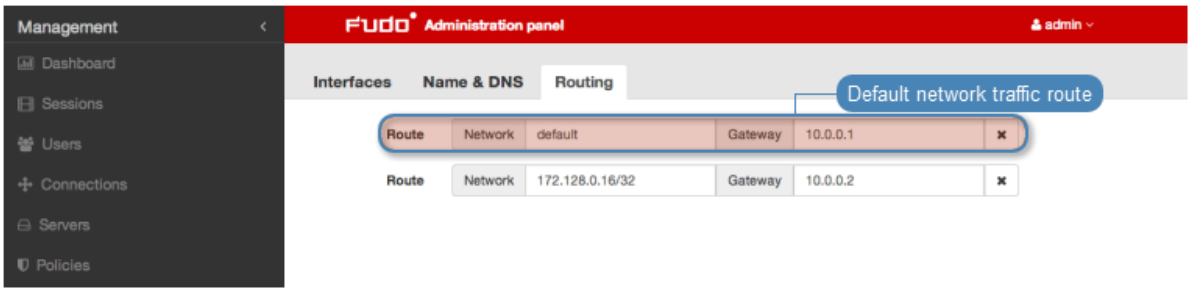
Related topics:

- *Network interfaces configuration*

15.2.4 Routing configuration

In default configuration, Wheel Fudo PAM directs all incoming traffic to defined gate. Static routing enables defining routes for packets coming from selected networks.

Note: When defining default route, enter `default` in the *Network* field.



Adding a route

To add a route, proceed as follows.

1. Select *Settings* > *Network configuration*.
2. Select *Routing* tab.
3. Click *Add route* to define a new route.
4. Enter network address along with the network mask (e.g. `10.0.1.1/32`) and gateway address.
5. Click *Save*.

Editing a route

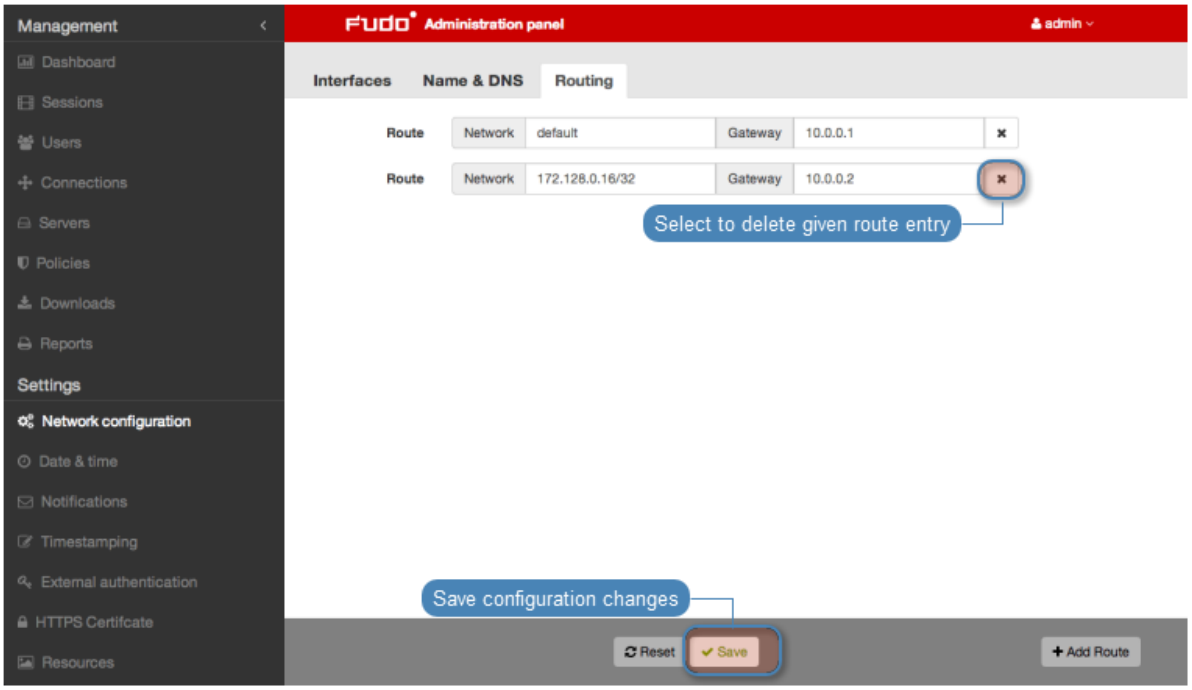
To edit a route, proceed as follows.

1. Select *Settings* > *Network configuration*.
2. Select *Routing* tab.
3. Find and edit desired route entry.
4. Click *Save*.

Deleting a route

To delete a route, proceed as follows.

1. Select *Settings* > *Network configuration*.
2. Select *Routing* tab.
3. Find desired route entry and click the delete icon.
4. Click *Save*.

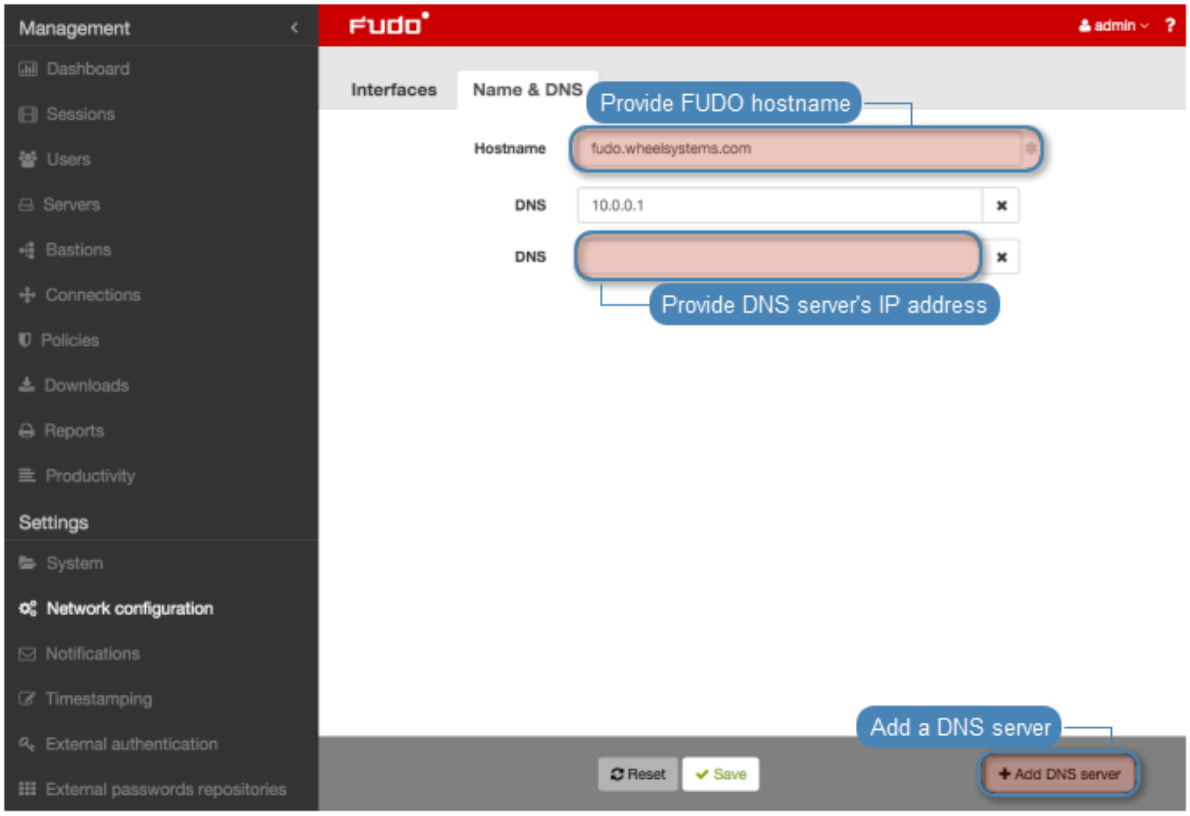


Related topics:

- *Network interfaces configuration*
- *Time servers configuration*

15.2.5 DNS servers configuration

Note: DNS servers enable using mnemonic hosts names instead of IP addresses when configuring various network resources.



Adding a DNS server definition

To add a DNS server definition, proceed as follows.

1. Select *Settings* > *Network configuration*.
2. Switch to the *Name & DNS* tab.
3. Click *Add new* to define new DNS server.
4. Enter DNS server IP address.
5. Click *Save*.

Editing a DNS server definition

To edit DNS server definition, proceed as follows.

1. Select *Settings* > *Network configuration*.
2. Switch to the *Name & DNS* tab.
3. Find given DNS server and double-click desired field.
4. Change parameter value as needed.
5. Click *Save*.

Deleting a DNS server definition

To delete a DNS server definition, proceed as follows.

Note: Deleting a DNS server definition may cause interruptions in device operation, if system configuration uses hosts names instead of IP addresses.

---

1. Select *Settings* > *Network configuration*.
2. Switch to the *Name & DNS* tab.
3. Find and select given DNS server definition.
4. Click *Delete*.
5. Click *Save* .

Related topics:

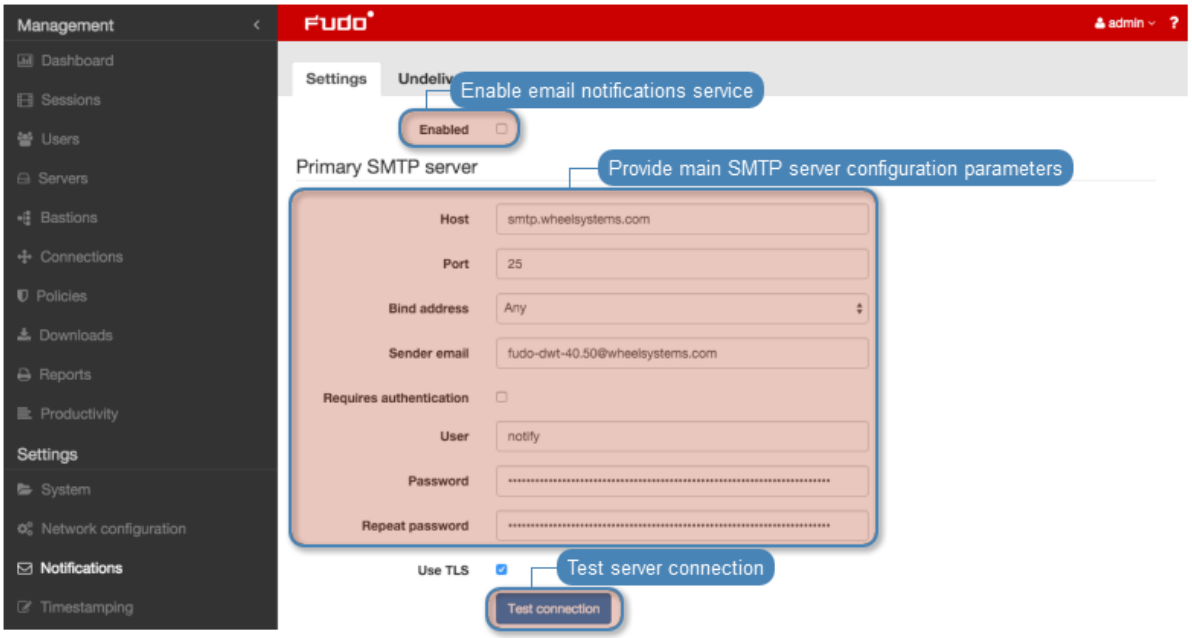
- *Network interfaces configuration*
- *Time servers configuration*

15.3 Notifications

Wheel Fudo PAM can send email notifications concerning defined connections (session start, session end, session inject start, session inject end). Notification service is configured when creating new or editing existing connection. Email notifications service requires configuring SMTP server.

To configure SMTP server, proceed as follows.

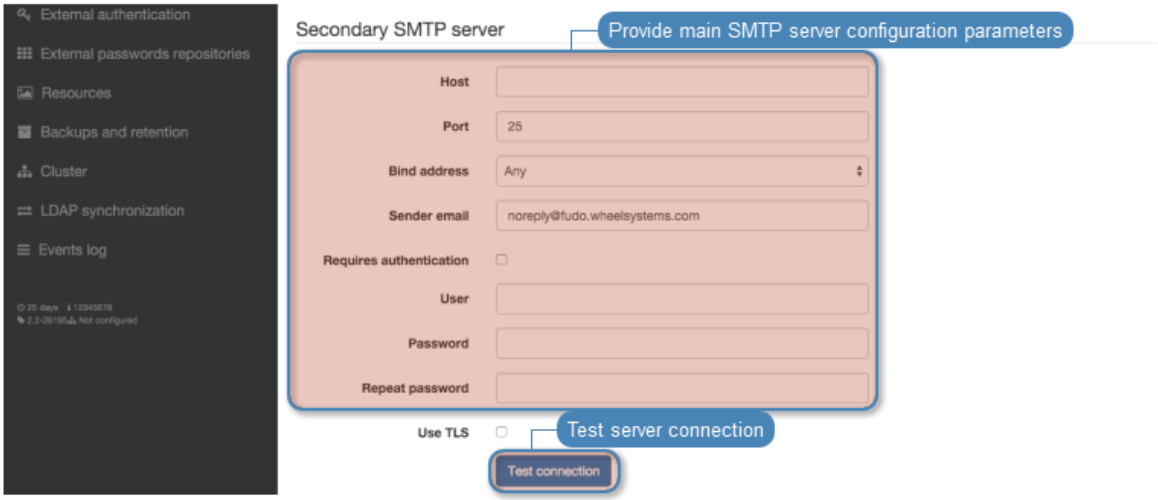
1. Select *Settings* > *Notifications*.
2. Select *Enabled* option.
3. Enter configuration parameters for the primary SMTP server.



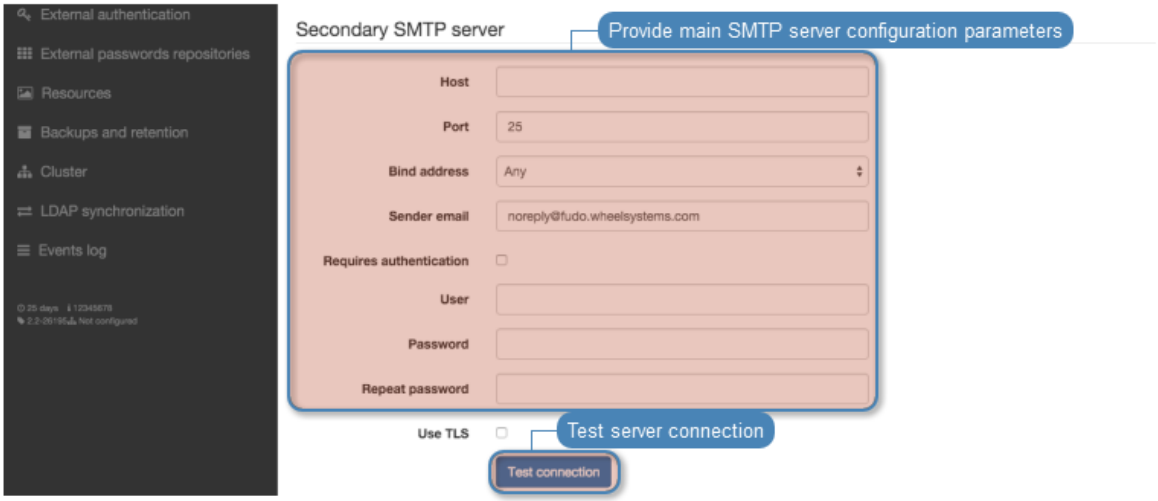
Parameter	Description
Address	SMTP server IP address.
Port	SMTP service port number.
Sender email	Email address from which the emails will be sent.
Requires authentication	Select if the SMTP server requires authentication.
User	User name for authentication on SMTP server.
Password	User password for authentication on SMTP server.
Use secure connection (*TLS*)	Select if the mail server uses TLS protocol.

Note: Click *Test connection* to make sure server parameters are correct.

4. Optionally, enter configuration parameters for the secondary SMTP server.



5. Enter server certificate in PEM format.



6. Click *Save*.

Related Topics:

- *Accounts*

15.4 Trusted timestamping

A trusted timestamp makes recorded session a more convincing evidence in court.

Note: Trusted timestamping feature requires signing a contract with an institution providing timestamping services.

Enabling and configuring trusted timestamping

Note: Wheel Fudo PAM will also timestamp sessions recorded before the feature was enabled.

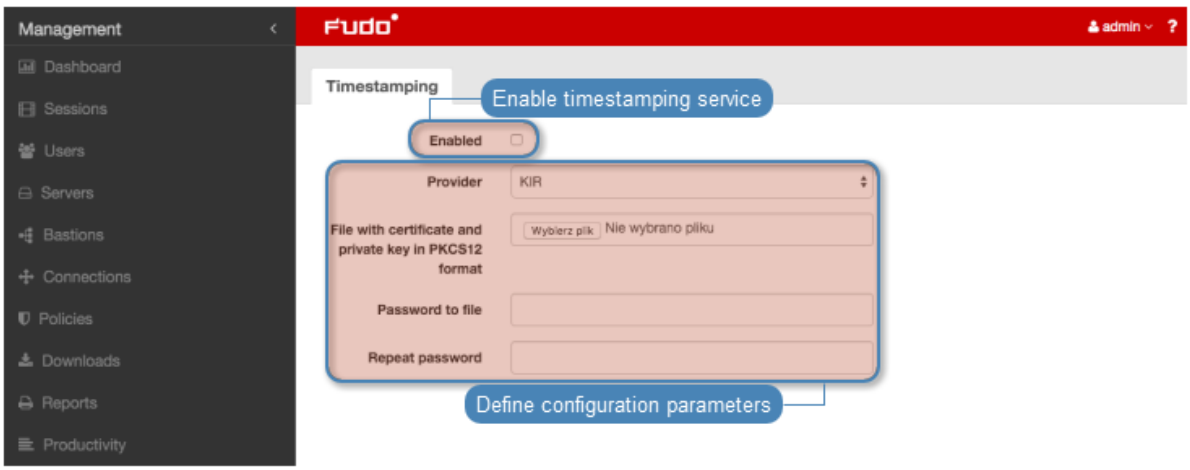
---

1. Select *Settings* > *Trusted Timestamping*.
2. Select *Enabled* option.
3. Select from the *Provider* drop-down list the institution providing trusted timestamping services.
4. Provide the certificate and the private key of the timestamping service.

Note: You should receive these information from your timestamping service provider.

---

5. Click *Save*.



Related topics:

- *Security measures*

15.5 External authentication

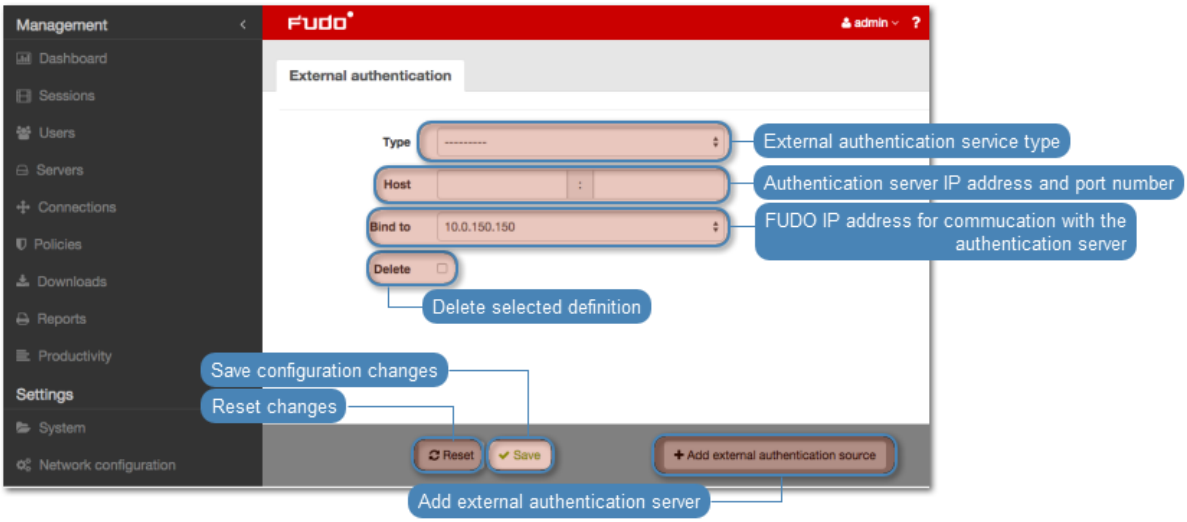
Some of the authentication methods, require defining connections to external authentication servers. These are:

- *CERB*,
- *RADIUS*,
- *LDAP*,
- *Active Directory*.

Authentication servers configuration page

Authentication servers configuration page enables adding new and editing existing authentication servers.

To open the authentication servers configuration page, select *Settings* > *External authentication*.



Adding a new external authentication server

To add an external authentication server, proceed as follows.

1. Select *Settings* > *External authentication*.
2. Click *+ Add external authentication source*.
3. Select authentication service type.
4. Provide configuration parameters depending on selected authentication system type.

Parameter	Description
CERB	
Host	Server's IP address.
Port	Port used to establish connections with given server.
Bind address	IP address used for sending requests to give host.
Secret	Secret used to establish server connection.
Service	CERB service used for authenticating Wheel Fudo PAM users.
RADIUS	
Host	Server's IP address.
Port	Port used to establish connections with given server.
Bind address	IP address used for sending requests to give host.
Secret	Secret used to establish server connection.
NAS ID	RADIUS server NAS-Identifier parameter.
LDAP	
Host	Server's IP address.
Port	Port used to establish connections with given server.
Bind address	IP address used for sending requests to give host.
User DN template	Template containing a path which will be used to create queries to LDAP server.
Active Directory	
Host	Server's IP address.
Port	Port used to establish connections with given server.
Bind address	IP address used for sending requests to give host.
Domain	Domain which will be used for authenticating users in Active Directory.

Note: Labeled IP addresses

In case of cluster configuration, select a labeled IP address from the *Bind address* drop-down list and make sure that other nodes have IP addresses assigned to this label. For more information refer to the *Labeled IP addresses* topic.

5. Click *Save*.

Editing authentication server definition

To edit an authorization server definition, proceed as follows.

1. Select *Settings* > *External authentication*.
2. Find the server definition and change its configuration as desired.
3. Click *Save*.

Deleting authentication server definition

To delete authentication server definition, proceed as follows.

1. Select *Settings* > *External authentication*.
2. Find desired server definition and select the *Delete* option.
3. Click *Save*.

Related topics:

- *User authentication methods and modes*
- *System overview*
- *Integration with CERB server*

15.6 External passwords repositories

Wheel Fudo PAM supports external passwords repositories for managing passwords to monitored servers.

15.6.1 CyberArk Enterprise Password Vault

Adding a new passwords repository

1. Select *Settings* > *External passwords repositories*.
2. Click *+ Add server*.
3. Select `CyberArk Enterprise Password Vault` from the *Type* drop-down list.
4. Enter object's name.
5. Provide the URL to the paswords server's API.
6. Provide application identification.
7. Define the account format string.
8. Click *Save*.

Editing a passwords repository

To edit a passwords repository definition, proceed as follows.

1. Select *Settings* > *External passwords repositories*.
2. Find the repository definition and change its configuration as desired.
3. Click *Save*.

Deleting a passwords repository

To delete a passwords repository definition, proceed as follows.

1. Select *Settings* > *External passwords repositories*.
2. Find desired repository definition and select the *Delete* option.
3. Click *Save*.

Related topics:

- *User authentication methods and modes*
- *System overview*
- *Integration with CERB server*

15.6.2 Hitachi ID Privileged Access Manager

Adding a new passwords repository

1. Select *Settings* > *External passwords repositories*.
2. Click *+ Add server*.
3. Select `Hitachi ID Privileged Access Manager` from the *Type* drop-down list.
4. Enter object's name.
5. Provide the URL to the paswords server's API.
6. Enter user login allowed to access passwords directory.
7. Provide user password in the *Password* and *Repeat password* fields.
8. Click *Save*.

Editing a passwords repository

To edit a passwords repository definition, proceed as follows.

1. Select *Settings* > *External passwords repositories*.
2. Find the repository definition and change its configuration as desired.
3. Click *Save*.

Deleting a passwords repository

To delete a passwords repository definition, proceed as follows.

1. Select *Settings* > *External passwords repositories*.
2. Find desired repository definition and select the *Delete* option.
3. Click *Save*.

Related topics:

- *User authentication methods and modes*
- *System overview*
- *Integration with CERB server*

15.6.3 Lieberman Enterprise Random Password Manager

Adding a new passwords repository

1. Select *Settings* > *External passwords repositories*.
2. Click *+ Add server*.
3. Select `Lieberman Enterprise Random Password Manager` from the *Type* drop-down list.
4. Enter object's name.
5. Provide the URL to the paswords server's API.
6. Define authention module assigned to the user who is allowed to access passwords repository.

7. Enter user login allowed to access passwords repository.
8. Provide user password in the *Password* and *Repeat password* fields.
9. Click *Save*.

Editing a passwords repository

To edit a passwords repository definition, proceed as follows.

1. Select *Settings* > *External passwords repositories*.
2. Find the repository definition and change its configuration as desired.
3. Click *Save*.

Deleting a passwords repository

To delete a passwords repository definition, proceed as follows.

1. Select *Settings* > *External passwords repositories*.
2. Find desired repository definition and select the *Delete* option.
3. Click *Save*.

Related topics:

- *User authentication methods and modes*
- *System overview*
- *Integration with CERB server*

15.6.4 Thycotic Secret Server

Adding a new passwords repository

1. Select *Settings* > *External passwords repositories*.
2. Click *+ Add server*.
3. Select `Thycotic Secret Server` from the *Type* drop-down list.
4. Enter object's name.
5. Provide the URL to the paswords server's API.
6. Enter user login allowed to access passwords repository.
7. Provide user password in the *Password* and *Repeat password* fields.
8. Define secret string format used for identifying objects on Thycotic Secret Server.
9. Click *Save*.

Editing a passwords repository

To edit a passwords repository definition, proceed as follows.

1. Select *Settings* > *External passwords repositories*.
2. Find the repository definition and change its configuration as desired.
3. Click *Save*.

Deleting a passwords repository

To delete a passwords repository definition, proceed as follows.

1. Select *Settings* > *External passwords repositories*.
2. Find desired repository definition and select the *Delete* option.
3. Click *Save*.

Related topics:

- *User authentication methods and modes*
- *System overview*
- *Integration with CERB server*

Related topics:

- *User authentication methods and modes*
- *System overview*
- *Integration with CERB server*

15.7 Resources

Wheel Fudo PAM enables customizing RDP and VNC login screen.

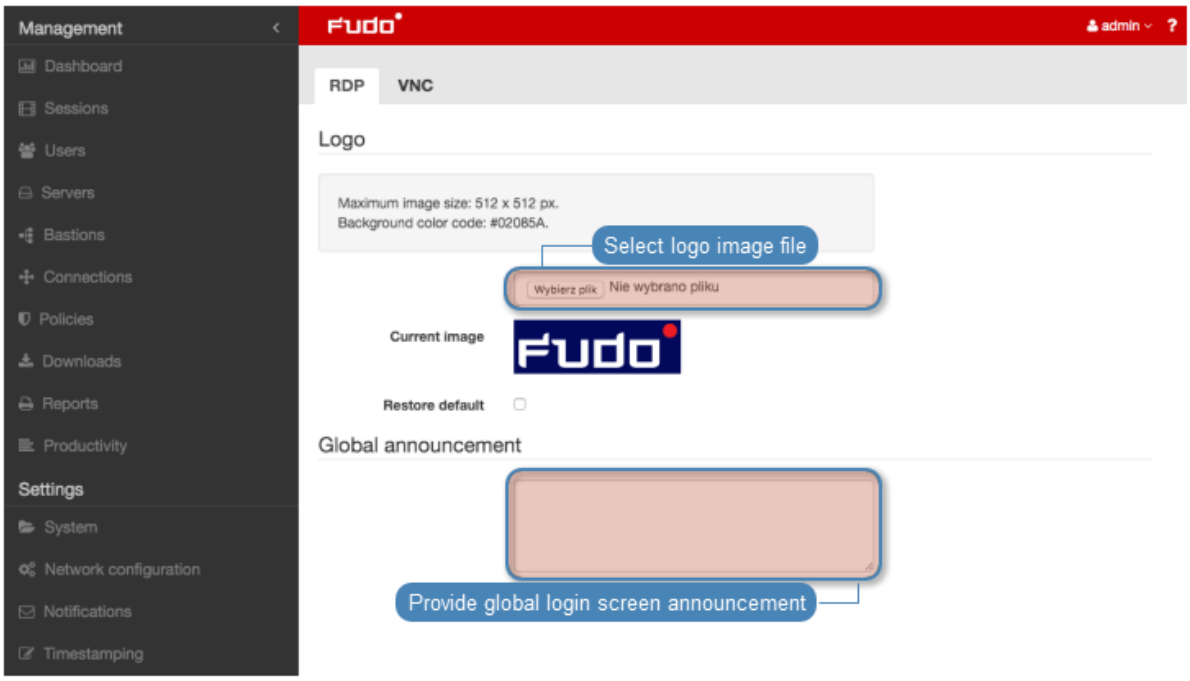
Changing logo

1. Select *Settings* > *Resources*.
2. Select the *RDP* or the *VNC* tab.

3. Click *Choose File* button and select desired image.

Note: Maximum image size is 512 x 512 px.

4. Click *Save*.



Restoring default logo

1. Select *Settings* > *Resources*.
2. Select *RDP* or *VNC* tab.
3. Select *Restore default* option.
4. Click *Save*.

Defining global announcement

Global announcement is displayed on RDP and VNC login screen.

Note: Apart from global announcement, WHEEL Wheel Fudo PAM PAM also enables configuring local server message in server configuration form.

1. Select *Settings* > *Resources*.
2. Select *RDP* or *VNC* tab.
3. Enter desired message in the *Global announcement* section.
4. Click *Save*.

Related topics:

- *Quickstart - RDP*

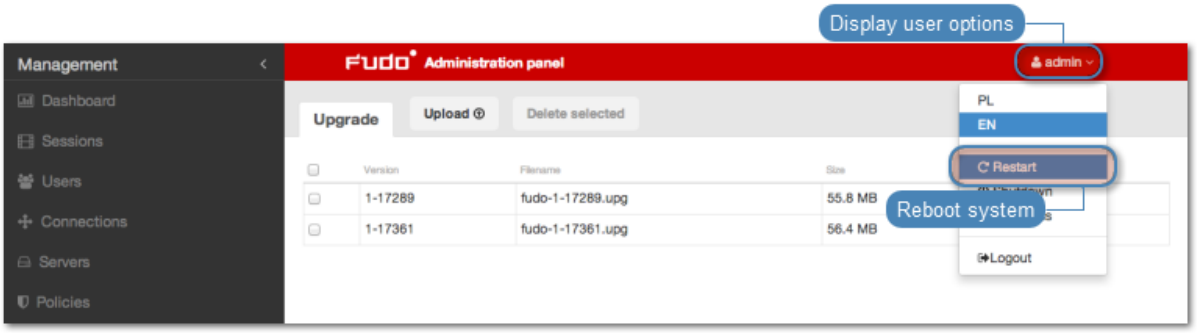
15.8 System version restore

In the case there is a problem with the current system revision, it is possible to restore the system to its previous version.

Warning: Restoring the system to the previous version will bring back the system's state prior the update. Session data and configuration changes in the current system revision will be lost.

