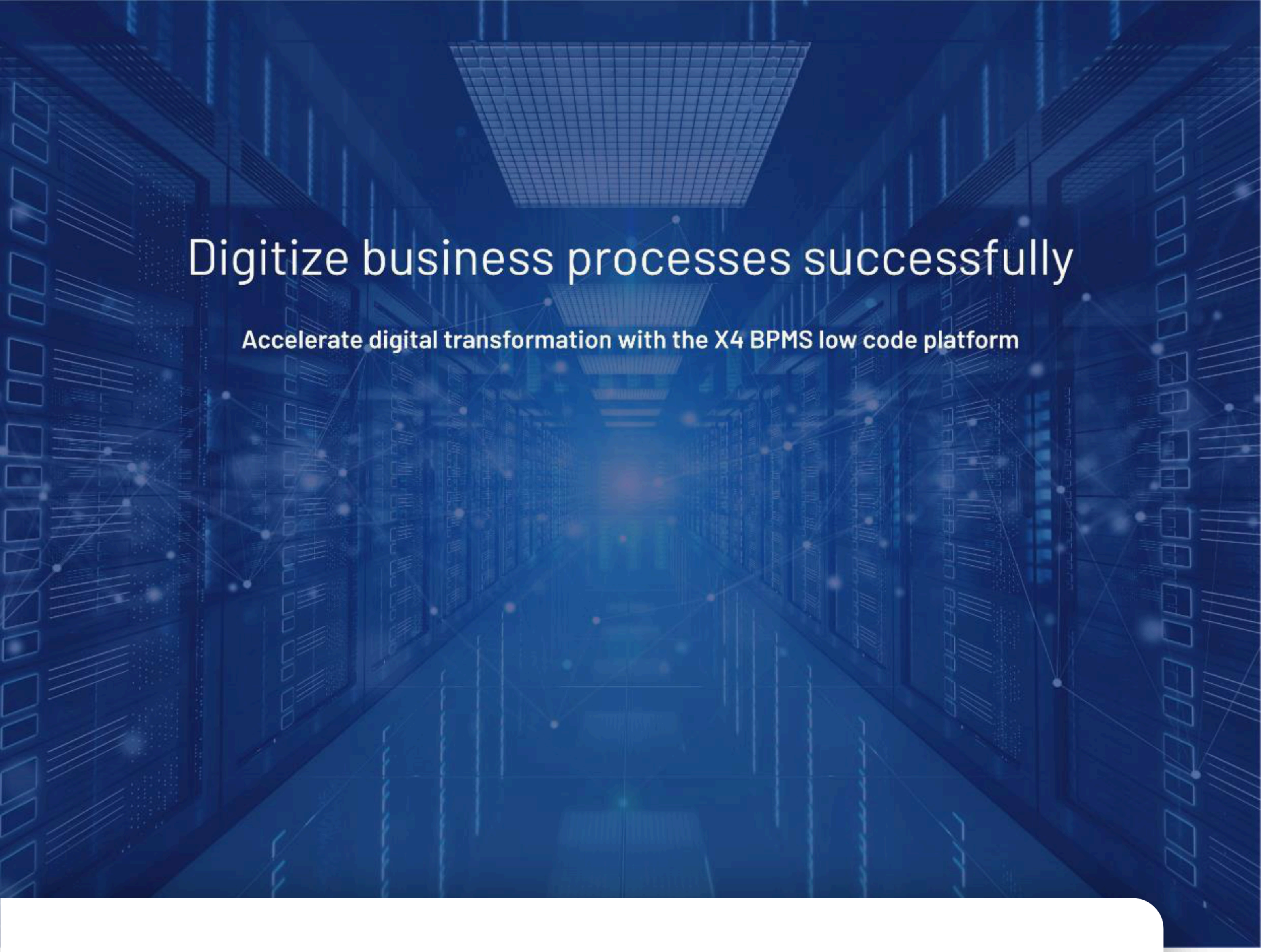
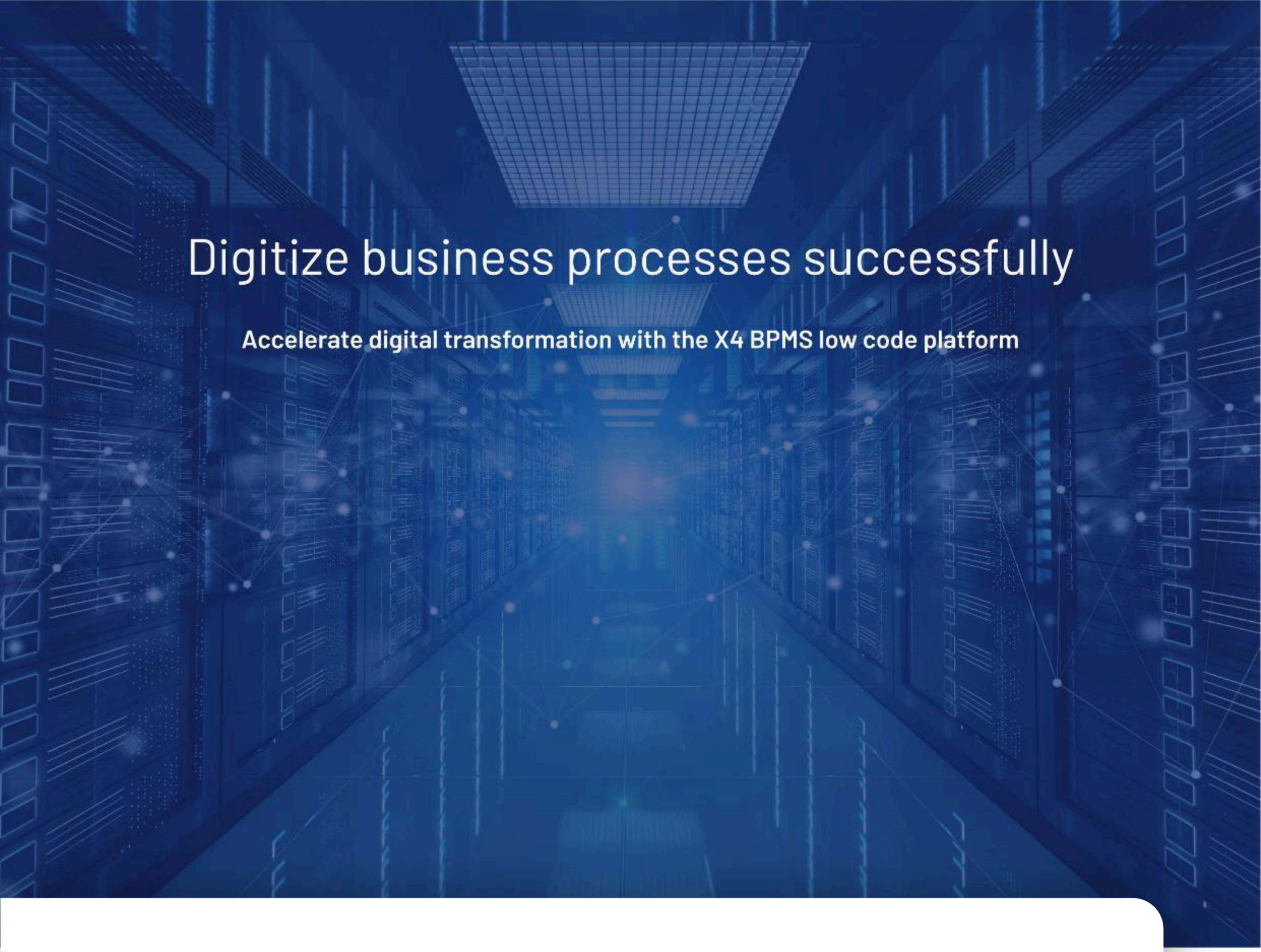


Digitize business processes successfully

Accelerate digital transformation with the X4 BPMS low code platform

X4 Administration Guide

SoftProject



Digitize business processes successfully

Accelerate digital transformation with the X4 BPMS low code platform

SoftProject

Contact

SoftProject GmbH

Am Erlengraben 3

D-76275 Ettlingen – Germany

Website: www.softproject.de

Sales

Phone: +49 7243 56175-0

vertrieb@softproject.de

SoftProject Support

Phone: +49 7243 56175-333

support@softproject.de

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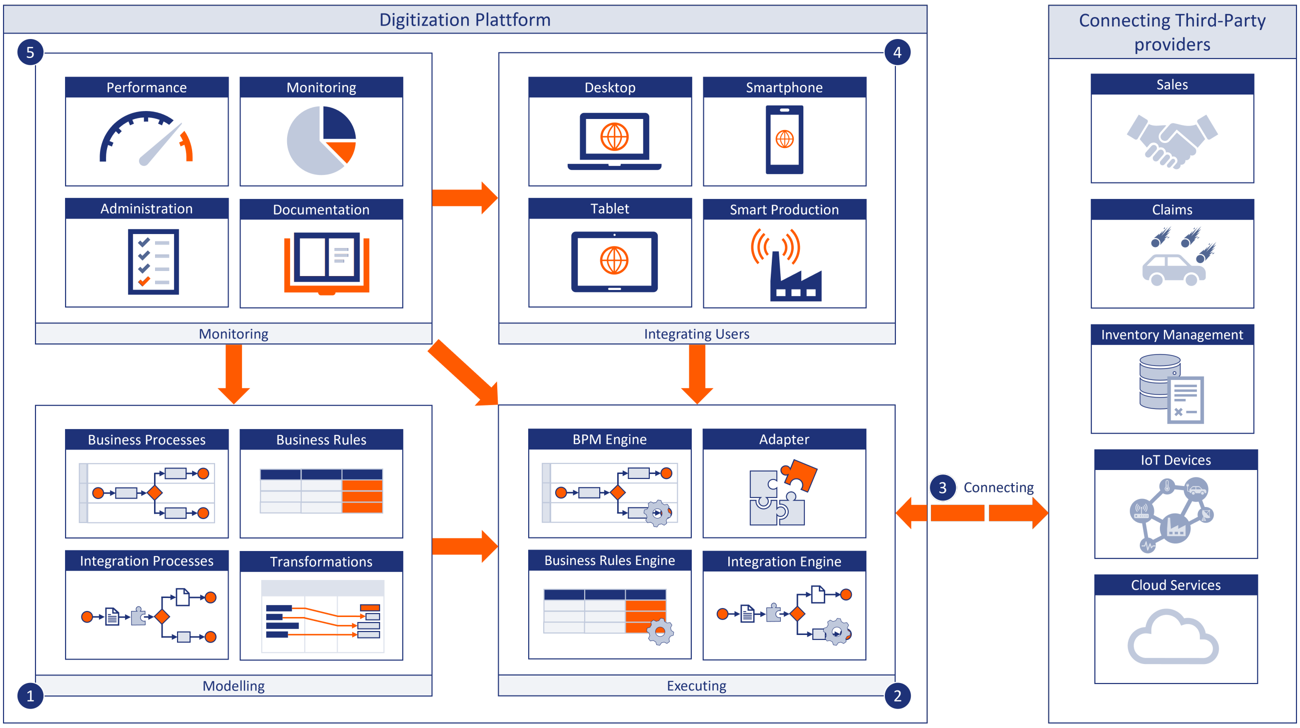
About the X4 BPMS

Digitalization requires a holistic approach, which presupposes that also the used solution has to reflect that. X4 BPMS supports you as a central platform in solving these challenges. The focus is on modeling, implementing and monitoring your business processes. Therefore, the X4 BPMS contains all necessary tools and is compatible with a variety of interfaces and formats. That helps to avoid isolated information silos and media breaks that inhibit productivity, and accelerate digitization at the same time.

Implementing business processes without programming effort enables a large number of users to enter into the management of business processes. That's important, since employees of the specialist department usually know best what is important in the respective business processes. Therefore, you should rely on the X4 BPMS as a platform whose tools reduce complexity to such an extent that business processes can be analyzed, optimized, modeled, as well as controlled and documented even without programming knowledge. All tools support integrated, graphical process modeling and implementation and generate processes that are executed by the X4 BPMS with high performance.

- **X4 Designer:** Modelling processes and rules graphically
- **X4 Server:** Simulating and executing processes and rules
- **X4 Adapter:** Integrating third-party systems into processes
- **X4 Activities**: Providing web apps for employees and customers



Who is the target group of this document?

This document targets administrators who want to install, configure and administer the X4 Server. In addition to detailed technical knowledge of the existing IT infrastructure, basic knowledge of Java EE, XML technologies and the application server is required.

1 System requirements

X4 Server

Operating system	• Microsoft Windows Server 2012, 2012 R2, 2016, 2019 • SUSE Linux Enterprise Server 15, Red Hat Enterprise Linux 8, Ubuntu Linux 18.04 LTS, Debian GNU/Linux 10.1 ⓘ • If you want to use the X4 server in another environment, we will be glad to consult you. • Only 64-bit operating systems are supported (x86_64). • For security reasons, a hardened configuration of the X4 Server is required to use the X4 Proxy Server. Do not hesitate to contact us for advice.
Platform	• **Runtime environment**: X4 Server is based on the Java 11 platform. With Version 11 Azul Zulu 11.54.23 (Java 11.0.14) is already included as runtime environment. • **Application server**: The X4 Server uses an integrated WildFly application server in version 25.0.1. • **Authentication provider**: The X4 server uses the authentication provider Keycloak in version 16.1.0. • **System database**: X4 Server requires a system database to manage runtime and authentication information. The following databases are supported: • Oracle (11g, 12c, 18c, 19c) • Microsoft SQL Server (2012 Service Pack 4, 2014 Service Pack 3, 2016 Service Pack 2, 2017) • PostgreSQL (11.5, 12.0) ⓘ • If you have special requirements regarding the Java runtime environment or if you want to use an alternative application server for customer-specific adaptations, do not hesitate to contact us for advice. • If you want to use the X4 Server with a different version of the above database management systems, do not hesitate to contact us for advice.
Hardware requirements	• At least 2 processor cores • At least 5 GB of free hard disk space • At least 8 GB RAM ⓘ Starting with a number of 500 processes to be executed, we recommend a system with at least 8 processor cores and 16 GB main memory, which must be available exclusively for X4 Server.

X4 Web Apps

Operating system	X4 Web Apps are cross-platform usable via browser.
Platform	Current browser (also mobile) with enabled JavaScript: • Google Chrome (latest version) • Mozilla Firefox (latest version and extended support release (ESR)) • Microsoft Edge (last 2 major versions) • Apple Safari (last 2 major versions) ⓘ Microsoft Internet Explorer and Microsoft Edge ("Project Spartan") are discontinued by Microsoft. Please switch to Microsoft Edge (Chromium-Based) or any other compatible browser.

X4 Designer

Operating system	• Microsoft Windows 8.1, 10 (since version 1803) • Microsoft Windows Server 2012, 2012 R2, 2016, 2019 ⓘ • Only 64-bit operating systems are supported (x86_64). • Only Windows operating systems allowing the execution of desktop applications are supported. Core versions of Microsoft Windows Server are not supported. • Desktop virtualization solutions (e.g. Citrix XenDesktop or Citrix XenApp) are not officially supported. However, some customers are using X4 Designer in environments like these. Do not hesitate to contact us for advice.
Platform	**Runtime environment** The X4 Designer is based on the Java 11 platform. Azul Zulu 11.54.23 (Java 11.0.14) is already integrated as runtime environment.
Hardware requirements	• At least 2 processor cores • At least 2 GB free hard disk space • At least 8 GB RAM

2 Installation

2.1 Installing the X4 Server

Here you will find information on how to install the X4 server.

⚠ Administrator permissions are required for the installation.

2.1.1 Installation on Windows systems

Here you will learn how to install the X4 Server - if required also as NT service - on Windows.

2.1.1.1 Install X4 Server

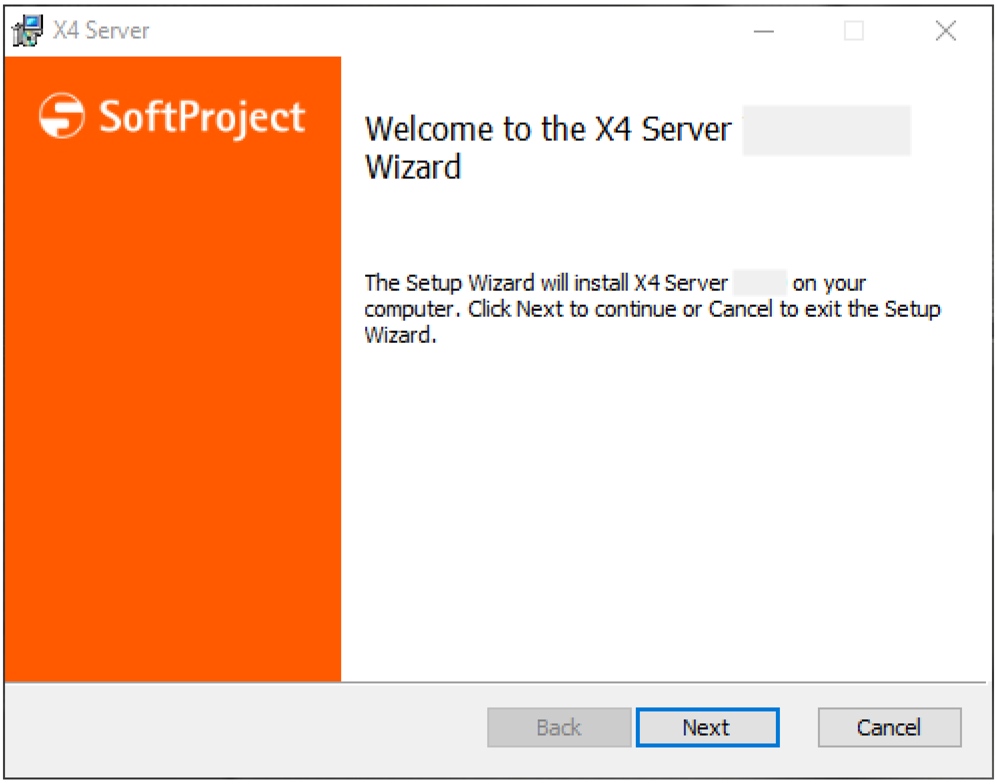
For **production purposes**, the X4 Server is provided as a separate MS Windows installation package in the form of an `MSI file`.

⚠

- You can install only one X4 Server on a Windows system. The MS Windows installation package overwrites existing installations. If you overwrite an existing installation, this can lead to problems and data loss.
- To use multiple X4 Servers for testing purposes, we provide the **MS Windows All-in-one** installation package in the download section of our website.

1. Run the installation package `X4ServerSetup_7.v.v_64bit.msi` provided by SoftProject with administrator rights or appropriate write rights.

   ⓘ Windows Defender SmartScreen issues a warning at the start of the installation. Click **More information** and start the installation routine as usual with **Run anyway**.



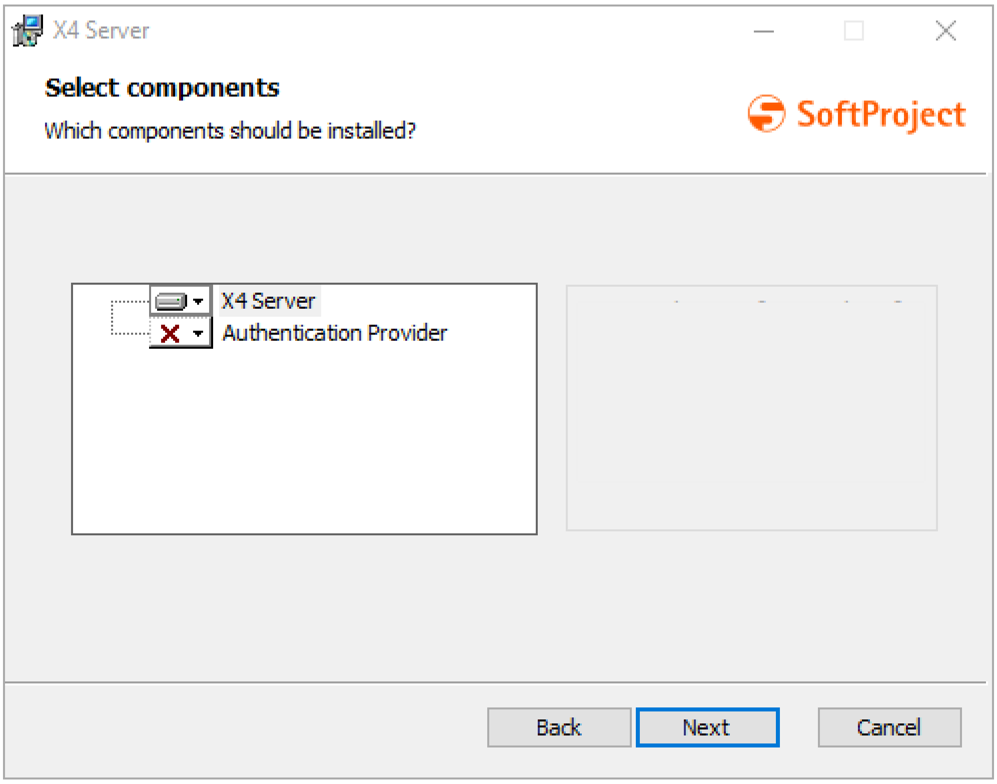
X4 Server

Welcome to the X4 Server Wizard

The Setup Wizard will install X4 Server on your computer. Click Next to continue or Cancel to exit the Setup Wizard.

2. Click **Next** to select the components to be installed.

> ⚠ If you do not have an Authentication Provider in use, you have to install the provided **Authentication Provider** component.

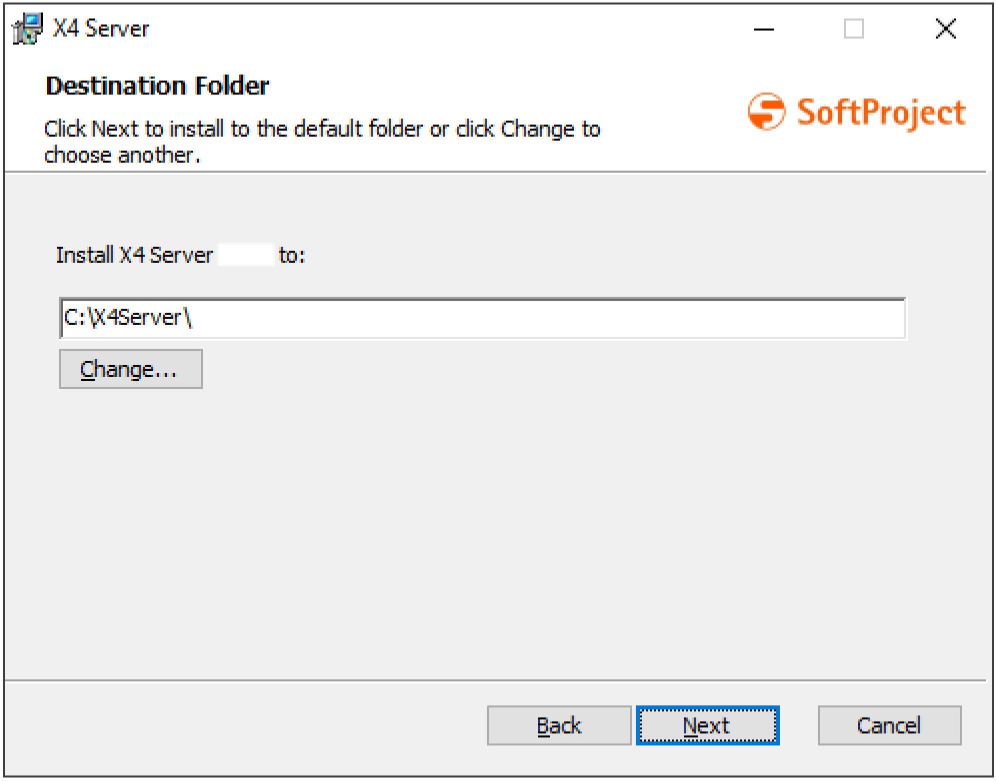


X4 Server

Select components

Which components should be installed?

3. Click **Next** to specify the installation path.



X4 Server

Destination Folder

Click Next to install to the default folder or click Change to choose another.

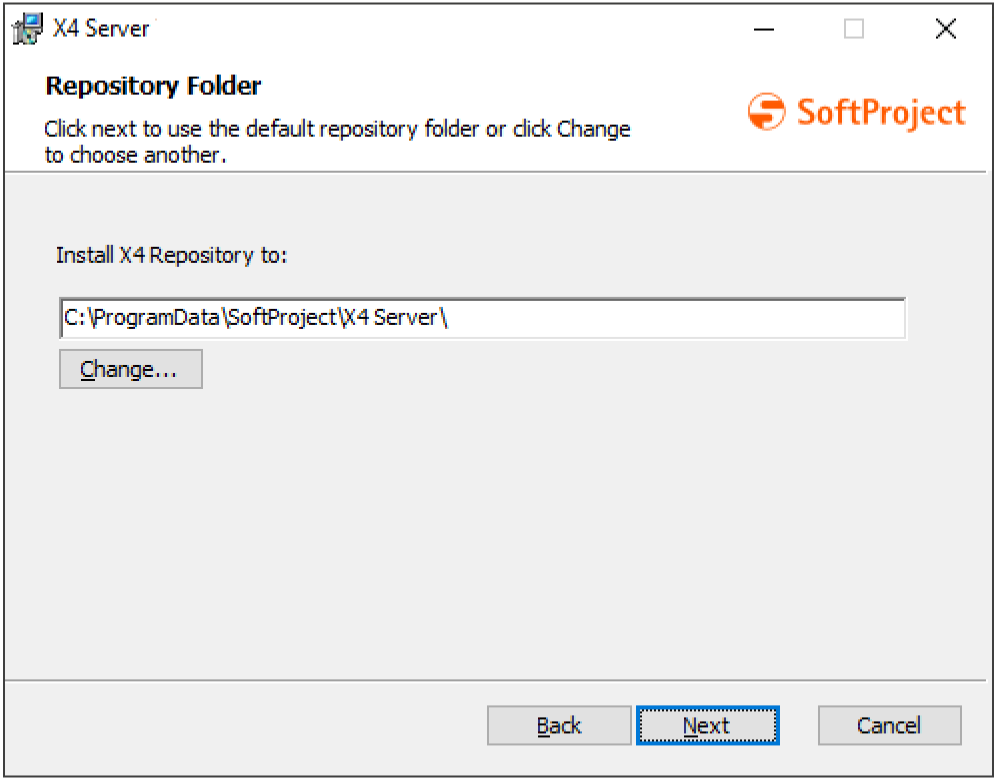
Install X4 Server to:

C:\X4Server\

ⓘ By default, the X4 Server is installed in `C:\X4Server_7.v.v.\`, but the installation path can be changed via **Change**.

⚠ Do not use spaces in the installation path. This may cause errors when installing the X4 Server as a service.

4. Click **Next** to specify the X4 repository path.



X4 Server

Repository Folder

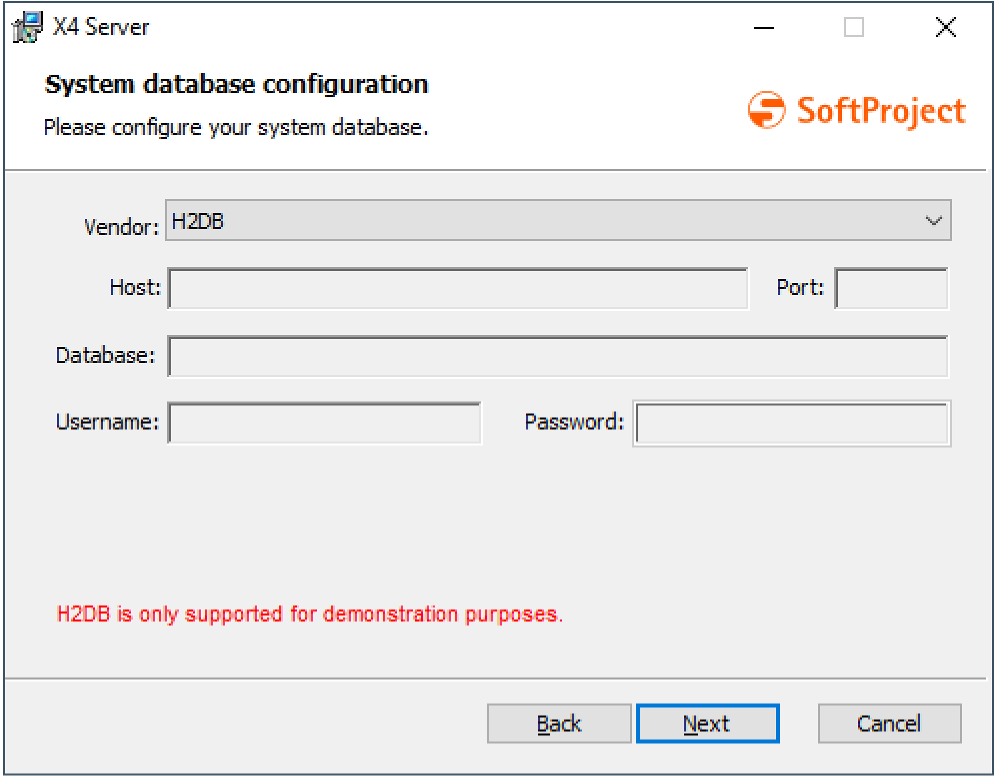
Click next to use the default repository folder or click Change to choose another.

Install X4 Repository to:

C:\ProgramData\SoftProject\X4 Server\

ⓘ By default, the X4 repository is installed in `C:\ProgramData\SoftProject\X4Server\`, but you can change the path via **Change**.

5. Click **Next** to configure the system database.



System database configuration

Please configure your system database.

Vendor: H2DB

Host:

Port:

Database:

Username:

Password:

H2DB is only supported for demonstration purposes.

6. Configure system database:
   - **Vendor**: Specify database to use
     - `H2DB`

       > ⚠ Note that `H2DB` is not suitable for productive use!

     - `Microsoft SQL Server`
     - `Oracle Database 11g`

       > ⚠ Note that the database driver for `Oracle Database 11g` is not included in the installation package. The corresponding driver must be installed separately, see also Setting up the Oracle Database.

     - `Oracle Database 12c/18c/19c`

       > ⚠ Note that the database driver for `Oracle Database 12c/18c/19c` is not included in the installation package. The corresponding driver must be installed separately, see also Setting up the Oracle Database.

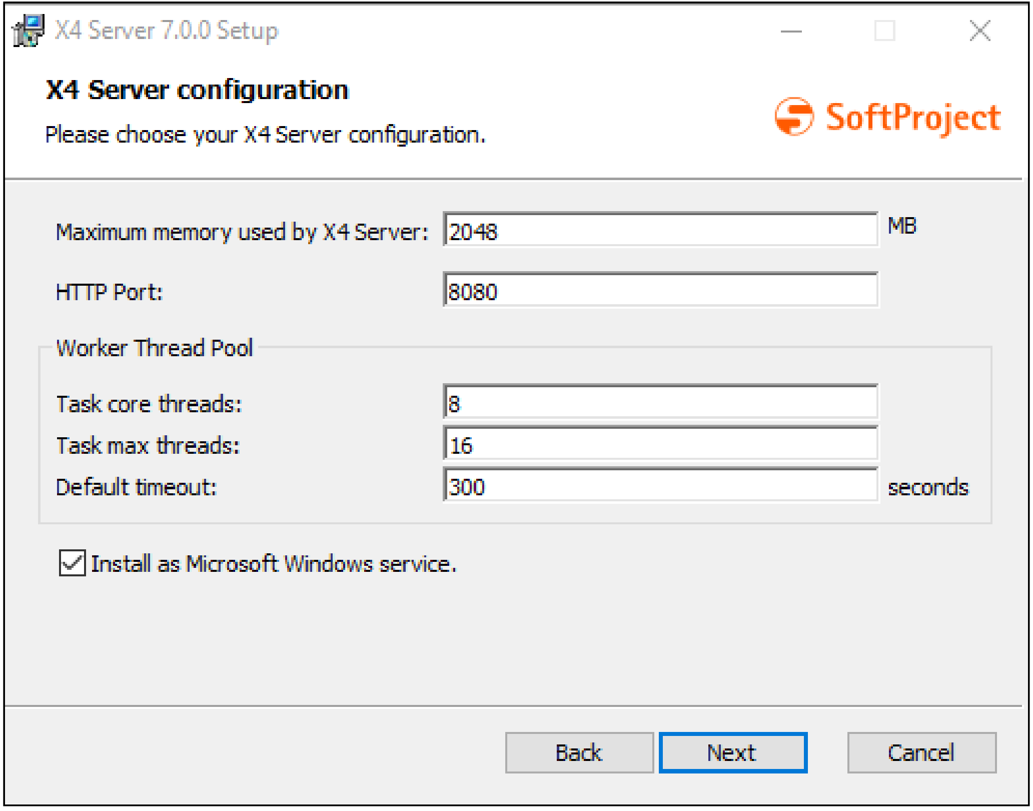
     - `PostgreSQL`

- **Host**: specify database host
- **Port**: Specify database port
- **Database**: Specify database
- **Authentication**: specify authentication with SQL `Server Authentication` or `Windows Authentication`

  > ⓘ This parameter is available only for `Microsoft SQL Server`.
  > If `Windows Authentication` is specified as authentication, the **Username** and **Password** credentials do not need to be specified because they correspond to the Windows credentials.

- **Username**: specify user name for database connection
- **Password**: specify password for database connection

7. Click **Next** to perform the X4 Server configuration.



X4 Server 7.0.0 Setup

X4 Server configuration

Please choose your X4 Server configuration.

Maximum memory used by X4 Server: 2048 MB

HTTP Port: 8080

Worker Thread Pool

Task core threads: 8

Task max threads: 16

Default timeout: 300 seconds

☑ Install as Microsoft Windows service.

8. Configure X4 Server:
   - **Maximum memory used by X4 Server**: Specify maximum memory used
   - **HTTP Port**: specify HTTP port for X4 Web Apps
   - Configure **Worker Thread Pool**:
     - **Task core threads**: Initial number of threads in the thread pool

       > ⓘ
       > - This number is the minimum number of threads that the server uses.
       > - The number of core threads should be able to handle the normal request load.

- **Aufgabe max Threads**: Maximum number of threads in the thread pool

  > ⓘ
  > - If no value is specified, the default value is used. The default value is calculated by the formula CPU-count * 16 if the JMX property `MaxFileDescriptorCount` allows this number, otherwise `max` is considered in the calculation to adjust the number accordingly.
  > - This property depends on the server hardware because the hardware can provide a maximum number of threads. It is used to control the maximum allocation of system resources under heavy load.
  > - The number of threads is between the initial number and the maximum number of threads in the thread pool.

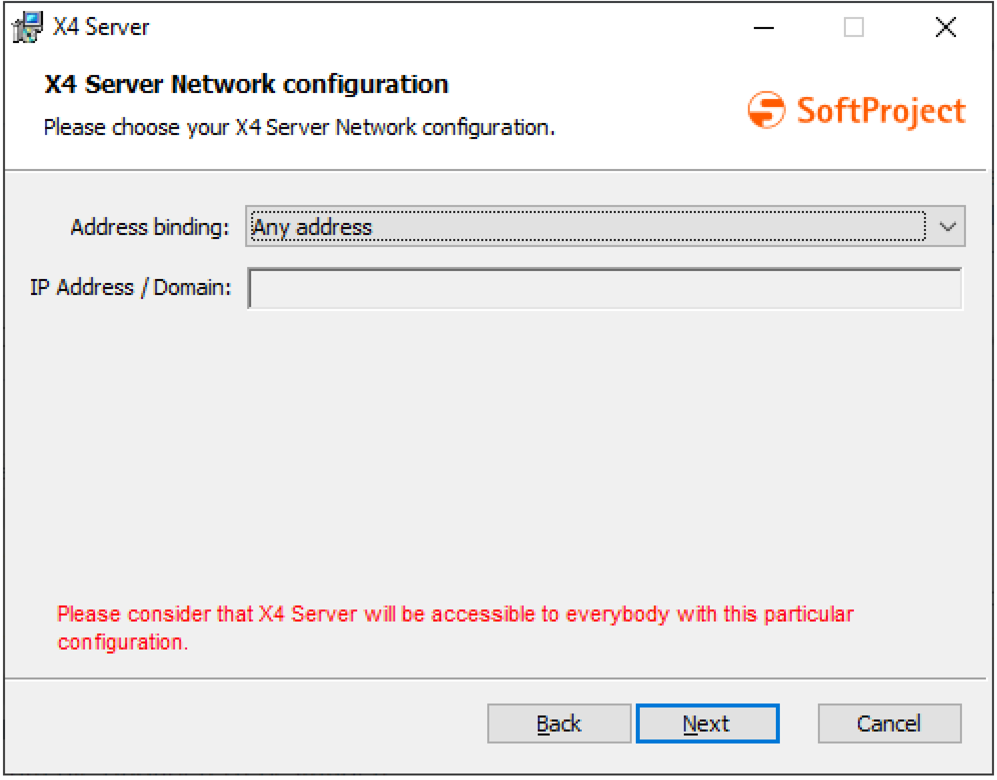
- **Default timeout**: Default transaction time in seconds

  > ⓘ For long-running transactions, WildFly may time out during the EJB processing method. In this case, you can change the default transaction runtime of 300 seconds using the `standalone.xml` file.

- **Install as Microsoft Windows service**: Activate if the X4 Server is to be installed as a service
- **Create a shortcut for X4 Server on the desktop**: Enable if you want to create a desktop shortcut for the X4 Server.

  > ⓘ This option is available when `Install as Microsoft service` is disabled.

9. Click **Next** to perform the network configuration for the X4 Server.



X4 Server

X4 Server Network configuration

Please choose your X4 Server Network configuration.

Address binding: Any address

IP Address / Domain:

Please consider that X4 Server will be accessible to everybody with this particular configuration.

   - `Address binding`: Specify address binding
     - `Any address`: Any address

       > ⚠ Note that specifying `Any Address` makes the X4 Server publicly accessible.

     - `IP Address/Domain`: Specific IP address and domain
   - **IP Address / Domain**: Specify IP address and domain
10. Click **Next** to confirm the information.
11. Click **Install** to perform the installation.
    The X4 Server will now be installed.
12. If required, enable the **Launch X4 Server when setup exists** option to start the server after installation.
13. Click **Finish** to terminate the installation.
    The installation is now complete.
14. Check whether error messages occurred in the server log.
    A correctly installed and started X4 server does not issue any error messages (`ERROR` or `FATAL`) in the server log.

2.1.1.2 Update existing installation since version 5.5.4

> ⚠ If you have an older version installed, you must first update to version 5.5.4.

You can find the current update tool in the download area on our website. For more information, please read the README.txt in the update tool.

2.1.1.3 Parameters of the unattended installation

To perform an unattended installation using the command line, the following parameters have to be set:

⚠ If a parameter is not specified, the default value is used during installation.