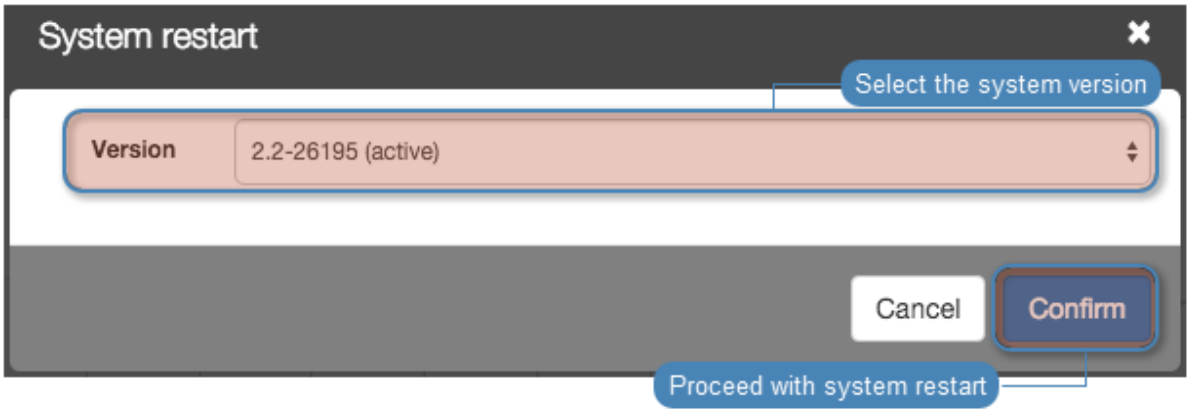
To restore the system to the previous revision, proceed as follows.

1. Connect one of the USB flash drives containing the encryption key.
2. Select *Restart* from user options menu.



3. Select the previous system revision to be loaded after restarting the system.

Note: Current system version is selected by default.



4. Click *Confirm* to proceed with restarting the system to the selected revision.

Warning: Restrating the system will terminate all current users' connections.

Related topics:

- *System initiation*

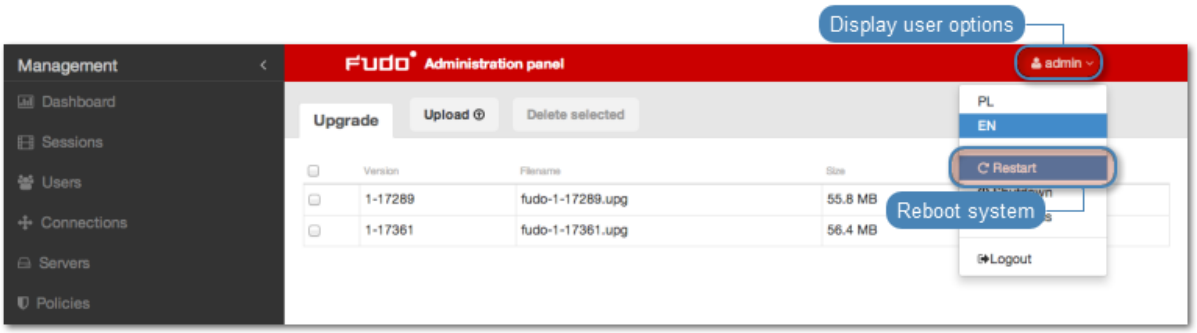
- *System update*

15.9 System restart

Note:

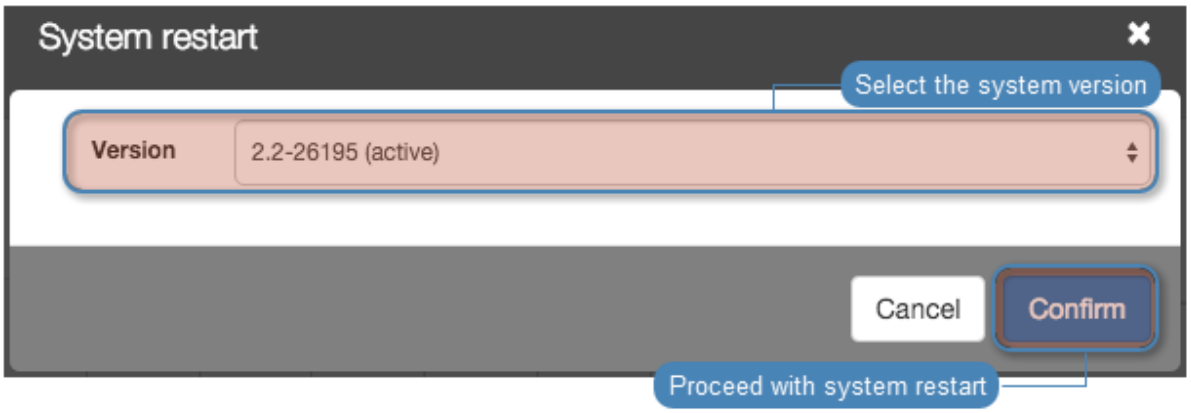
- System restart requires USB flash drive with the encryption key connected to the device.
- Restrating the system will terminate all current users' connections.
- Use the *Deny new connections* option in the *Sessions* section in the system settings menu.

1. Connect one of the USB flash drives containing the encryption key.
2. Select *Restart* from user options menu.



3. Select the previous system revision to be loaded after restarting the system.

Note: Current system version is selected by default.



4. Click *Confirm* to proceed with restarting the system to the selected revision.

Related topics:

- *System initiation*
- *System version restore*

15.10 SNMP

Wheel Fudo PAM's status can be monitored over SNMPv3 protocol.

15.10.1 Configuring SNMP

1. Select *Settings* > *System*.
2. Select *Enabled* option in the *SNMPv3* section.
3. From the *IP address* drop-down list select IP address, which will be used for SNMP communication.
4. Click *Save*.
5. Select *Management* > *Users*.
6. Click + *Add*.
7. Select `service` from the *Role* drop-down list and fill in the rest of the *General* section parameters.
8. Select `password` from the *Authentication* drop-down list and enter the password string.

Note:

- SNMP user password must be at least eight characters long.
- SNMP service authenticates the service account using the first defined password.

---

9. Select *Enabled* option in the *SNMP* section.
10. Select authentication methods from the *Authentication method* drop-down list.
11. Select the SNMP encryption algorithm from the *Encryption* drop-down list.
12. Clikc *Save*.

15.10.2 SNMP MIBs

Wheel Fudo PAM supports following MIBs:

- MIB-II (RFC 1213)
- HOST-RESOURCES-MIB (RFC 2790) - partly supported
- UCD-SNMP-MIB

15.10.3 Getting SNMP readings using `snmpwalk`

Note: Getting SNMP readings requires installing *Net-SNMP 5.7.3*.

Fetching all SNMP information

```
snmpwalk -v3 -u "${SNMP_USER}" -a SHA -A "${SNMP_PASSWORD}" -x AES -X
"${SNMP_PASSWORD}" -l authPriv "${FUDO_IP}" .1
```

Fetching specific SNMP information

```
snmpwalk -v3 -u "${SNMP_USER}" -a SHA -A "${SNMP_PASSWORD}" -x AES -X
"${SNMP_PASSWORD}" -l authPriv "${FUDO_IP}" .1.3.6.1.4.1.24410
```

Data specifier	Description
.1.3.6.1.4.1.24410.1.1.1	Disk status (ZFS status)
.1.3.6.1.4.1.24410.1.1.2	Power supply status **Note:** This feature is not supported on all Wheel Fudo PAM units. Contact Wheel Systems technical support for more information.
.1.3.6.1.4.1.24410.1.1.3	CPU temperatures
.1.3.6.1.4.1.24410.1.1.4	S.M.A.R.T status

15.10.4 Wheel Fudo PAM specific SNMP extensions

Overview

Extensions enable monitoring the number of active sessions, ZFS status, PSU status (if available), CPU temperature on all cores, S.M.A.R.T status such as temperature, health or reallocated sectors.

MIB specification file

Provided MIB file specification can be uploaded to the SNMP manager to enable Wheel Fudo PAM specific SNMP extensions.

```
WHEEL-SYSTEMS-MIB DEFINITIONS ::= BEGIN

--
-- MIB definition for Wheel Systems products
--

IMPORTS
        MODULE-IDENTITY, OBJECT-TYPE, Integer32, Gauge32, Counter32, enterprises
                FROM SNMPv2-SMI;

wheel MODULE-IDENTITY
        LAST-UPDATED "201704240000Z"    -- 24 April 2017
        ORGANIZATION "www.wheelsystems.com"
        CONTACT-INFO
                 "Postal:   Wheel Systems Inc. (USA)
                                    31 N 2nd Street 370,
                                    San Jose, CA 95113
                  Phone:    +1 (415) 800 3230
                  email:    info@wheelsystems.com"
        DESCRIPTION
        "Top-level infrastructure of the Wheel Systems enterprise MIB tree"
```

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```
        REVISION     "201704240000Z"
        DESCRIPTION
        "Moved common to .1, fudo to .2."
        REVISION     "201703270000Z"
        DESCRIPTION
        "Added objects for checking CPU temperature."
        REVISION     "201703150000Z"
        DESCRIPTION
        "Added objects describing status of power supply units."
        REVISION     "201703060000Z"
        DESCRIPTION
        "New objects to monitor disk status."
        REVISION     "201702140000Z"
        DESCRIPTION
        "First draft"
        ::= { enterprises 24410 }

products  OBJECT IDENTIFIER ::= { wheel 1 }

common OBJECT IDENTIFIER ::= { products 1 } -- Objects common to more than one␣
↪product.
fudo   OBJECT IDENTIFIER ::= { products 2 }

zpool OBJECT IDENTIFIER ::= { common 1 }

syncPercentage OBJECT-TYPE
        SYNTAX     Integer32 (0..100)
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
                "Percentage of vdev synchronization."
        ::= { zpool 1 }

syncTimeLeft OBJECT-TYPE
        SYNTAX     OCTET STRING
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
                "Time left for synchronization or N/A if it cannot be determined."
        ::= { zpool 2 }

vdevTable OBJECT-TYPE
        SYNTAX      SEQUENCE OF VdevEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
                "The table of vdevs. The vdev is an element in ZFS pool"
        ::= { zpool 3 }

vdevEntry OBJECT-TYPE
        SYNTAX      VdevEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
                "An entry for one vdev status in ZFS pool."
        INDEX { vdevIndex }
```

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```
        ::= { vdevTable 1 }

VdevEntry ::= SEQUENCE {
        vdevIndex         Integer32,
        vdevStatus        OCTET STRING
}

vdevIndex OBJECT-TYPE
        SYNTAX     Integer32 (1..2147483647)
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
                "A unique value for each vdev in ZFS pool."
        ::= { vdevEntry 1 }

vdevStatus OBJECT-TYPE
        SYNTAX     OCTET STRING
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
                "Status of the vdev in ZFS pool."
        ::= { vdevEntry 2 }

powerSupply OBJECT IDENTIFIER ::= { common 2 }

powerSupplyTable OBJECT-TYPE
        SYNTAX      SEQUENCE OF PowerSupplyEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
                "The table of power supply units status, such as which unit is
                 operating."
        ::= { powerSupply 1 }

powerSupplyEntry OBJECT-TYPE
        SYNTAX      PowerSupplyEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
                "An entry in power supply table representing the status of the
                 associated power supply unit."
        INDEX { powerSupplyIndex }
        ::= { powerSupplyTable 1 }

PowerSupplyEntry ::= SEQUENCE {
        powerSupplyIndex   Integer32,
        powerSupplyStatus  INTEGER
}

powerSupplyIndex OBJECT-TYPE
        SYNTAX     Integer32 (1..2147483647)
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
                "A unique index for each power supply unit."
        ::= { powerSupplyEntry 1 }
```

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```
powerSupplyStatus OBJECT-TYPE
        SYNTAX     INTEGER {
                unknown(1),
                present(2),
                absent(3),
                configError(4),
                acLost(5),
                predictiveFailure(6),
                failed(7)
        }
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
                "The status of power supply unit. When everything is working, reported
                 status should be present(1). This information is gathered from IPMI
                 subsystem."
        ::= { powerSupplyEntry 2 }

cpu OBJECT IDENTIFIER ::= { common 3 }

cpuTable OBJECT-TYPE
        SYNTAX      SEQUENCE OF CpuEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
                "The table of CPUs statuses."
        ::= { cpu 1 }

cpuEntry OBJECT-TYPE
        SYNTAX      CpuEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
                "An entry in CPU table representing the status of the associated CPU."
        INDEX { cpuIndex }
        ::= { cpuTable 1 }

CpuEntry ::= SEQUENCE {
        cpuIndex       Integer32,
        cpuTemperature Gauge32
}

cpuIndex OBJECT-TYPE
        SYNTAX     Integer32 (1..2147483647)
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
                "A unique index for each CPU."
        ::= { cpuEntry 1 }

cpuTemperature OBJECT-TYPE
        SYNTAX     Gauge32
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
```

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```
                "The temperature of CPU in degree Celsius."
        ::= { cpuEntry 2 }

smart OBJECT IDENTIFIER ::= { common 4 }

smartTable OBJECT-TYPE
        SYNTAX      SEQUENCE OF SmartEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
                "The table contains devices with enabled SMART and their statuses.␣
↪Note
                that interpretation all elements reported in this table are hard disk
                manufacturer dependent. Values are reported as raw value or as
                (normalized value - threshold). The lower is value of
                (normalized value - threshold) the worst. Keep in mind that every
                manufacturer uses their own algorithms for calculating 'normalized
                value'."
        ::= { smart 1 }

smartEntry OBJECT-TYPE
        SYNTAX      SmartEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
                "An entry in SMART table representing the status of the associated
                device."
        INDEX { smartIndex }
        ::= { smartTable 1 }

SmartEntry ::= SEQUENCE {
        smartIndex              Integer32,
        smartModelFamily        OCTET STRING,
        smartDeviceModel        OCTET STRING,
        smartSerialNumber       OCTET STRING,
        smartHealth             INTEGER,
        smartTemperature        Gauge32,
        smartReallocatedSectors Gauge32,
        smartPendingSectors     Gauge32,
        smartUncorrectable      Gauge32,
        smartUdmaCrcErrors      Gauge32,
        smartReadErrorRate      Gauge32,
        smartSeekErrorRate      Gauge32
}

smartIndex OBJECT-TYPE
        SYNTAX     Integer32 (1..2147483647)
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
                "A unique index for each SMART-enabled device."
        ::= { smartEntry 1 }

smartModelFamily OBJECT-TYPE
        SYNTAX     OCTET STRING
        MAX-ACCESS read-only
```

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```
        STATUS     current
        DESCRIPTION
                "Model family of device."
        ::= { smartEntry 2 }

smartDeviceModel OBJECT-TYPE
        SYNTAX     OCTET STRING
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
                "Device model."
        ::= { smartEntry 3 }

smartSerialNumber OBJECT-TYPE
        SYNTAX     OCTET STRING
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
                "Serial number of the device."
        ::= { smartEntry 4 }

smartHealth OBJECT-TYPE
        SYNTAX     INTEGER {
                unknown(1),
                ok(2),
                failed(3)
        }
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
                "Health of the device as reported by SMART system."
        ::= { smartEntry 5 }

smartTemperature OBJECT-TYPE
        SYNTAX     Gauge32
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
                "The temperature of disk in degree Celsius."
        ::= { smartEntry 6 }

smartReallocatedSectors OBJECT-TYPE
        SYNTAX     Gauge32
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
                "The number of reallocated sectors: bad sectors found and then␣
↪remapped.
                Reported as raw value of 'Reallocated Sectors Count' SMART attribute."
        ::= { smartEntry 7 }

smartPendingSectors OBJECT-TYPE
        SYNTAX     Gauge32
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
```

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```
                "The number of sectors waiting to be remapped. Reported as raw value␣
↪of
                'Current Pending Sector Count' SMART attribute."
        ::= { smartEntry 8 }

smartUncorrectable OBJECT-TYPE
        SYNTAX     Gauge32
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
                "The number of uncorrectable errors when accessing sectors. Reported␣
↪as
                raw value of 'Offline Uncorrectable Sector Count' SMART attribute."
        ::= { smartEntry 9 }

smartUdmaCrcErrors OBJECT-TYPE
        SYNTAX     Gauge32
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
                "The number of errors in data transfer determined by the means of␣
↪ICRC.
                Reported as raw value of 'UltraDMA CRC Error Count' SMART attribute."
        ::= { smartEntry 10 }

smartReadErrorRate OBJECT-TYPE
        SYNTAX     Gauge32
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
                "The rate of hardware read errors. Reported as
                (normalized value - threshold) of 'Read Error Rate' SMART attribute."
        ::= { smartEntry 11 }

smartSeekErrorRate OBJECT-TYPE
        SYNTAX     Gauge32
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
                "The rate of seek errors. Reported as (normalized value - threshold)␣
↪of
                'Seek Error Rate'."
        ::= { smartEntry 12 }

sessionTable OBJECT-TYPE
        SYNTAX      SEQUENCE OF SessionEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
                "The table of active sessions on Fudo."
        ::= { fudo 1 }

sessionEntry OBJECT-TYPE
        SYNTAX      SessionEntry
        MAX-ACCESS  not-accessible
        STATUS      current
```

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```
        DESCRIPTION
                "An entry for one session type on Fudo. For example, information about
                active RDP sessions."
        INDEX { sessionIndex }
        ::= { sessionTable 1 }

SessionEntry ::= SEQUENCE {
        sessionIndex         Integer32,
        sessionName          OCTET STRING,
        sessionDescription   OCTET STRING,
        sessionActive        Counter32
}

sessionIndex OBJECT-TYPE
        SYNTAX     Integer32 (1..2147483647)
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
                "A unique value for each supported sessions on Fudo."
        ::= { sessionEntry 1 }

sessionName OBJECT-TYPE
        SYNTAX     OCTET STRING
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
                "A name of session type."
        ::= { sessionEntry 2 }

sessionDescription OBJECT-TYPE
        SYNTAX     OCTET STRING
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
                "A description of session type."
        ::= { sessionEntry 3 }

sessionActive OBJECT-TYPE
        SYNTAX     Counter32
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
                "A number of active sessions of this type."
        ::= { sessionEntry 4 }

END
```

Related topics:

- *Security measures*
- *Troubleshooting*

15.11 Backups and retention

Data retention

Wheel Fudo PAM implements two stage data retention. First data is moved from the internal storage to the external storage connected over fiber channel interface. After defined time period session data is automatically deleted.

To enable data retention service, proceed as follows.

1. Select *Settings* > *Backups and retention*.
2. Select *Moving session data to external storage enabled* option in the *Data retention* section.
3. Define how long data will be stored locally before it is moved to the external storage.
4. Select *Session data removal enabled* option to have the data automatically removed after specified time period.
5. Define how long data will be stored before being deleted.

Note: Global retention parameter values have lower priority than the values set in the *accounts*.

---

6. Click *Save*.

System backup

Warning: Data backup contains confidential information.

Data stored on Wheel Fudo PAM can be backed up on an external server running `rsync` service. Backup service has to be enabled on Wheel Fudo PAM and requires uploading external server's public SSH key, to authorize access to Wheel Fudo PAM.

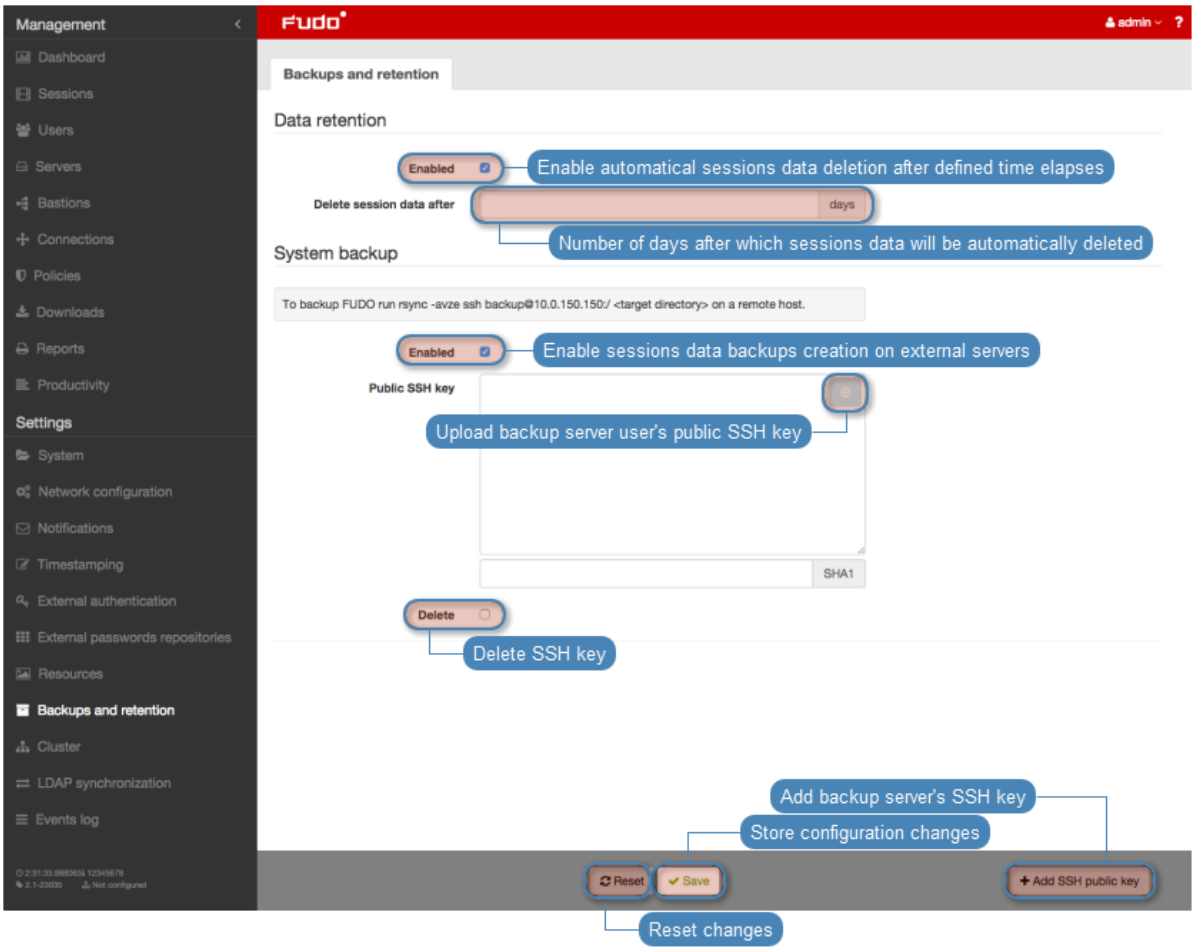
Automated data backup requires configuring `rsync` service on a remote server and granting access rights to data stored on Wheel Fudo PAM by uploading to Wheel Fudo PAM server's public SSH key.

Note: Sessions data is stored on a compressed file system with compression ratio of up to 12:1. Data is decompressed upon being copied by `rsync` thus it will occupy more space on the target server than indicated by Wheel Fudo PAM storage usage. Make sure there is enough storage space on the target server to store uncompressed data.

To enable automated backups service, proceed as follows.

1. Select *Settings* > *Backups and retention*.
2. Select *Enabled* option in the *System backup* section.
3. Click *Add SSH public key*.
4. Paste or upload the remote server user's public SSH key.
5. Click *Save*.
6. Run `rsync` on the backup server:

```
rsync -avze ssh backup@fudo_ip_address:/  <destination_folder>
```



Restoring system from backup

System restore service is provided by Wheelsystems technical support department on terms agreed in the SLA.

Related topics:

- *Exporting/importing system configuration*
- *Security measures*

15.12 External storage

Wheel Fudo PAM enables storing session data on external storage devices connected to Fudo through a fiber channel interface.

Note: External storage in cluster configuration

- In cluster configuration, each node must have a dedicated *WWN* object.
- Data stored externally is not replicated between cluster nodes.

15.12.1 Configuring external storage

1. Select *Settings* > *External storage*.

Note: Fiber channel cards status is depicted by the icons.

- ■ - both fiber channel cards are operational.
- ■ - external storage volume is degraded - one of the fiber channel card is down.
- ■ - both fiber channel cards are down.

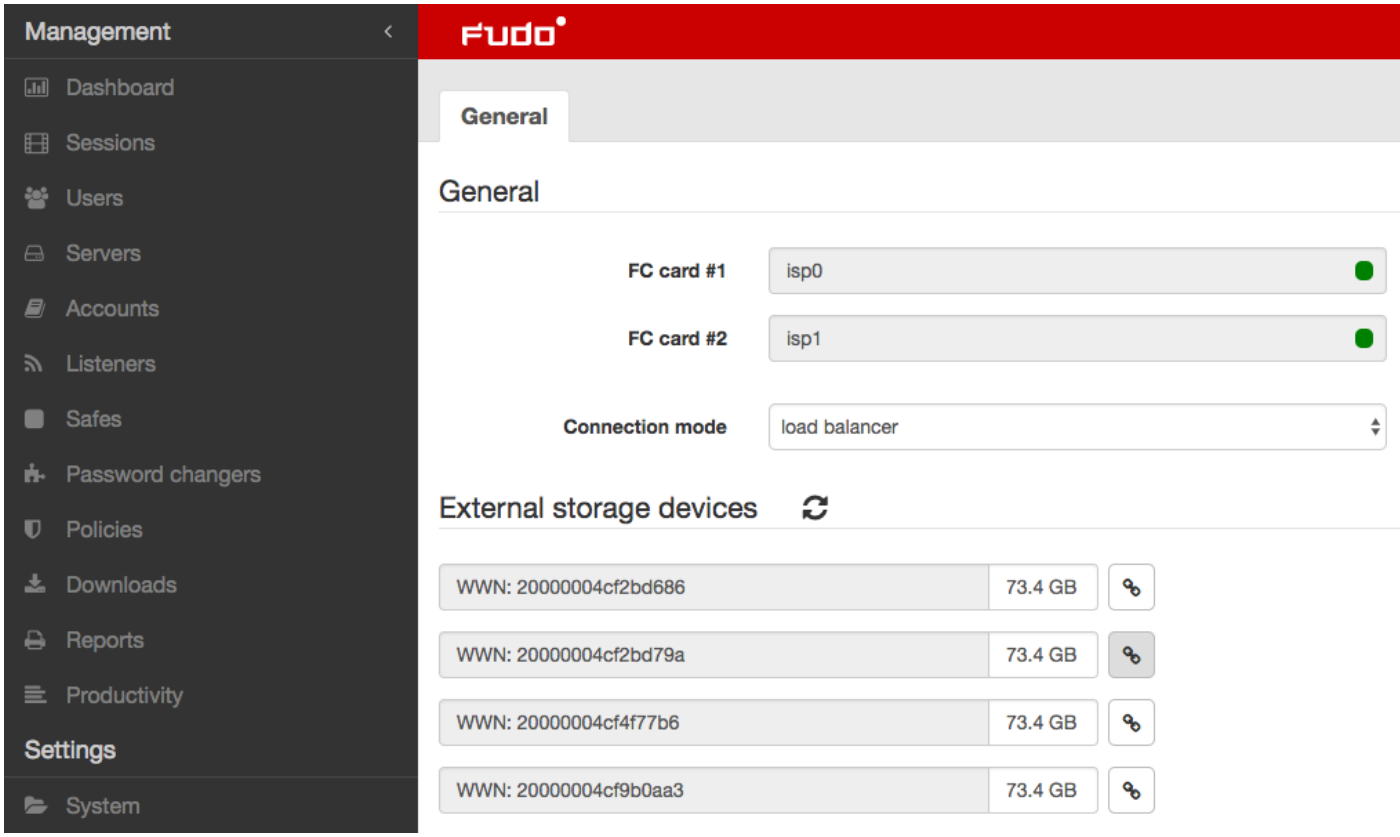
---

2. Select fiber channel cards operating mode.
   - Failover - data is transmitted using one fiber channel interface. If the card fails, the other one takes over ensuring continuous availability of the external storage device.
   - Load balancing - both fiber channel interfaces are used to transfer data between Wheel Fudo PAM and the external storage device.
3. In the *External storage devices* section, select desired *WWN* object and click the  icon.

Note: Click the ↻ icon to refresh the list of available storage devices.

---

4. Click *Save* and proceed with enabling *session data retention*.

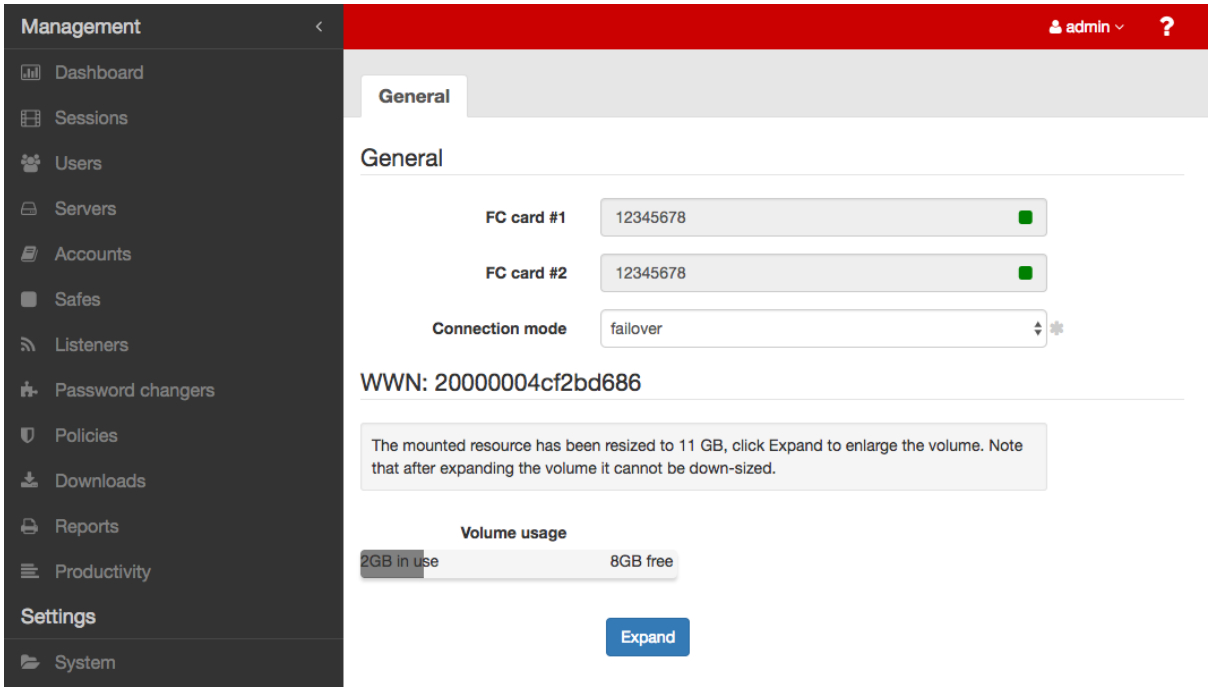


15.12.2 Expanding external storage device

After resizing the WWN object, it must be expanded in Wheel Fudo PAM in order to take advantage of the additional storage space.

Warning: The storage device cannot be down-sized after it has been expanded.

1. Select *Settings* > *External storage*.
2. In the section describing the *WWN* object click *Expand*.



3. Confirm expanding external storage.
4. Click *Save*.

Related topics:

- *Backups and retention*

15.13 Exporting/importing system configuration

Wheel Fudo PAM enables exporting current system state, defined objects and configuration settings, which later can be used to initiate the system.

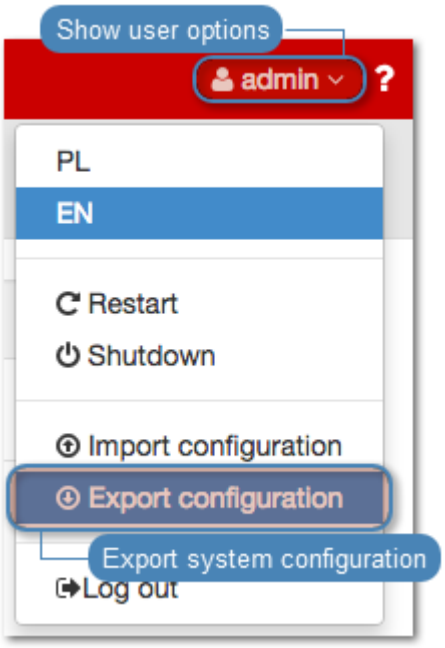
Warning: Exported configuration data contains confidential information.

Note: Configuration export and import options are available only for the *superadmin* users.

15.13.1 Exporting system configuration

To export system configuration, proceed as follows.

1. Select *Export configuration* from the user menu.
2. Save the configuration file.

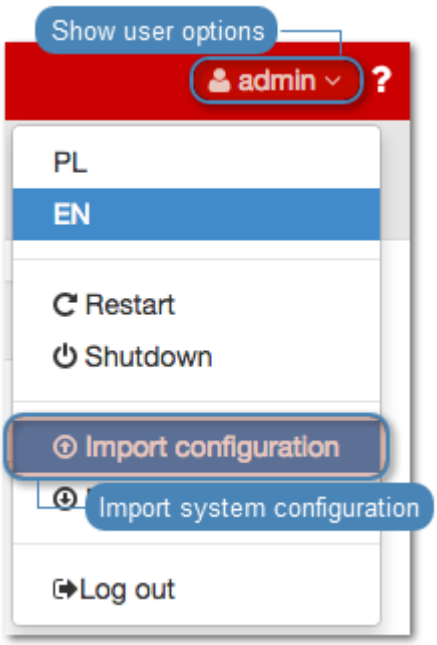


15.13.2 Importing system configuration

Warning: Importing a configuration file and initiating system with imported data will delete all existing session data.

To import a system configuration file, proceed as follows.

1. Select *Import configuration* from the user menu.



2. Provide the path to the desired configuration file and click *Confirm*.
3. Click *Confirm* to proceed with initiating the system with the imported data.

Related topics:

- *Backups and retention*
- *System initiation*
- *System update*

15.14 Cluster configuration

Wheel Fudo PAM cluster ensures uninterrupted access to servers in case of cluster node failure as well as enables implementing static load balancing.

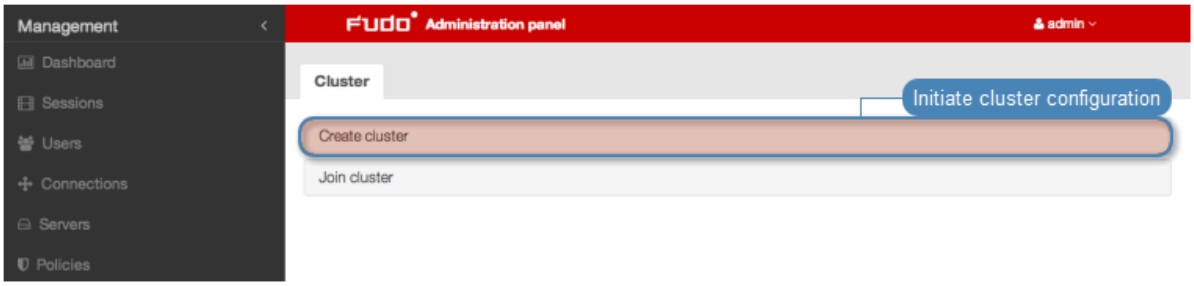
Warning: Cluster configuration does not facilitate data backup. If session data is deleted on one of the cluster nodes, it is also deleted from other nodes.

15.14.1 Initiating cluster

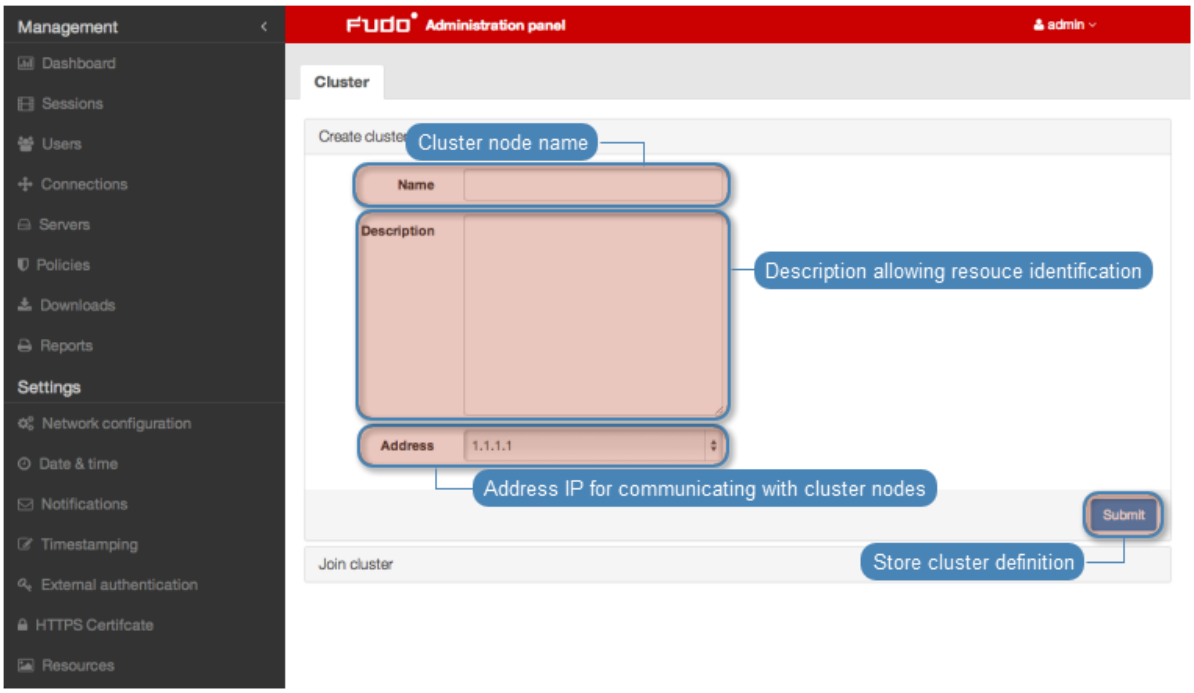
Warning: In cluster configuration all cluster nodes must have *NTP server configured*.

To initiate Wheel Fudo PAM cluster, proceed as follows.

1. Select *Settings* > *Cluster*.
2. Click *Create cluster*, to display cluster definition options.



3. Provide node name and description helping identify given object.
4. From the *Address* drop-down list, select IP address for communicating with other cluster nodes.



5. Click *Submit*.

Note: Message concerning cluster key can be ignored when initiating cluster.

Related topics:

- *Adding cluster nodes*
- *Editing cluster nodes*
- *Deleting cluster nodes*
- *Forcing full data synchronization*
- *Security: Cluster configuration*
- *Redundancy groups*
- *Cluster configuration*

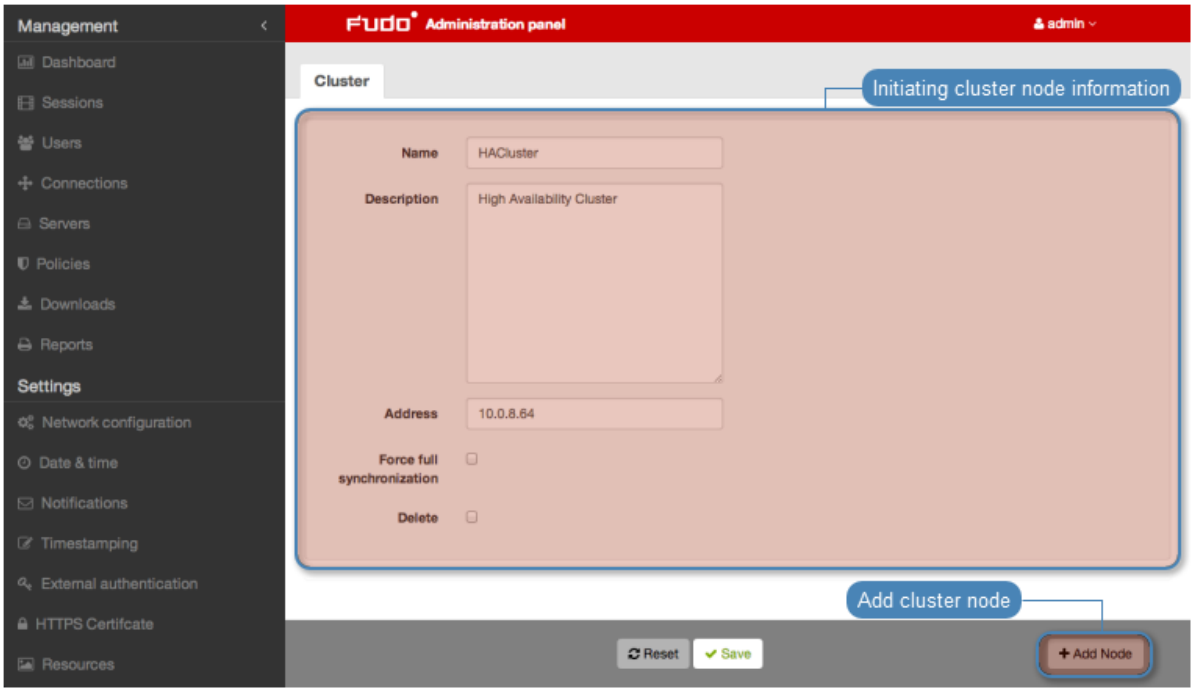
15.14.2 Adding cluster nodes

Warning:

- Session and configuration data (servers, users, safes, accounts, listeners, external authentication servers) of the joining node are deleted and initiated with data replicated from the cluster.
- Data model objects: *safes*, *users*, *servers*, *accounts* and *listeners* are replicated within the cluster and object instances must not be added on each node. In case the replication mechanism fails to copy objects to other nodes, contact technical support department.

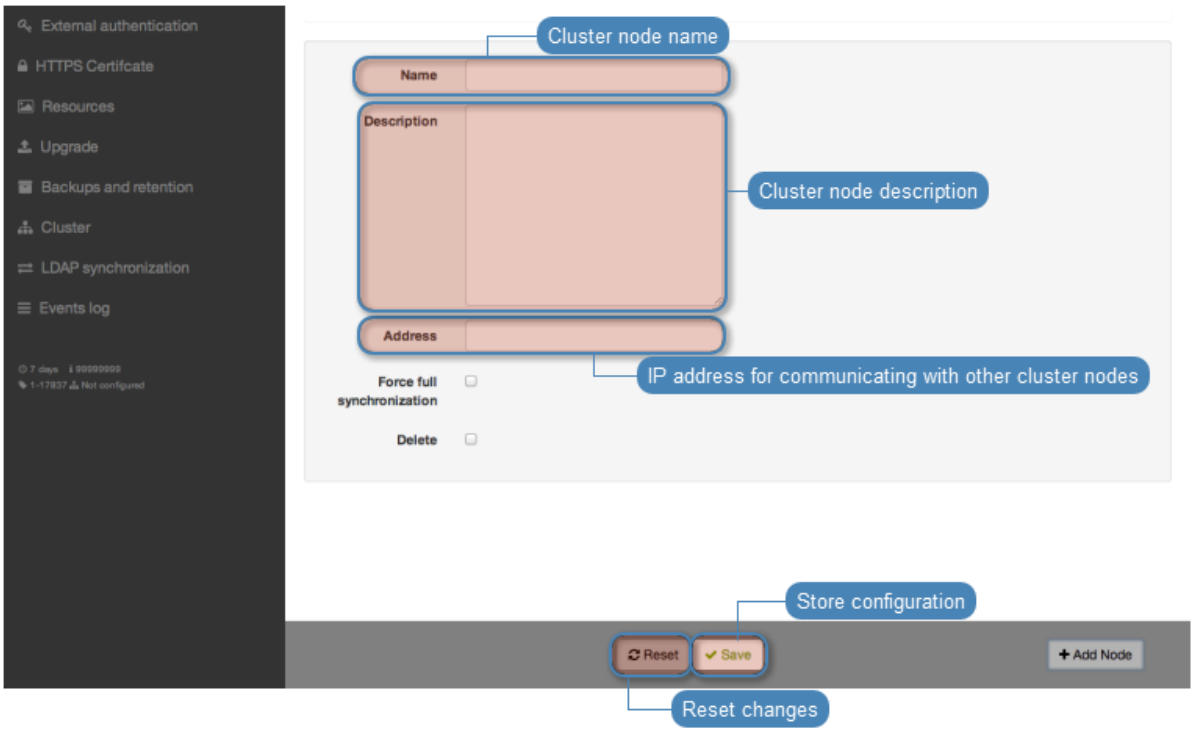
To add a node to Wheel Fudo PAM cluster, proceed as follows.

1. Log in to the Wheel Fudo PAM administration panel where the cluster has been *initiated*.
2. Select *Settings* > *Cluster*.
3. Click *Add node* to display new node configuration parameters.

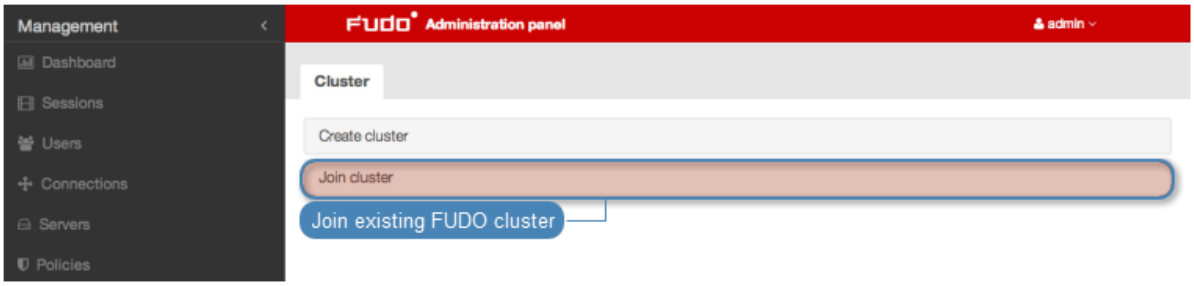


4. Provide node's name and optional description.
5. Provide node's IP address.

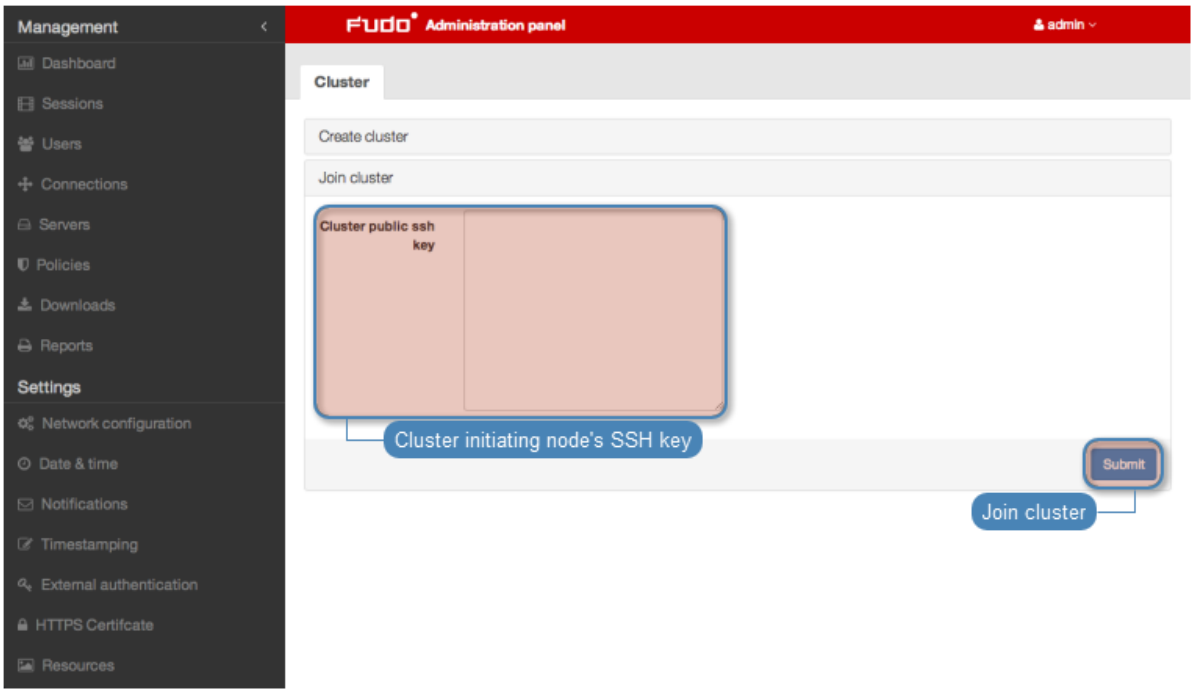
Note: Management option has to be enabled on given network interface. Refer to *Network settings: Network interfaces configuration* for details on configuring network interfaces.



6. Click *Submit*, to add node definition.
7. Copy cluster key to clipboard.
8. Log in to administration panel of the joining node.
9. Select *Settings* > *Cluster*.
10. Click *Join cluster*.



11. Paste cluster public SSH key and click *Submit*.



Related topics:

- *Editing cluster nodes*
- *Deleting cluster nodes*
- *Forcing full data synchronization*
- *Security: Cluster configuration*

15.14.3 Editing cluster nodes

To modify a cluster node's configuration, proceed as follows.

1. Select *Settings* > *Cluster*.
2. Find and edit desired node parameters.
3. Click *Submit*.

Related topics:

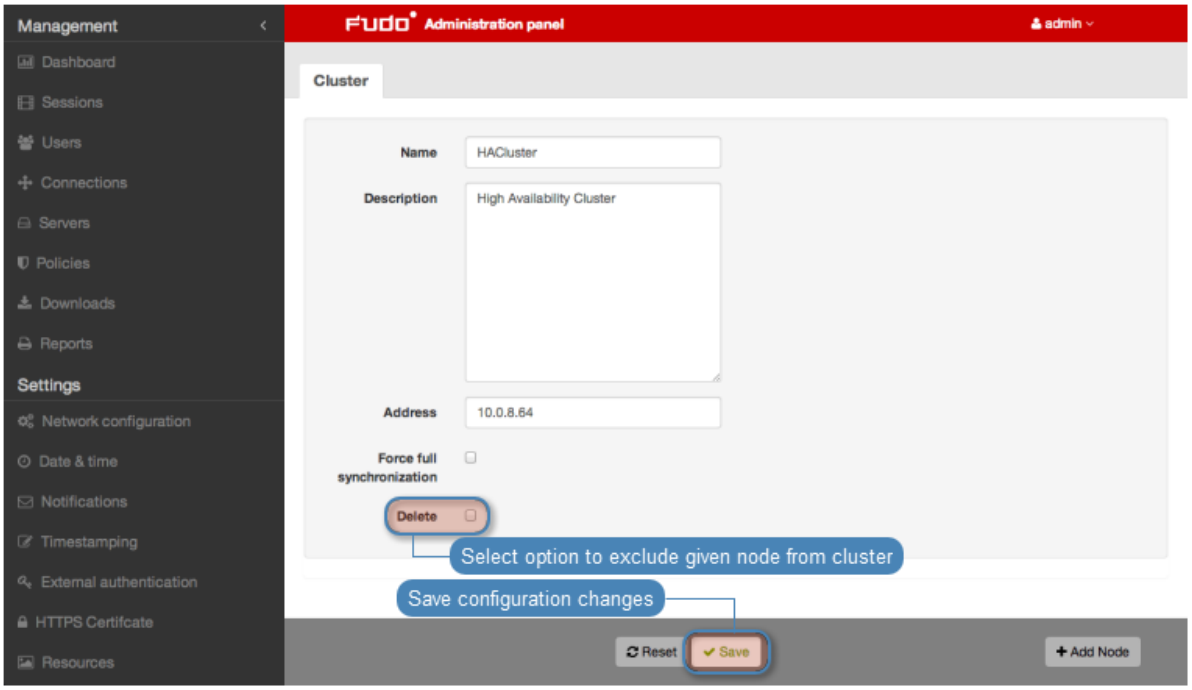
- *Adding cluster nodes*
- *Deleting cluster nodes*
- *Forcing full data synchronization*
- *Security: Cluster configuration*

15.14.4 Deleting cluster nodes

Warning: Removing a node and re-adding it to a cluster may result in data loss.

To remove a cluster node, proceed as follows.

1. Select *Settings* > *Cluster*.
2. Find desired node and select *Delete*.
3. Click *Submit*.



Related topics:

- *Adding cluster nodes*
- *Editing cluster nodes*
- *Forcing full data synchronization*
- *Security: Cluster configuration*

15.14.5 Forcing full data synchronization

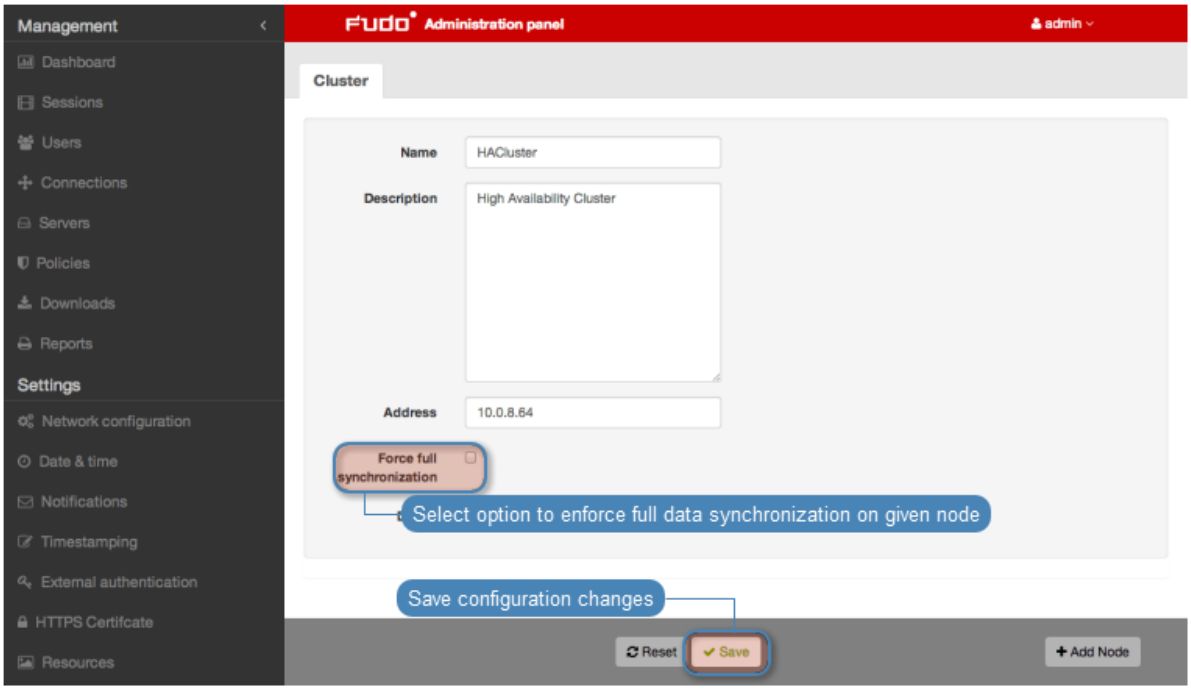
> **Warning:** Before enforcing full data synchronization contact Wheel Systems' technical support.

In case data stored on a certain cluster node gets desynchronized, it is necessary to perform forced data synchronization on given node.

To force data synchronization on a certain node, proceed as follows.

1. Log in to Wheel Fudo PAM administration panel on a node other than the one which requires synchronization.
2. Select *Settings* > *Cluster*.
3. Find and select node which requires data synchronization.

4. Select *Force full synchronization* option and click *Submit*.



Related topics:

- *Adding cluster nodes*
- *Editing cluster nodes*
- *Deleting cluster nodes*
- *Security: Cluster configuration*

15.14.6 Redundancy groups

Redundancy groups agregate IP addresses assigned to network interfaces enabling implementing static load balancing scenarios while fully preserving high availability features.

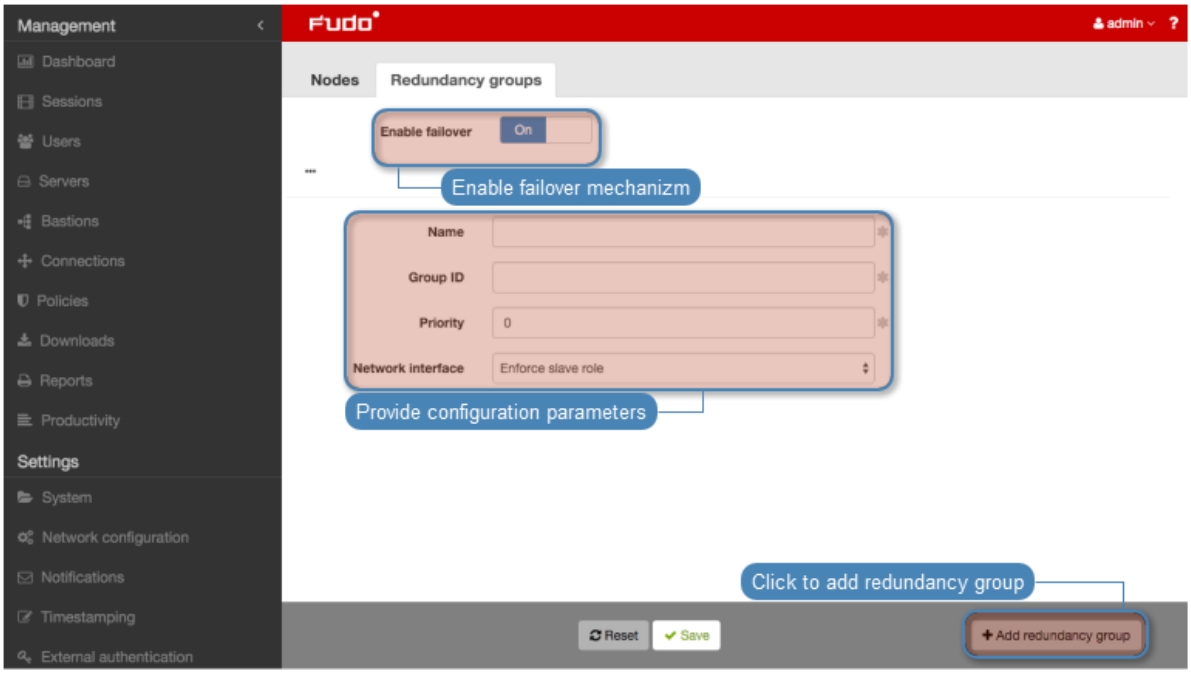
Note: Redundancy groups configuration options are available only after initializing the cluster.

Adding redundancy groups

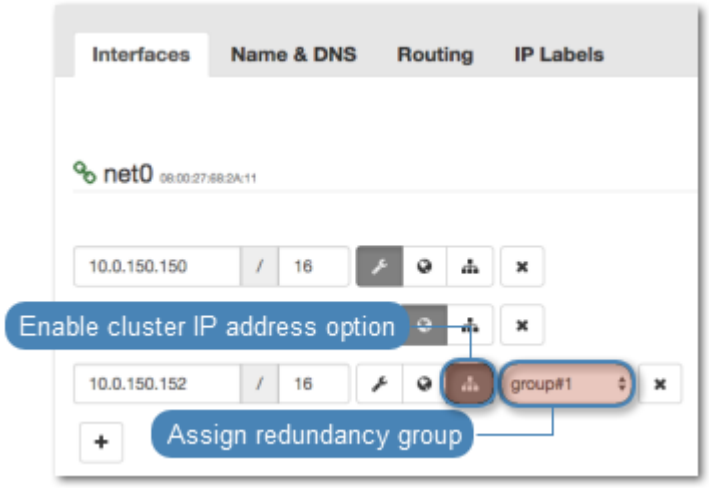
To add a redundancy group, proceed as follows.

1. Select *Settings* > *Cluster*.
2. Switch to the *Redundancy groups* tab.
3. Click *+ Add redundancy group*.
4. Define group properties.

Parameter	Description
Name	Descriptive name of the redundancy group.
ID	Redundancy groups identifier (1-255).
Priority	Redundancy group priority (0-254), the lower the number the higher the priority.
	Redundancy group with higher priority assumes the *master* role and handles all requests to monitored servers accessed through IP addresses assigned to this group. In case given cluster node crashes, user requests are directed to on of the remaining nodes with the highest priority defined for given redundancy group.
Interface	Network interface used for communicating with other cluster nodes.



5. Click *Save*.
6. Select *Settings* > *Network configuration*.
7. Click + to add new IP address.
8. Enter IP address and click the icon to mark the entry as a cluster IP address.
9. Assign previously added redundancy group.
10. Click *Save*.

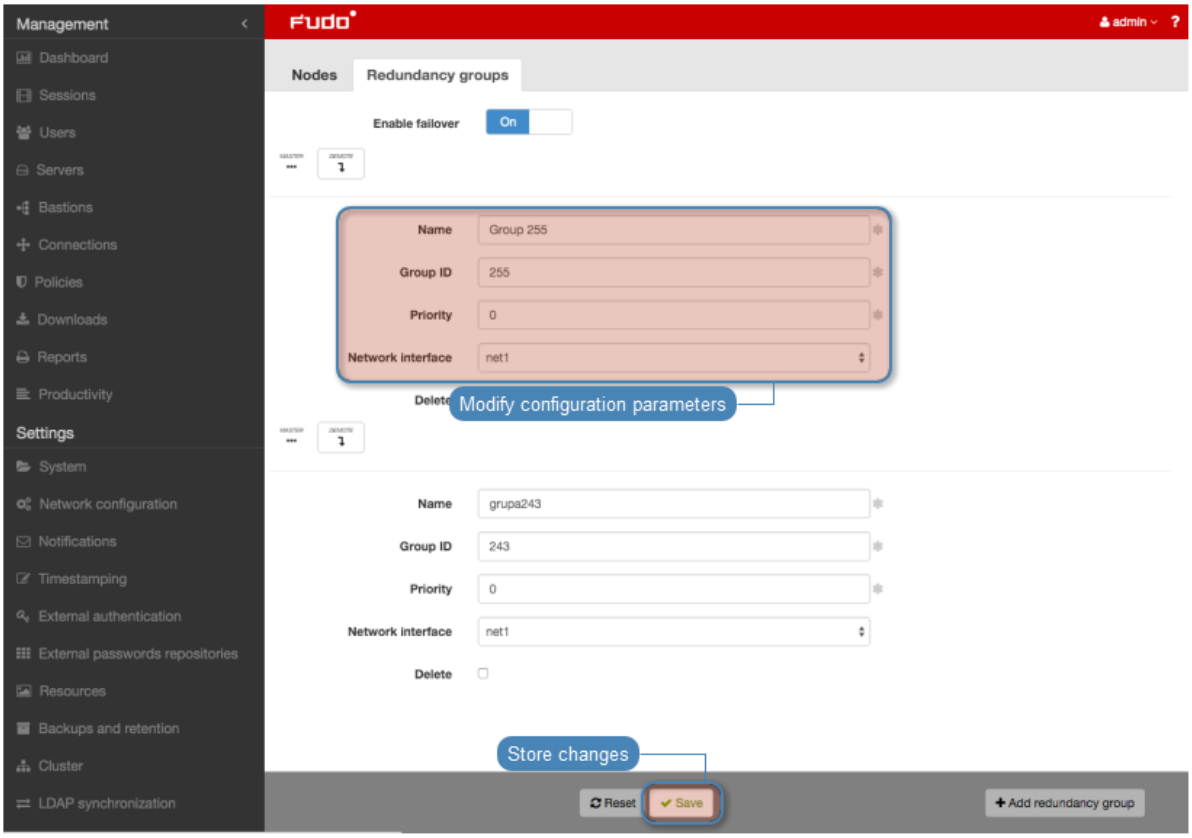


Note: Cluster IP address must be defined on every cluster node.

Editing redundancy groups

To modify a redundancy group, proceed as follows.

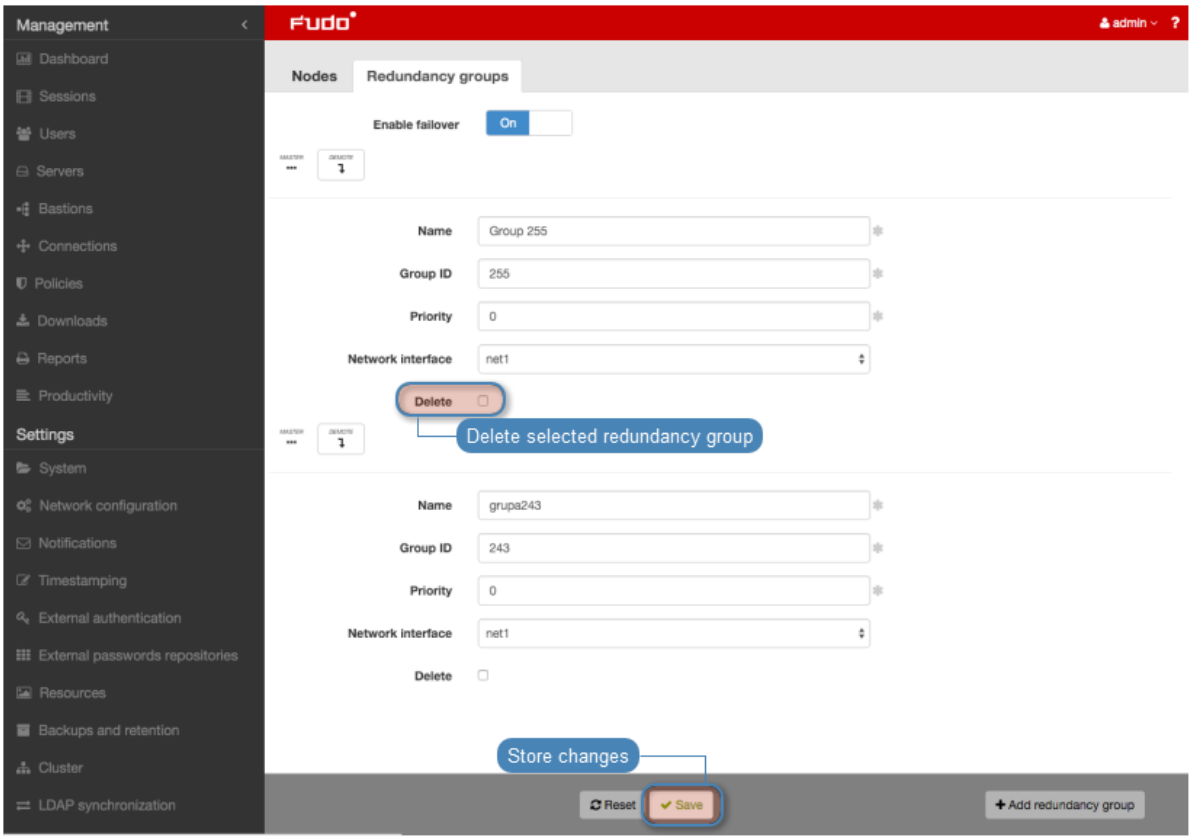
1. Select *Settings* > *Cluster*.
2. Switch to the *Redundancy groups* tab.
3. Find and edit desired redundancy group definition.
4. Click *Save*.



Deleting a redundancy group

To delete a redundancy group, proceed as follows.

1. Select *Settings* > *Cluster*.
2. Switch to the *Redundancy groups* tab.
3. Select *Delete* next to the desired redundancy group.
4. Click *Save*.

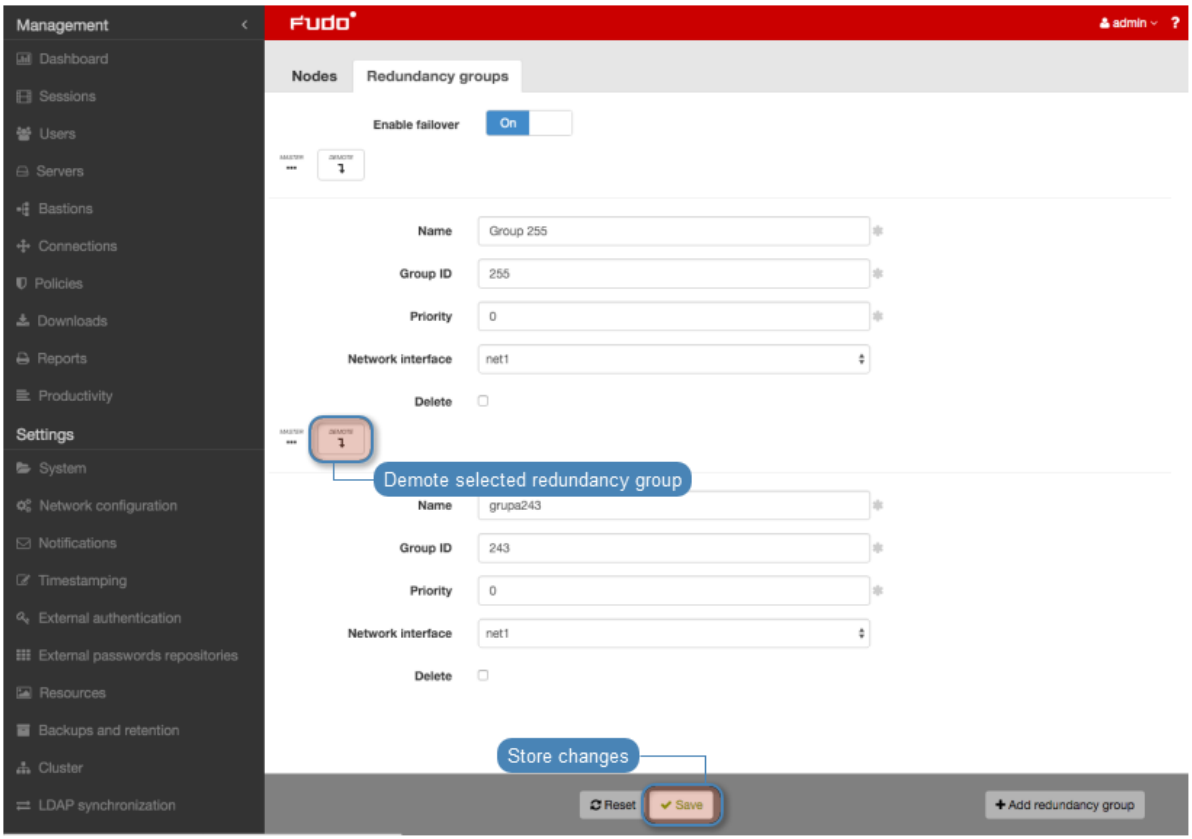


Demoting a redundancy group

Note: Demoting redundancy group transfers the master role for given group to another cluster node. The master role is assumed by on of the remaining nodes, on which the given redundancy group has the highest priority defined.

To demote a redundancy group, proceed as follows.

1. Select *Settings* > *Cluster*.
2. Switch to the *Redundancy groups* tab.
3. Click *Demote* next to the desired redundancy group.
4. Click *Confirm*.



Note: If after demoting a redundancy group no other node assumes the master role for the given group, it will be reassigned to the node which previously had this role.

Enforcing a slave role

Note: Enforcing a permanent slave role on a redundancy group ensures that the given node will not assume master role on given redundancy group despite the state that other nodes are in. It's recommended for directing all traffic to other nodes before performing maintenance tasks on given cluster node.

To enforce a permanent slave role on a redundancy group, proceed as follows.

1. Select *Settings* > *Cluster*.
2. Switch to the *Redundancy groups* tab.
3. Find desired redundancy group and select `Enforce slave mode` from the *Interface* drop-down list.
4. Click *Save*.

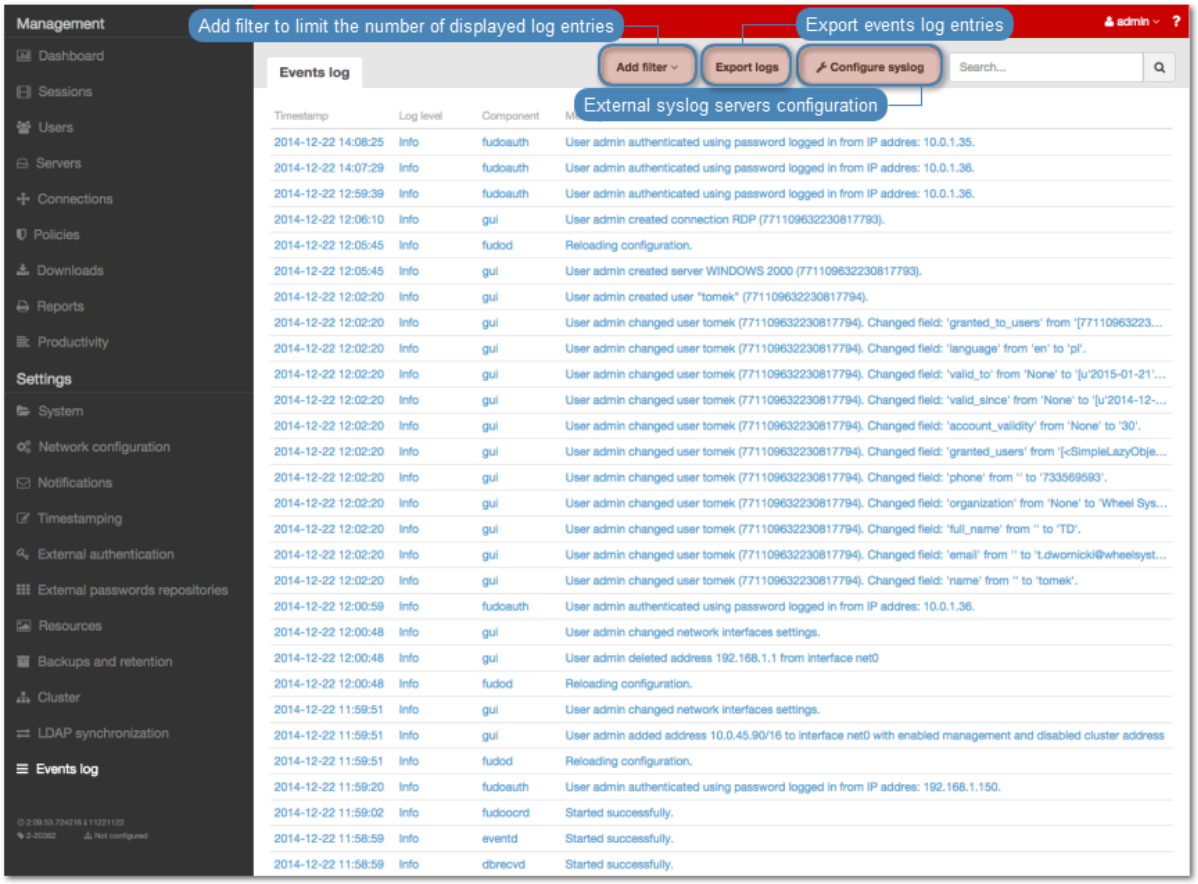
Related topics:

- *Security: Cluster configuration*
- *Initiating cluster*
- *Cluster configuration*

15.15 Events log

System log is an internal registry of users activities which influence system state (login information, administrative actions, etc.).

To display system log contents, select Settings > System log.



External syslog servers

Adding a Syslog server

To add a *Syslog* server, proceed as follows.

1. Select *Settings* > *Events log*.
2. Click *Configure syslog* to display syslog servers configuration settings.
3. Select *Enable events logging on syslog servers* option to activate sending logs to defined syslog servers.
4. Click *+*.
5. Provide server's IP address and port number.
6. Click *Save*.

Note: Log entries sent to syslog servers are formatted as follows:

```
[<log_level>] (<component_name>) (object_name: object_id) <message>
```

Example:

```
[INFO] (fudordp) (fudo_server:  848388532111147015) (fudo_session:
848388532111147219)          (fudo_user:  848388532111147012) (fudo_connection:
848388532111147014)    User user0 authenticated using password logged in from IP
addres:  10.0.40.101.
```

Editing Syslog server definition

To edit a *Syslog* server definition, proceed as follows.

1. Select *Settings* > *Events log*.
2. Click *Configure syslog* to display syslog servers configuration settings.
3. Find and edit desired syslog server definition.
4. Click *Save*.

Deleting Syslog server definition

To delete a *Syslog* server definition, proceed as follows.

1. Select *Settings* > *Events log*.
2. Click *Configure syslog* to display syslog servers configuration settings.
3. Find desired server definition and click the i icon.
4. Click *Save*.

Exporting events log

To export events log entries, proceed as follows.

1. Select *Settings* > *Events log*.
2. Click *Export logs* and select where to save exported log entries.

Related topics:

- *Security*
- *Managing servers*

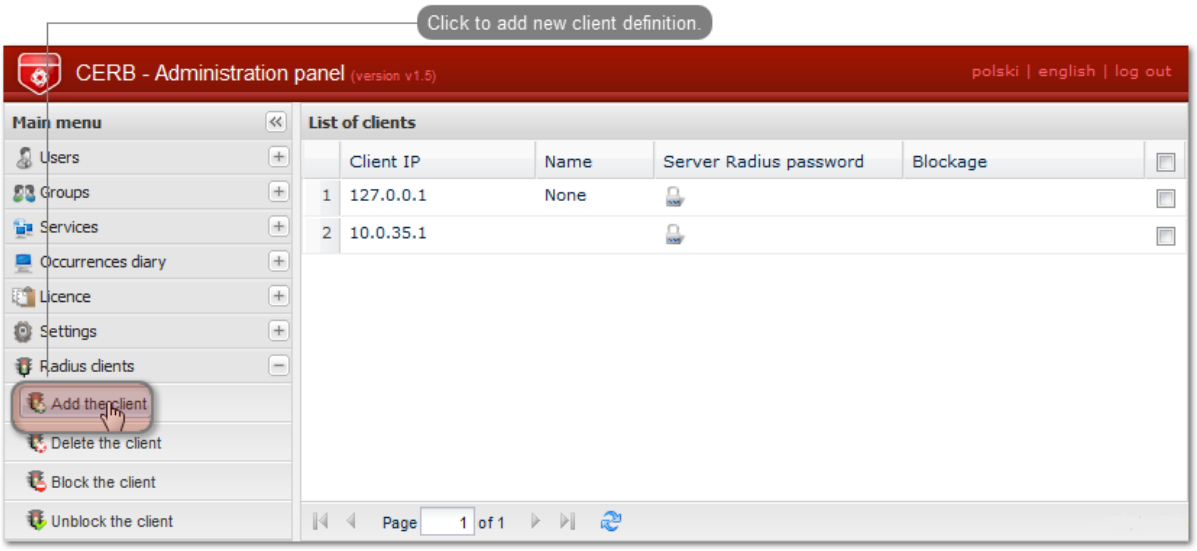
15.16 Integration with CERB server

CERB is complete user authorization solution which supports a number of authorization mechanisms (i.e. mobile token, onetime passwords, etc.). The following procedure describes configuration steps required to enable Wheel Fudo PAM to verify users credentials using CERB server.

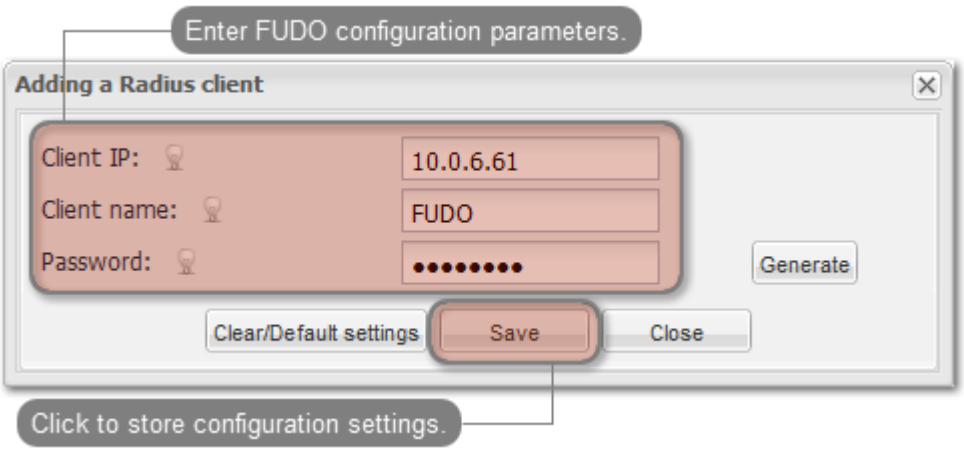
CERB server configuration

1. Adding RADIUS client.

- Select *RADIUS clients* > *Add client* to add Wheel Fudo PAM as a RADIUS client.



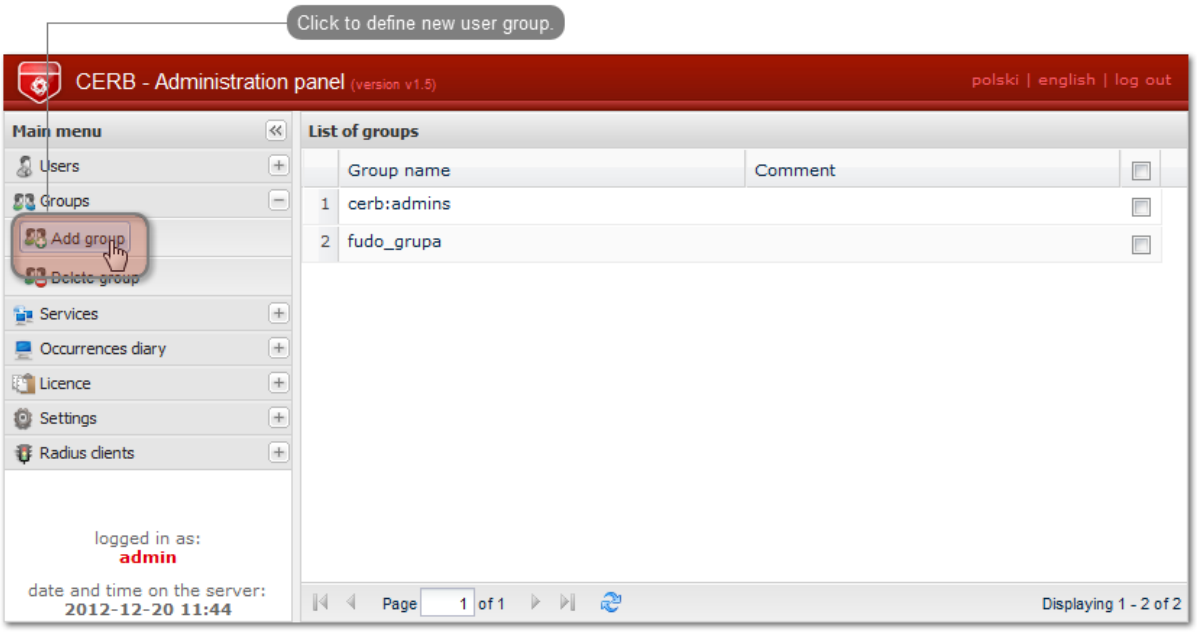
- Provide Wheel Fudo PAM IP address, client's name and password and click *Save*.



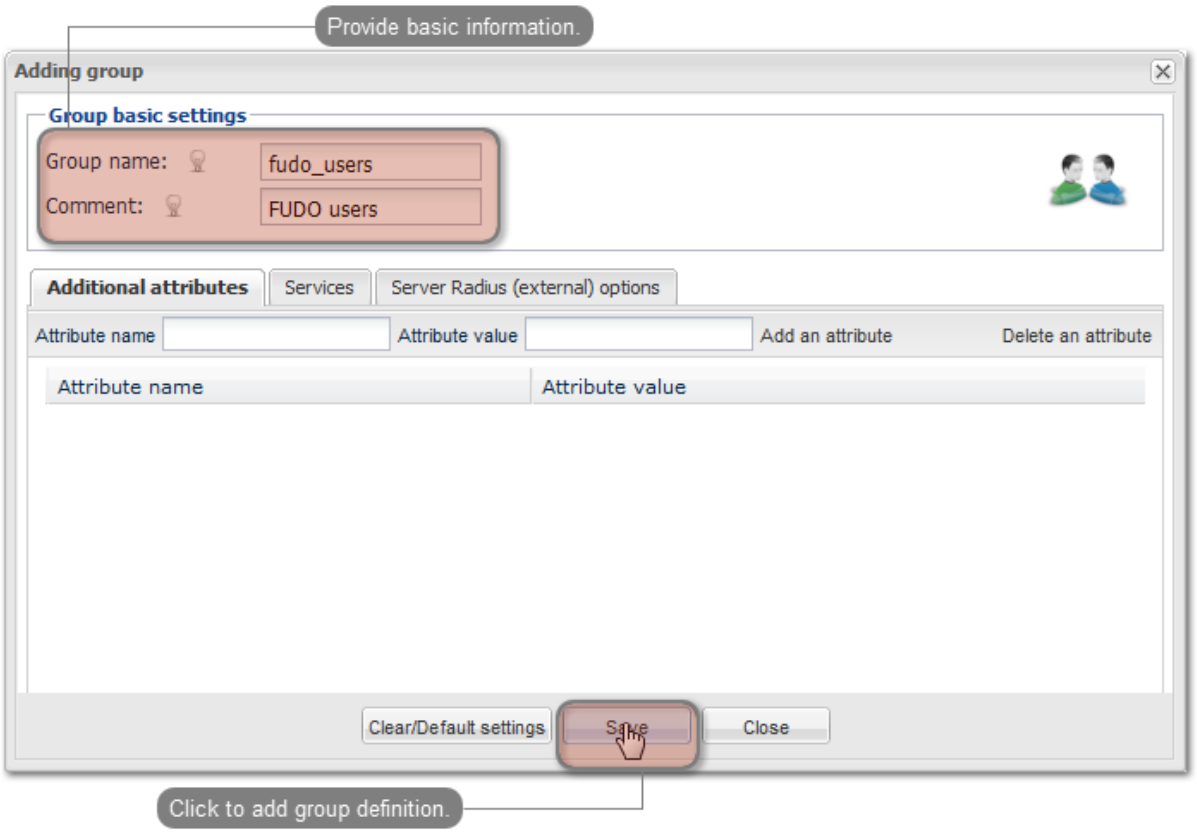
Note: Password will be required to define external authorization server in Wheel Fudo PAM administration panel.

2. Adding user group.

- Select *Groups* > *Add group* to define Wheel Fudo PAM users who will be authorized by the CERB server.

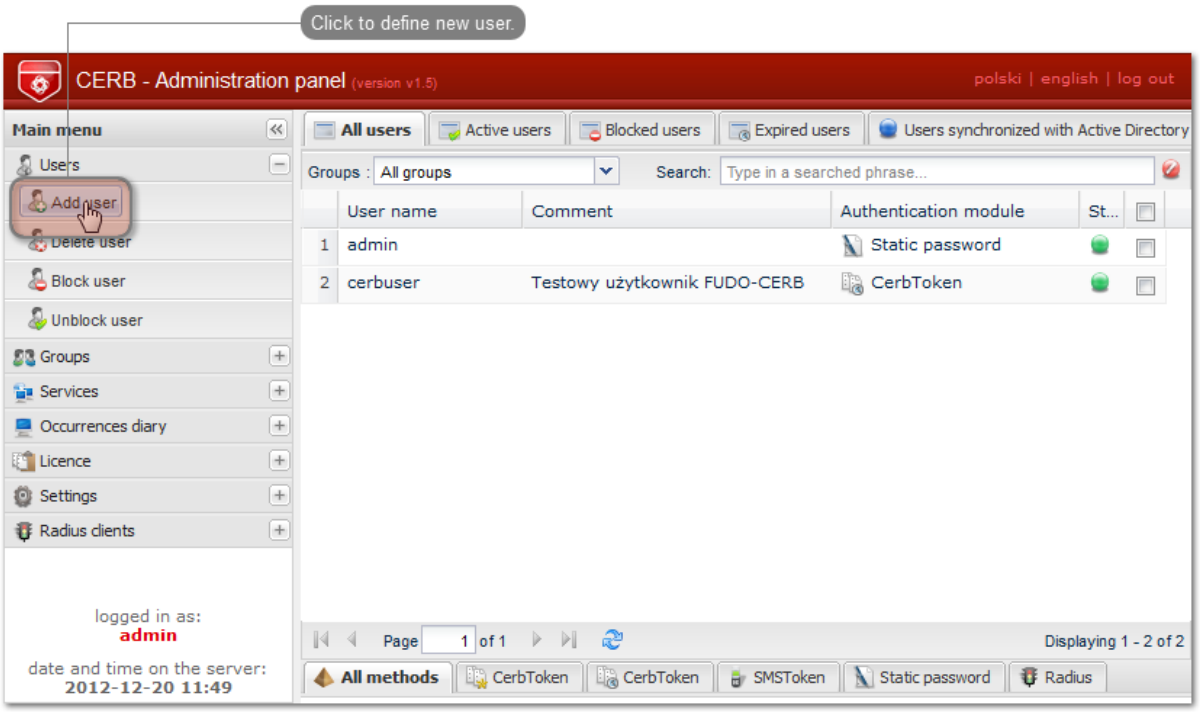


- Enter group's name (`fudo_users`) and click *Save*.

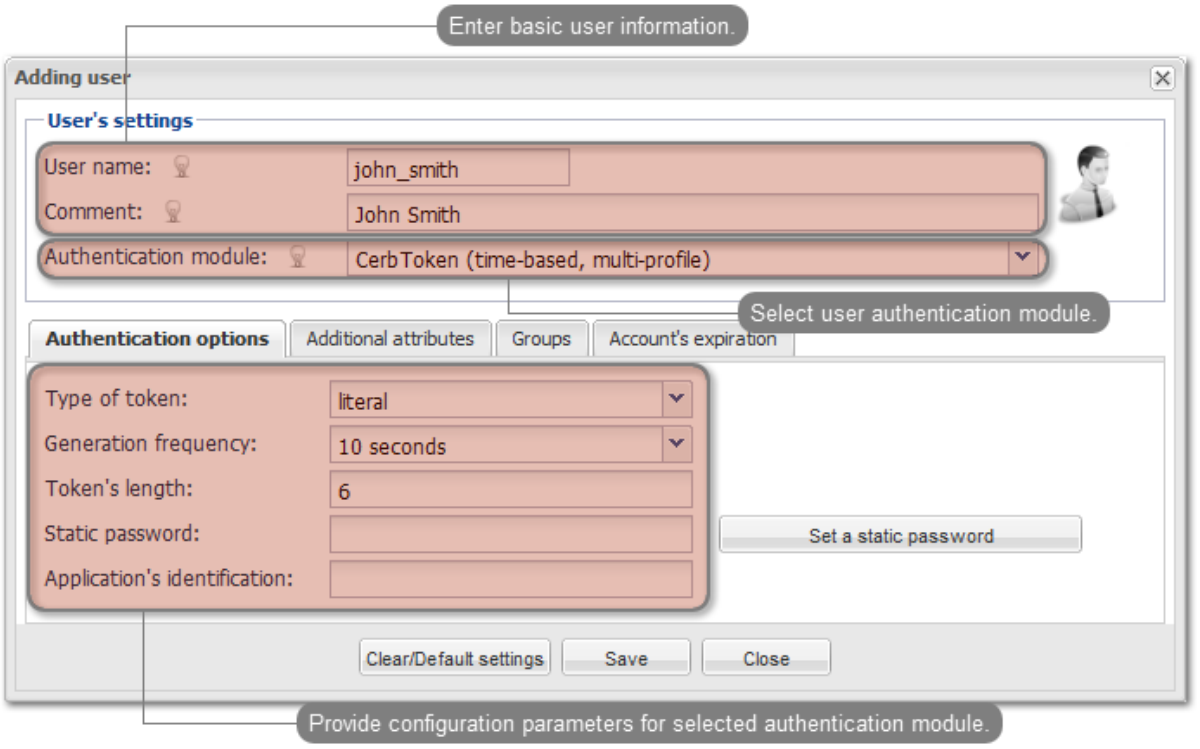


3. Adding user.

- Select *Users* > *Add user* to open new user definition window.

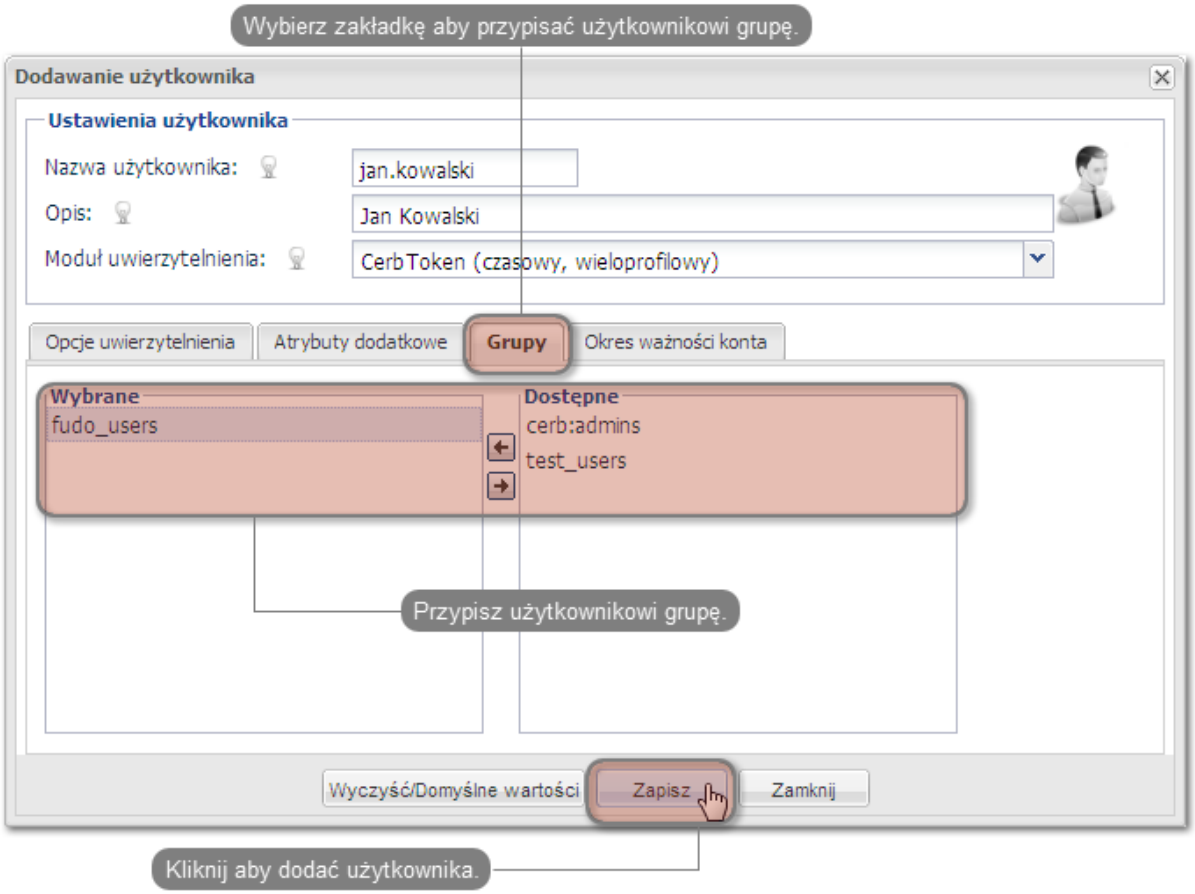


- Provide user name, description and select desired authorization module (refer to CERB server documentation form more information on authorization modules).



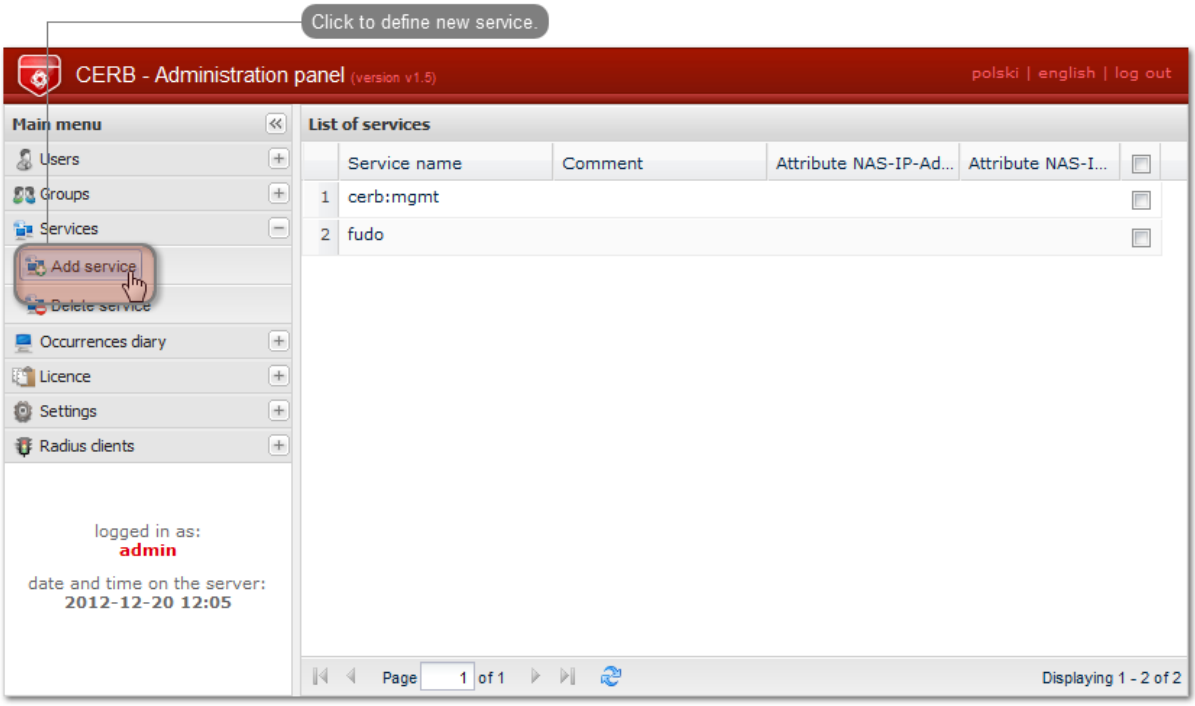
Note: Username is used to authenticate users on Wheel Fudo PAM.

- Assign user to previously created `fudo_users` group and click *Save*.



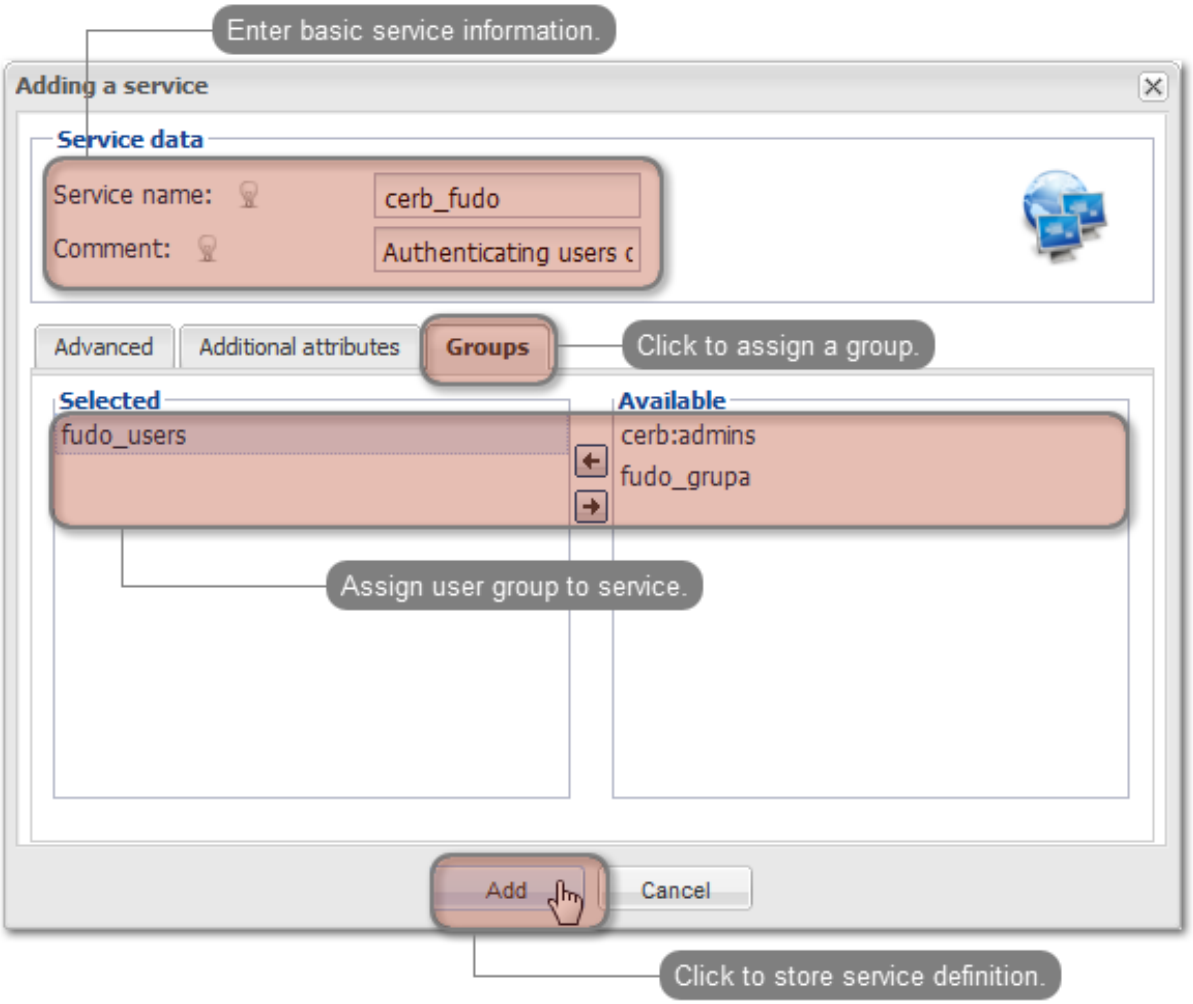
4. Configuring service.

- Select *Services* > *Add service* to open new service definition window.



- Provide name identifying authorization service (`cerb_fudo`) and service description.

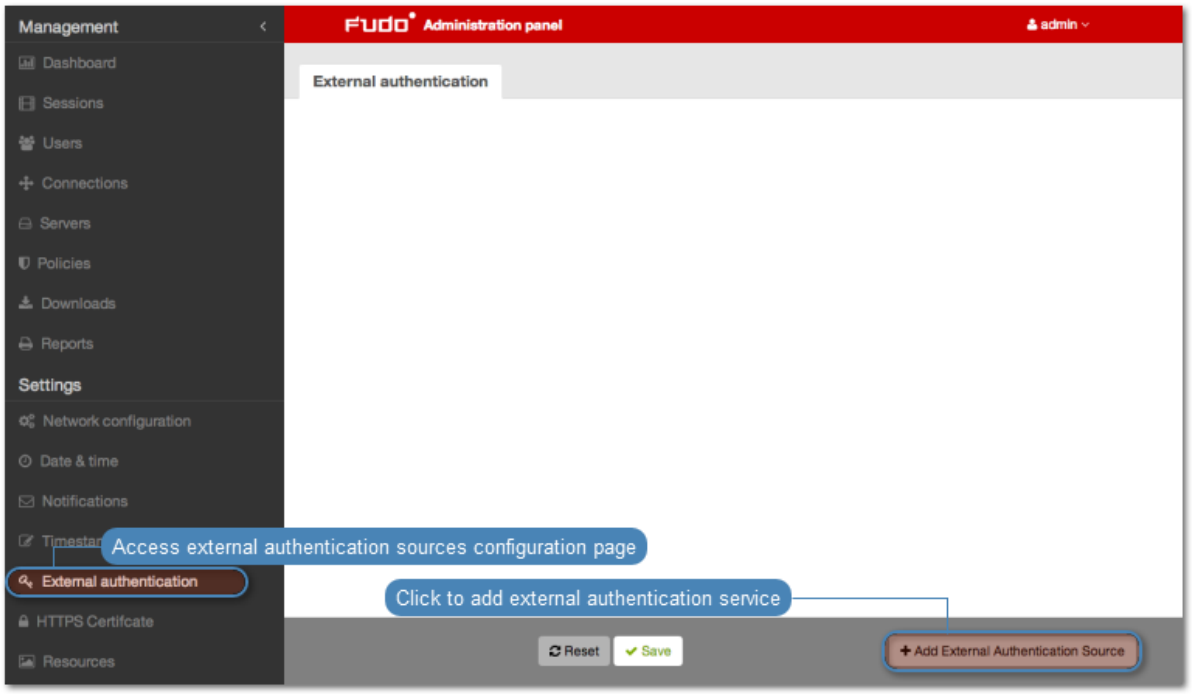
- Add `fudo_users` group to service and click *Add*.



Wheel Fudo PAM server configuration

1. Adding CERB external authorization server.

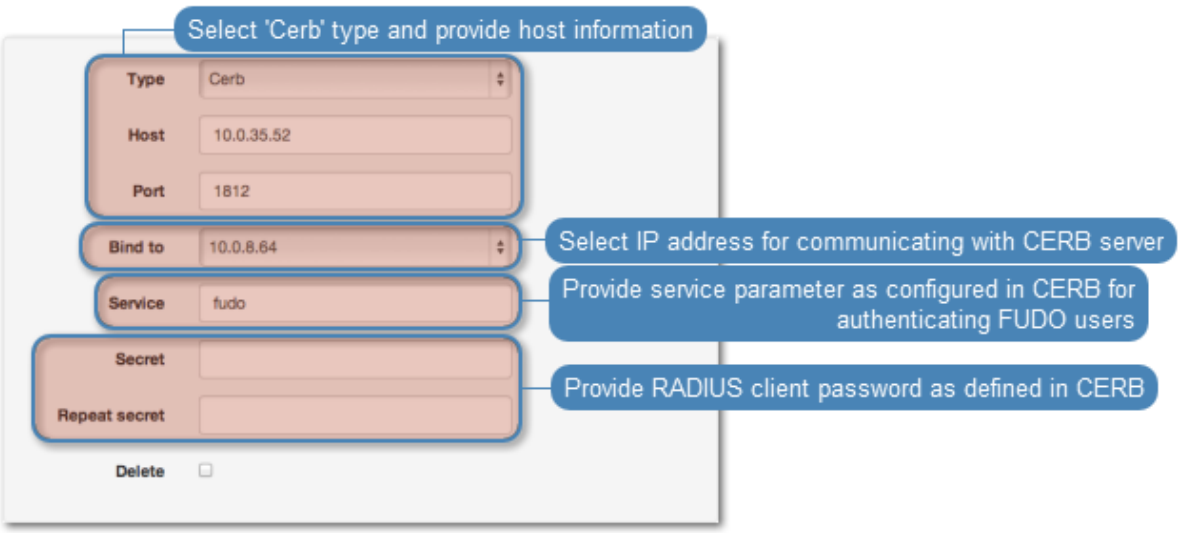