Parameter	Description
`INSTALLFOLDER`	Installation path **Possible values** • Path specification (default: `C:\X4Server_<version>\`)
`PRODUCTNAMEDIRECTORY`	X4 Repository folder • Path specification (default: `C:\ProgramData\SoftProject\X4Server\`) ⚠ Do not use spaces in the installation path. This may cause errors when installing the X4 server as a service.
`INSTALLSERVICE`	Install X4 Server as Windows Service **Possible values** • `True` (default): X4 server is installed as a Windows service • `False`: X4 server is not installed as a Windows service
`INSTALLDESKTOPSHORTCUT`	Create X4 server desktop shortcut (only possible if X4 server is not installed as Windows service) **Possible values** • `True` (default): Desktop shortcut is created • `False`: Desktop shortcut is not created
`DATABASETYPE`	Database type **Possible values** • `h2` (default): H2 • `postgresql`: PostgreSQL • `sqlserver`: Microsoft SQL Server • `oracle11`: Oracle Database 11g • `oracle12`: Oracle Database 12c/18c/19c

Parameter	Description
HOSTDB	Database host - IP address (example: 127.0.0.1)
PORTDB	Database port - Integers (example: 3307)
DATABASENAME	Database name
USERNAMEDB	Username for authentication to the database
PASSWORDDB	Password for authentication to the database
MEMORY	Maximum used memory in MB - Integers (default: 2048)
HTTPPORT	HTTP port - Integers (default: 8080)
AUTHENTICATION_SQLSERVER	Database authentication type **Possible values** - sqlserver (default) - windows
TASKCORETHREADS	Minimum number of threads **Possible values** - Integers (default: 8)
TASKMAXTHREADS	Maximum number of threads **Possible values** - Integers (default: 16)
DEFAULTTIMEOUT	Timeout in seconds **Possible values** - Integers (default: 300)
ADDRESSTYPE	Address type **Possible values** - anyAddress (default): any address ⚠ Note that with this configuration the X4 server is accessible to everyone. - ipDomain: IP address/domain

Parameter	Description
EXTERNALLIP	IP address/domain (only relevant if `ADDRESSTYPE=ipDomain`) **Possible values** • IP address (example: `127.0.0.1`)

2.1.2 Installation on Ubuntu/Debian Linux systems

The following describes how the X4 Server and Keycloak based on a Debian package (`.deb`) can be automatically installed on an Ubuntu or Debian Linux system, registered as a service, started and administered.

2.1.2.1 Install X4 Server

> ⓘ **Note!**
>
> - The installation package is started with `sudo` permissions.
> - During the installation of the X4 Server, a new user `X4` and a new group `X4` are created.
> - After installation, the X4 Server file system belongs to the user `X4` and the group `X4`.
> - The installed service `X4 Server` is started with `sudo` permissions, but the user `X4` is the owner of this service execution.
> - Make sure that you have the appropriate rights for the specified installation path.

1. Load the Debian package `X4-Server_Ubuntu-7.v.v-r.x86_64` provided by SoftProject onto the Ubuntu or Debian system.
2. Run the installation with the command `sudo dpkg -i X4-Server_Ubuntu-7.v.v-r.x86_64.deb`.

   > ⚠ If you do not want the authentication provider Keycloak installed, use the command `sudo X4_INSTALL_AUTH_PROVIDER=no dpkg -i X4-Server_Ubuntu-7.v.v-r.x86_64.deb`.

   Example: *`sudo dpkg -i X4-Server_Ubuntu-7.0.0-1.x86_64.deb`* for release `1` of X4 Server version `7.0.0`.

   > ⓘ The X4 Server is installed under `/opt/X4` by default. The `INSTALL_PATH` variable can be used to change the installation path, e.g. `sudo INSTALL_PATH=/myNewPath/Tools dpkg -i X4-Server_Ubuntu-7.v.v-r.x86_64.deb`

   The X4 Server is now installed in the specified folder, registered as the `X4-Server` service and started directly. This process may take a few seconds.

> ⓘ
> - If an installation of the X4 Server already exists, the central components of the X4 Server are automatically updated when the installation command `sudo dpkg -i X4-Server_Ubuntu-7.v.v-r.x86_64.deb` is executed again. Backup copies of the configuration files are created in the subfolder `/opt/X4_backups`.
> - To migrate files that are not part of the automatic update process, the installation path of the X4 BPMS must be specified in the installation and migration tool. For example, specifying `/opt/X4/jdk/bin/java -jar en.softproject.x4.database-6.3.0.jar --installX4path /opt/X4/Server` will migrate all `.war` files that have not already been migrated automatically to the new installation.

3. Check whether error messages occurred in the server log `/opt/X4/wildfly/standalone/log/server.log`.
   A correctly installed and started X4 Server does not give any error messages (`ERROR` or `FATAL`) in the server log. This should be the case at the second start of the X4 Server at the latest.
4. Check whether error messages occurred in Keycloak log `/opt/X4/keycloak/standalone/log/server.log`.
   A correctly installed and started Keycloak does not output any error messages (`ERROR` or `FATAL`) in Keycloak log.
5. Restart the X4 Server with the command `sudo service X4-Server restart.`
   The X4 Server has been successfully installed and is running as service `X4-Server`.
6. Restart the Keycloak with the command `sudo service X4-Authentication-Provider restart`.
   The Keycloak has been installed successfully.

After successfully installing or updating the X4 Server via a Debian package, the installation folder contains the following items:

Folder	Explanation
`jdk`	Contains the current Java runtime version as runtime environment for the WildFly application server
`SQL`	Contains the supplied in-memory database for test purposes in subfolder `H2DB`
`wildfly`	Contains the pre-configured WildFly application server
`keycloak`	Contains Keycloak
`X4DB`	Contains the central X4 repository
`x4.license`	Licence file for the X4 Server, see Installing licences via the Designer
`X4config.xml`	Central configuration file of the X4 Server, see Configuration via X4config.xml

2.1.2.2 Control options for the X4 Server service

The following options are available via the command line to control the X4 Server or its service `X4-Server`:

Start `X4-Server` service:	Execute the command `service X4-Server start`.

Stop `X4-Server` service:	Execute the command `service X4-Server stop`.
Restart the `X4-Server` service:	Execute the command `service X4-Server restart`.

2.1.2.3 Control options for Keycloak

The following options are available via the command line to control Keycloak `X4-Authentication-Provider`:

Start `X4-Authentication-Provider` service:	Execute the command `service X4-Authentication-Provider`.
Stop `X4-Authentication-Provider` service:	Execute the command `service X4-Authentication-Provider`.
Restart the `X4-Authentication-Provider` service:	Execute the command `service X4-Authentication-Provider`.

2.1.2.4 Uninstall X4-Server service

To uninstall an X4 Server installed via Debian package and its corresponding service `X4-Server`, enter the command `sudo dpkg -r X4-Server`.

For a clean removal of all installation artefacts including configuration files etc. from the `X4-Server` service run the command `sudo dpkg -P X4-Server`.

ⓘ When uninstalling, it is not necessary to set the `INSTALL_PATH` variable.

2.1.3 Installation on Red Hat Enterprise Linux systems

How to automatically install, register as a service, start, and manage the complete X4 Server on a Red Hat Enterprise Linux system based on an RPM (`.rpm`) package is described below.

2.1.3.1 Installing the X4 Server

ⓘ Before installation, make sure that the IP address of the server and the host name are entered under `/etc/hosts`.
Example: `192.168.147.153 vmettopensuse01`

ⓘ **Please note!**

- The installation package is started with `sudo` permissions.
- During the installation of the X4 Server, a new user `X4` and a new group `X4` are created.
- After installation, the X4 Server file system belongs to the user `X4` and the group `X4`.
- The installed service `X4 Server` is started with `sudo` permissions, but the user `X4` is the owner of this service execution.
- Make sure that you have the appropriate rights for the specified installation path.

1. Load the RPM package `X4-Server_RHEL-7.v.v-r.x86_64.rpm` provided by SoftProject onto the Red Hat system.
2. Execute the installation with the command `sudo rpm -i X4-Server_RHEL-7.v.v-r.x86_64.rpm`.
   Example: *`sudo rpm -i X4-Server_RHEL-7.0.0-1.x86_64.rpm`* for release `1` of X4 Server version `7.0.0`.

   > ⓘ The X4 server is installed under `/opt/X4` by default. The `--prefix` parameter can be used to change the installation path, e.g. `sudo rpm -i X4-Server_RHEL-7.v.v-r.x86_64.rpm --prefix=/new_path`

   The X4 Server is now installed in the specified folder, registered as the `X4-Server` service and started directly. This process may take a few seconds.
3. If necessary, copy your license file `x4.license` into the installation folder of the X4 server.
   Example: *`sudo cp x4.license /opt/X4`*
4. If necessary, check whether error messages occurred in the server log `/opt/X4/wildfly/standalone/log/server.log`.
   A correctly installed and started X4 server does not output any error messages (`ERROR` or `FATAL`) in the server log. This should be the case at the second start of the X4 Server at the latest.
5. If necessary, check whether error messages occurred in Keycloak log `/opt/X4/keycloak/standalone/log/server.log`.
   A correctly installed and started Keycloak instance does not output any error messages (`ERROR` or `FATAL`) in the log.

After successfully installing or updating the X4 Server via RPM package, the installation folder contains the following elements:

Folder	Explanation
`jdk`	Contains the current Java runtime version as runtime environment for the WildFly application server
`SQL`	Contains the supplied in-memory database for test purposes in subfolder `H2DB`
`wildfly`	Contains the pre-configured WildFly application server
`keycloak`	Contains Keycloak
`X4DB`	Contains the central X4 repository
`x4.license`	Licence file for the X4 Server, see Installing licences via the Designer
`X4config.xml`	Central configuration file of the X4 Server, see Configuration via X4config.xml

2.1.3.2 Control options for the X4 Server service

The following options are available from the command line to control the X4 server or its service `X4-Server`:

Starting service `X4-Server`:	Execute command `systemctl start X4-Server`.
Stopping service `X4-Server`:	Execute command `systemctl stop X4-Server`.

Restarting service `X4-Server`:	Execute command `systemctl restart X4-Server`.
See status of service `X4-Server`:	Execute command `systemctl status X4-Server`.
Reload service `X4-Server`:	Execute command `systemctl reload X4-Server`.

2.1.3.3 Control options for Keycloak

The following options are available from the command line to control Keycloak `X4-Authentication-Provider`:

Starting service `X4-Authentication-Provider`:	Execute command `systemctl start X4-Authentication-Provider`.
Stopping service `X4-Authentication-Provider`:	Execute command `systemctl stop X4-Authentication-Provider`.
Restarting service `X4-Authentication-Provider`:	Execute command `systemctl restart X4-Authentication-Provider`.
See status of service `X4-Authentication-Provider`:	Execute command `systemctl status X4-Authentication-Provider`.
Reload service `X4-Authentication-Provider`:	Execute command `systemctl reload X4-Authentication-Provider`.

2.1.3.4 Uninstalling the service X4-Server

To uninstall an X4 server installed via RPM package and its corresponding service `X4 server`, enter the command `sudo rpm -e X4-Server_RHEL-7.v.v-r.x86_64`.
During uninstallation, backup copies of the configuration files, system database and `X4DB` are automatically created under `opt/x4_backups`.

2.1.4 Installation on SuSe Linux systems

How the complete X4 server based on an RPM package (`.rpm`) can be automatically installed on an Open-Suse Linux system, registered as a service, started and managed is described below.

2.1.4.1 Install X4 Server

Prerequisite

- The **insserv-compat** package is installed.
  The package can be installed in the command line with the following command: `zypper install insserv-compat`

> Before installation, make sure that the IP address of the server and the host name are entered under `/etc/hosts`.
> *Example:* `192.168.147.153 vmettopensuse01`

ⓘ **Please note!**

- The installation package is started with `sudo` permissions.
- During the installation of the X4 Server, a new user `X4` and a new group `X4` are created.
- After installation, the X4 Server file system belongs to the user `X4` and the group `X4`.
- The installed service `X4 Server` is started with `sudo` permissions, but the user `X4` is the owner of this service execution.
- Make sure that you have the appropriate rights for the specified installation path.

1. Load the RPM package `X4-Server_SLES-7.v.v-r.x86_64.rpm` provided by SoftProject onto the Suse Linux system.
2. Execute the installation with the command `sudo rpm -i X4-Server_SLES-7.v.v-r.x86_64.rpm`.
   Example: *`sudo rpm -i X4-Server_SLES-7.0.0-1.x86_64.rpm`* for release `1` of X4 Server version `7.0.0`.

   ⓘ The X4 server is installed under `/opt/X4` by default. The `--prefix` parameter can be used to change the installation path, e.g. `sudo rpm -i X4-Server_SLES-7.v.v-r.x86_64.rpm --prefix=/new_path`

   The X4 Server is now installed in the specified folder, registered as the `X4-Server` service and started directly. This process may take a few seconds.

   ⓘ To migrate files that are not part of the automatic update process, the installation path of the X4 BPMS must be specified in the installation and migration tool. For example, specifying `/opt/X4/jdk/bin/java -jar de.softproject.x4.database-7.0.0.jar --installX4path /opt/X4/Server` will migrate all `.war` files that have not already been migrated automatically to the new installation.
3. If necessary, copy your license file `x4.license` into the installation folder of the X4 server.
   Example: *`sudo cp x4.license /opt/X4`*
4. Check whether error messages occurred in the server log `/opt/X4/wildfly/standalone/log/server.log`.
   A correctly installed and started X4 Server does not give any error messages (`ERROR` or `FATAL`) in the server log. This should be the case at the second start of the X4 Server at the latest.

After successfully installing or updating the X4 Server via RPM package, the installation folder contains the following elements:

Folder	Explanation
`jdk`	Contains the current Java runtime version as runtime environment for the WildFly application server
`SQL`	Contains the supplied in-memory database for test purposes in subfolder `H2DB`

Folder	Explanation
`wildfly`	Contains the pre-configured WildFly application server
`X4DB`	Contains the central X4 repository
`x4.license`	Licence file for the X4 Server, see Installing licences via the Designer
`X4config.xml`	Central configuration file of the X4 Server, see Configuration via X4config.xml

2.1.4.2 Control options for the X4 Server service

The following options are available from the command line to control the X4 server or its service `X4-Server`:

Starting service `X4-Server`:	Execute `systemctl start X4 server` or `service X4 server start` command.
Stopping service `X4-Server`:	Execute `systemctl stop X4 server` or `service X4 server stop` command.
Restarting service `X4-Server`:	Execute `systemctl restart X4 server` or `service X4 server restart` command.
See status of service `X4-Server`:	Execute `systemctl status X4 server` or `service X4 server status` command.
Reload service `X4-Server`:	Execute `systemctl reload X4 server` or `service X4 server reload` command.

2.1.4.3 Uninstalling the service X4-Server

To uninstall an X4 server installed via RPM package and its corresponding service `X4 Server`, enter the command `sudo rpm -e X4-Server_SLES-7.v.v-r.x86_64`.

During uninstallation, backup copies of the configuration files, the system database and the `X4DB` are automatically created under `opt/x4_backups`.

2.1.5 Installing the X4 Server in Docker

In this section, you will learn how to install the X4 Server in a docker and run it as a docker container.

ⓘ **Prerequisites**

- Docker has to be installed and set up on your system. You can find information within the Docker documentation under https://docs.docker.com/.
- Knowledge of the docker mode of operation is assumed.
- `x4_server:6.x.x` refers to the current X4 BPMS version.

1. Run the docker using the command `docker run -d -p 8080:8080 --name x4-servercontainer softproject/x4_server`.

Further helpful commands:

Application example	Command
Run a container and display the logs after creating the container:	`docker run -d -p 8080:8080 --name x4-server-container softproject/x4_server && docker logs x4-server-container`
Run X4 Server with a PostgreSQL database X4 • Host: `10.0.75.1` • Default PostgreSQL port: `5432`	`docker run -d -p 8080:8080 -e DATABASE_MODE='postgresql' -e DATABASE_HOST='10.0.75.1' softproject/x4_server`
Run X4 Server with port 8081 and a PostgreSQL database X4 • Host: `10.0.75.1` • Port: `5435`	`docker run -d -p 8081:8080 -e DATABASE_MODE='postgresql' -e DATABASE_HOST='10.0.75.1' -e DATABASE_PORT='5435' softproject/x4_server`
Run X4 Server with port 8081 and a PostgreSQL database X4 • Access data: `postgres/postgres` • Host: `10.0.75.1` • Port: `5435`	`docker run -d -p 8081:8080 -e DATABASE_MODE='postgresql' -e DATABASE_USER='postgres' -e DATABASE_PASSWORD='postgres' -e DATABASE_HOST='10.0.75.1' -e DATABASE_PORT='5435' softproject/x4_server`
Run X4 Server with an MS SQL database X4 • Access data: `X4/X4` • Host: `10.0.75.1` • Port: `1434`	`docker run -d -p 8080:8080 -e DATABASE_MODE=sqlserver -e DATABASE_HOST=10.0.75.1 -e DATABASE_NAME=X4 -e DATABASE_PORT=1434 -e DATABASE_USER=X4 -e DATABASE_PASSWORD=X4 softproject/x4_server`
Run X4 Server and map the X4DB folder from an external path to the X4DB folder within the container (only for Linux)	`docker run -d -p 8080:8080 -v /home/anyUser/X4/X4DB/1:/opt/X4/X4DB/1 softproject/x4_server`

Environment variables

Variable	Erläuterung
`X4_UID`	The unix user ID the technical process is run as
`X4_GID`	The unix group ID the technical process is run as
`JAVA_XMS`	Initial heap space for the JVM Default value: *`512M`*
`JAVA_XMX`	Maximum heap space for the JVM Default value: *`2048M`*
`DATABASE_MODE`	Determines the database connection driver and strategy Possible values are `h2` (default), `postgresql` and `sqlserver`

Variable	Erläuterung
`DATABASE_HOST`	Host name of the database server (if not `h2`) The default value is `database`, obliging you to change it.
`DATABASE_PORT`	Port number of the database server (if not `h2`). The default port for PostgreSQL server (`postgres`) is 5432. The default port is not set automatically.
`DATABASE_NAME`	Name of the database hosted within the database server to use for the X4 Server (if not `h2`)
`DATABASE_USER`	Name of the database user
`DATABASE_PASSWORD`	Password to access the database

2.1.6 Installing the X4 Server on other operating systems

If required, the X4 Server can also be installed on other operating systems. Please contact SoftProject for further information.

2.2 Initially installing a licence

1. Click the 🔗 icon in the toolbar.
2. Click **Install license**.
3. Select X4 license
4. Click **Open**.
   Your new license is now installed. In the status bar at the bottom of X4 Designer you can see how long your license is still valid.

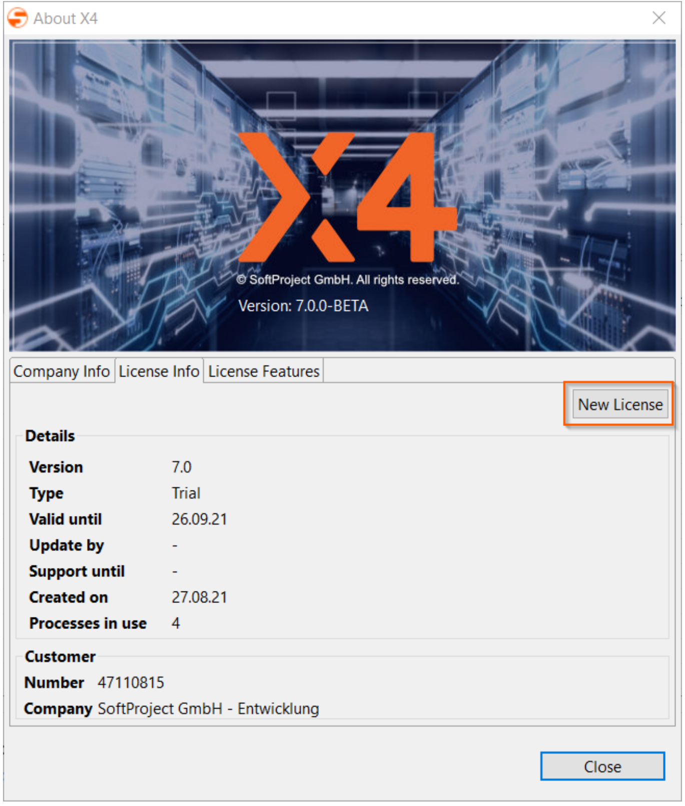
> Via **Help** > **About X4 BPMS** > **License Information** and **License Features** you have the possibility to retrieve information about your license at any time.

2.3 Renewing license

> To renew a license, you must have previously installed a license.

1. Click **Help** in the menu bar.

2. Click **About X4 BPMS** in the dialog.



© SoftProject GmbH. All rights reserved.
Version: 7.0.0-BETA

Details

Version	7.0
Type	Trial
Valid until	26.09.21
Update by	-
Support until	-
Created on	27.08.21
Processes in use	4

Customer

Number 47110815
Company SoftProject GmbH - Entwicklung

3. Under **License Info** click **New license**.
4. Navigate to the new license and click **Open**.
   If the installation is successful, the license information will update automatically after a short time.

2.4 Displaying license information

⚠ To display license information, a license must be installed.

1. In the X4 Designer menu bar, click **Help > About X4 BPMS** .
2. To view the license information, click the **License Info** tab or the **License Features** tab.

2.5 Install and uninstall X4 Designer

2.5.1 Install X4 Designer

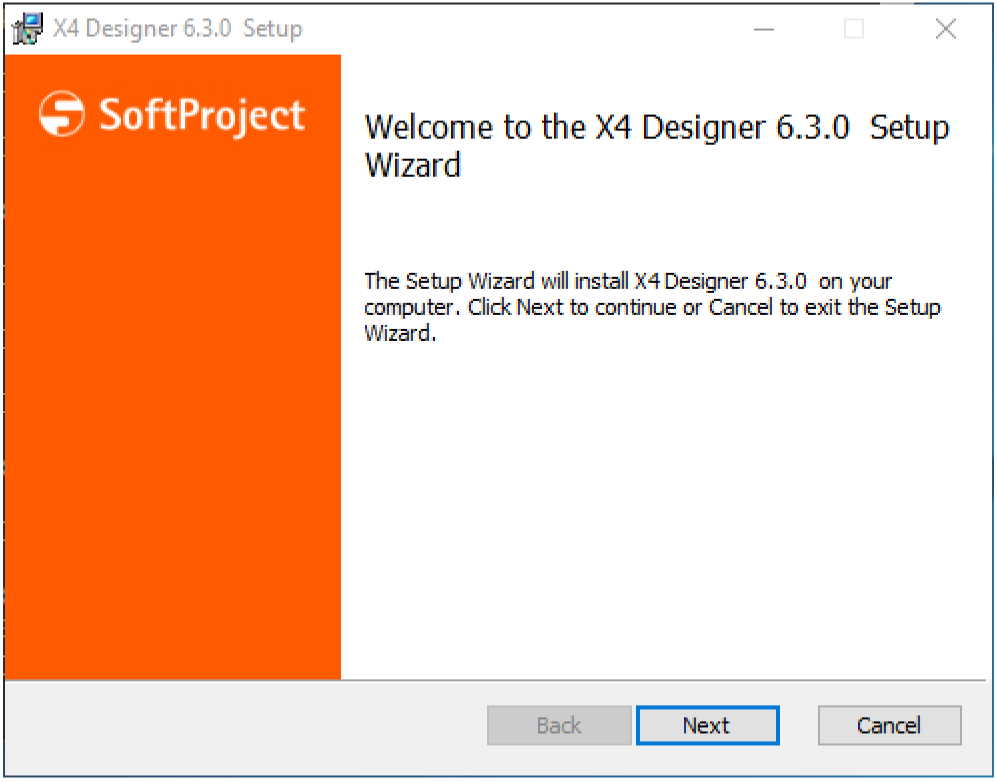
For **production purposes**, the X4 Designer is provided as a separate MS Windows installation package in the form of an `MSI file`.

- You can install only one X4 Designer on a Windows system. The MS Windows installation package overwrites existing installations. If you overwrite an existing installation, this can lead to problems and data loss.
- To use multiple X4 Designer for testing purposes, we provide the **MS Windows All-in-one** installation package in the download section of our website.

1. Double-click the `X4Designer_Setup.msi` executable file to begin the installation.

   Windows Defender SmartScreen issues a warning at the start of the installation. Click **More information** and start the installation routine as usual with **Run anyway**.

   The start screen of the installation routine will now open.



X4 Designer 6.3.0 Setup

Welcome to the X4 Designer 6.3.0 Setup Wizard

The Setup Wizard will install X4 Designer 6.3.0 on your computer. Click Next to continue or Cancel to exit the Setup Wizard.

2. Click **Next**.
3. Specify the installation path for X4 Designer.
4. If necessary, create a shortcut to the desktop by activating the option **Create a shortcut for X4 Designer on the desktop**.
5. Click **Next** to confirm the path.
6. Click **Install** to execute the installation.
   The progress of the installation is now displayed.
7. **Finish** button to terminate the installation.

✓ By activating the **Launch X4 Designer when setup exists** option, X4 Designer is started immediately after installation.

The X4 Designer has now been installed under the specified path.

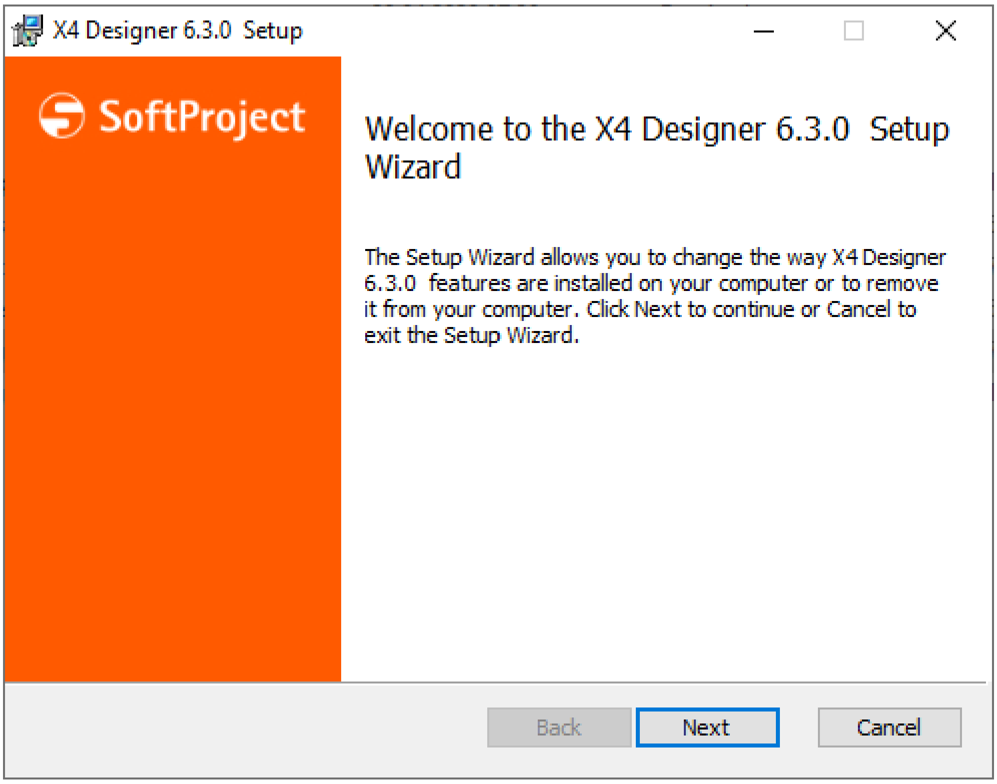
8. If not already done automatically, start X4 Designer to check the installation.

✓ **Unattended installation**

The installation of the X4 Designer can also be performed via an unattended installation. To do this, enter the following command in the command line, for example: `*C:\Installation location of the MSI /q/n /L*V "C:\temp\test.log*`

2.5.2 Uninstall X4 Designer

X4 Designer can be uninstalled either via the Windows Start menu, the Windows Control Panel or by executing the installation file again.

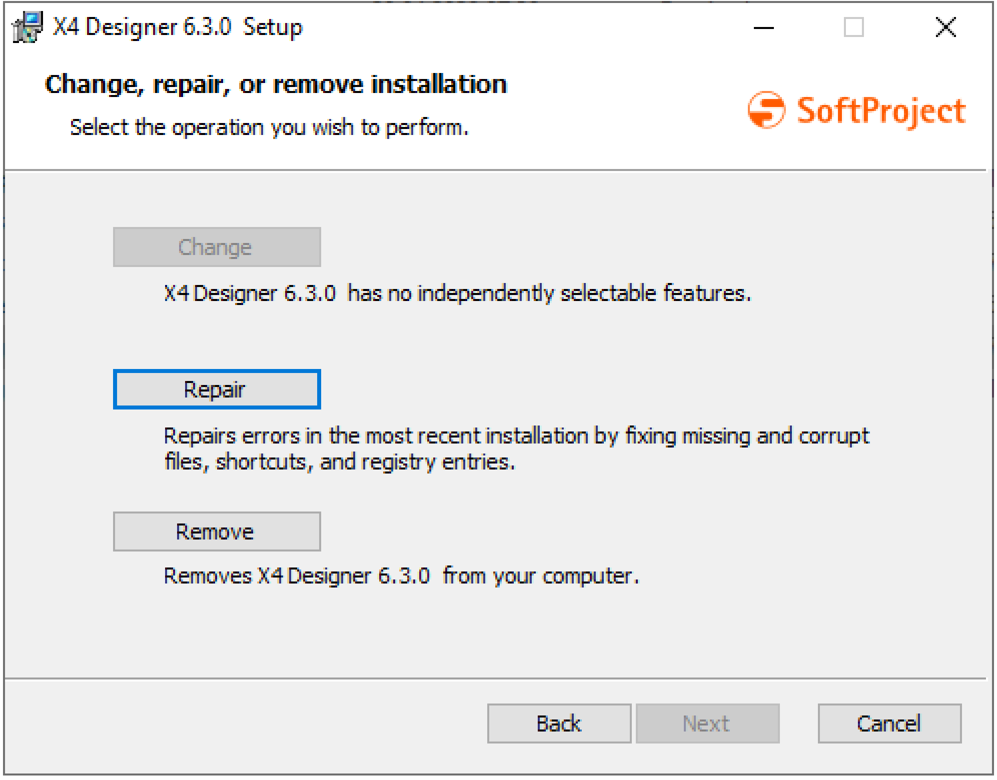
1. Die Ausführbare Datei `X4Designer_Setup.msi` doppelklicken.
   Der Startbildschirm der Installationsroutine wird nun geöffnet.
2. 

X4 Designer 6.3.0 Setup

Welcome to the X4 Designer 6.3.0 Setup Wizard

The Setup Wizard allows you to change the way X4 Designer 6.3.0 features are installed on your computer or to remove it from your computer. Click Next to continue or Cancel to exit the Setup Wizard.

3. Click **Next** to open the **Change, repair, or remove installation** window.



X4 Designer 6.3.0 Setup

Change, repair, or remove installation

Select the operation you wish to perform.

X4 Designer 6.3.0 has no independently selectable features.

Repairs errors in the most recent installation by fixing missing and corrupt files, shortcuts, and registry entries.

Removes X4 Designer 6.3.0 from your computer.

4. Click **Remove**.
5. In the next window click **Remove** again to start the uninstallation.
   The progress of the uninstallation is now displayed.
6. Click **Finish** to terminate the uninstallation.
   X4 Designer has now been uninstalled.

2.5.3 Parameters of the unattended installation

To perform an unattended installation using the command line, the following parameters must be set:

Parameters	Description
`INSTALLFOLDER`	Installation path

2.6 Installation and migration of the system database and X4DB

You can download the update tool from the download section of our website.

2.7 Installation of the authentication provider

The authentication provider Keycloak is included in the X4 Server installation package.

If you want to launch the Keycloak authentication provider as a Docker container, you need to load the Docker image.

✓ For more information, see section Loading Docker image and launching container.

3 Configuration

3.1 Configuring the X4 Server

How to customize the configuration of the *X4 Server* to your environment

3.1.1 Setting up the Database

- Setting up the Oracle Database
- Configuration for MSSQL and PostgreSQL

3.1.1.1 Setting up the Oracle Database

If you are using an Oracle database, the following additional settings must be made:

Using the migration/installation tool with Oracle

ⓘ **Note:**

- The migration/installation tool must be run even if no migration of an existing X4 BPMS installation is intended.
- Before running the migration/installation tool, you must first create an empty database named `X4`.
- To use the migration tool (see Updating the X4 Server) with Oracle, the Oracle driver must be added to the classpath when starting the tool.
- You can find drivers for the corresponding Oracle database under https://www.oracle.com/database/technologies/appdev/jdbc.html.

Providing the driver as WildFly module

1. Download the corresponding driver under https://www.oracle.com/database/technologies/appdev/jdbc.html.
2. Create a WildFly module for the JDBC driver. Therefore, create the folder structure `oracle\jdbc\main` under `X4\Server\wildfly\modules\`.
3. Unpack the JDBC driver (e. g.: *`ojdbc.jar`*) within the folder structure created above.
4. Create the file `module.xml` with the following content:

module.xml

```
<module xmlns="urn:jboss:module:1.5" name="oracle.jdbc"><!-- The namespace
urn:jboss:module:1.5 may differ depending on the WildFly version. -->
  <resources>
    <resource-root path="ojdbc.jar"/><!-- Enter the file name of the JDBC
driver to be used and which is situated within the specified folder here. -->
  </resources>
  <dependencies>
    <module name="javax.api"/>
    <module name="javax.transaction.api"/>
  </dependencies>
</module>
```

The module `oracle.jdbc` is now available.

Registering the driver within the standalone.xml

To use the driver within the datasources, register the driver within the `standalone.xml` under `X4\Server\wildfly\standalone\configuration\`:

```
...
<subsystem xmlns="urn:jboss:domain:datasources:5.0">
  <datasources>
    ...
    <drivers>
      ...
      <driver name="oracle" module="oracle.jdbc"><!-- Enter the module name here -->
        <driver-class>oracle.jdbc.driver.OracleDriver</driver-class>
      </driver>
    </drivers>
  </datasources>
</subsystem>
...
```

Configuring the datasources

Configure the Oracle datasources within the `standalone.xml` under `X4\Server\wildfly\standalone\configuration\`:

```
...
<subsystem xmlns="urn:jboss:domain:datasources:5.0">
  <datasources>
    ...
    <datasource jta="false" jndi-name="java:/X4BAM_DS" pool-name="X4BAM_DS" enabled="
true" use-java-context="true">
      <connection-url>jdbc:oracle:thin:@localhost:1521/pluggable-database</connection-
url><!-- Enter the corresponding Host, Port, SID or Service name here -->
      <driver>oracle</driver><!-- Enter the driver name here -->
      <security>
        <user-name>X4SERVER</user-name>
        <password>X4</password>
      </security>
      <statement>
        <prepared-statement-cache-size>32</prepared-statement-cache-size>
      </statement>
      <!-- In <validation> and <timeout> define settings for automatic reconnection
-->
      <validation>
        <check-valid-connection-sql>select 1 from dual</check-valid-connection-sql>
        <validate-on-match>false</validate-on-match>
        <background-validation>true</background-validation>
        <background-validation-millis>1000</background-validation-millis>
      </validation>
      <timeout>
        <allocation-retry>60</allocation-retry>
        <allocation-retry-wait-millis>1000</allocation-retry-wait-millis>
      </timeout>
    </datasource>
    <datasource jta="true" jndi-name="java:/PermissionDS" pool-name="PermissionDS"
enabled="true" use-java-context="true">
      <connection-url>jdbc:oracle:thin:@localhost:1521/pluggable-database</connection-
url><!-- Enter the corresponding Host, Port, SID or Service name here -->
      <driver>oracle</driver><!-- Enter the driver name here -->
      <security>
        <user-name>X4SERVER</user-name>
        <password>X4</password>
      </security>
      <statement>
        <prepared-statement-cache-size>32</prepared-statement-cache-size>
      </statement>
      <!-- In <validation> and <timeout> define settings for automatic reconnection
-->
      <validation>
        <check-valid-connection-sql>select 1 from dual</check-valid-connection-sql>
        <validate-on-match>false</validate-on-match>
        <background-validation>true</background-validation>
        <background-validation-millis>1000</background-validation-millis>
      </validation>
      <timeout>
        <allocation-retry>60</allocation-retry>
        <allocation-retry-wait-millis>1000</allocation-retry-wait-millis>
      </timeout>
    </datasource>
```

```
      <drivers>
        ...
        <driver name="oracle" module="oracle.jdbc"><!-- Enter the module name here -->
          <driver-class>oracle.jdbc.driver.OracleDriver</driver-class>
        </driver>
      </drivers>
    </datasources>
  </subsystem>
...
```

3.1.1.2 Configuration for MSSQL and PostgreSQL

If you are using a PostgreSQL or MS SQL database, the following additional settings must be made:

Using the migration/installation tool with Oracle

> ⓘ The migration/installation tool must be run even if no migration of an existing X4 BPMS installation is intended, see Updating the X4 Server.
> Before running the migration/installation tool, you must first create an empty database named `X4`.

Configuring the datasources

Configure the datasources within the `standalone.xml` under `X4\Server\wildfly\standalone\configuration\` as follows:

```
...
<!-- PostgreSQL -->
<datasource jta="false" jndi-name="java:/X4BAM_DS" pool-name="X4BAM_DS" enabled="true
" use-java-context="true">
    <connection-url>jdbc:postgresql://localhost:5432/X4</connection-url>
    <driver>postgresql</driver>
    <new-connection-sql>SET search_path TO X4SERVER;</new-connection-sql>
    <pool>
        <max-pool-size>20</max-pool-size>
    </pool>
    <security>
        <user-name>x4</user-name>
        <password>x4</password>
    </security>
    <statement>
        <prepared-statement-cache-size>20</prepared-statement-cache-size>
        <share-prepared-statements>true</share-prepared-statements>
    </statement>
    <!-- In <validation> and <timeout> define settings for automatic reconnection -->
    <validation>
        <check-valid-connection-sql>select 1</check-valid-connection-sql>
        <validate-on-match>false</validate-on-match>
        <background-validation>true</background-validation>
        <background-validation-millis>1000</background-validation-millis>
    </validation>
    <timeout>
        <allocation-retry>60</allocation-retry>
        <allocation-retry-wait-millis>1000</allocation-retry-wait-millis>
    </timeout>
</datasource>
<datasource jndi-name="java:/PermissionDS" pool-name="PermissionDS" enabled="true"
use-java-context="true">
    <connection-url>jdbc:postgresql://localhost:5432/X4</connection-url>
    <driver>postgresql</driver>
    <new-connection-sql>SET search_path TO X4SERVER;</new-connection-sql>
    <pool>
        <max-pool-size>20</max-pool-size>
    </pool>
    <security>
        <user-name>x4</user-name>
        <password>x4</password>
    </security>
    <statement>
        <prepared-statement-cache-size>20</prepared-statement-cache-size>
        <share-prepared-statements>true</share-prepared-statements>
    </statement>
    <!-- In <validation> and <timeout> define settings for automatic reconnection -->
    <validation>
        <check-valid-connection-sql>select 1</check-valid-connection-sql>
        <validate-on-match>false</validate-on-match>
        <background-validation>true</background-validation>
        <background-validation-millis>1000</background-validation-millis>
    </validation>
    <timeout>
```

```
        <allocation-retry>60</allocation-retry>
        <allocation-retry-wait-millis>1000</allocation-retry-wait-millis>
    </timeout>
</datasource>
<!-- MSSQL -->
<datasource jndi-name="java:/PermissionDS" pool-name="PermissionDS" enabled="true"
use-ccm="true">
    <connection-url>jdbc:sqlserver://localhost:1433;databaseName=X4</connection-url>
    <driver>sqlserver</driver>
    <transaction-isolation>TRANSACTION_READ_COMMITTED</transaction-isolation>
    <pool>
        <min-pool-size>5</min-pool-size>
        <max-pool-size>20</max-pool-size>
    </pool>
    <security>
        <user-name>x4s</user-name>
        <password>x4</password>
    </security>
    <!-- In <validation> and <timeout> define settings for automatic reconnection -->
    <validation>
        <check-valid-connection-sql>select 1</check-valid-connection-sql>
        <validate-on-match>false</validate-on-match>
        <background-validation>true</background-validation>
        <background-validation-millis>1000</background-validation-millis>
    </validation>
    <timeout>
        <allocation-retry>60</allocation-retry>
        <allocation-retry-wait-millis>1000</allocation-retry-wait-millis>
    </timeout>
</datasource>
<datasource jta="false" jndi-name="java:/X4BAM_DS" pool-name="X4BAM_DS" enabled="true
" use-ccm="true">
    <connection-url>jdbc:sqlserver://localhost:1433;databaseName=X4</connection-url>
    <driver>sqlserver</driver>
    <transaction-isolation>TRANSACTION_READ_COMMITTED</transaction-isolation>
    <pool>
        <min-pool-size>5</min-pool-size>
        <max-pool-size>20</max-pool-size>
    </pool>
    <security>
        <user-name>x4s</user-name>
        <password>x4</password>
    </security>
    <!-- In <validation> and <timeout> define settings for automatic reconnection -->
    <validation>
        <check-valid-connection-sql>select 1</check-valid-connection-sql>
        <validate-on-match>false</validate-on-match>
        <background-validation>true</background-validation>
        <background-validation-millis>1000</background-validation-millis>
    </validation>
    <timeout>
        <allocation-retry>60</allocation-retry>
        <allocation-retry-wait-millis>1000</allocation-retry-wait-millis>
    </timeout>
</datasource>
```

```
...
<drivers>
    ...
    <driver name="postgresql" module="org.postgresql">
        <driver-class>org.postgresql.Driver</driver-class>
    </driver>
    <driver name="sqlserver" module="com.microsoft.sqlserver">
        <driver-class>com.microsoft.sqlserver.jdbc.SQLServerDriver</driver-class>
    </driver>
    ...
</drivers>
```

3.1.2 Configuring via the X4config.xml

The global configuration file `X4config.xml` allows you to change various setting of the X4 Server.