- Select *Settings* > *External authentication*.
- Click *Add external authentication source* to add CERB server definition.



- Provide CERB server IP address, *secret* and service name identifying authorization service.

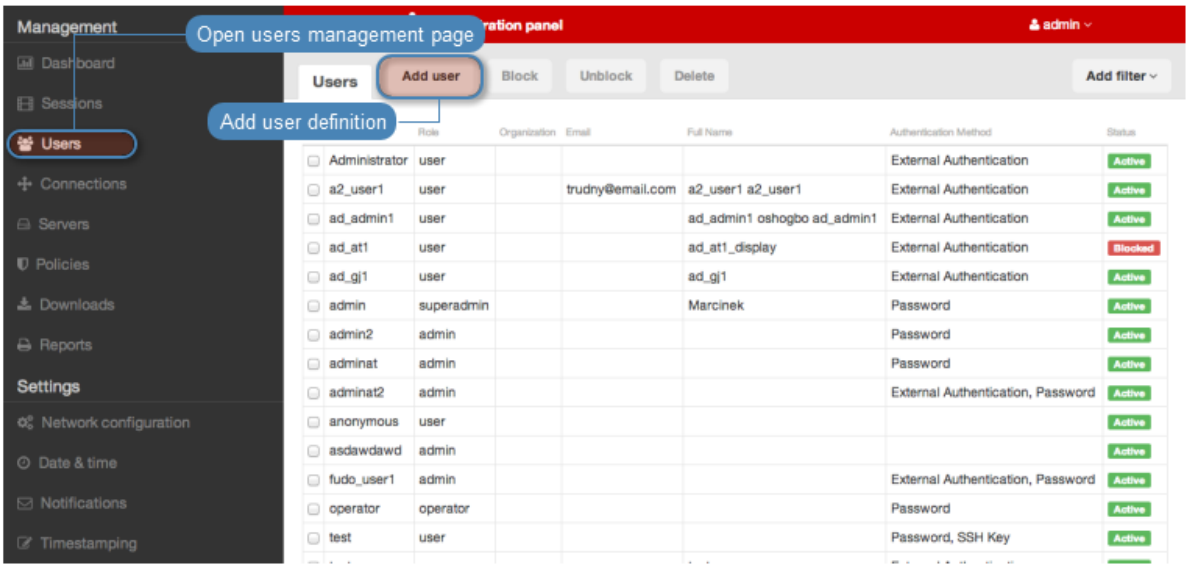
Note: Secret must match the RADIUS client password on CERB server. Service name must match the service name on CERB

- Click *Save*.



2. Adding user.

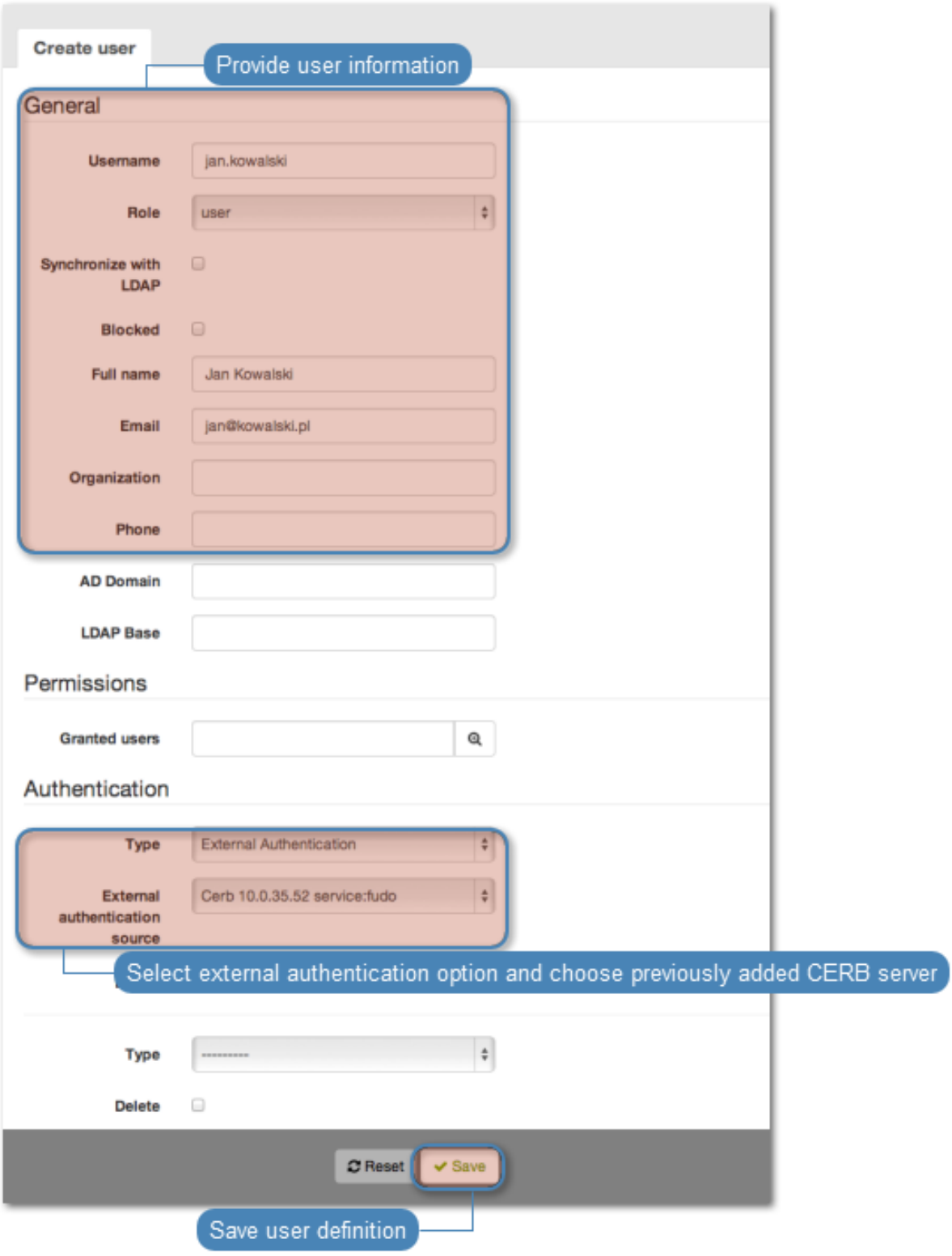
- Select *Management* > *Users*.
- Click *Add*.



- Provide basic user information.

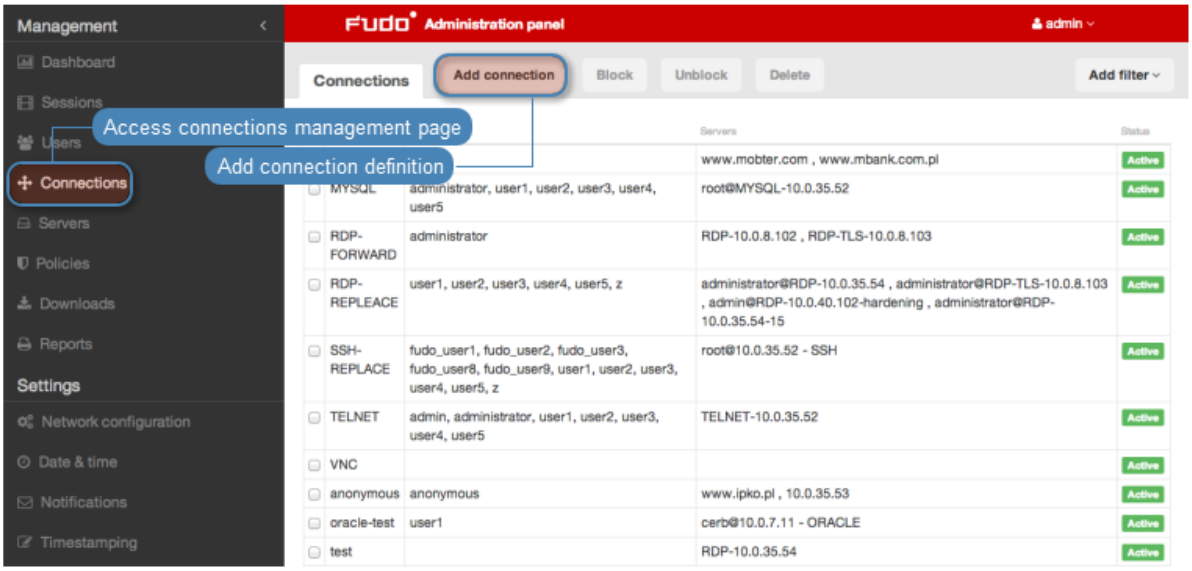
Note: Username must match the user name defined on CERB server.

- Select `CERB` from the drop-down list as authorization method and select previously added authorization server.
- Click *Save*.

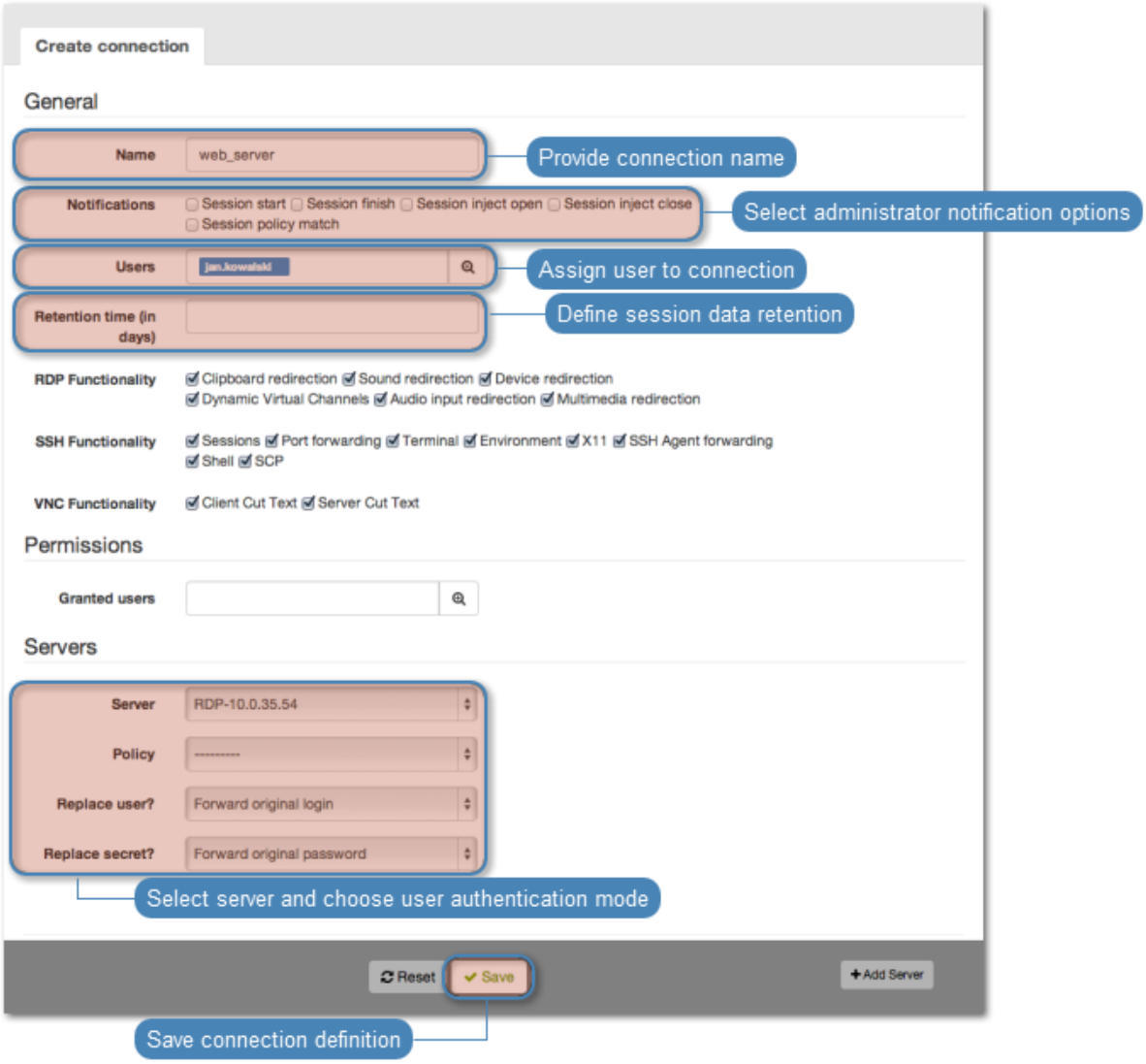


3. Adding connection.

- Select *Management* > *Connections*.
- Click + *Add*.



- Provide basic connection parameters.
- Select previously defined user.
- Select target server to enable user access within given connection.
- Select user authorization mode (*User authorization mode*).
- Click *Save*.



15.17 System maintenance

The following section contains descriptions of maintenance procedures.

15.17.1 Backing up encryption keys

Encryption keys stored on USB flash drives are necessary to initialize the file system, which stores session data. If the USB flash drive is lost or damaged, it will be impossible to boot the system and access session data.

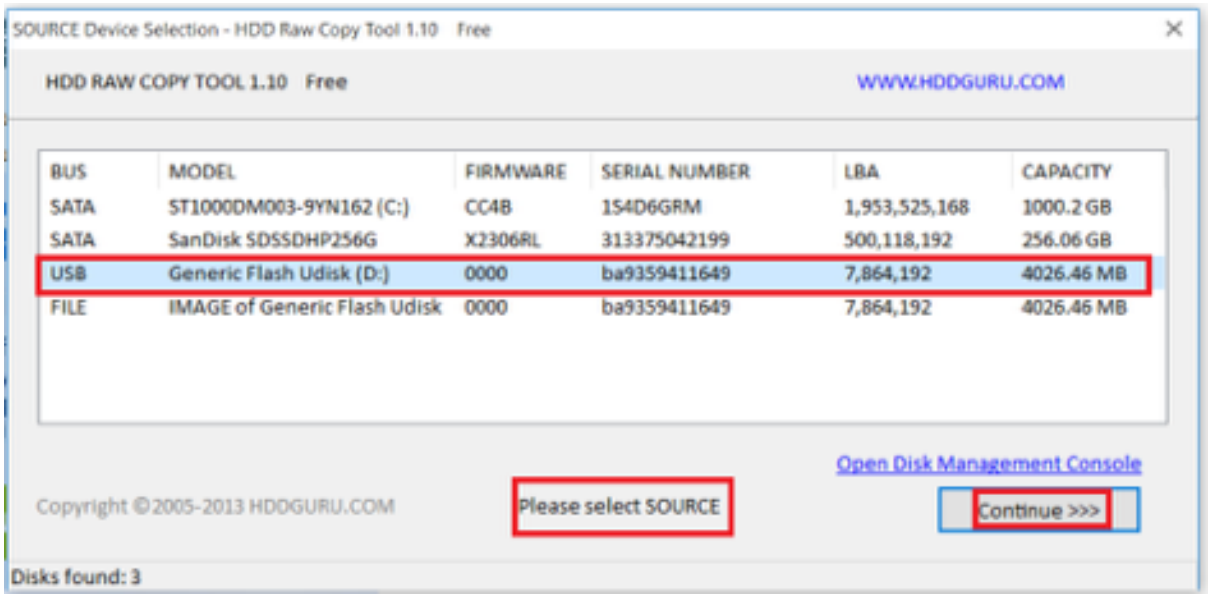
Microsoft Windows

> **Warning:** After connecting the flash drive to your computer, do not initiate or format it. Ignore the system message about it not being able to read data and proceed with the backup procedure.

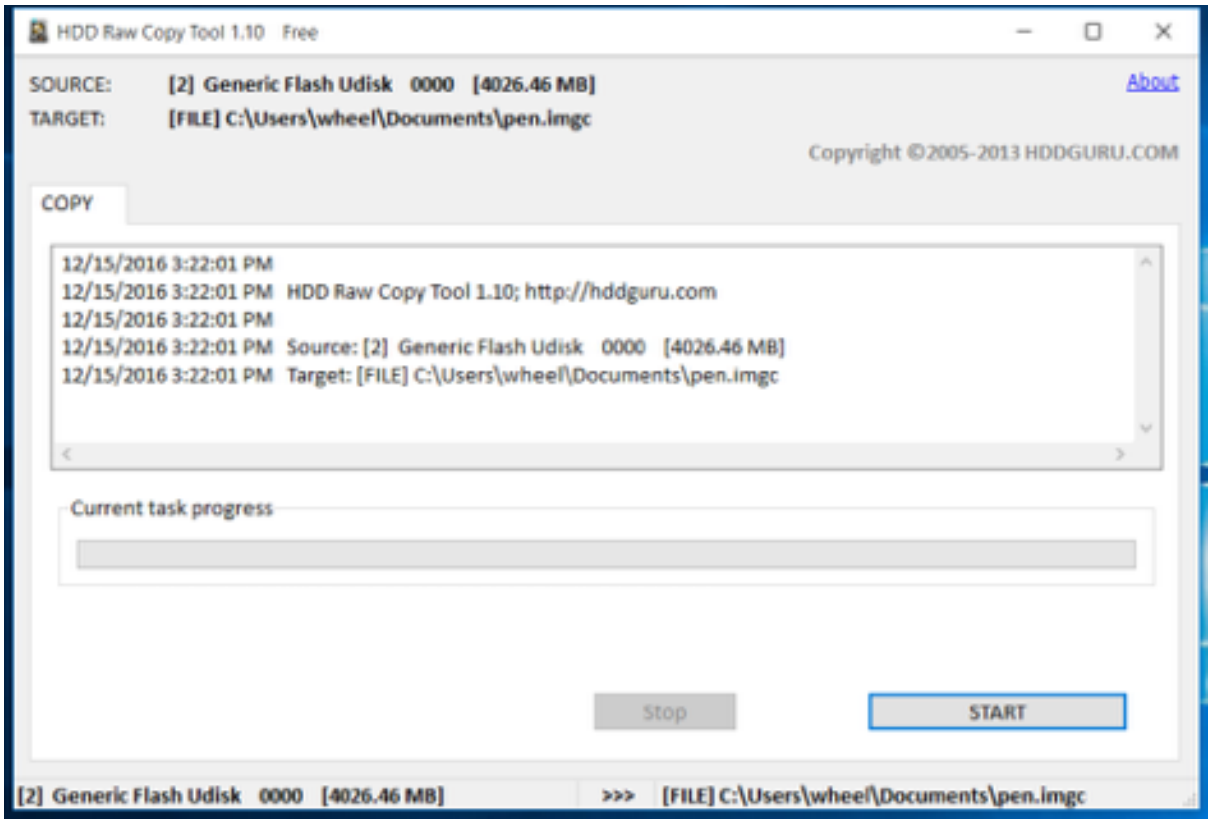
1. Download and install *HDD Raw Copy Tool*.

`http://hddguru.com/software/HDD-Raw-Copy-Tool/` (portable version is also available)

2. Start the program.
3. On the source drive selection window, choose the USB drive with the encription key and click *Continue*.

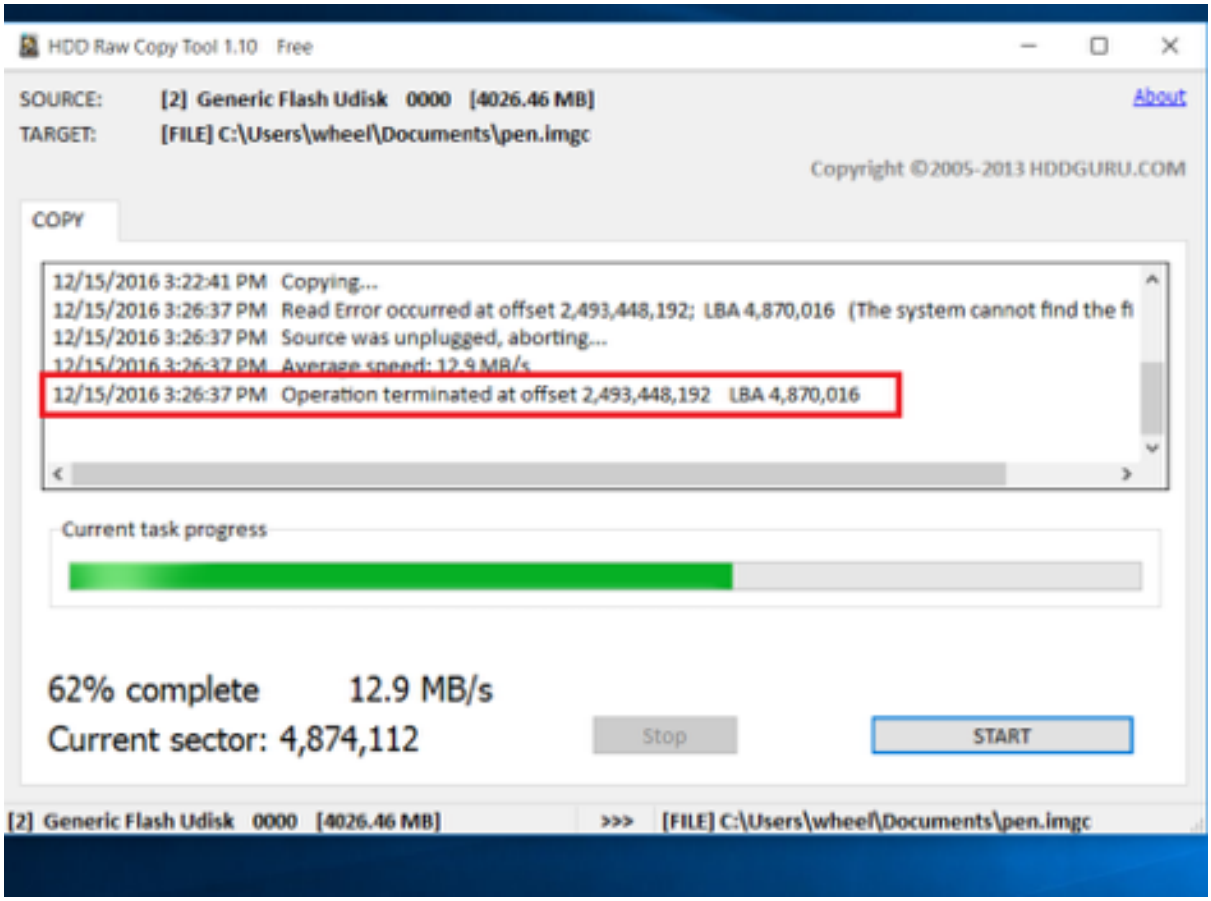


4. Click *FILE* twice, select the target image file and click *Continue*.
5. Click *START* to proceed with copying data.

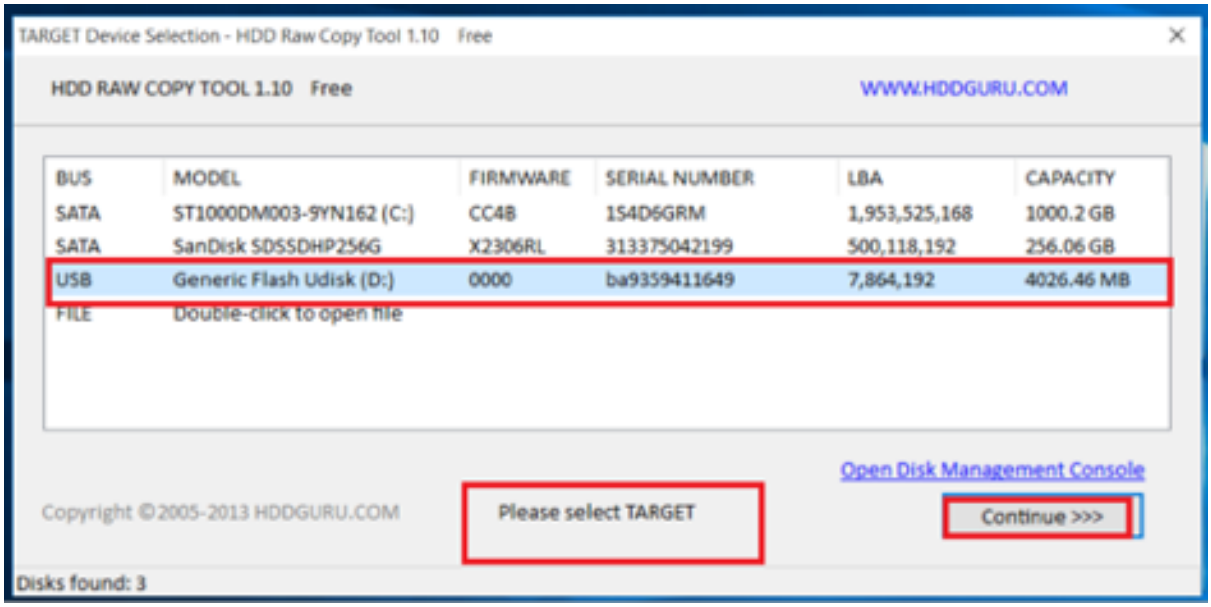


6. Once the following message occurs

`Operation terminated at offset...` close the application and disconnect the USB drive.



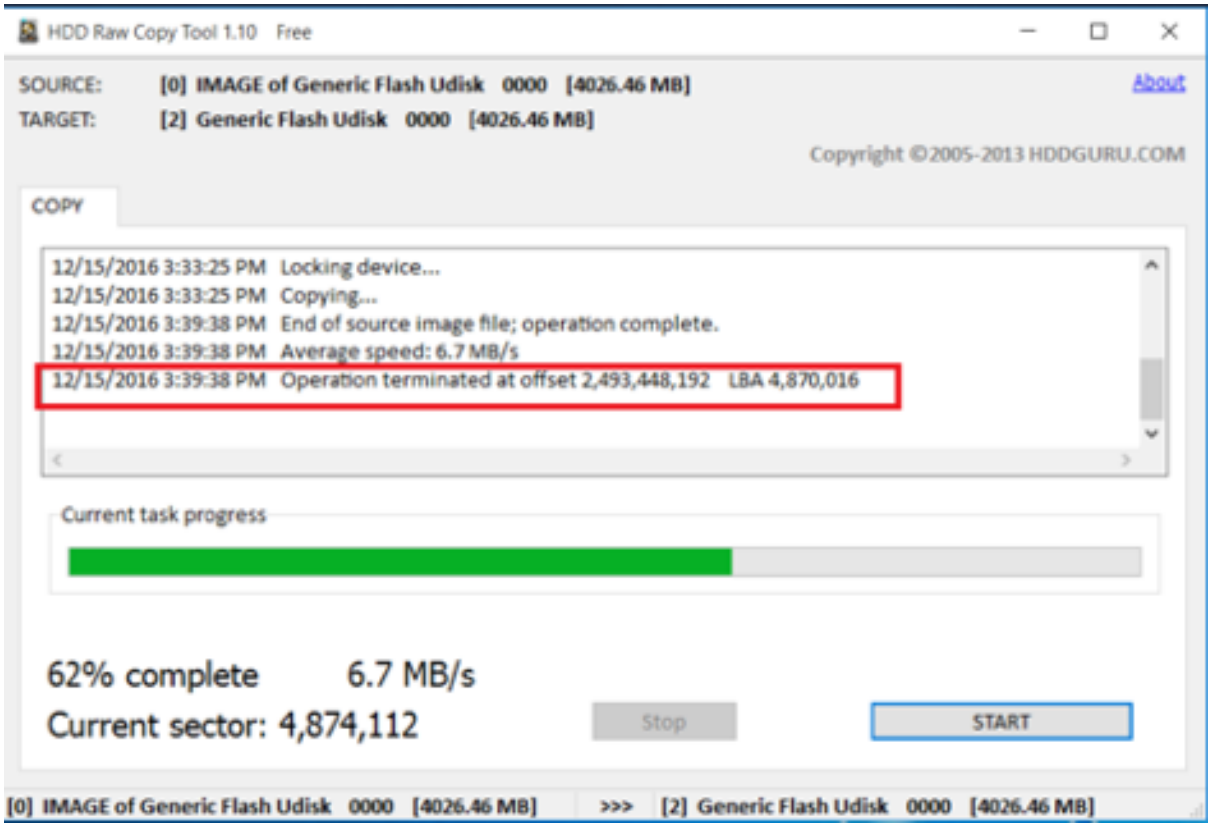
7. Connect another USB drive and start *HDD Raw Copy Tool*.
8. On the source drive selection screen select *FILE* and browse the file system to find the encryption keys image file.
9. Select the newly connected USB flash drive as a target device and click *Continue*.



10. Click *Continue*.

11. Click *START*.
12. The copying will end once the following message occurs:

    ```
    Operation terminated at offset....
    ```



13. Close the application and disconnect the USB drive.

Mac OS X

1. Start the terminal.
2. Execute the `sudo -s` command and enter password.
3. Execute the `diskutil list` to list connected drives.
4. Find the drive with the following partitions layout:

```
/dev/disk2 (external, physical):
#: TYPE NAME SIZE IDENTIFIER
0: GUID_partition_scheme *8.0 GB disk2
1: F649773F-1CD6-11E1-9AD2-00262DF29F0D 3.1 KB disk2s1
2: 2B163C2B-1FE5-11E1-8300-00262DF29F0D 1.0 KB disk2s2
```

5. Execute the `dd if=/dev/disk2 of=fudo_pen.img bs=1m` command, where `if` points to the USB drive.
6. Disconnect the flash drive and connect the new one.
7. Execut the `dd if=fudo_pen.img of=/dev/disk2 bs=1m` command.
8. Execute the `sync` command.
9. Disconnect the USB flash drive from your computer.

Linux

1. Start the terminal.
2. Execute the `sudo -s` command and enter password.
3. Execute the `dmesg | less` command to determine the USB flash drive identifier.
4. Execute the `dd if=/dev/disk2 of=fudo_pen.img bs=1m` command, where `if` points to the USB drive.
5. Disconnect the flash drive and connect the new one.
6. Execut the `dd if=fudo_pen.img of=/dev/disk2 bs=1m` command.
7. Execute the `sync` command.
8. Disconnect the USB flash drive from your computer.

Related topics:

- *Events log*
- *Frequently asked questions*

15.17.2 Monitoring system condition

Monitoring system condition allows preventing system failures and overloads, ensuring Wheel Fudo PAM Wheel Fudo PAM remains operational.

Monitoring active sessions

1. Login to Wheel Fudo PAM administration panel.
2. Select *Management* > *Dashboard*.
3. Check the number of currently running user sessions.

Note: Wheel Fudo PAM supports up to 300 RDP connections.

Monitoring network bandwidth

1. Login to Wheel Fudo PAM administration panel.
2. Select *Management* > *Dashboard*.
3. Check current network transfer rate.

Note: Wheel Fudo PAM features 1Gbps network interface cards. In case the current network bandwidth usage exceeds 500Mbps, users may notice a decrease in system communication performance.

Related topics:

- *System log*
- *Frequently asked questions*

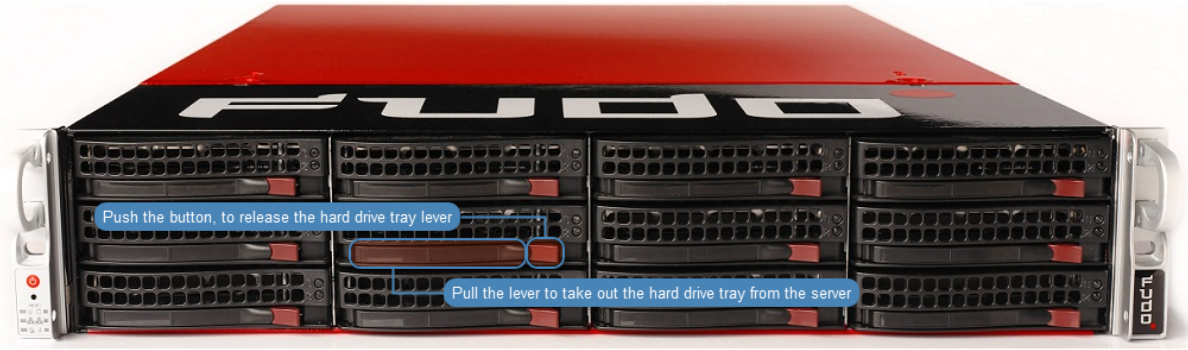
15.17.3 Hard drive replacement

In default configuration, Wheel Fudo PAM's storage array comprises 12 hard drives in RAIDZ2 configuration running ZFS file system allowing the system to remain fully operational in case of a failure of two hard drives.

Replacing a hard drive

1. Move the front bezel release latch to the left and take the front bezel off.

2. Push the hard drive tray lever release button and pull the lever to take out the tray from the chassis.



3. Unscrew the screws securing the hard drive and take out the hard drive from the tray.
4. Install replacement hard drive in the tray and secure it with the screws.
5. Install the hard drive tray back in the server.

Note: Wheel Fudo PAM will automatically detect the change in the storage array state and will start rebuilding the data structure. The duration of the array rebuilding process depends on the volume of data stored on the server.

Related topics:

- *Hardware overview*
- *Frequently asked questions*

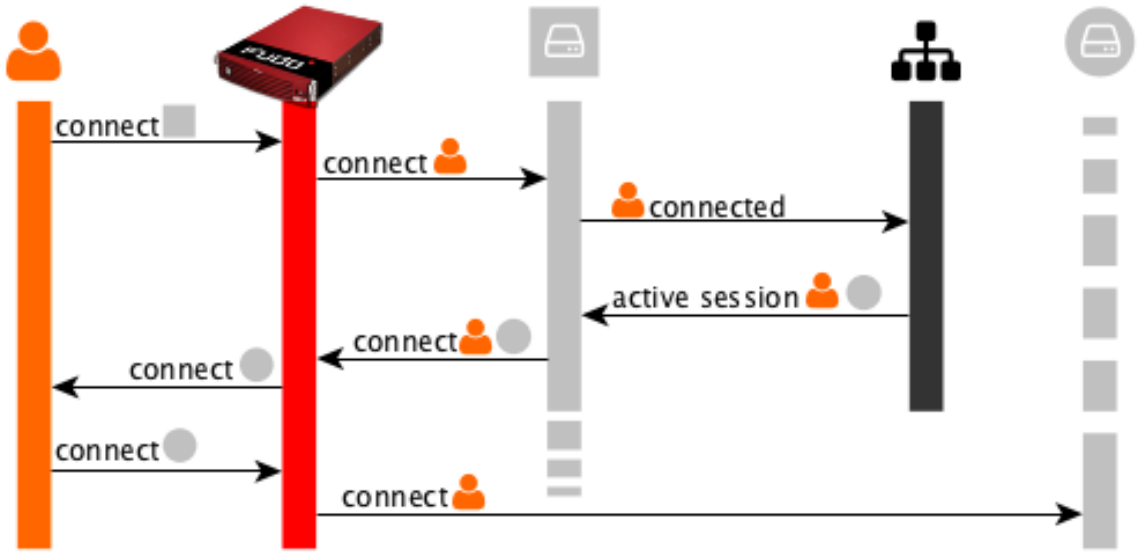
CHAPTER 16

Reference information

16.1 RDP connections broker

Connections broker enables users to reconnect to their existing sessions on a specific server within a pool of load-balanced resources.

If the broker identifies an existing user session on another server, the connection will be redirected to it and the user will be prompted to login again.



Note: To successfuly redirect a connection, the server identified by the broker must be defined on Wheel Fudo PAM, it must listen on default RDP port (3389) and user must be allowed to connect to given server.

Related topics:

- *Data model*
- *RDP*
- *Servers*
- *Accounts*

16.2 Error codes

Error code	Error message and description
FSE0001	*Internal system error*
FSE0002	*FUDO certificate error.*
FSE0003	*Unable to change configuration settings.*
FSE0004	*Configuration import error*
FSE0005	*Unable to initialize ${disk}.* Replace defective drive. **Note:** Hard drives numbering starts from 0. If there is a problem with the hard drive number 1, physically it's the second drive in the top row.
FSE0006	*Invalid license*
FSE0007	*Unable to find license file*
FSE0008	*Unable to attach hard drive ${disk}.*
FSE0009	*Upgrade failed.*
FSE0010	*License expired.*
FSE0020	*System backup error.*
FSE0024	*Hard drive belongs to another FUDO (${diskserial}) ${disk}.*
FSE0026	*Cluster communication error.*
FSE0028	*Unable to join node to cluster.*
FSE0031	*Timestamping service communication error.*
FSE0032	*Unable to timestamp session.*
FSE0033	*Unknown timestamping service provider.*
FSE0040	*Cluster communication error. Local FUDO version is %s than %s FUDO version.*
FSE0046	*There is no filter called %s.*
FSE0048	*Error authenticating user over RADIUS.*
FUE0057	*Authentication method 'password', required by MySQL, requested by the user %s, logging in from IP address %s, was not found.*
FUE0058	*Authentication method 'password', required by MySQL, requested by the user %s, was not found.*
FSE0061	*Incorrect password repository configuration: login is empty.*
FSE0062	*Incorrect password repository configuration: password is empty.*
FSE0063	*Incorrect server configuration: ERPM namespace is empty.*
FSE0064	*Incorrect server configuration: ERPM name is empty.*
FSE0065	*License configuration error.*

Continued on next page

Table 1 – continued from previous page

Error code	Error message and description
FSE0066	*Unable to block user %jd.*
FSE0067	*Error connecting to Lieberman ERPM server %s: incorrect URL in configuration.*
FSE0068	*Error connecting to Lieberman ERPM server %s: incorrect protocol specified.*
FSE0069	*Error fetching password from Lieberman ERPM server %s: unable to get sessid for user %s.*
FSE0070	*Error fetching password from Lieberman ERPM server %s: unable to get password for user %s for the %s/%s server.*
FSE0076	*Unable to establish connection, could not find specified transparent server (tcp://%s:%u).*
FSE0077	*LDAP authentication error.*
FSE0078	*LDAP authentication error: unable to connect from %s to %s.*
FUE0079	*Authentication timeout after %ju key attempt%s and %ju password attempt%s.*
FUE0080	*Authentication timeout after %lu key attempt%s.*
FUE0081	*Authentication timeout after %lu password attempt%s.*
FSE0082	*Unable to establish connection to server %s (%s).*
FSE0083	*Unable to establish connection from %s to server %s (%s).*
FUE0089	*Authentication timeout.*
FSE0090	*Unable to connect to the passwords repository server %s.*
FSE0091	*Unable to add server %s.*
FSE0092	*Passwords repository server %s communication error.*
FSE0093	*Error connecting to Thycotic server %s: incorrect URL in configuration.*
FSE0094	*Error connecting to Thycotic server %s: incorrect protocol specified.*
FSE0095	*Error fetching password from Thycotic server %s: unable to get sessid for user %s.*
FSE0096	*Error fetching password from Thycotic server %s.*
FSE0097	*Error fetching password from Thycotic server %s: unable to get secretid for server %s.*
FSE0098	*Error fetching password from Thycotic server %s: unable to get password for user %s for the %s server.*
FUE0099	*Connection terminated.*
FUE0101	*Unable to find matching HTTP connection.*
FUE0103	*HTTP connection error.*
FUE0106	*Authentication failed: %s.*
FUE0108	*MySQL connection error.*
FUE0110	*Oracle connection error.*
FUE0112	*RDP connection error.*
FUE0113	*TLS Security configured, but missing TLS private key.*
FUE0114	*TLS Security configured, but missing TLS certificate.*
FUE0115	*Standard RDP Security configured, but missing private key.*
FUE0116	*TLS certificate verification failed.*
FUE0117	*RSA key verification failed.*
FUE0124	*SSH connection error.*
FUE0125	*User %s failed to authenticate after %d attempts, disconnecting.*
FUE0127	*Invalid authentication method: expected passwordor sshkey, got %s.*

Continued on next page

Table 1 – continued from previous page

Error code	Error message and description
FUE0129	*Failed to authenticate against the server as user %s using %s.*
FUE0130	*Failed to authenticate against the server as user %s using %s (received %s).*
FUE0132	*Client requested incorrect terminal dimensions (%dx%d).*
FUE0133	*MSSQL connection error.*
FUE0134	*TN3270 connection error.*
FUE0135	*Unknown TN3270 command: %02x.*
FUE0136	*Telnet connection error.*
FSE0137	*Unable to read private key.*
FSE0138	*Server's certificate does not match configured certificate.*
FUE0139	*VNC connection error.*
FUE0140	*Client version: %s is higher than the client integrated in FUDO: %s.*
FUE0141	*VNC connection error. Client answered with unsupported security type: %hhu.*
FUE0142	*VNC connection error. Server version: %s is lower than client version: %s.*
FUE0144	*User %s failed to authorize logging in from IP address: %s.*
FUE0145	*User %s failed to authorize.*
FUE0146	*User %s failed to authenticate logging in from IP address: %s.*
FUE0147	*User %s failed to authenticate.*
FSE0148	*Listening on %s:%u failed while adding bastion %s.*
FAE0153	*Session indexing failure.*
FAE0154	*Session conversion failure for session %s.*
FAE0165	*Error authenticating user <user_name>.*
FAE0189	*Error saving NTP servers: <server_name>.*
FAE0232	*MySQL session playback error.*
FAE0267	*Error generating report %d: %s.*
FSE0283	*Unable to process pattern: %s.*
FSE0285	*Unable to read certificate.*
FSE0286	*No peer certificate received.*
FSE0290	*Unable to add server %s because %s is listening on same IP address and port.*
FUE0305	*Client connection closed: encryption is not available.*
FUE0306	*Client connection closed.*
FSE0307	*Error fetching password from HiPAM server %s: unable to get sessid for user %s.*
FSE0308	*HiPAM server internal error.*
FSE0309	*Error fetching password from HiPAM server %s: unable to get sessdat for user %s.*
FSE0310	*Incorrect server configuration: HiPAM name is empty.*
FSE0311	*Unable to fetch password from HiPAM.*
FSE0312	*Error connecting to HiPAM server %s: incorrect URL in configuration.*
FSE0313	*Error connecting to HiPAM server %s: incorrect protocol specified.*
FUE0314	*Invalid pixel format.*
FUE0315	*Unable to fetch standard RDP certificate.*
FUE0316	*Protocol security negotiation failure.*
FUE0317	*Unable to establish connection to server %s.*

Continued on next page

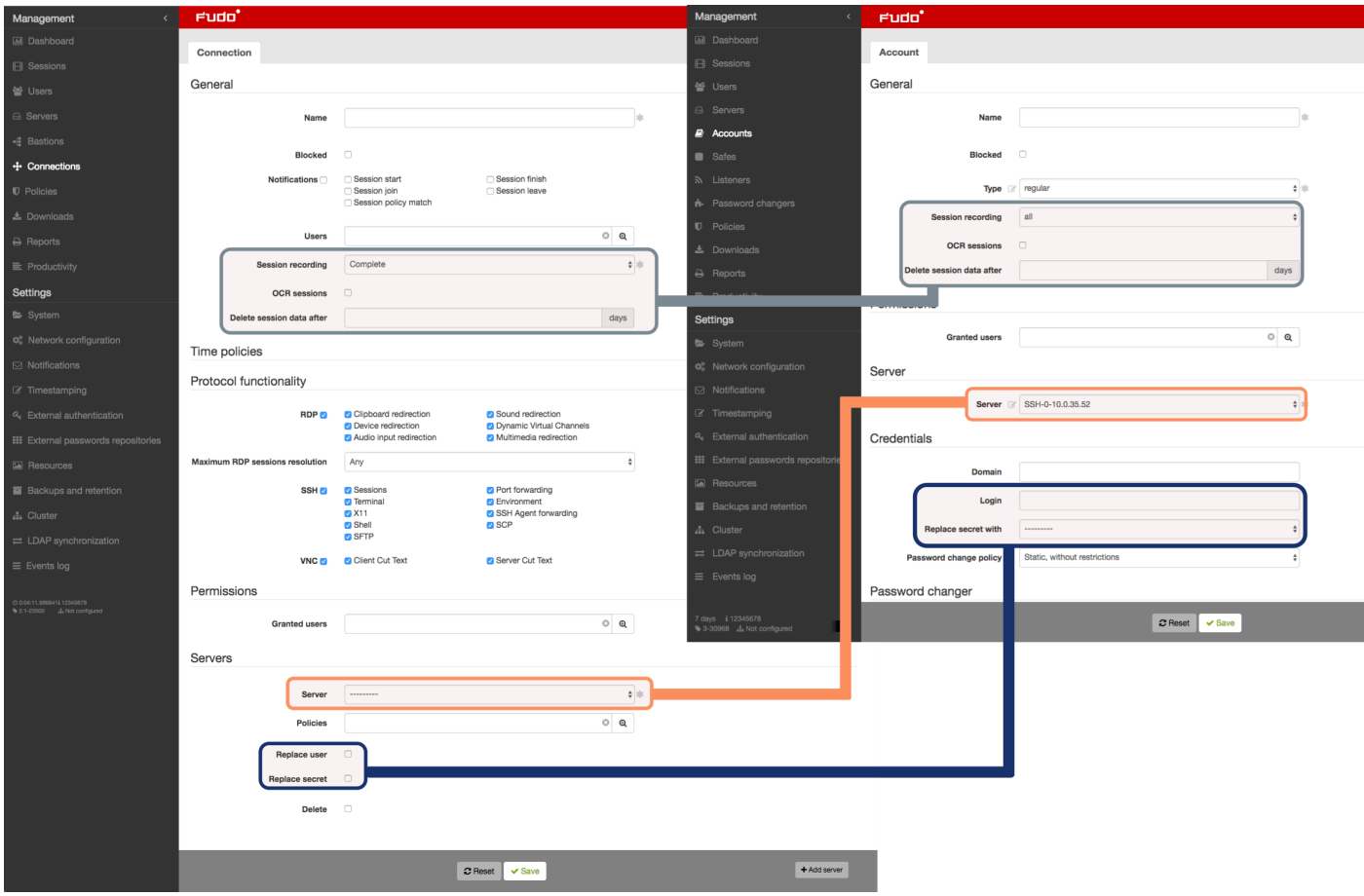
Table 1 – continued from previous page

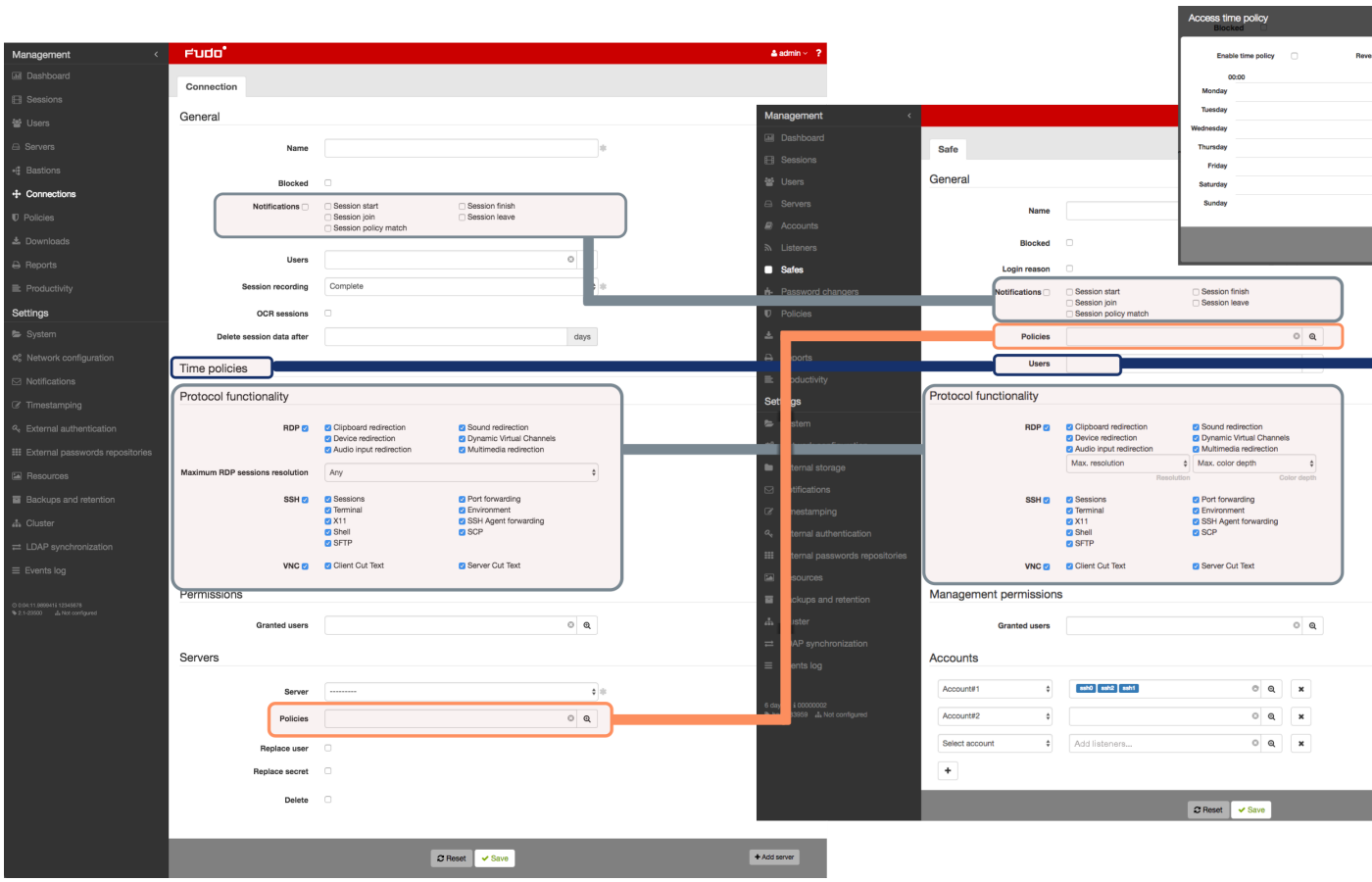
Error code	Error message and description
FUE0318	*Unable to fetch SSL certificate.*
FSE0330	*Bad login field configured on server. Error while processing user %s.*
FSE0331	*Error while processing userAccountControl value of user %s.*
FUE0346	*Client sent a packet bigger than %d bytes.*
FSE0347	*Cluster communication error. Local FUDO version: ${lversion}, remote FUDO version: ${rversion}.*
FSE0348	*Unable to get configuration settings.*
FUE0351	*Client sent unsupported NTLM v1 response.*
FSE0352	*Bastion requires login and server delimited with one of '%s' (%s).*
FSE0355	*Inconsistent data, starting recovery replication to node ${name}.*
FUE0359	*Server rejected X11 connection: %.*s.*
FUE0360	*Server requires unsupported X11 authentication: %.*s.*
FSE0362	*Unable to propagate ARP.*
FUE0363	*User %s has no access to host %s:%u.*
FUE0365	*RDP server %s:%u has to listen on the default RDP port in order to redirect sessions.*
FSE0366	*Error connecting to CyberArk server %s: incorrect URL in configuration.*
FSE0367	*Error connecting to CyberArk server %s: incorrect protocol specified.*
FSE0368	*Error fetching password from CyberArk server %s.*
FSE0369	*Error fetching password from CyberArk server %s: unable to get password for user %s for server %s.*
FSE0372	*Unable to invalidate OTP password %jd.*
FSE0375	*Unable to add listener %s.*
FSE0376	*Unable to add listener %s because %s is listening on same IP address and port.*
FSE0377	*Bastion requires login and server delimited with a '%s' character (login: %s).*
FSE0378	*Unable to establish connection, could not find a server (login: %s).*
FSE0379	*Unable to establish connection, could not find specified transparent server (tcp://%s:%u) (login: %s).*
FSE0380	*Unable to authenticate user %s: server is blocked.*
FSE0381	*Unable to authenticate user %s: account not found.*
FSE0382	*Unable to authenticate user %s: account is blocked.*
FSE0383	*Unable to authenticate user %s: user not found.*
FSE0384	*Unable to authenticate user %s: user is blocked.*
FSE0385	*Unable to authenticate user %s: safe not found.*
FSE0386	*Unable to authenticate user %s: safe is blocked.* Unblock the safe in question to allow users to connect to servers which use this safe.
FSE0420	*Unable to authenticate user %s against server %s.*
FSE0461	*Invalid data from AD server.*
FAE0464	*User %s is not allowed to login from address %s.* Add the specified IP address in the user object configuration in the *API* section.

16.3 Fudo 2.2 to Fudo 3.0 parameters mapping

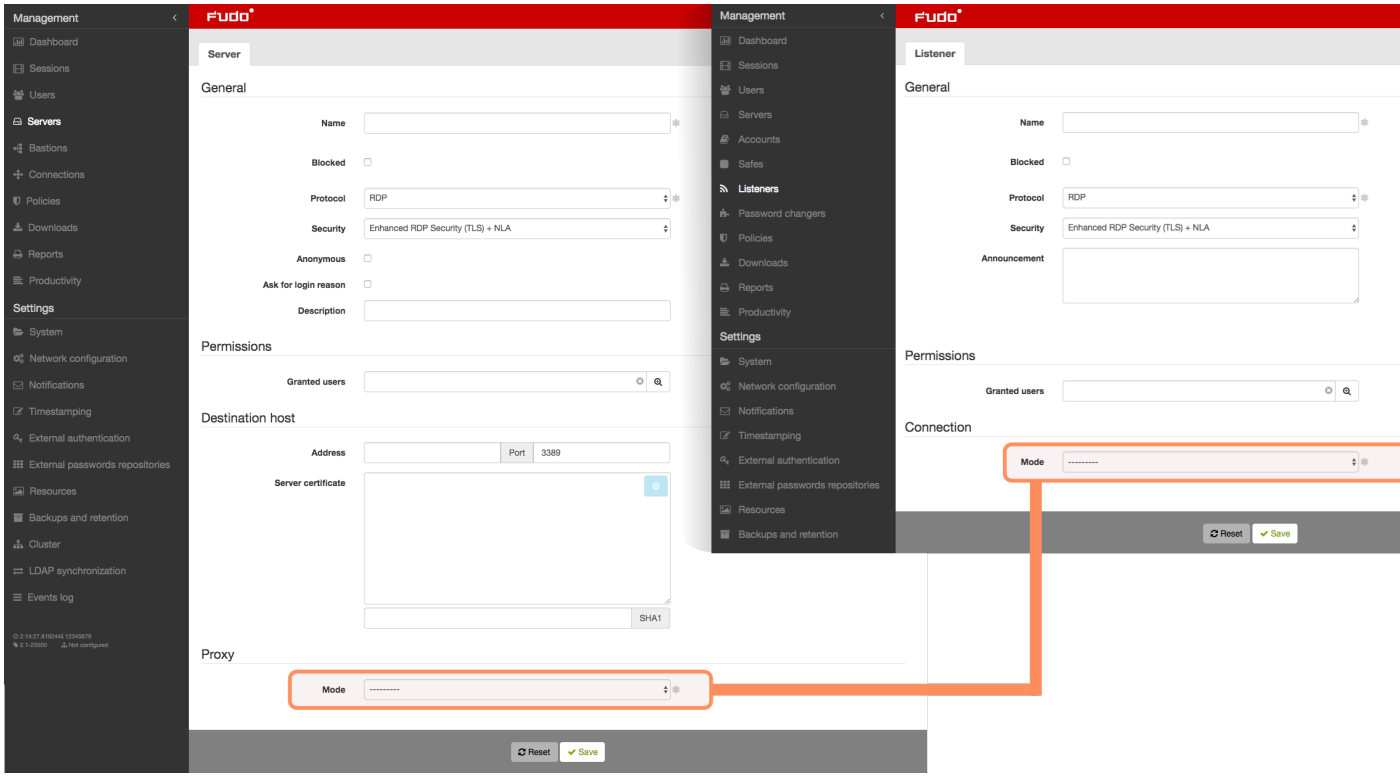
This topic describes how certain parameters from Fudo 2.2 map to Fudo 3.0 data model.

16.3.1 Connection




Management
Dashboard
Sessions
Users
Servers
Bastions
Connections
Policies
Downloads
Reports
Productivity
Settings
System
Network configuration
Notifications
Timestamping
External authentication
External passwords repositories
Resources
Backups and retention
Cluster
LDAP synchronization
Events log
Connection
General
Name
Blocked
Notifications
Session start
Session finish
Session join
Session leave
Session policy match
Users
Session recording
Complete
OCR sessions
Delete session data after
days
Time policies
Protocol functionality
RDP
Clipboard redirection
Sound redirection
Device redirection
Dynamic Virtual Channels
Audio input redirection
Multimedia redirection
Maximum RDP sessions resolution
Any
SSH
Sessions
Port forwarding
Terminal
Environment
X11
SSH Agent forwarding
Shell
SCP
SFTP
VNC
Client Cut Text
Server Cut Text
Permissions
Granted users
Servers
Server
Policies
Replace user
Replace secret
Delete
Reset
Save
Add server
Safe
Login reason
Max. resolution
Max. color depth
Management permissions
Accounts
Account#1
Account#2
Select account
Add listeners...
Access time policy
Enable time policy
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday

16.3.2 Server


Management
Dashboard
Sessions
Users
Servers
Bastions
Connections
Policies
Downloads
Reports
Productivity
Settings
System
Network configuration
Notifications
Timestamping
External authentication
External passwords repositories
Resources
Backups and retention
Cluster
LDAP synchronization
Events log
Server
General
Name
Blocked
Protocol
RDP
Security
Enhanced RDP Security (TLS) + NLA
Anonymous
Ask for login reason
Description
Permissions
Granted users
Destination host
Address
Port
3389
Server certificate
SHA1
Proxy
Mode
Reset
Save
Listener
Announcement
Connection

16.4 Data model migration from Wheel Fudo PAM version 2.2 to 3.0

This topic describes data model migration mechanisms that are applied when performing upgrade from Wheel Fudo PAM version 2.2 to 3.0.

Note: In case of unsuccessful upgrade to version 3.0 data model issues which caused upgrade procedure to fail can be found in the system evetns log.

16.4.1 Server

Servers, which have the same IP address and port number assigned are replaced with a single object. Name of the resulting object is a concatenation of the servers' names in ascending order, separated by comma.

> **Warning:** If there are two servers with the same IP address and port number assigned but with different protocol, description, external password repositorie, RDP security level, HTTP settings, TLS settings, certificates or public keys, upgrade will fail.

16.4.2 Safe (previously *connection*)

- Anonymous connection becomes a *safe* object, which can be deleted.
- For each *bastion* object (a group of servers operating in *bastion* mode, assigned to the same *bastion*) and associated connection, there is a *safe* object created using the following naming convention: `<connection name> > <bastion name>`.
- For each server operating in *gateway*, *proxy* or *transparent* mode, migration procedure creates a *safe* object named `<connection name> > <server name`.
- Automatically created *safe* object inherits connection's access rights, granted privileges, protocols settings, notifications settings and LDAP mapping.
- OCR settings, sessions recording and session data retention parameters are moved to corresponding *account* objects.
- Time policies are replicated as user specific regulations applicable to each safe.

Note: Click selected safe on user's configuration form to display time access settings.

- After migration, login credentials policies are reflected within the safe.

16.4.3 Account (previously *login credentials*)

For each login credentials sections in every connection, migration mechanism creates a separate *account* object.

- If login credentials contain the user login string the resulting account is of the *regular* type and its name is a combination of the login and server's name - `<login> @ <final server name>`.
- If login credentials do not contain the user login string and concern credentials forwarding connection, the resulting account object is of the *forward* type and it is named `forward for <final server name>`.
- If login credentials do not contain the user login and are used for anonymous connections, the resulting account object is of the *anonymous* type and it is named `anonymous for <final server name>`.
- Duplicated loign credentials are replaced by a single *account* object. Object's management rights, OCR settings, sessions recording settings, session data retention settings are inherited from the connection object that the *account* object derives from.

Warning: If login credentials contain the login string but do not contain the secret (if the login is substituted but the secret field remains empty) the data migration process will fail.

16.4.4 Listener (previously *bastion* or part of a server)

- For each server operating in *proxy*, *transparent* or *gateway* mode, there is a *listener* object created with the same connection mode.
- Newly created object inherits server's access rights, TLS settings and RDP security level parameter.
- Server announcement setting is also passed on to the *listener* object.
- Listener is assigned to all safes that have been created based on connections which were associated with the server that the listener derived from.
- Bastion becomes a listener operating in the *bastion* mode. Access rights and bastion settings are transferred to the listener. The listener is assigned to all safes that have been

created based on connections associated with at least one server from the bastion that the listener derived from.

16.4.5 Sessions

- Each session has its safe, server and account identifiers updated accordingly. If a session concerned a server, which was not operating in *bastion* mode, it also has the listener identifier set.

16.5 Supported protocols

This topic describes in detail Wheel Fudo PAM protocols support.

16.5.1 Citrix StoreFront (HTTP)

Supported connection modes:

- Gateway,
- Proxy,
- Transparent.

Notes:

- Session player displays raw text without graphical rendering.
- Lack of bastion mode support results from protocol's limitations. Citrix StoreFront itself provides access to a bastion of hosts. When logging to Citrix StoreFront, user can select desired host to connect to over ICA protocol.

16.5.2 HTTP

Supported connection modes:

- Gateway,
- Proxy,
- Transparent.

Notes:

- Session player displays raw text without graphical rendering.
- Bastion mode is not supported due to limitations of the protocol.
- Access to external resources is not monitored.
- Following redirections is not supported.

16.5.3 ICA

Supported connection modes:

- Bastion (option to enter account or target server in the ICA file),
- Gateway,
- Proxy,
- Transparent.

Supported client applications:

- Citrix Receiver.

16.5.4 Modbus

Supported connection modes:

- Gateway,
- Proxy,
- Transparent.

Notes:

- Bastion mode is not supported due to limitations of the protocol.

16.5.5 MS SQL (TDS)

Supported connection modes:

- Bastion,
- Gateway,
- Proxy,
- Transparent.

Supported client applications:

- SQL Server Management Studio,
- sqsh.

16.5.6 MySQL

Supported connection modes:

- Gateway,
- Proxy,
- Transparent.

Supported client applications:

- Official MySQL client,

- PyMySQL libraries for Python.

Notes:

- Bastion mode is not supported due to limitations of the protocol.
- Active Directory and other external authentication sources are not supported.

16.5.7 Oracle

Oracle is a proprietary protocol and its implementation requires reverse engineering. This results in a limited support in development of new features as well as addressing potential issues.

Supported connection modes:

- Gateway,
- Proxy,
- Transparent.

Supported client applications:

- SQLDeveloper 4.1.3.20.78,
- SQL*Plus: Release 11.2.0.4.0 Production.

Notes:

- Active Directory and other external authentication sources are not supported.
- Session player only displays clients querries (server's responds are not included).
- Oracle 10 and 11 are supported.
- Bastion mode is not supported due to limitations of the protocol.

16.5.8 RDP

Supported connection modes:

- Bastion,
- Gateway,
- Proxy,
- Transparent.

Supported client applications:

- All official Microsoft clients for Windows and macOS,
- FreeRDP 2.0 i newer.

Notes:

- When authenticating Fudo users against AD (or other external source) the TLS+NLA (Network Level Authentication) is not supported; TLS mode is used instead. NLA mode on server side is supported.
- RemoteApp support is in development.

16.5.9 SSH

Supported connection modes:

- Bastion,
- Gateway,
- Proxy,
- Transparent.

Supported features:

- Connections multiplexing,
- SCP,
- Ports redirection.

Notes:

- SFTP sessions playback is not supported,
- SSH keys forwarding is not supported.

16.5.10 Telnet

Supported connection modes:

- Bastion,
- Gateway,
- Proxy,
- Transparent.

Notes:

- User must authenticate twice - first against Fudo and then against the target host.

16.5.11 Telnet 3270

Supported connection modes:

- Bastion,
- Gateway,
- Proxy,
- Transparent.

Notes:

- User must authenticate twice - first against Fudo and then against the target host.

Supported client applications:

- IBM Personal Communications,
- c3270.

16.5.12 Telnet 5250

Supported connection modes:

- Bastion,
- Gateway,
- Proxy,
- Transparent.

Notes:

- User must authenticate twice - first against Fudo and then against the target host.
- It is not possible to join a Telnet 5250 session.

Supported client applications:

- IBM Personal Communications,
- tn5250.

16.5.13 VNC

Supported connection modes:

- Bastion,
- Gateway,
- Proxy,
- Transparent.

Supported client applications:

- TightVNC,
- RealVNC.

16.5.14 X11

X11 protocol is supported within the SSH protocol.

Supported servers:

- Xorg,
- Xming,
- XQuartz.

16.6 ICA configuration file

The `.ica` configuration file defines connection parameters for establishing connections with remote host over the ICA protocol.

16.6.1 Non-TLS connections ICA file