3.1.2.1 iXServ configuration

In the `server > services` element within the `X4config.xml`, various X4 Server services can be enabled and disabled.

`<snmpagent>`	Activate SNMP (Simple Network Management Protocol). For this, an SNMP Trap Appender must be configured, see SNMP trap appender. **Possible values:** • *`on`*: Enable SNMP service • *`off`*: Disable SNMP service (default)
`<jcoserver>`	Enable SAP Java Connector service **Possible values:** • *`on`*: Activate JCo service • *`off`*: Disable JCo service (default)

3.1.2.2 SNMP configuration

Within the element `<snmp>` of the `X4config.xml` you can configure various settings for the *Simple Network Management Protocol* (SNMP). MIB files that are required therefore can be requested at the SoftProject support team.

`<readCommunity>`	Configure the SNMP *Read-only Community String* **Possible values:** *`public`*: Public (default)

`<writeCommunity>`	Configure the SNMP *Write Community String* **Possible values:** *`private`*: Private (default)
`<agentPort>`	Port at which the SNMP agent listens **Possible values:** • Any integer number • *`10161`*: Port 10161 (default)
`<version>`	Used SNMP version **Possible values:** • *`1`*: Use SNMP version 1 • *`2`*: Use SNMP version 2 (default)

3.1.2.3 Configuring the Placeholder Storage for X4 Server

A placeholder storage is configured within the file `X4config.xml` . The root element `x4` can be added a `placeholder` element where the configuration is made.

```
<placeholder>
    <storage>
        <class>example.PlaceholderStorage</class><!-- Fully qualified class name of
the implementation to be used. -->
        <config /><!-- Optional and depending on the placeholder storage
implementation. -->
    </storage>
</placeholder>
```

Available Placeholder Storages

The following three placeholder storages are available by default:

Name	Class name	Description
Properties Placeholder Storage	de.softproject.integration.engine.placeholder.PropertiesPlaceholderStorage	Placeholders are stored in `Properties` files in the file system. The directory containing the files is configurable.
SQL Placeholder Storage	de.softproject.integration.engine.placeholder.SQLPlaceholderStorage	Placeholders are stored in an SQL database. The target database is configurable.

Name	Class name	Description
In-Memory Placeholder Storage	de.softproject.integration.engine.placeholder.InMemoryPlaceholderStorage	Placeholders are stored in main memory and are therefore NOT persistent. If no or no valid placeholder storage is defined, it will be used as fallback.

Properties Placeholder Storage Configuration

The directory where the `Properties` files are located can be defined within the `config` element as follows:

```
<placeholder>
    <storage>
        <class>de.softproject.integration.engine.placeholder.PropertiesPlaceholderSto
rage</class>
        <config>
            <path>C:/X4/PlaceholderStorage/</path>
        </config>
    </storage>
</placeholder>
```

SQL Placeholder Storage Configuration

The database to be used can be defined within the `config` element as follows:

> ⚠ The corresponding tables must exist in the *X4Server schema*!

```
<placeholder>
    <storage>
        <class>de.softproject.integration.engine.placeholder.SQLPlaceholderStorage</
class>
        <config>
            <jndi>java:/X4BAM_DS</jndi>
        </config>
    </storage>
</placeholder>
```

3.1.2.4 LDAPS configuration

To allow self-signed certificates for LDAPS, the path to the truststore and the corresponding password must be specified in the `X4config.xml` configuration file via the `<trustStore>` and `<trustStorePassword>` elements.

> ⚠ You can specify only one truststore. The specified truststore affects the HTTPS configuration and the use of certificates.

```
<x4>
...
    <webContainerURL/>
    <trustStore>TrustStore path</trustStore>
    <trustStorePassword>TrustStore password</trustStorePassword>
    <logging/>
...
</x4>
```

3.1.3 Configuring the Logging

How to configure the X4 Server's logging behavior.

3.1.3.1 Save Point Configuration for the X4 Server

The Save Point configuration for the X4 server can be configured via the `X4config.xml`. The following parameters can be defined:

Sample logging configuration

```
<savepoint storage="database"></savepoint>
```

Explanation of the parameters of the `savepoint` element:

Attribute	Description
`storage`	Defines the location for processing save points in the X4 server *Possible values:* • *`filesystem`*: Save Points are written to the filesystem, to the server directory `savepoints` • *`database`*: Save Points are written to the X4 system database

> ⓘ If the `savepoint` element in the `X4config.xml` is removed, then no save points are saved.

3.1.3.2 SNMP trap appender

As an extension for Log4j you can use an appender for Simple Network Management Protocol (SNMP) traps. It allows to output log events as formatted string to a specific Management Host as an SNMP trap.

To generate SNMP traps it is required to configure an SNMP trap appender for Log4j, and to assign a corresponding category to the appender.

3.1.3.3 Ad hoc logging at runtime

For extended error analysis, it is possible to log the output of individual process steps at runtime. This requires neither changing the `.wrf` file of the related technical process nor restarting the server. In addition, conditional logging in sub-processes is also made possible, e.g. if a sub-process was called by a certain main process.

Configuration

The logging behaviour can be controlled via the `tracelog.properties` file under `X4\Server\X4DB\0`. The expected format is also described here, among other things, if a process or process step is to be addressed and logging is to be switched on:

- **Log individual process steps:** Individual process steps that are to be logged can be specified according to the following scheme: *`<user>/<process path>/<ActionID> = 1`*
- **Conditional logging of subprocess steps:** If single process steps are to be logged in a subprocess that was called by a specific parent process, this can be specified using the following scheme: *`executor_user>/<process_path_parent>/<user>/<process_path_subprocess>/<ActionID> = 1`*

The content of the log output corresponds to the content of the logging via *Log4J* on a transition, i.e. the status or the data of the last process step is logged via *Log4J*. The Log4J logger used is `de.softproject.integration.logging.integrated.TraceLog` and the Log4J log level is `INFO`.

If changes have been made in the `tracelog.properties` file, the configuration must be read in again. The reading of the configuration can be triggered via the MBean. To do this, execute the MBean operation **reloadTraceLogSettings**.

Sample configurations

Log single process steps

Sample configuration for logging a specific process step

```
1/Test/Log/logtest.wrf/2 = 1
```

Explanation

Logging is enabled for:

- user *`1`*
- Process *`Test/Log/logtest.wrf`*
- Process component with *`Action ID 2`*

Conditional logging of subprocess steps

Sample configuration for conditional logging of a subprocess

```
1/Test/Log/logtestParent.wrf/1/Test/Log/logtestSub.wrf/2 = 1
```

Explanation

Logging is enabled for:

- User `1`
- Process `Test/Log/logtestSub.wrf`
- Process component with `Action ID 2`

Condition:

- Process `Test/Log/logtestParent.wrf` was executed by
- user `1`

3.1.4 Configuring the production mode

As the most common way to improve the performance, the *X4 Server* provides a production mode. Thereby, the caching for the repository is activated.

1. In the central configuration file `X4config.xml` set the value of `<productionMode>` to *on*.
2. Restart the X4 Server, see Controlled shutdown of the X4 Server (via JMX).
   The production mode respectively the caching is enabled after the restart.

ⓘ **Please note:**

- To disable the production mode, set the value of `<productionMode>` back to *off* and restart the server.
- To edit the repository during the production mode, e.g if you want to modify processes and schedules, it is not required to restart the *X4 Server*.

3.1.5 Enabling SSL and HTTPS for X4 Server

SSL and HTTPS can be configured for the X4 Server that is based on WildFly.

Requirements

- You have already created a keystore
- You have a valid certificate

3.1.5.1 Customize key-stores

1. Open the **standalone.xml** in the server directory under **\wildfly\standalone\configuration**.
2. Modify the following lines.

```
<subsystem xmlns="urn:wildfly:elytron:14.0" final-providers="combined-
providers" disallowed-providers="OracleUcrypto">
...
    <tls>
        <key-stores>
            <key-store name="KeystoreName">
            <credential-reference clear-text="password"/>
            <file path="server.keystore" relative-to="jboss.server.config.dir"/
>
            </key-store>
        </key-stores>
        ...
        ...
    </tls>
    ...
</subsystem>
```

- `name`: Name of the key-store. Used to reference the key-store in the `key-manager` element.
- `file`: Path to the key-store. In the above example, a relative path is specified. If you specify an absolute path to the key-store, the `relative-to` attribute is obsolete.

3.1.5.2 Customize key-managers

1. Open the **standalone.xml** in the server directory under **\wildfly\standalone\configuration**.
2. Modify the following lines.

```
<subsystem xmlns="urn:wildfly:elytron:14.0" final-providers="combined-
providers" disallowed-providers="OracleUcrypto">
...
    <tls>
        ...
        <key-managers>
            <key-manager name="KeymanagerName" key-store="KeystoreName">
                <credential-reference clear-text="password"/>
            </key-manager>
        </key-managers>
        ...
    </tls>
    ...
</subsystem>
```

- `name`: Name of the key-manager.
- `key-store`: Name of the key-store that will be used.

- `clear-text`: Password of the key-store.

3.1.5.3 Customize server-ssl-contexts

1. Open the **standalone.xml** in the server directory under **\wildfly\standalone\configuration**.
2. Modify the following lines.

```
<subsystem xmlns="urn:wildfly:elytron:14.0" final-providers="combined-
providers" disallowed-providers="OracleUcrypto">
...
    <tls>
        ...
        <server-ssl-contexts>
            <server-ssl-context name="httpsSSC" key-manager="KeymanagerName"
protocols="TLSv1.2"/>
        </server-ssl-contexts>
        ...
    </tls>
    ...
</subsystem>
```

- `name`: Name of the SSL-context.
- `key-manager`: Name of the key-manager that will be used.
- `protocols`: SSL/TLS protocol to be used. The above example uses TLSv1.2.

3.1.5.4 Customize https-listener

1. Open the **standalone.xml** in the server directory under **\wildfly\standalone\configuration**.
2. Modify the following lines.
3. To disable HTTP, remove the `<http-listener>` line.

```
<subsystem xmlns="urn:jboss:domain:undertow:12.0" default-server="default-
server" default-virtual-host="default-host" default-servlet-container="default"
 default-security-domain="other" statistics-enabled="$
{wildfly.undertow.statistics-enabled:${wildfly.statistics-enabled:false}}">
    ...
    <https-listener name="https" socket-binding="https" ssl-context="httpsSSC"
enable-http2="true"/>
    ...
</subsystem>
```

- `ssl-context`: Name of the SSL context that will be used.

3.1.5.5 Customize socket-binding

1. Open the **standalone.xml** in the server directory under **\wildfly\standalone\configuration**.
2. Modify the following lines.

```
<socket-binding-group name="standard-sockets" default-interface="public" port-
offset="${jboss.socket.binding.port-offset:0}">
    ...
    <socket-binding name="https" port="${jboss.https.port:8443}"/>
    ...
</socket-binding-group>
```

ⓘ By default, the https port is set to 8443, but you can customize the port as you wish.

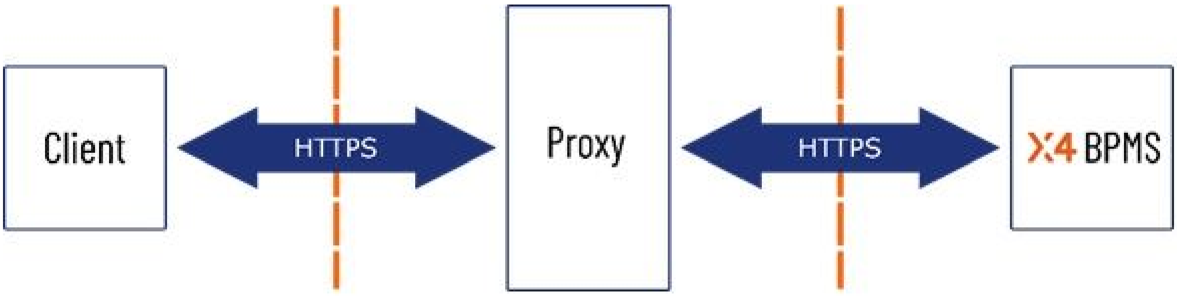
✓ For more information, see the official WildFly documentation at https://docs.wildfly.org/25/WildFly_Elytron_Security.html#configure-ssltls.

3.1.6 Enabling a Reverse Proxy Server for the X4 Server

When using a proxy server to make a WebApp with the associated Keycloak available via the internet, the reverse proxy server needs to be configured in Keycloak and X4 WildFly.

Requirements

You use a Reverse Proxy Server



3.1.6.1 Setting up Keycloak and WildFly

1. Open the **standalone.xml** under **\keycloak\standalone\configuration**
2. Search for `http-listener`.
3. Changes the following values:
   a. `redirect-socket="https` to `proxy-https`
   b. `proxy-address-forwarding="true"`

```
<http-listener name="default" socket-binding="http" redirect-socket="proxy
-https" enable-http2="true" proxy-address-forwarding="true"/>
```

4. Search for `socket-binding-group`
5. Add the following line

```
<socket-binding name="proxy-https" port="443"/>
```

6. Save the file **standalone.xml**.

3.1.6.2 X4 BPMS WildFly

1. Open the **standalone.xml** under **\wildfly\standalone\configuration** .
2. Search for `http-listener`.
3. Change the following values
   a. `redirect-socket="https"` to `proxy-https`
   b. `proxy-address-forwarding="true"`

```
<http-listener name="default" socket-binding="http" redirect-socket="proxy
-https" enable-http2="true" proxy-address-forwarding="true"/>
```

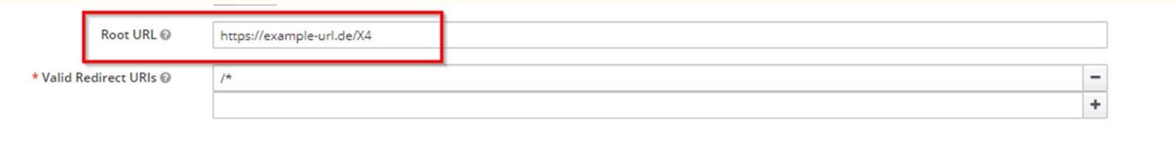
4. Search for `socket-binding-group`.
5. Add the following line:

```
<socket-binding name="proxy-https" port="443"/>
```

6. Save the file **standalone.xml**.

⚠ As soon as the requests are forwarded to the proxy, the root URL must be adjusted in the Keycloak interface.

1. Open the keycloak interface via localhost:8085
2. Select your X4 client and enter the following
   a. Domain used for forwarding at Root URL
   b. Reference to /x4



Root URL: https://example-url.de/X4

* Valid Redirect URIs: /*

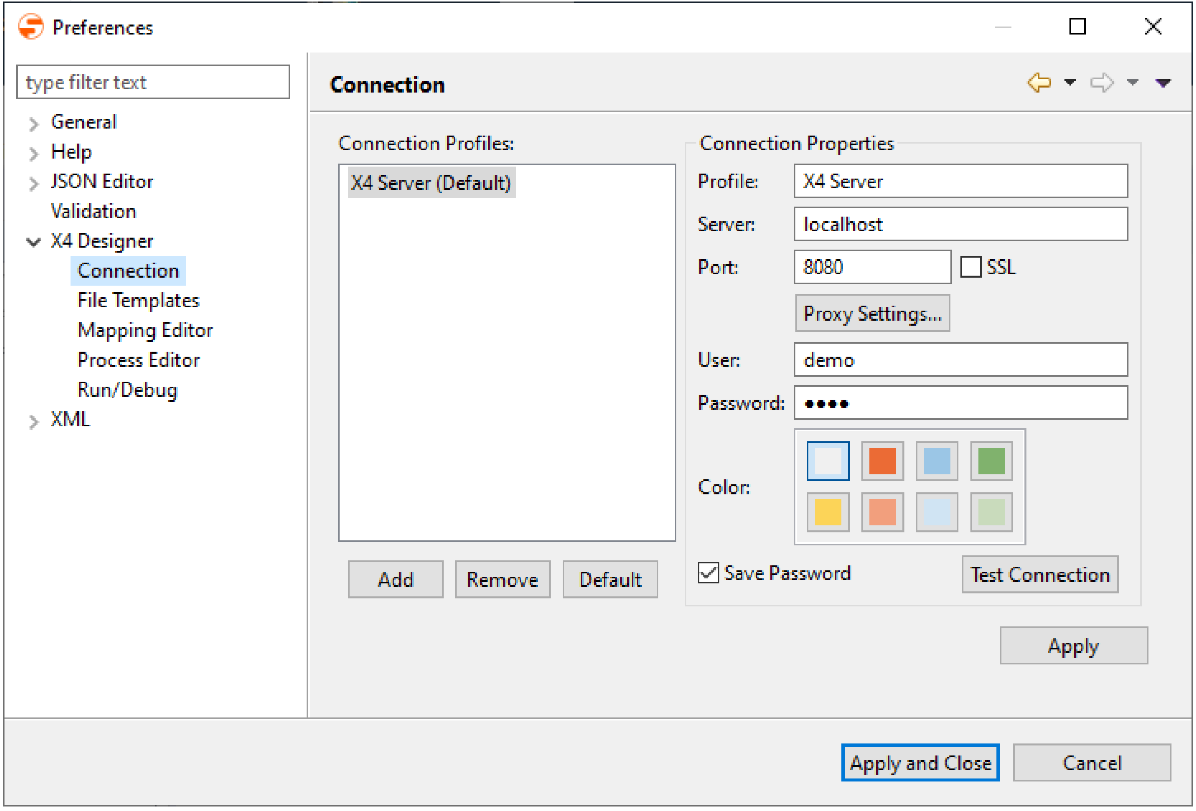
3.2 Configuring the X4 Designer

How to customize the appearance and behavior of the *X4 Designer*

3.2.1 Editing the connection configuration

Connection profiles with the respective profile data can be stored under **Connection.**

1. Select menu **Tools> Options**.
2. On the left side, double-click **X4 Designer**, and select **Connection** to open the connections configuration.



Profile: X4 Server

Server: localhost

Port: 8080 ☐ SSL

User: demo

Password: ••••

☑ Save Password

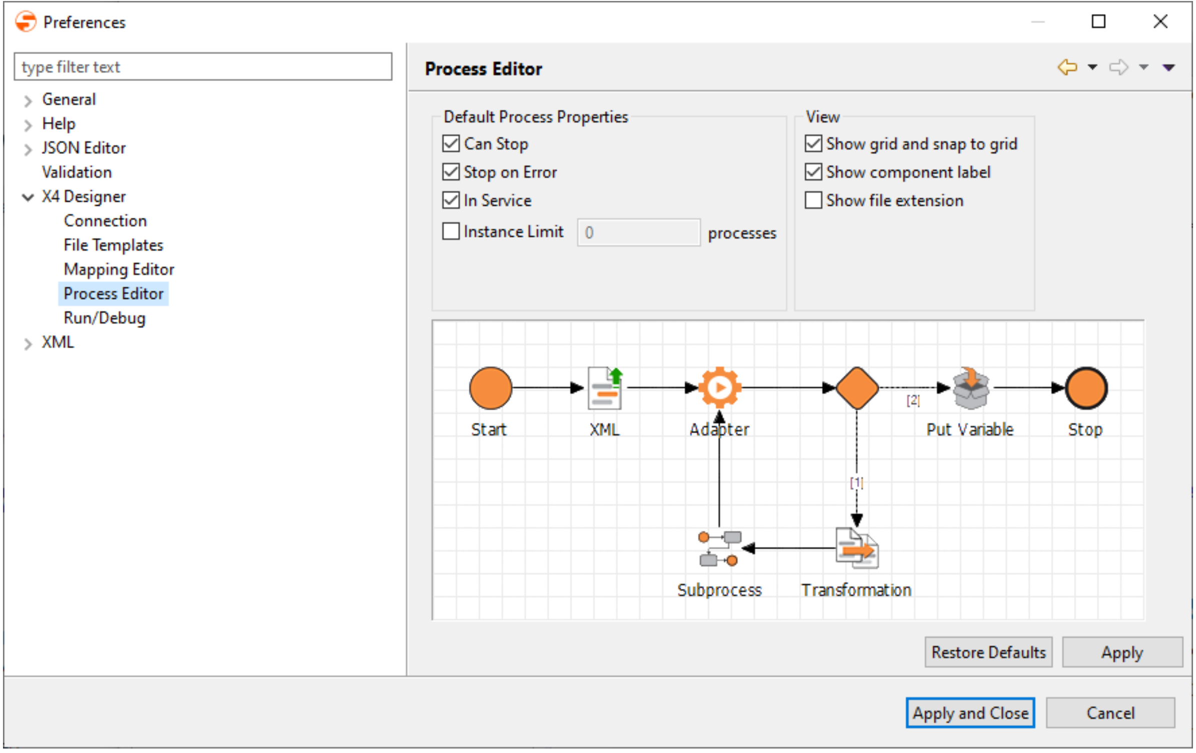
3. Make the required connection settings:
   - **Profile:** Name of the connection profile (arbitrary)
   - **Server:** IP address or host name of the *X4 Server* (Example: `localhost`)
   - **Port:** Port number
   - **Proxy Settings:** Default settings for proxy servers and your internet connection
   - **User:** Name of the repository user
   - **Password:** Corresponding password
   - **Color:** Color for the connection setting (optional)
     ℹ The color will be displayed in the *X4 Designer*'s status bar on the next connect and helps you to differentiate between different *X4 Servers*.
4. Click **Test Connection** to check if the connection functions properly.
5. Click **Apply and Close** to save the configuration and close the window.

3.2.2 Configuring the Process Editor

Under **Process Editor** , settings for the representation of processes can be stored.

1. Select menu **Tools> Options**.

2. On the left side, double-click **X4 Designer**, and select **Process Editor** to open the Process Designer configuration.



Default Process Properties

☑ Can Stop

☑ Stop on Error

☑ In Service

☐ Instance Limit 0 processes

View

☑ Show grid and snap to grid

☑ Show component label

☐ Show file extension

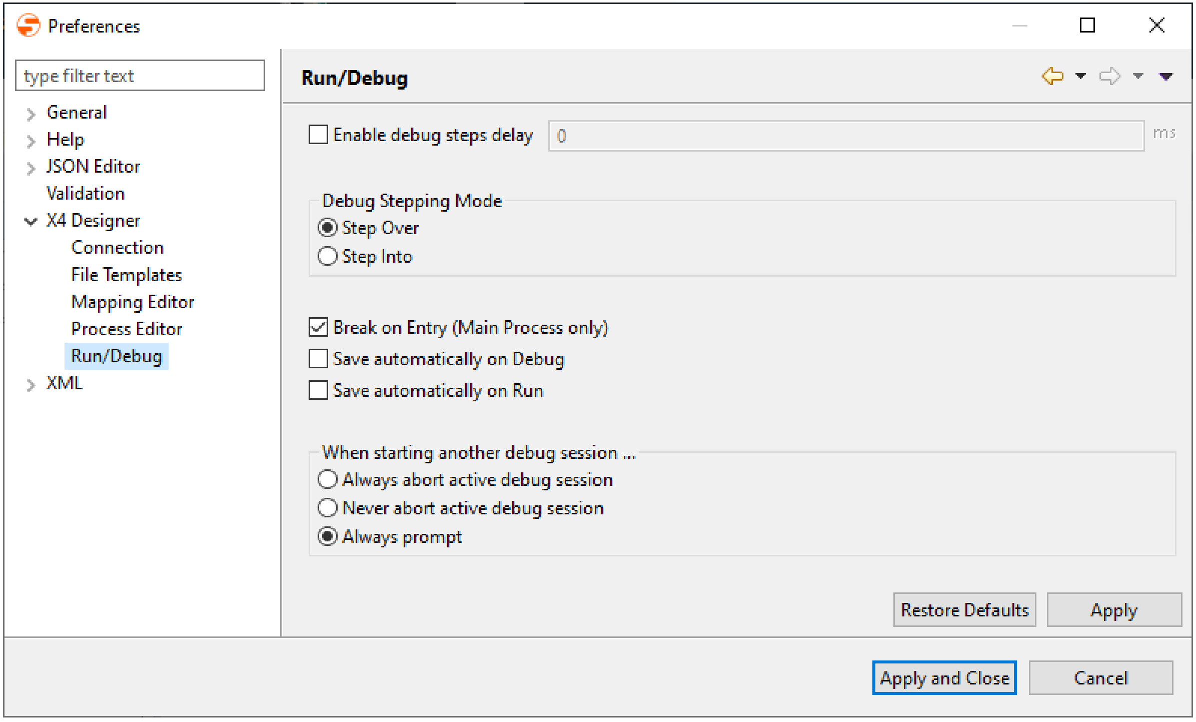
3. Edit default behavior and properties of new processes in **Default Process Properties**:
    - **Can Stop:** Allows the process to be terminated
    - **Stop on Error:** Cancels process execution automatically when an error occurs
    - **Public/Private:** Process is executable
    - **Instance Limit:** Limit the number of process instances
    - **Show grid and snap to grid:** Display a grid and align all symbols to the grid lines
    - **Show component label:** Display a text label below process component symbols
    - **Show file extension:** Show process components with their file extensions (deactivated by default)
4. Click **Apply and Close** to save the configuration and close the window.

3.2.3 Configuring the Run/Debug Mode

You can define the behavior of processes when they are run or debugged in the *X4 Designer*.

1. Select menu **Tools > Options**.

2. On the left side double-click **X4 Designer**, and select **Run/Debug** to open the configuration.



Run/Debug

☐ Enable debug steps delay 0 ms

Debug Stepping Mode
● Step Over
○ Step Into

☑ Break on Entry (Main Process only)
☐ Save automatically on Debug
☐ Save automatically on Run

When starting another debug session ...
○ Always abort active debug session
○ Never abort active debug session
● Always prompt

3. Make the required settings:
   - **Enable debug steps delay:** Define the delay (in milliseconds) between each run process step in debug mode

     ℹ The delay is only applied, if the process execution is continued via **Resume**.
   - **Debug Stepping Mode:** Default appearance of debugged process steps:
     - **Step Over**: Execute steps and debug each sub-process as one step
     - **Step Into**: Execute steps, jump into sub-processes, and display each sub-process action in debug mode
   - **Break on Entry (Main Process only):** Stop debugging after executing the first process action
   - **Save automatically on debug:** Save the process automatically before debugging
   - **Save automatically on run:** Save the process automatically before running
   - **When starting another debug session:** The debugger's bahaviour when another debugging session is already active:
     - **Always abort active debug session:** The active debugging session will be aborted, and a new debugging session will start immediately.
     - **Never abort active debug session:** The active debugging session will never be aborted when trying to start another session (the active session must be aborted manually by the user).
     - **Always prompt:** When starting debug mode you will be prompted to abort.

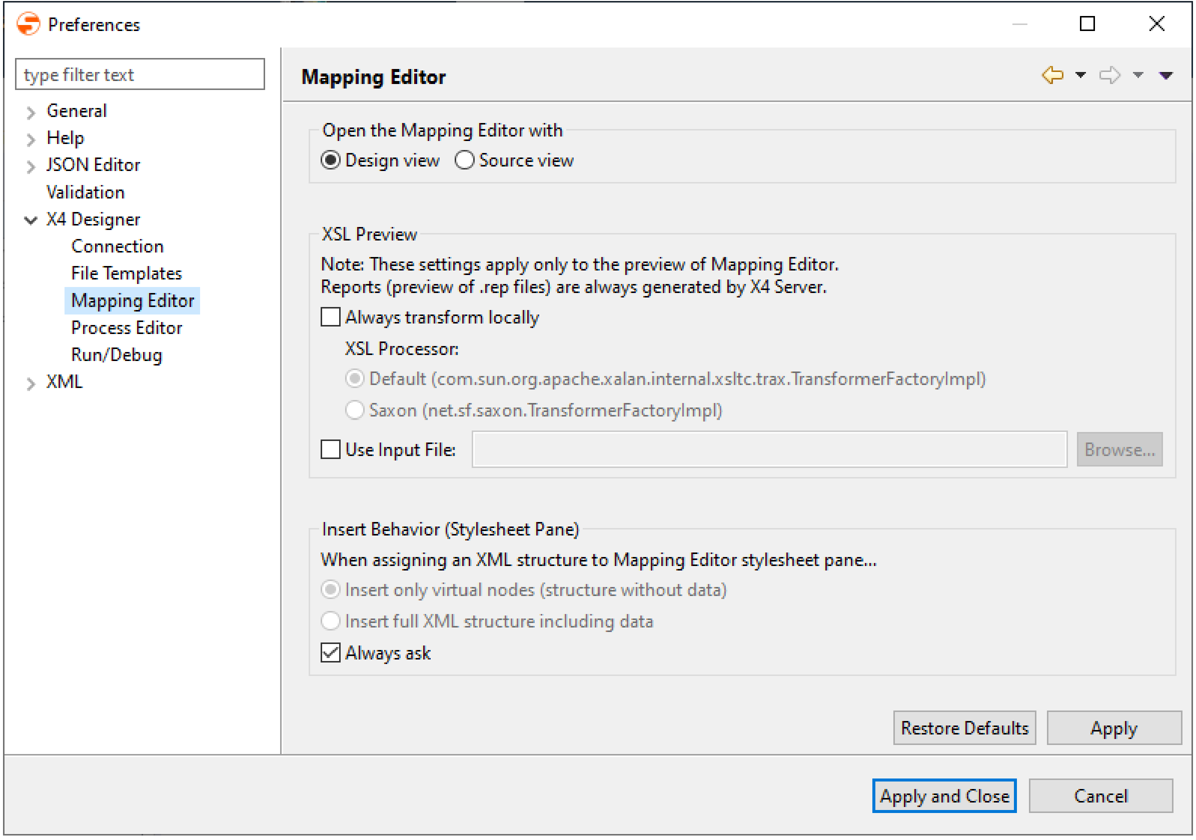
     ℹ The debugging can always be restarted via the F4 key.
4. Click **Apply and Close** to save the configuration and close the window.

3.2.4 Configuring the Mapping Editor

For the Mapping Editor's transformation preview, you can define whether the transformation is executed by the X4 Server or locally by the X4 Designer. In addition, you can configure if XML structures shall be inserted with or without content.

> ⓘ This configuration applies only to the Mapping Editor when clicking ▶ ▾ or when pressing the **F9** key! XSL mappings in executed processes are always transformed on the X4 Server!

1. Select menu **Tools > Options**.
2. On the left side, double-click **X4 Designer**, and select **Mapping Editor**.



Mapping Editor

Open the Mapping Editor with

● Design view ○ Source view

XSL Preview

Note: These settings apply only to the preview of Mapping Editor.
Reports (preview of .rep files) are always generated by X4 Server.

□ Always transform locally

XSL Processor:

● Default (com.sun.org.apache.xalan.internal.xsltc.trax.TransformerFactoryImpl)

○ Saxon (net.sf.saxon.TransformerFactoryImpl)

□ Use Input File:

Insert Behavior (Stylesheet Pane)

When assigning an XML structure to Mapping Editor stylesheet pane...

● Insert only virtual nodes (structure without data)

○ Insert full XML structure including data

☑ Always ask

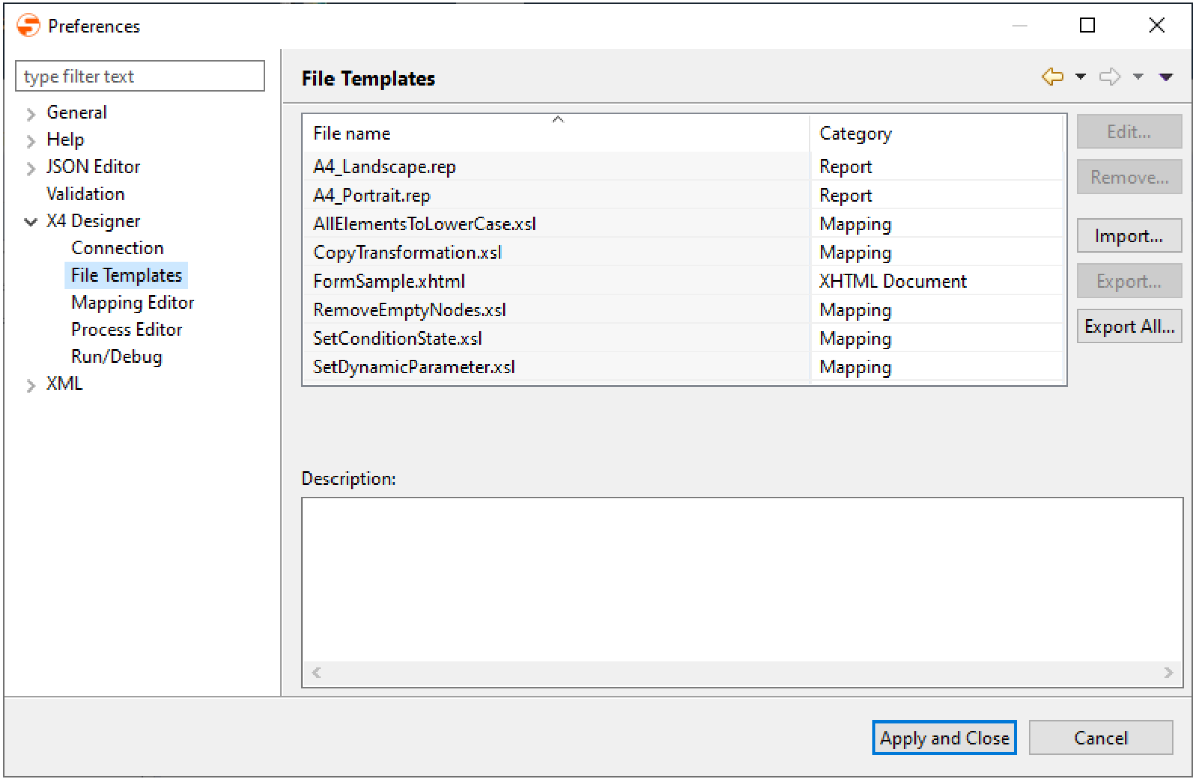
3. Configure the Mapping Editor's behavior:
   - In **Open the Mapping Editor with** define how XSL mappings shall be opened:
     - **Design view:** Open in the graphical mapping view (default)
     - **Source view:** Open in the source code view
   - In **XSL Preview** configure the behavior of XSL transformation previews
   - In **Insert Behavior (Stylesheet Pane)** define the default behavior when inserting XML:
     - **Insert only virtual nodes:** Display only the structure as virtual nodes in the Stylesheet pane
     - **Insert full XML structure including data:** Insert the full XML document structure including values
     - **Always ask:** Always ask when inserting XML via drag&drop, via the context menu or by **Strg+V** (checked by default

4. Click **Apply and Close** to save the configuration and close the window.

3.2.5 Managing templates for repository elements

X4 Designer allows to define file templates for processes, process components or folders enabling to create repeating patterns quickly and easily.

1. Select menu **Tools > Options**.
2. On the left side, double-click **X4 Designer**, and select **File templates** to open the template configuration.



File name	Category
A4_Landscape.rep	Report
A4_Portrait.rep	Report
AllElementsToLowerCase.xsl	Mapping
CopyTransformation.xsl	Mapping
FormSample.xhtml	XHTML Document
RemoveEmptyNodes.xsl	Mapping
SetConditionState.xsl	Mapping
SetDynamicParameter.xsl	Mapping

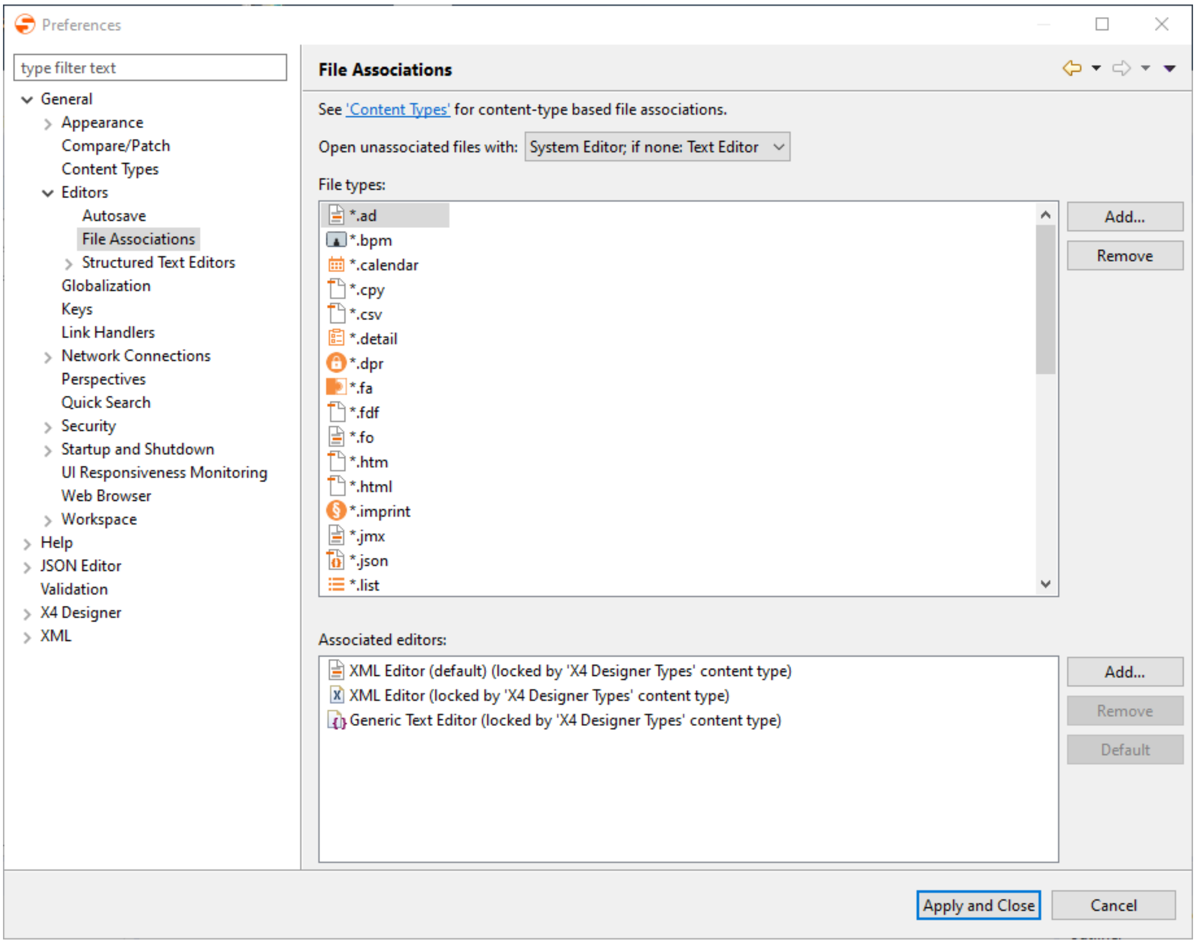
3. Manage the templates as desired:
   - **Edit:** Edit the template's name or description text
   - **Remove:** Delete a selected template
   - **Import:** Import an existing template folder
     ⓘ Only template directories with the same structure as the folder `<X4>/X4DB/0/Templates` can be imported.
   - **Export** respectively **Export All:** Export a selected template respectively all templates as template directories
4. Click **Apply and Close** to save the configuration and close the window.