```
[ApplicationServers]
<connection name>=

[<connection name>]
ProxyType=SOCKSV5
ProxyHost=<host>:<port>
ProxyUsername=*
ProxyPassword=*
Address=<login użytkownika>
Username=<login użytkownika>
ClearPassword=<hasło>
TransportDriver=TCP/IP
EncryptionLevelSession=Basic
Compress=Off
```

Note: `<connection name>` is for information only and can be any string of characters.

16.6.2 TLS connections ICA file

```
[ApplicationServers]
<connection name>=

[<connection name>]
ProxyType=SOCKSV5
ProxyHost=<host>:<port>
ProxyUsername=*
ProxyPassword=*
Address=<login użytkownika>
Username=<login użytkownika>
ClearPassword=<hasło>
TransportDriver=TCP/IP
EncryptionLevelSession=Basic
Compress=Off
```

Note: `<connection name>` służy do celów informacyjnych i może być dowolnym ciągiem znaków.

Related topics:

- *ICA*
- *Model danych*

CHAPTER 17

AAPM (Application to Application Password Manager)

17.1 Overview

The AAPM module enables secure passwords exchange between applications.

An essential part of the AAPM module is the `fudopv` script. It is installed on the application server and it communicates with the Wheel Fudo PAM Secret Manager module to retrieve passwords.

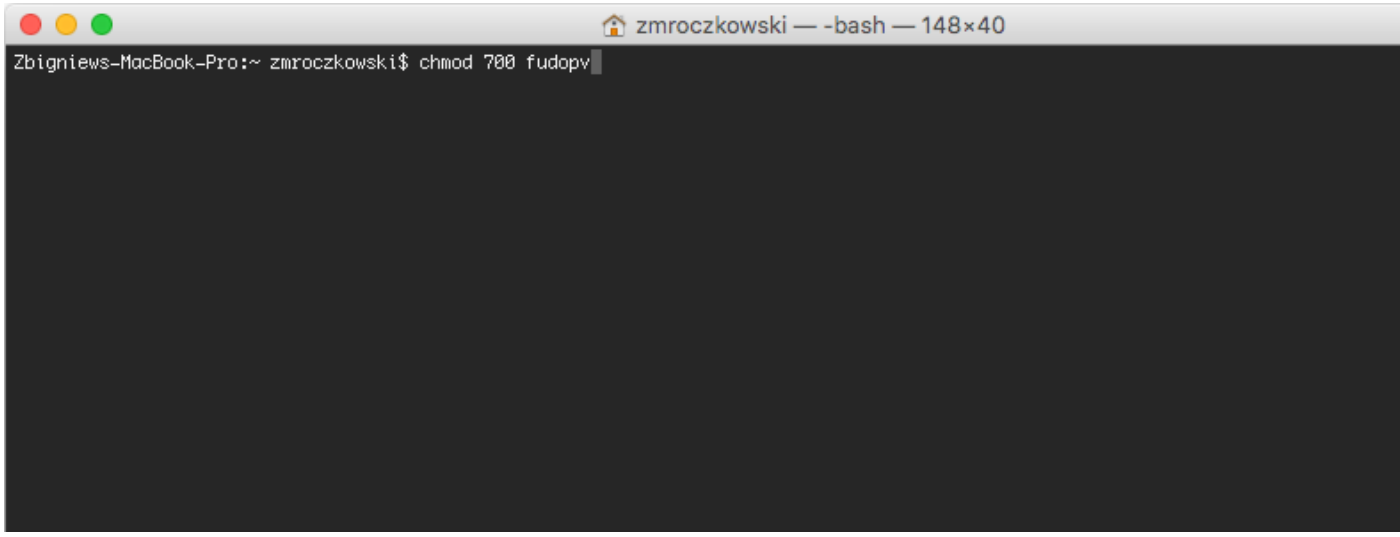
17.2 *fudopv*

Execution parameters

```
fudopv [<options>] <command> [<parameters>]
```

Command/option/parameter	Description
Commands	
`getcert`	Fetch Wheel Fudo PAM SSL certificate.
`getpass` <type> <account>	Fetch password to selected account. type: • `direct` - direct, unmonitored connection; • `fudo` - connection monitored by the *PSM* module
Options	
`-c <path>`	Use configuration file from provided path.
`--cfg <path>`	
`-h, --help`	Show options and parameters list.

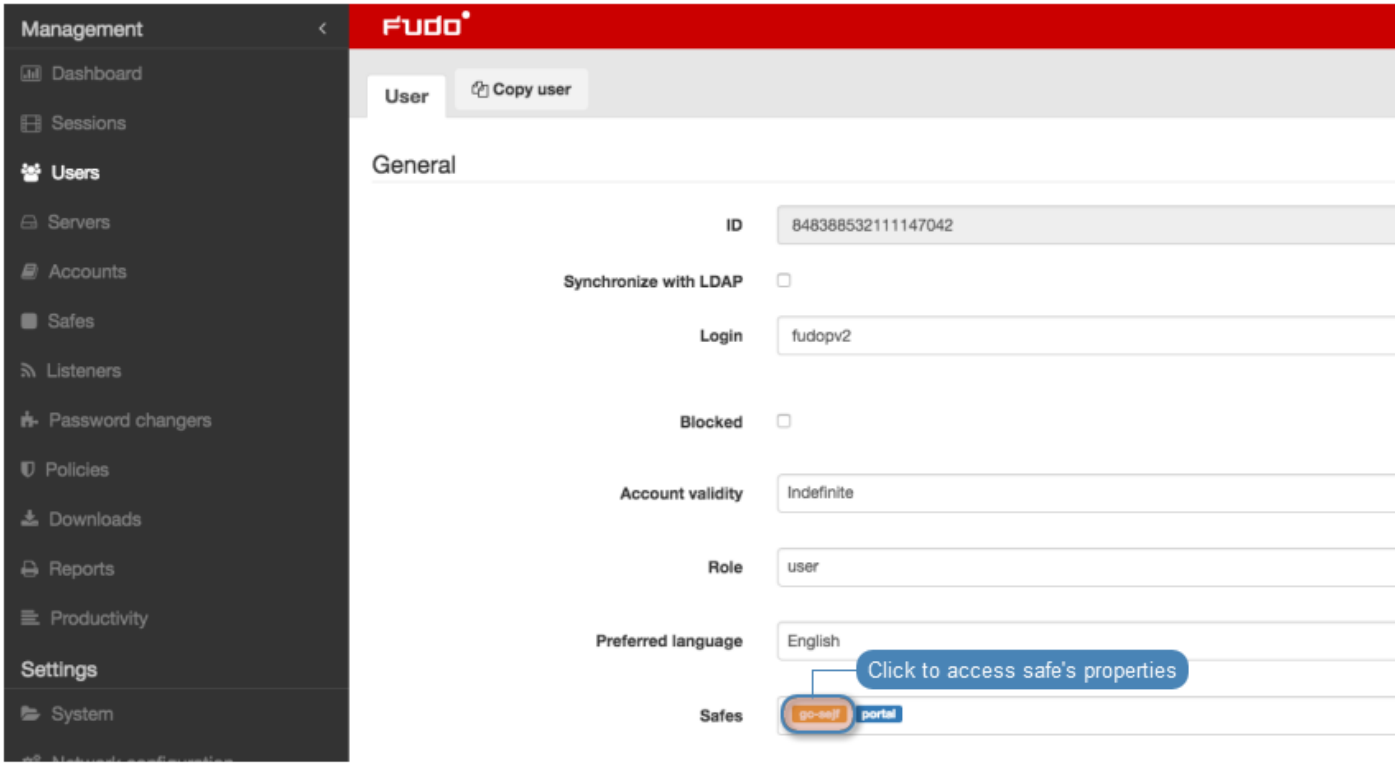
1. Upload `fudopv` script to the server and change its access rights to allow execution.



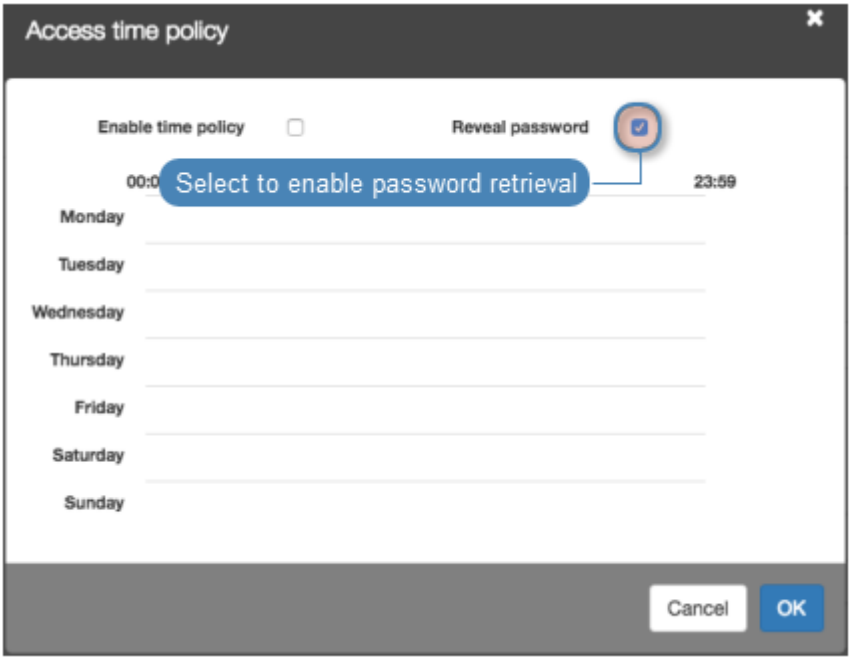
2. Log in to the Wheel Fudo PAM administration panel.
3. Create a user object with `user` role, static or one-time password authentication and server's IP address defined in the *API* section.

Note:

- Select *Management* > *Users*.
- Click *+Add*.
- Enter user's name.
- Define account's validity period.
- Select `user` from the *Role* drop-down list.
- Assign safe and click the object to open its properties.

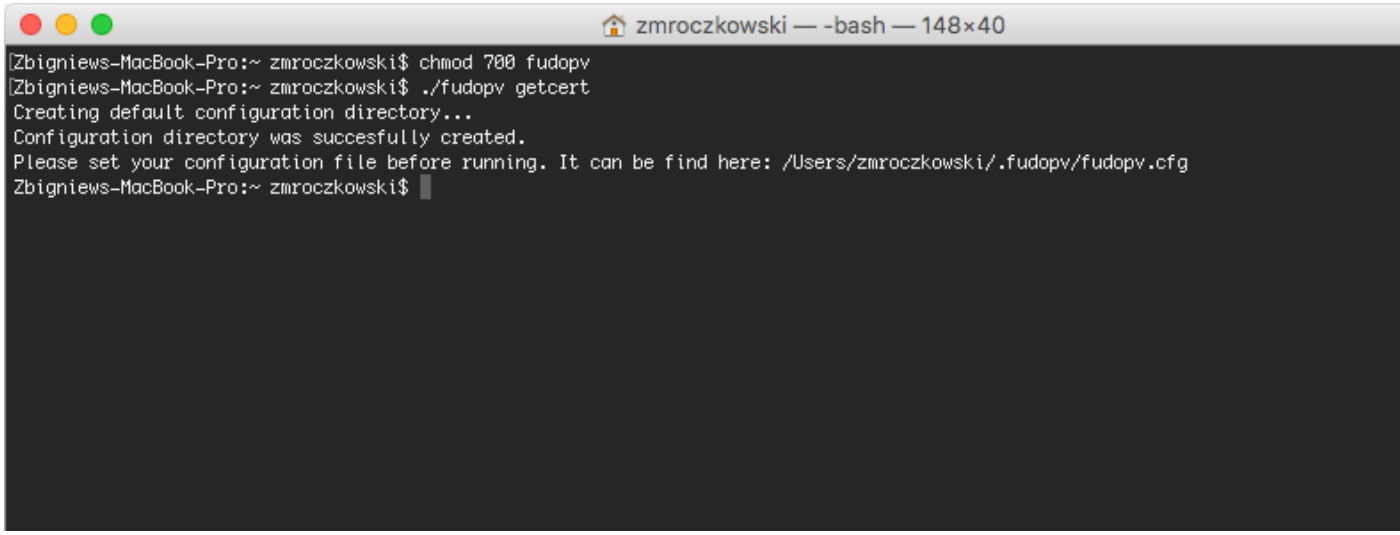


- Select the *Reveal password* option.



- In the *Authentication* section, select `Password` or `One time password` from the *Type* drop-down list.
- In case of static password authentication, type in the password in *Password* and *Repeat password* fields.
- In the *API* section, click the + icon and enter the IP address of the server, which will be requesting passwords using `fudopv` script.
- Click *Save*.

4. Run `fudopv getcert` command to initiate the configuration.



Note: `fudopv` configuration files are stored in the `.fudopv` folder in user's home folder.

5. Open `fudopv.cfg` file in a text editor of your choice.

Section	Description
[FUDO]	
address	Wheel Fudo PAM's IP address.
cert_path	Path to the Wheel Fudo PAM's SSL certificate files.

[CONN]	
bind_ip	IP address of the server, running the fudopv script. The IP address must be the same as the IP address defined in the *API* section in user configuration.

[AUTH]	
username	User login as defined in step 3.
otp	Path to the otp.txt file containing the one time password.
secret	Path to the secret.txt file containing user's static password.

Note:

- In the [FUDO] section, in the address line, enter the Wheel Fudo PAM IP address.
- Leave the cert_path line as is, it will be updated automatically after successfully running the fudopv getcert command.
- In the [CONN] section, uncomment the bind_ip line and provide the IP address of the server running the fudopv script.
- In the [AUTH] section, in the username line, provide the login of the user object defined in step 3.
- Depending on the users authentication method, comment the corresponding line defining the authentication secret information.

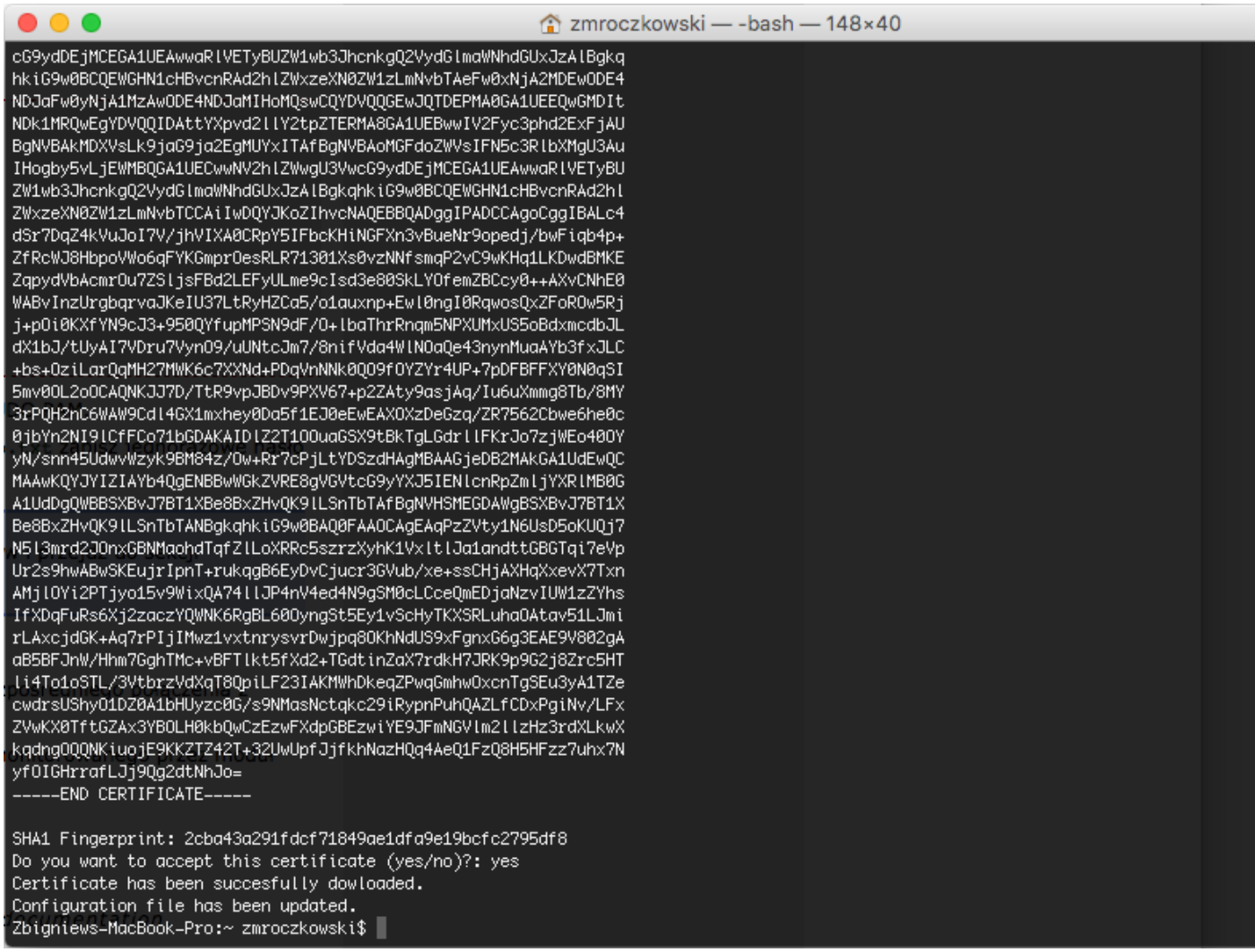
For example:

```
[FUDO]
address=10.0.0.8.61
cert_path=<CERT_PATH>

#[CONN]
bind_ip=10.0.0.8.11

[AUTH]
username=fudopv
#otp=/Users/zmroczkowski/.fudopv/otp.txt
secret=/Users/zmroczkowski/.fudopv/secret.txt
```

6. Run fudopv getcert command to fetch Wheel Fudo PAM's SSL certificate.



Note: After running the script successfully, the path to the certificate in the configuration file will be automatically updated.

.fudopv — vi fudopv.cfg — 148×40