3.2.6 Assigning file types to external or internal editors

X4 Designer allows to link any file types with editors and other programs.

1. Select the menu **Tools > Options**.

2. On the left side, select **General > Editors > File Associations** .



See 'Content Types' for content-type based file associations.

Open unassociated files with: System Editor; if none: Text Editor

File types:

*.ad
*.bpm
*.calendar
*.cpy
*.csv
*.detail
*.dpr
*.fa
*.fdf
*.fo
*.htm
*.html
*.imprint
*.jmx
*.json
*.list

Associated editors:

XML Editor (default) (locked by 'X4 Designer Types' content type)
XML Editor (locked by 'X4 Designer Types' content type)
Generic Text Editor (locked by 'X4 Designer Types' content type)

3. In **File types**, select an existing file type or add a new by clicking **Add**.

> ⓘ You can either define a file extension using a * wildcard or a full file name. Example: `*.xyz or Filename.xyz`

4. In **Associated editors**, select a suitable editor for the file type, or open the **Editor Selection** window by clicking **Add**. Then select the editor from a list of available editors.

> ⓘ If you want to use an external editor, choose the option **External programs** within the **Editor Selection** window and click **Browse** to select the file of the external *application. Example:* `C:\Program Files\Notepad++\notepad++.exe`.

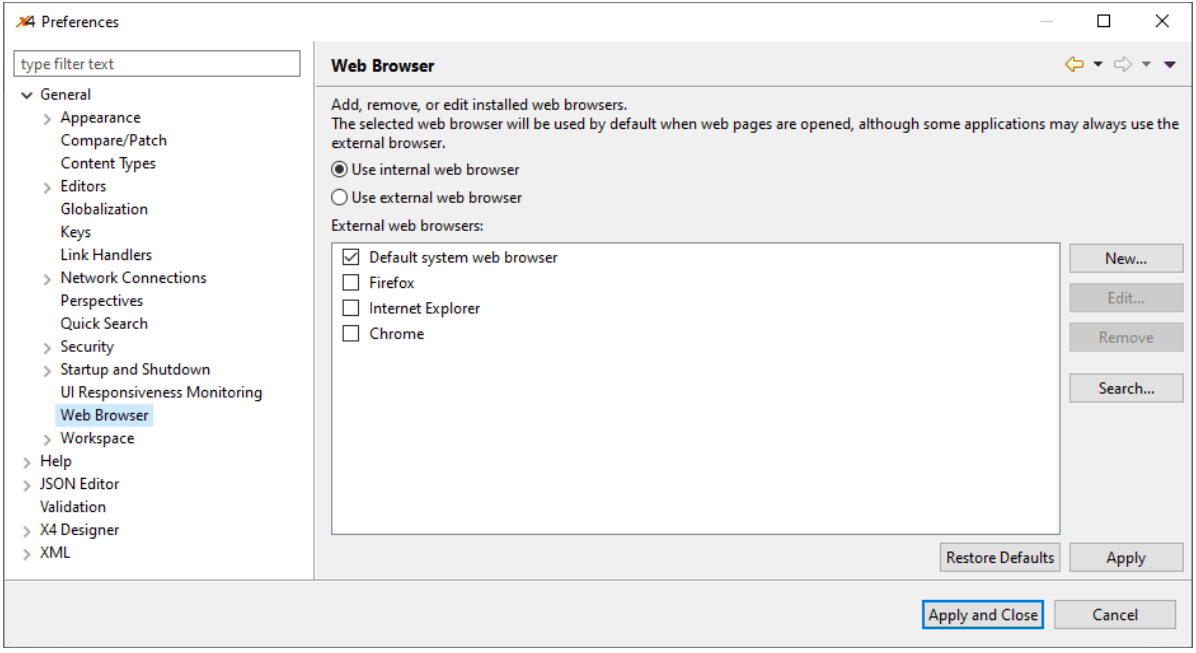
> ✓ If the file type shall be opened by default with a selected editor, click **Default**.

5. Click **Apply and Close** to save the settings and close the window.
   The **Repository Navigator**'s context menu entry **Open with** now provides all internal or external editors assigned to this file type.

3.2.7 Configuring the Web Browser

Different browsers can be used to display browser-based components of the X4 BPMS (see System requirements). The browser used can be specified in the X4 BPMS.

1. Open **Tools> Options**.
2. On the left side, choose **General** > **Web Browser** to open the browser.



Web Browser

Add, remove, or edit installed web browsers.
The selected web browser will be used by default when web pages are opened, although some applications may always use the external browser.

● Use internal web browser
○ Use external web browser

External web browsers:

☑ Default system web browser
□ Firefox
□ Internet Explorer
□ Chrome

3. Choose one of the defined browsers or click **New**.
4. If **New** was clicked:
   - **Name:** Display name of the browser configuration
   - **Location:** File system path to the browser
   - **Parameters:** Parameters that are to be used when the browser is called.

> To use Microsoft Edge the following must be entered:
> **Location:** File system path to Microsoft prompt, e.g. *C:\Windows\System32\cmd.exe*
> **Parameters:** /c "start microsoft-edge:%URL%"

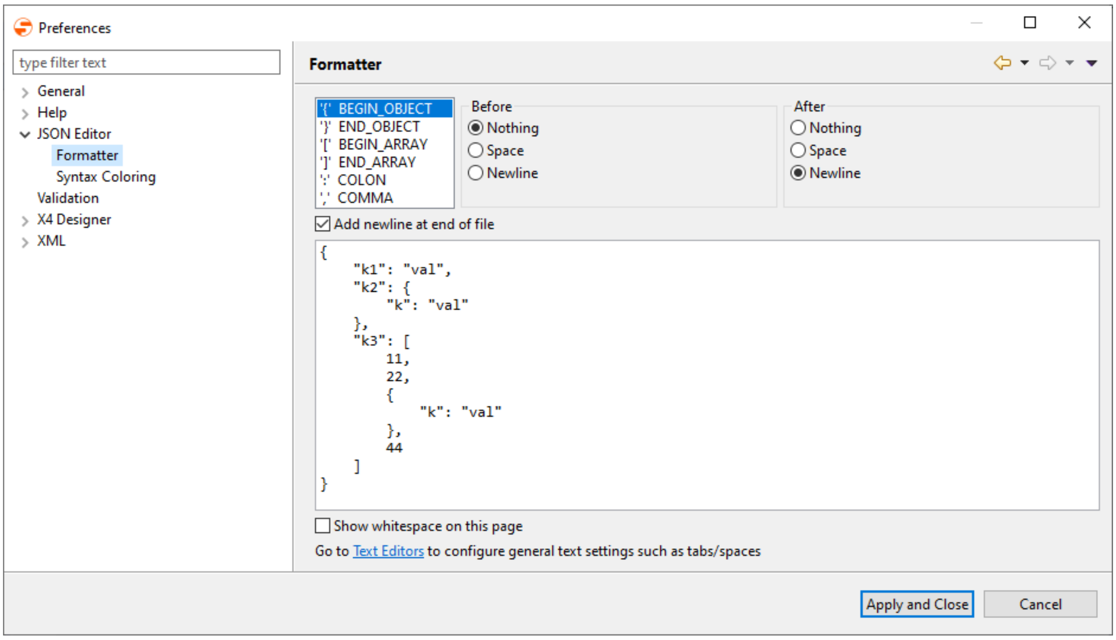
5. Confirm the settings with **OK**.
6. Click **Apply and Close** to save the configuration and close the window.

3.2.8 Configuring the JSON Editor

Under **JSON Editor**, settings for the JSON Editor can be stored.

1. Select menu**Tools> Options**.
2. On the left side, double-click**JSON Editor** to open the editor configuration.
3. Make the desired settings:

- Set the formatting of the JSON code under **Formatter**



Formatter

'{' BEGIN_OBJECT
'}' END_OBJECT
'[' BEGIN_ARRAY
']' END_ARRAY
':' COLON
',' COMMA

Before: ● Nothing ○ Space ○ Newline

After: ○ Nothing ○ Space ● Newline

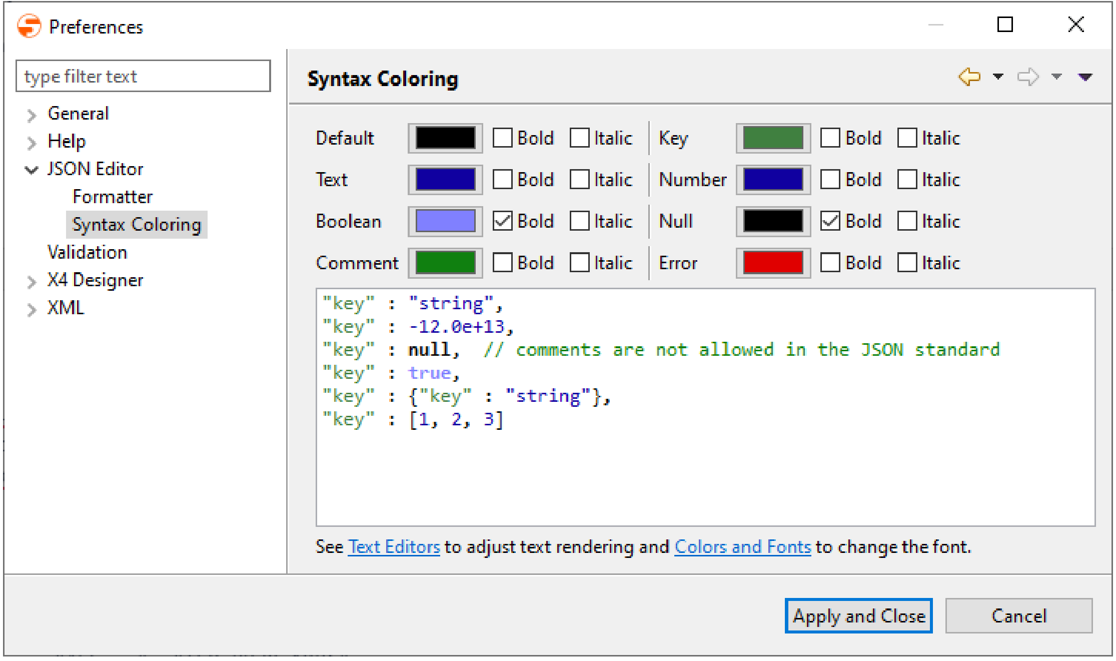
☑ Add newline at end of file

```
{
    "k1": "val",
    "k2": {
        "k": "val"
    },
    "k3": [
        11,
        22,
        {
            "k": "val"
        },
        44
    ]
}
```

□ Show whitespace on this page

Go to Text Editors to configure general text settings such as tabs/spaces

- Set the colors for syntax highlighting under **Syntax Coloring**



Syntax Coloring

Default	⬛	□ Bold	□ Italic	Key	🟩	□ Bold	□ Italic
Text	🟦	□ Bold	□ Italic	Number	🟦	□ Bold	□ Italic
Boolean	🟪	☑ Bold	□ Italic	Null	⬛	☑ Bold	□ Italic
Comment	🟩	□ Bold	□ Italic	Error	🟥	□ Bold	□ Italic

```
"key" : "string",
"key" : -12.0e+13,
"key" : null,  // comments are not allowed in the JSON standard
"key" : true,
"key" : {"key" : "string"},
"key" : [1, 2, 3]
```

See Text Editors to adjust text rendering and Colors and Fonts to change the font.

4. Click **Apply and Close** to save the configuration and to close the window.

3.2.9 Changing the Help Language

The integrated help can be opened in a separate window via the menu **Help > Help Contents**. The help is divided into books, each one focusing on a different topic within the context of the X4 BPMS.

The language of the displayed help contents is based on the specified system language. However, it is possible to change the language at any time. If the system language is neither German nor English, the help will be displayed in English by default.

The language can be adjusted within the file `X4Designer.ini` under `<X4>/Designer`. To switch the language, the language specification `en` for English or `de` for German must be adjusted.

Example: Adjustment for english help contents

```
-startup
plugins/org.eclipse.equinox.launcher_1.2.0.v20110502.jar
--launcher.library
plugins/org.eclipse.equinox.launcher.win32.win32.x86_1.1.100.v20110502
-nl
en
-vm
jre\bin\
-vmargs
-Xms64m
-Xmx1024m
-XX:MaxPermSize=128m
```

After restarting the X4 Designer, the help contents are available in the respective language.

4 Administering the X4 Server

Learn how to administer a productive X4 BPMS installation via JMX.

4.1 Updating the X4 Repository in production mode

In the X4 Server's production mode the caching for the X4 Repository is enabled. You can update repository project without restarting the server.
To avoid that outdated cache files will be used, the cache must be reset after updating the X4 Repository. This can be done with a JMX Management Bean (MBean) provided by the X4 Server with the name `X4Management`.

ⓘ The JMX MBean `X4Management` allows to reset the cache using the method `resetCache()`. In addition, caching statistics can be accessed with the method `cacheStatistics()` and an SAP JCo server can be restarted using the method `restartSAPJcoServer()`.

1. Update your X4 Repository.
2. Open the JMX MBean `X4Management`
   - Start the jconsole tool.
   - Open the JMX MBean `X4Management` in a domain `de.softproject.X4`
3. Invoke the MBean method `resetCache()`.
   The cache will be reset.

4.2 Controlled shutdown of the X4 Server (via JMX)

How to shut down the *X4 Server* in a controlled way during processes are running

ⓘ **Prerequisites for shutting down**
A controlled shutdown of the X4 Server ensures that all currently running processes are fully executed and no more processes are started. This requires that the property `Can Stop` is not set for processes that are not allowed to be stopped. Moreover, endless processes must be modeled in such a way that they interrupt processing at regular intervals so that they can be stopped.
Depending on the message queue adapter, this can be done as follows:

- *JMS* and *RequestReply Transfer*: Specify a timeout in parameter `timeout`. If the adapter returns the status *0*, the queue is empty and the process control goes back to the adapter, allowing the process to be halted.
- *MQ Series Transfer* and *WebSphere MQ*: Enable the parameter `MQGetMessageOptions.options.MQC.MQGMO_WAIT` to activate waiting for a message, and specify in parameter `MQGetMessageOptions.waitInterval` a timeout in milliseconds that will be waited until an appropriate message can be received.

1. Access the MBean `X4Management`

  - Start the jconsole tool.
  - Open the MBean `X4Management` in a domain `de.softproject.X4`
2. Invoke the MBean method `setAllOutOfService()`.
   The property `OutOfService` will be set for all processes. This causes that no more processes can be started.
3. Invoke the MBean method `stopAllProcesses()`.
   All processes that are currently executed and are allowed to be stopped, will be terminated.
4. Wait until the MBean method `runningWorkflowCount()` displays *0*.
   No process is executed any longer.

> Alternatively, you can also invoke the method `shutdownAllProcesses(longtimeoutInMS)`. This causes the MBean methods `setAllOutOfService()`, `stopAllProcesses()`, and `runningWorkflowCount()` to be executed consecutively.
>
> - In **ParamValue** specify a timeout in milliseconds, to be handed over to the method as parameter `longtimeoutInMS`.
> - Click **Invoke** to execute the method. This returns *`True`*, if `runningWorkflowCount()` displays *`0`* before the timeout exceeds.

5. Shut down the X4 Server.

4.3 Providing Process Libraries

Process libraries provide an easy way to use process models for multiple users. They allow know-how to be bundled, stored centrally and to be reused in a targeted manner.

To provide process libraries the following steps are required:

1. *Installing the process library*: Place the process library as `ZIP` or `jar` file under `Server\X4DB\X4modules`.
2. *Configuring and providing the process library*: Configure and provide the process library on the Server via the file `modules.xml` (`Server\X4DB\X4modules\`).