```
[FUDO]
address=10.0.45.47
cert_path=/Users/zmroczkowski/.fudopv/gui.cert.pem

#[CONN]
bind_ip=10.0.1.35

[AUTH]
username=fudopv2
#otp=/Users/zmroczkowski/.fudopv/otp.txt
secret=/Users/zmroczkowski/.fudopv/secret.txt
~
~
~
~
~
~
~
~
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~
~
~
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~
~
~
~
~
~
~
"fudopv.cfg" 11L, 216C
```
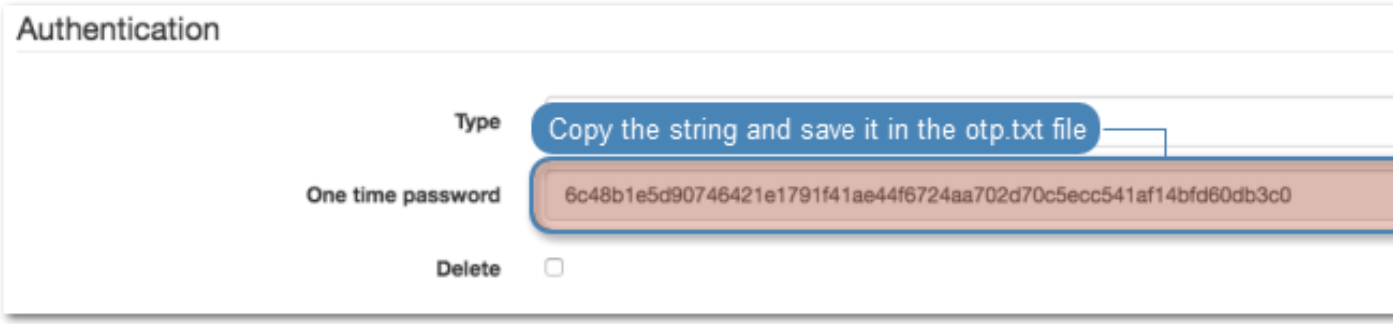

7. Edit the `secret.txt` file and provide user's static password; or edit the `otp.txt` file and store the one time password.

Note:

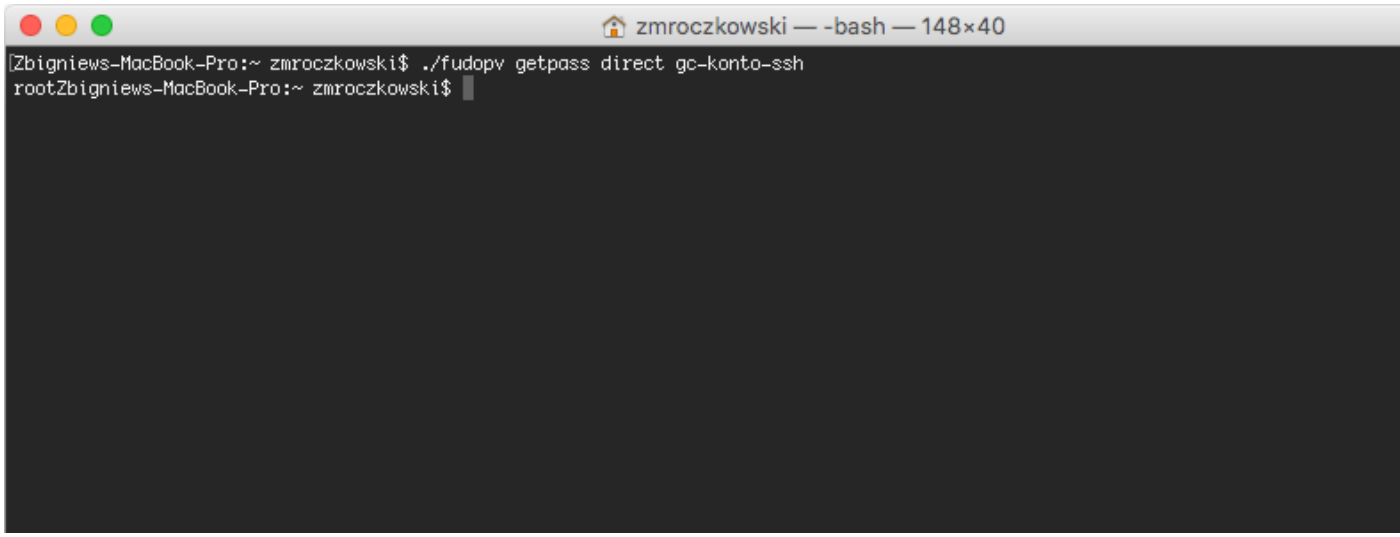
- The one time password can be found in user's properties, in the *Authentication* section.



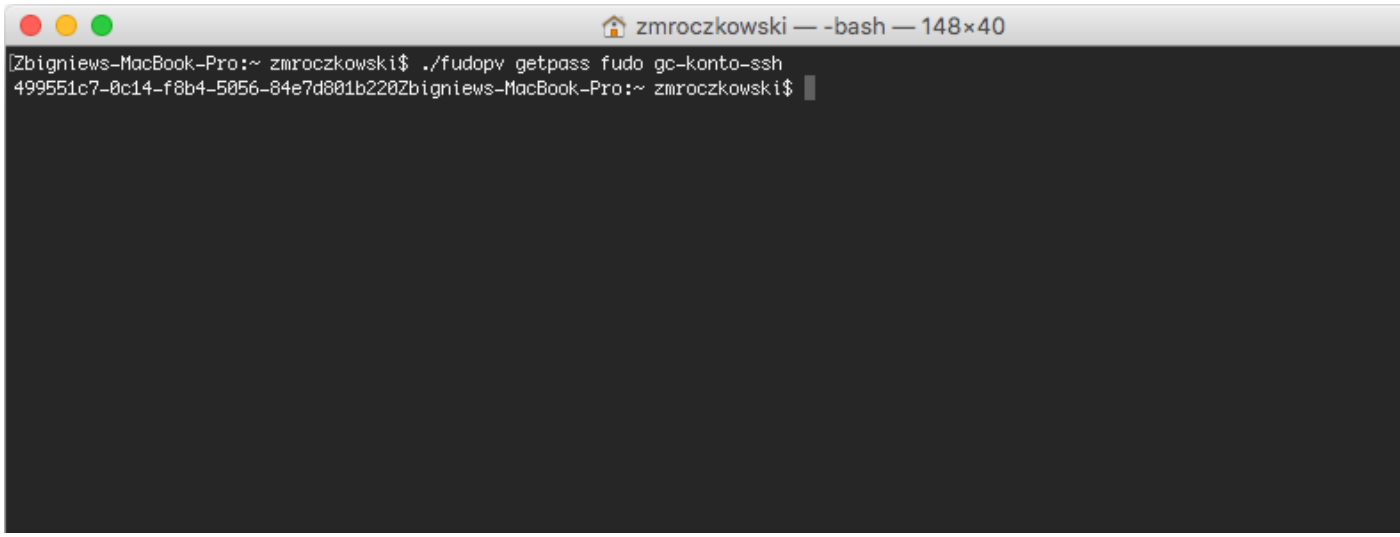
- The `otp.txt` file will be automatically updated each time the `fudopv getpass` command is run.

8. Run command:

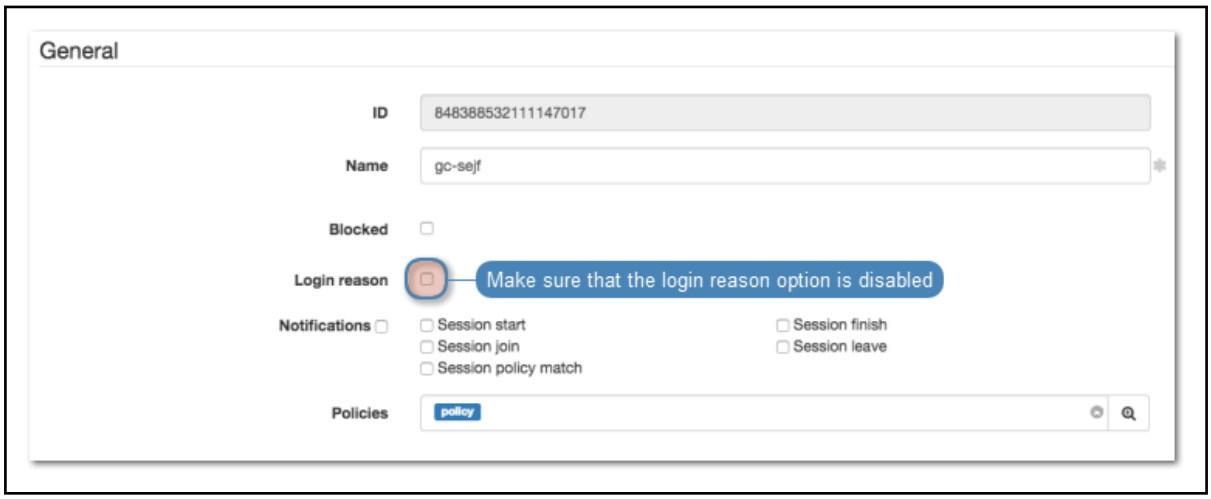
- `fudopv getpass direct <account_name>`, to fetch password to connect directly to the server.



- `fudopv getpass fudo <account_name>`, to fetch password to establish monitored connection with the target host.



Warning: Correct operation of the `fudopv` script requires disabling the login reason prompt option in the safe's properties.



17.3 API interface

AAPM's API interface is described in detail in the *Wheel Fudo PAM - API documentation* manual.

Related topics:

- *Data model*
- *System overview*
- *Setting up password changing on a Unix system*

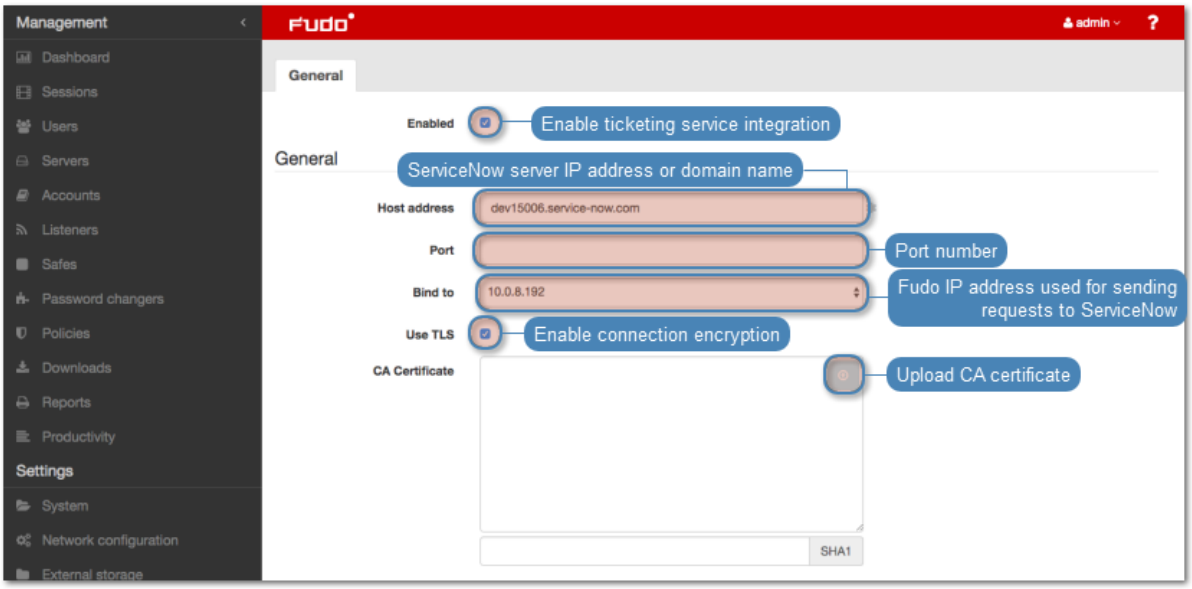
CHAPTER 18

Service Now

18.1 Configuration

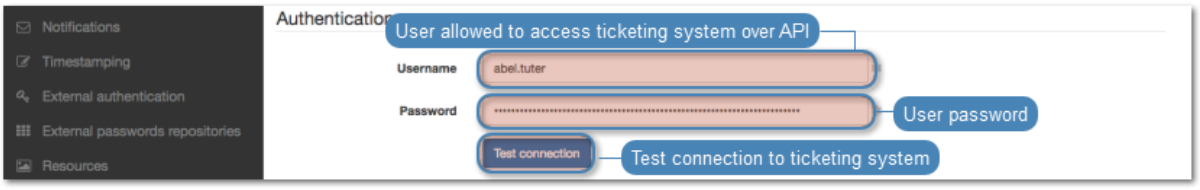
To configure *ServiceNow*, proceed as follows.

1. Select *Settings* > *Ticketing system*.
2. Select *Enable* option to enable ticketing service integration.
3. In the *General* section, provide IP address and port number of *ServiceNow* REST API.
4. Select the *Use TLS* option to enable connection encryption.
5. From the *Bind to* drop-down list, select the IP address used by Wheel Fudo PAM for sending requests to *ServiceNow* API.

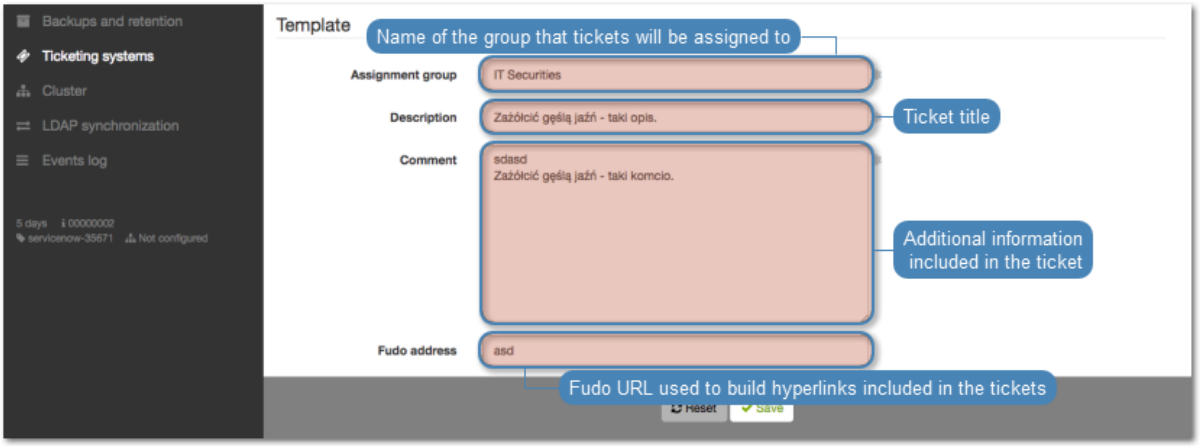


6. In the *Authentication* section, provide user credentials allowed to access *ServiceNow* over defined REST API.

Note: Click *Test connection* to verify configuration parameter values. The result of testing will be a ticket in *ServiceNow*, containing the configuration values prefixed with the `test_` string.



7. In the *Template* section, in the *Assignment group*, define the *ServiceNow* users group to which the tickets will be assigned.
8. In the *Description* field, provide the ticket template title.
9. In the *Comment* field, provide additional information to be included in the ticket.
10. Enter Fudo URL that will be used to create quick access hyperlinks included in tickets.



11. Click *Save*.

Related topics:

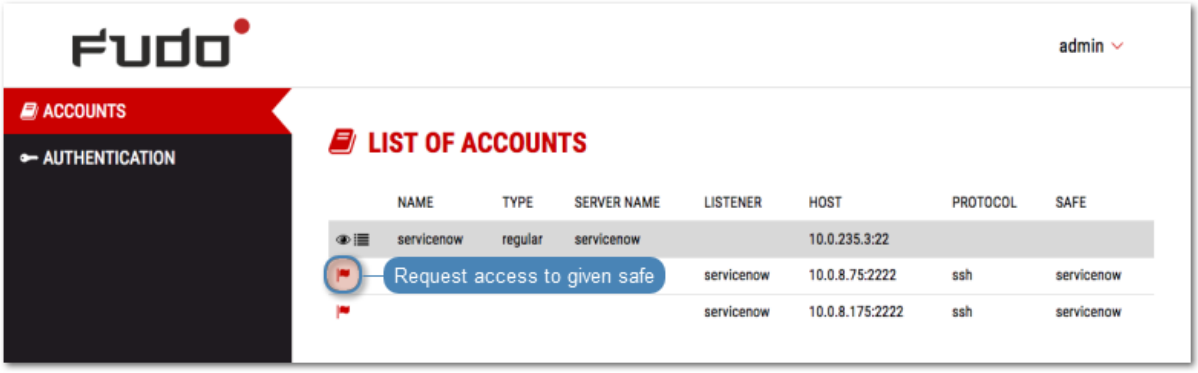
- *Requesting access to safe*
- *Granting access*

18.2 Requesting access to safe

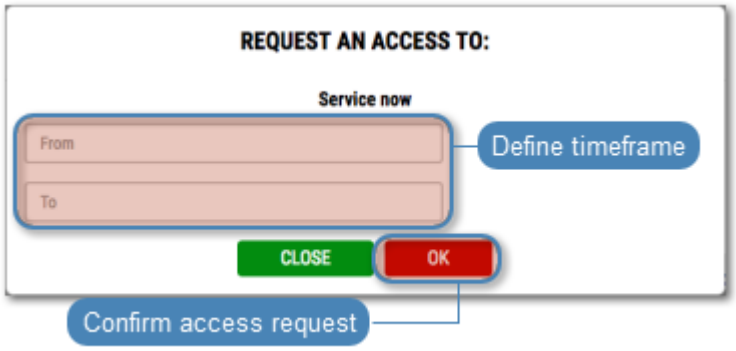
Note: Usernames on Wheel Fudo PAM and *ServiceNow* must be the same to ensure correct requests processing.

To request access to safe, proceed as follows.

1. Log in to *User Portal*.
2. Find desired safe and click .



3. Define time period and click *OK*.



Note: Click the icon to access time settings.

Related topics:

- *Configuration*
- *Granting access*

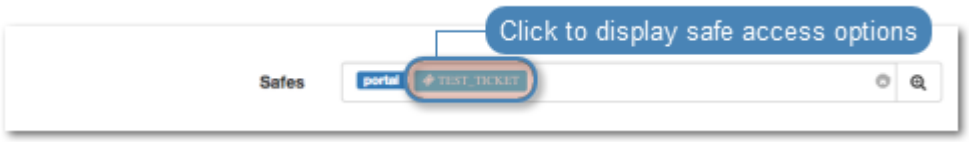
18.3 Granting access

To grant access based on a *ServiceNow* ticket, proceed as follows.

1. Select *Management* > *Users*.
2. Find and click user requesting access.

Note: Users with pending access requests are marked with icon.

3. In the *Safes* field, find and click the object that the user requests to access.



4. Deselect *Blocked* option and define access time period.
5. Click *Accept*.

Note: Safe access management options can be also accessed from within the safe edit form.

Related topics:

- *Configuration*

- *Requesting access to safe*

CHAPTER 19

Troubleshooting

19.1 Booting up

Problem	Symptoms and solution
Wheel Fudo PAM does not boot up	• Make sure that both power supplies are connected to power outlets. Not connecting both power supplies will result in sound alarm. • Make sure that encryption key is properly connected. • In case the problem is a result of unsuccessful system update, wait a few minutes. During that time, Wheel Fudo PAM will detect the problem and will restore previous system revision.

19.2 Connecting to servers

Problem	Symptoms and solution
Cannot connect to server	**Symptoms:** • User cannot log in. • Events log entry: *Authentication failed: Invalid username kowalski or password.*
	Solution: • Verify that user definition exists in Wheel Fudo PAM database. • Make the login credentials are correct. • Make sure that the client software does not have outdated credentials stored.
	Symptoms: events log entry: *Unable to establish connection to server zbigniew (10.0.35.53:3399).*
	Cause: incorrect server configuration.
	Solution: • Verify that the server in question is properly configured (IP address, port number). • Check if the server is reachable from Wheel Fudo PAM: 1. Log in to Wheel Fudo PAM administration panel. 2. Select *Settings* > *System*, *Diagnostics* tab. 3. Enter server address in the *Ping* section and execute command and test host's availability. • Check if the server is reachable on given port number: 1. Log in to Wheel Fudo PAM administration panel. 2. Select *Settings* > *System*, *Diagnostics* tab. 3. Enter server address along with the port number in the *Netcat* section and execute command.

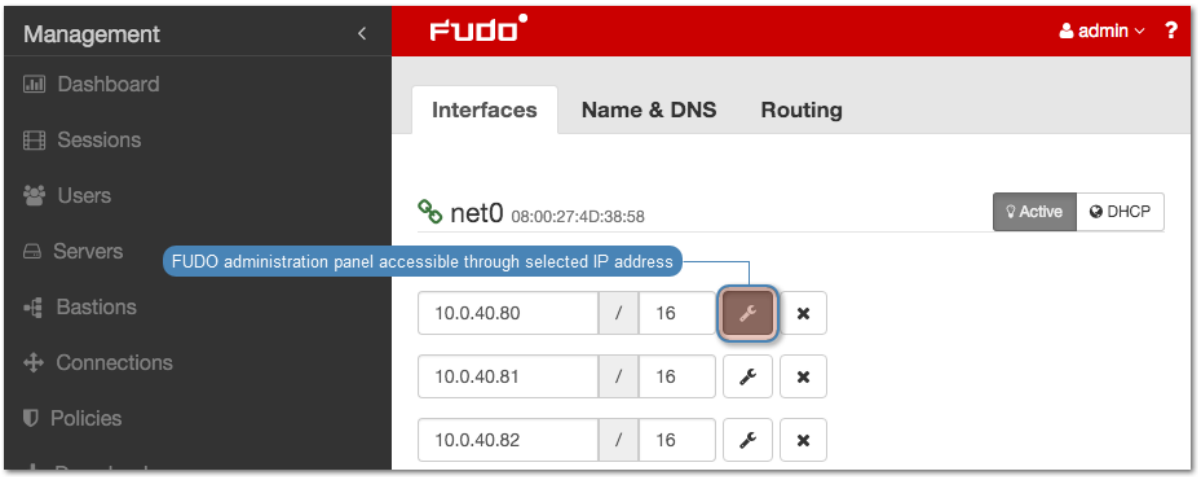
Problem	Symptoms and solution
When logging in not all of the users see the Wheel Fudo PAM logon screen.	**Cause:** • Credentials stored in RDP client result in users being automatically logged in to remote host. • Credentials stored in RDP client, user is successfully authenticated against credentials stored so the Wheel Fudo PAM logon screen is not displayed. Next, Wheel Fudo PAM forwards user credentials to target server but they are no longer valid which results in Windows gina being displayed.
	Symptoms: • Client software message: *Connection closed by remote host.* • Events log entry: *Failed to authenticate against the server as user root using password.*
	Cause: incorrect login credentials.
	Solution: provide correct login credentials in server configuration.
	Symptoms: • RDP client message: *Connection refused.* • SSH client message: *ssh: connect to host 10.0.1.111 port 10011: Connection refused*
	Cause: server has been blocked.
	Solution: log in to Wheel Fudo PAM administration panel and unblock the server.

Problem	Symptoms and solution
Connection is terminated	**Symptoms:** • User tries to log in to server monitored by Wheel Fudo PAM, after entering username and password session is immediately terminated. • Events log entry: *TLS certificate verification failed.*
	Solution:
	Download new target host certificate in the *Target host* section.
	
	Symptoms: • After entering username and password the connection is terminated. • Events log entry: *RDP connection error.*
	Solution: check if in the *General* tab in TCP-Rdp properties, the *Encryption level* option is not set to `FIPS Compliant`.
Cannot connect to server	**Symptoms:** • Cannot log in to server with error message *User user0 not allowed to connect to server.* • Events log entry: *Authentication failed: User user0 not allowed to connect to server.*
	Cause: user is not assigned to proper connection.
	Solution: add user to appropriate connection object.

Problem	Symptoms and solution
	Symptoms: • After entering username and password, the screen freezes. • Events log entry *Terminating session: User user0 (id=848388532111147010) is blocked.*
	Cause: user is blocked.
	Solution: log in to Wheel Fudo PAM administration panel and unblock the user in question.
User has to provide login credentials twice	**Symptoms:** user connecting over RDP protocol enters login credentials and immediately afterwards is asked again for the same login information.
	Cause: server is a part of an infrastructure managed by connections broker which has detected an active user's session on another server.
	Symptoms: user connecting over SSH protocol enters login credentials and immediately afterwards is asked again for login information.
	Cause: in *connection* object options for login and password substitution are enabled but the input fields are left blank which results in two fold authentication - first time against Wheel Fudo PAM and second time against the target host.
Cannot connect to server over RDP protocol	**Symptoms:** • User connecting over RDP is disconnected a moment after establishing connection. • Events log entry: *RDP server 10.0.0.:33890 has to listen on the default RDP port in order to redirect sessions.*
	Cause: connection is redirected to a host which does not listen on port number 3389.
	Solution: configure server in question so it accepts user connections on port number 3389.
	Symptoms: • Events log entry: *User user0 has no access to host 192.168.0.1:3389*
	Cause: connections broker determines an existing user session on another server and redirects user to that host but it is not configured on Wheel Fudo PAM or the user does not have sufficient access rights to connect to given server.
	Solution: • Make sure that the server object exists. • Add user to proper *connection* object.

19.3 Logging to administration panel

Problem	Symptoms and solution
Cannot log in to administration panel	• Make sure that Wheel Fudo PAM IP address is correct. • Set Wheel Fudo PAM IP address from the console as described in the *Wheel Fudo PAM System documentation* in the *Network interfaces configuration* topic. • Make sure that the IP address in question has the management access option enabled.



19.4 Session playback

Problem	Symptoms and solution
Cannot playback exported video	**Cause:** required video codecs are missing.
	Solution: install correct video codecs.
Administrator user does not see sessions	**Symptoms:** session list does not contain expected entries.
	Cause: insufficient access rights.
	Solution: grant access rights to specific user, server and connection objects.
Cannot playback session in session player	**Symptoms:** message: `Could not find session data.`
	Cause: recording has been disabled in connection properties when given session transpired.
	Solution: enable session recording to be able to playback session material in future.

19.5 Cluster configuration

Problem	Symptoms and solution
Data model objects are not replicated to other nodes	**Symptoms:** Objects created on a node are not copied to other cluster nodes. **Solution:** Contact technical support department.

CHAPTER 20

Frequently asked questions

1. How many user sessions can be stored on Wheel Fudo PAM at once?

2. How Wheel Fudo PAM supports sessions archiving?

3. How to calculate storage space required for archiving sessions?

4. How users can hide their activities on servers which they access through Wheel Fudo PAM?

5. How to determine unauthorized access attempts to supervised servers?

6. Is it possible to hide the Wheel Fudo PAM login screen when connecting over the RDP protocol?

7. Why the users list in the connection's properties is incomplete?

8. Why is a user removed from the LDAP/AD server still present on Wheel Fudo PAM?

9. How frequently are users' definitions synchronized with an LDAP/AD server?

*10. I see * instead of the keystrokes in the session player. Is it possible to see the actual keyboard input?*

11. Can I deactivate a session URL?

1. How many user sessions can be stored on Wheel Fudo PAM at once?

Wheel Fudo PAM is delivered with 20TB of hard drive space dedicated to storing users sessions.

Size of the stored session is determined by user's activity. A minute of recorded connection takes on average:

RDP	1 MB active user session (no activity generates almost no data). Definite session size depends on the screen resolution, color depth and actual user activity.
SSH	50 kB active session.

Given that assumptions, 20TB of disk space allows recording:

- approximately 36 years of RDP sessions;
- approximately 760 years of SSH sessions.

Note: Wheel Fudo PAM allows specifying how long sessions data should be stored, and will automatically delete session data after a certain time, determined by *retention* parameter, elapses.

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2. How Wheel Fudo PAM supports sessions archiving?

All sessions are stored on Wheel Fudo PAM internal storage space. In addition to that, Wheel Fudo PAM allows exporting sessions in native format or a video record.

3. How to calculate storage space required for archiving sessions?

File size of sessions in native format are the same as in question 1. In case of video record, file size depends on the codec and resolution settings.

4. How users can hide their activities on servers which they access through Wheel Fudo PAM?

In case of the SSH protocol, Wheel Fudo PAM supports SCP channel and monitors all transferred files, including scripts. This allows auditing given session searching for malicious code embedded in software sent to the server.

Protection of other communication channels (e.g. web browser or other applications) are task for different kind of solutions. There is no solution similar to Wheel Fudo PAM which are able to monitor such channels, thus it is important to create proper server configuration by the system administrator.

5. How to determine unauthorized access attempts to supervised servers?

Unauthorized access and DoS attacks attempts, can be determined by analyzing event log entries. Each ERROR or WARNING severity entries should be closely examined. Cases of login timeout errors can be potential DoS attack attempts.

6. Is it possible to hide the Wheel Fudo PAM login screen when connecting over the RDP protocol?

Hiding the Wheel Fudo PAM login screen requires using the `Enhanced RDP Security (TLS) + NLA` security mode.

7. Why the users list in the connection's properties is incomplete?

The users list in the connection's properties does not contain users synchronized with the LDAP service. To assign a connection to an LDAP synchronized user, define a group mapping in the *LDAP synchronization properties* or disable the synchronization option for the given user.

8. Why is a user removed from the LDAP/AD server still present on Wheel Fudo PAM?

Deleting a user object from an AD or an LDAP server requires performing the full synchronization to reflect those changes on Wheel Fudo PAM. The full synchronization process is triggered automatically once a day at 00:00, or can be triggered manually in the *LDAP synchronization* settings view.

9. How frequently are users' definitions synchronized with an LDAP/AD server?

New users definitions and changes in existing objects are imported from the directory service periodically every 5 minutes. The full synchronization process is triggered automatically once a day at 00:00.

10. I see * instead of the keystrokes in the session player. Is it possible to see the actual keyboard input?

Presenting keyboard input qualifies as a sensitive feature and it is disabled by default. Enabling displaying keystorkes in the session player requires a consent from two `superadmin` users. Refer to the *Sensitive features* topic for the details on enabling this functionality.

11. Can I deactivate a session URL?

Active session URL can be deactivated anytime. URL revoking procedure is described in the *Sessions sharing* topic.

CHAPTER 21

Glossary

DNS Domain Name Server - name server service which maps IP addresses to hosts names which are easier to remember.

SSH Secure Shell - networking protocol for secure communication with remote systems.

Syslog Events logging standard in computer systems. Syslog server collects and stores log data from networked devices, which can be later used for analysis and reporting.

Fingerprint Characters string being a result of a hash function on input data, allowing to determine if the input data has been altered.

RDP Remote Desktop Protocol - remote access protocol to computer systems running Microsoft operating system.

VNC Remote access protocol to graphical user interfaces.

RADIUS Remote Authentication Dial In User Service - networking protocol used to control access to different services within IT infrastructure.

Static password Basic user authorization method which uses login and password combination to determine users's identity.

Public key Authentication method which uses a pair of keys - private (held only by the user) and public (publicly available) to determine user's identity.

CERB Complete user authentication and authorization solution, supporting different authentication methods i.e., mobile token (mobile phone application), static password, SMS one-time passwords, etc.

LDAP Lightweight Directory Access Protocol - distributed catalog services management and access protocol in IP networks.

Active Directory Users authorization and authentication in Windows domain.

AD Active Directory - users authorization and authentication in Windows domain.

CIDR Short notation of network addressing, in which the IP address is written according to the IPv4 standard, and the subnet mask is provided as a number of *1* in the subnet mask in binary system (192.168.1.1 - 255.255.255.0; 192.168.1.1/24).

heartbeat Network packet used for informing other cluster nodes about machine's current state. If a cluster node does not receive a heartbeat packet in a given timeframe, it will take over the master node role and will start processing users' requests.

anonymous safe An anonymous safe has at least one anonymous account assigned to it and it can only have that type of accounts assigned. You cannot assign users to anonymous safes.

AAPM AAPM (Application to Application Password Manager) module enables secure password exchange between applications.

Efficiency Analyzer Efficiency Analyzer module delivers statistical information on users' activity.

PSM (Privileged Session Management) PSM module is used for recording remote access sessions.

server

servers Server is a definition of the IT infrastructure resource, which can be accessed over one of the specified protocols.

listener Listener determines server connection mode (proxy, gateway, transparent, bastion) as well as its specifics.

user User defines a subject entitled to connect to servers within monitored IT infrastructure. Detailed object definition (i.e. unique login, full name, email address etc.) enables precise accountability of user actions when login and password are substituted with a shared account login credentials.

account Account defines the privileged account existing on the monitored server. It specifies the actual login credentials, user authentication mode: anonymous (without user authentication), regular (with login credentials substitution) or forward (with login and password forwarding); password changing policy as well as the password changer itself.

safe Safe directly regulates user access to monitored servers. It specifies available protocols' features, policies and other details concerning users and servers relations.

hot-swap Hot-swap mechanism enables replacing hardware components without the necessity to turn the system off.

time policy Time policy mechanism enables defining time periods during which users are allowed to connect ot monitored hosts.

password changer Tool which enables facilitating automated password changing on a server.

policy Mechanism which enables defining patterns which in case of being detected will trigger defined actions.

shared session User session which was joined by another user.

fudopv AAPM module script, installed on the server, which enables secure password exchange between applications.

SSH access Service access to Wheel Fudo PAM over SSH protocol.

VLAN Virtual networks mechanism, enabling separation of broadcast domains.

DHCP Mechanism for dynamic IP addressing management i LAN networks.

timestamp Session data hash value, which enables verifying that the data has not been modified.

external authentication server Server storing user data used for verification of user login credentials when connecting to Wheel Fudo PAM or the monitored server.

passwords repository Passwords repository manages password to privileged accounts on monitored hosts.

data retention Data retention mechanism automatically deletes session data after define time period transpires.

redundancy group Defined group of IP addresses, which in case of a system failure, will be seamlessly carried over to another cluster node to maintain the availability of the services.

RDP connections broker Remote sessions management mechanism for server farms.

PSM PSM (Privileged Session Monitoring) module enables monitoring and recording remote access sessions.

WWN World Wide Name - unique object identifier in external storage solutions.

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