Sample configuration via the modules.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<modules>
    <global project="MyFirstLibrary" jar="MyFirstLibrary.zip"/>
    <local userId="1" project="MySecondLibrary" jar="MyFirstLibrary.jar"/>
</modules>
```

Explanation:

Element	Description
`global`	The library is provided globally and thus available for all users
`local`	The library is provided locally and thus available only for a certain user
`userId`	User who can access the library
`project`	Project name; The project name must correspond to the project name of the process library.
`jar`	Reference to the `ZIP` or `jar` file of the process library

5 High Availability

In systems with high workloads or critical services, high availability is an important part of the system landscape. With X4 BPMS, there are several scenarios for implementing high availability.

Basically, three different use cases are described: load balancing, fail over and high availability with planned process executions.

With high availability, data integrity often plays a role and must therefore be guaranteed. Thus, it is important to consider the database in the system landscape.

The load balancer is an external system component that must be set up based on the environment. It receives the external requests and forwards them to the corresponding X4 Server instance. This makes external callers independent of the underlying system landscape and allows extensions to be made without having to perform changes on client side.

5.1 Load Balancing

In the case of load balancing, the problem is caused by many simultaneous requests and their processing. More requests are to be processed simultaneously by connecting several X4 Server instances behind a load balancing system, thus achieving higher computing power. This enables a high demand-driven scalability. However, it must be ensured that the shared data of the X4 systems is known to all systems. Therefore, there are different scenarios depending on the application.

5.1.1 Scenario – Few Mainly Reading Database Accesses

If the processes contain mainly calculations or additional services are addressed, a load distribution can be realized over several X4 Servers, each of them managing its system database, and another database containing the shared data. Here, two expansion stages can be distinguished.

5.1.1.1 Simple – Direct database access

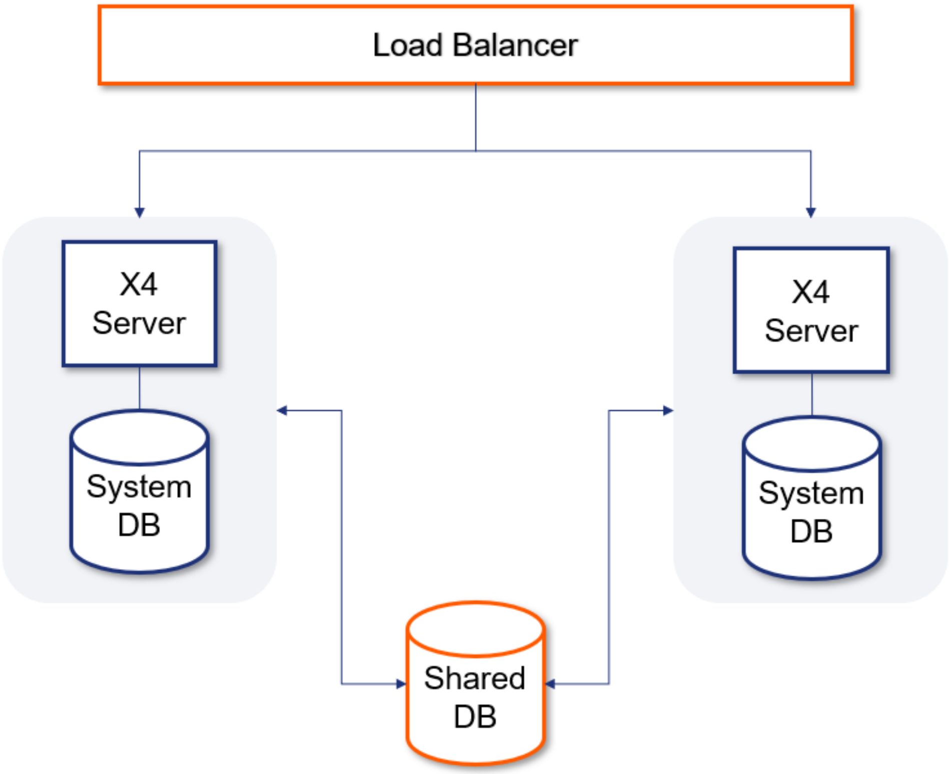


Figure: Direct database access

Access to the shared data can be managed directly via the database' access layer. This is the simplest solution to the problem and a good solution for small systems since the database itself cannot be easily decoupled.

5.1.1.2 Complex – Shared access via an X4 instance

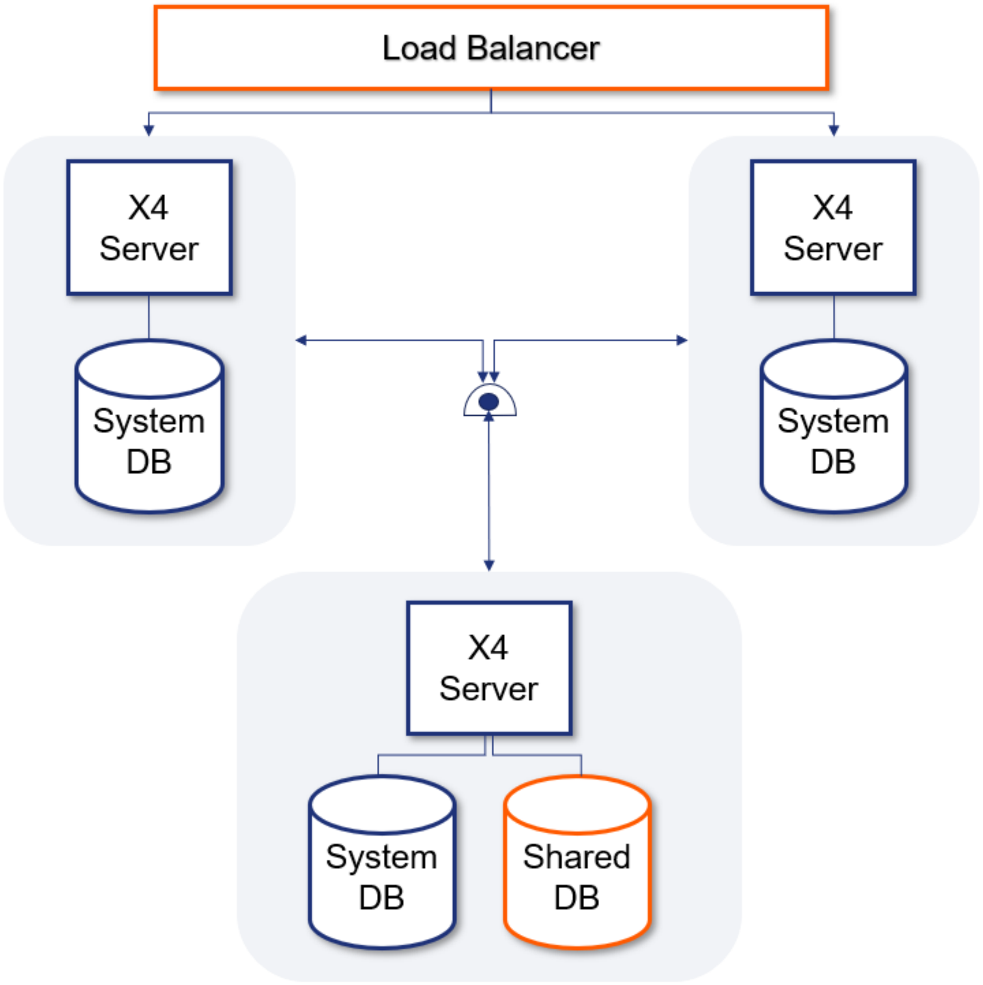


Figure: Shared database access via an X4 instance

If the database should be decoupled, it is a good idea to insert a service layer between the database and the X4 Servers. It encapsulates the common database and thus makes the data storage layer exchangeable. This is important for larger systems in order to better guarantee maintainability, testability and integrity.

5.1.2 Scenario – Shares Access via Message Queue

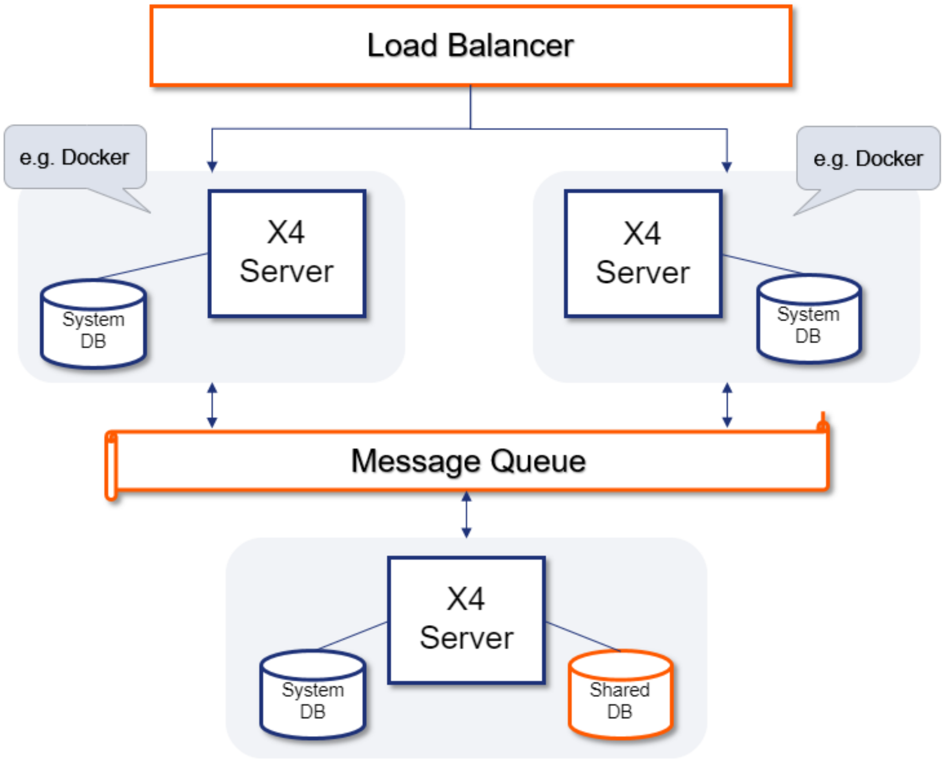


Figure: Shared database access via Message Queue

Another possibility to decouple the database is via a middleware. This is recommended for critical applications where no messages may be lost between the X4 Servers and the X4 Server of the shared database. The middleware ensures that messages are kept persistent until they have been processed by the recipient.

5.2 Fail Over

In contrast to load balancing, fail over operation requires that the system is accessible at all times. However, usually only one server is primarily used for requests. If this server fails, the second server is used and the end user does not notice the failure.

A keep-alive service ensures that the load distributor is notified if a system failure occurs. This allows to immediately switch over to the second server.

5.2.1 Scenario – A Single Exclusive Database

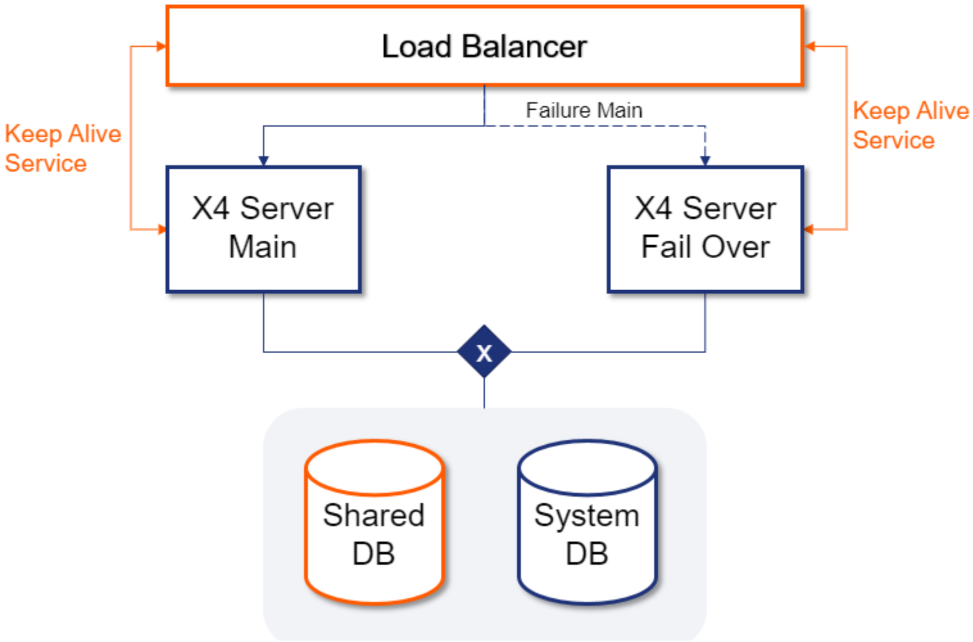


Figure: A single database with exclusive access

The simplest system contains two X4 Server instances that can receive both requests. A single database is used for both servers. Thus, for data integrity it is important that only one of the two servers has access to the database at a time.

Scheduled services can be implemented using an external scheduler or a logical lock on a table of the shared database *Shared DB*.

5.2.2 Scenario – System Database per X4 Server

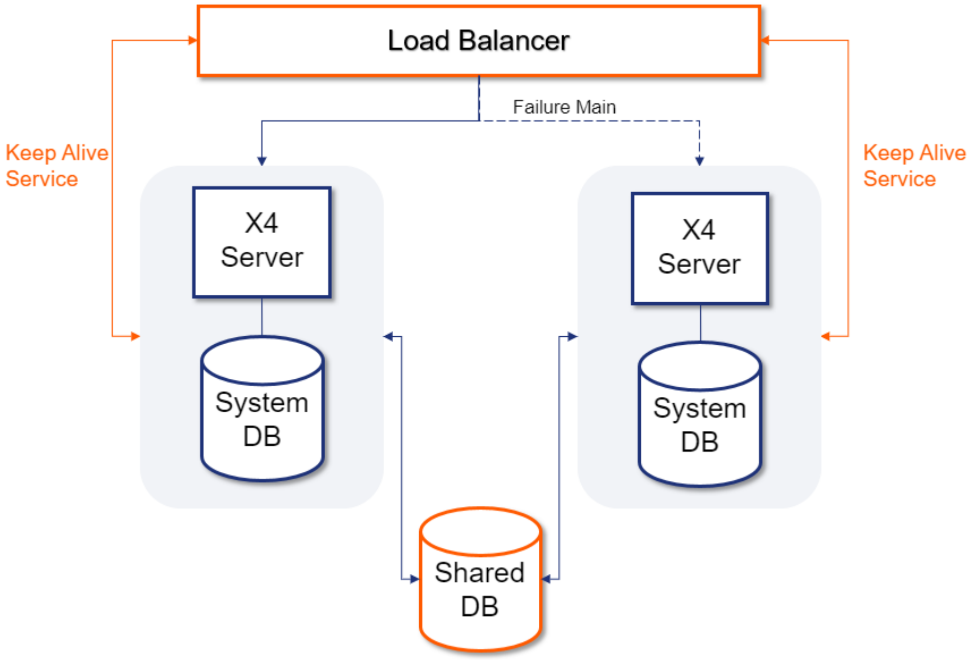


Figure: Separate system databases

If load balancing and fail over are to be provided through the system structure, each X4 Server requires its own system database. This allows each X4 Server to respond to requests. If only ail over is to be ensured, all requests are redirected to only one of the two X4 Servers.

Scheduled services can be implemented using an external scheduler or a logical lock on a table of the shared database *Shared DB*.

5.3 Load Balancing via Scheduler

If, in addition to load balancing, processes are to be started automatically via a scheduler, it must be ensured that execution is not triggered multiple times.

5.3.1 Scenario – Dedicated X4 Server for Scheduling

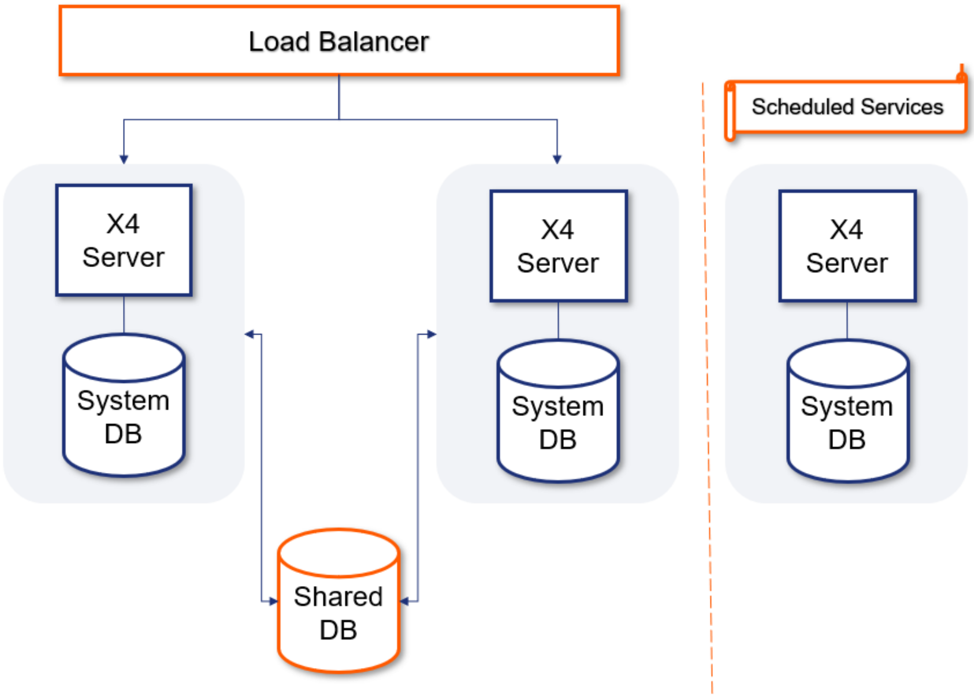


Figure: Dedicated Scheduler X4 Server

If scheduling should take place independently of the current load distribution, a dedicated X4 Server is set up containing only the automatically started processes. This X4 Server instance has the possibility to notifying the other X4 Systems via the shared database. As described in the section *Scenario – Shared Access via Message Queue*, it is also possible to exchange messages with the shared database via a message queue.

5.3.2 Scenario – One Server Responsible for Scheduling

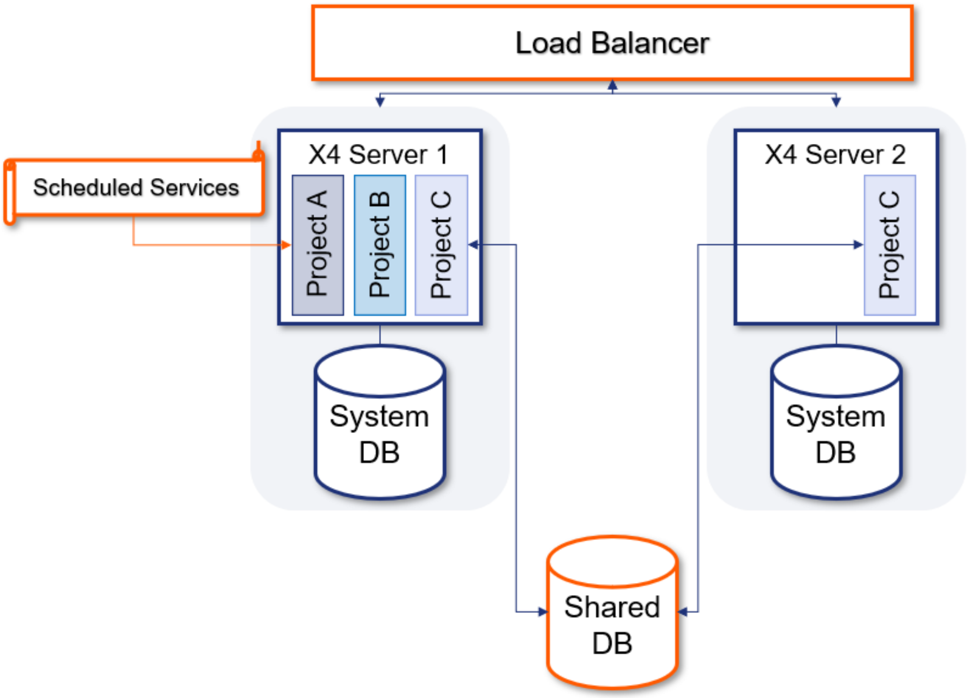


Figure: Planned processes in X4 project

If no additional X4 Server instance should be used for the automatic execution of processes, a separate project within the X4 projects can be used for these processes. This project is then installed exclusively on one of the two X4 Servers. This ensures that only this server instance executes the processes.

5.3.3 Scenario – External Scheduler

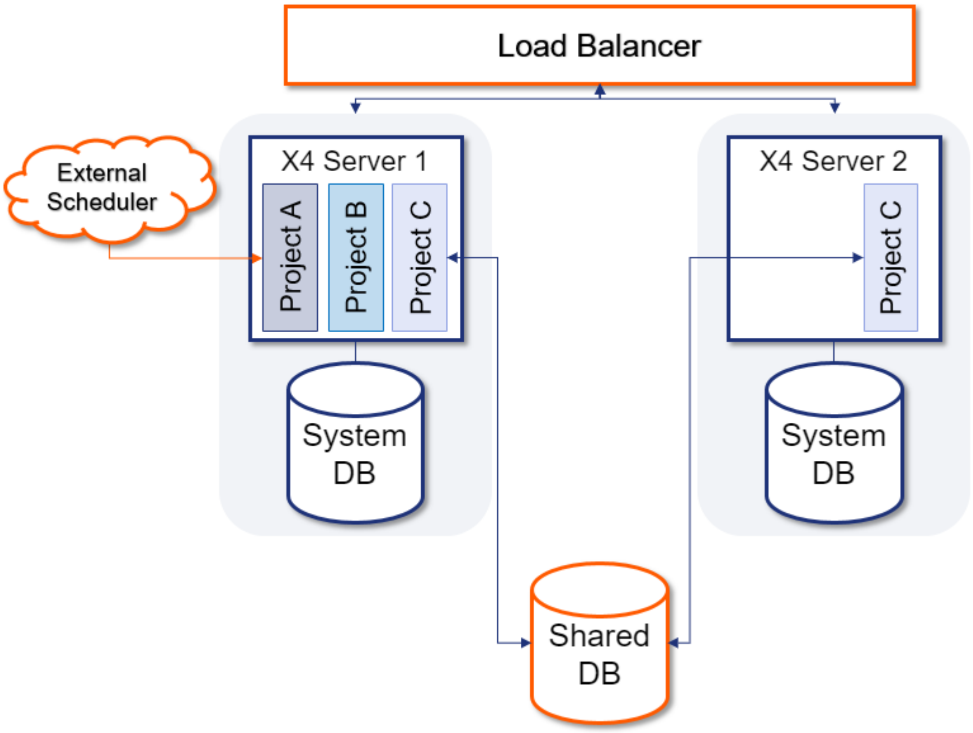


Figure: Planned processes via external scheduler service

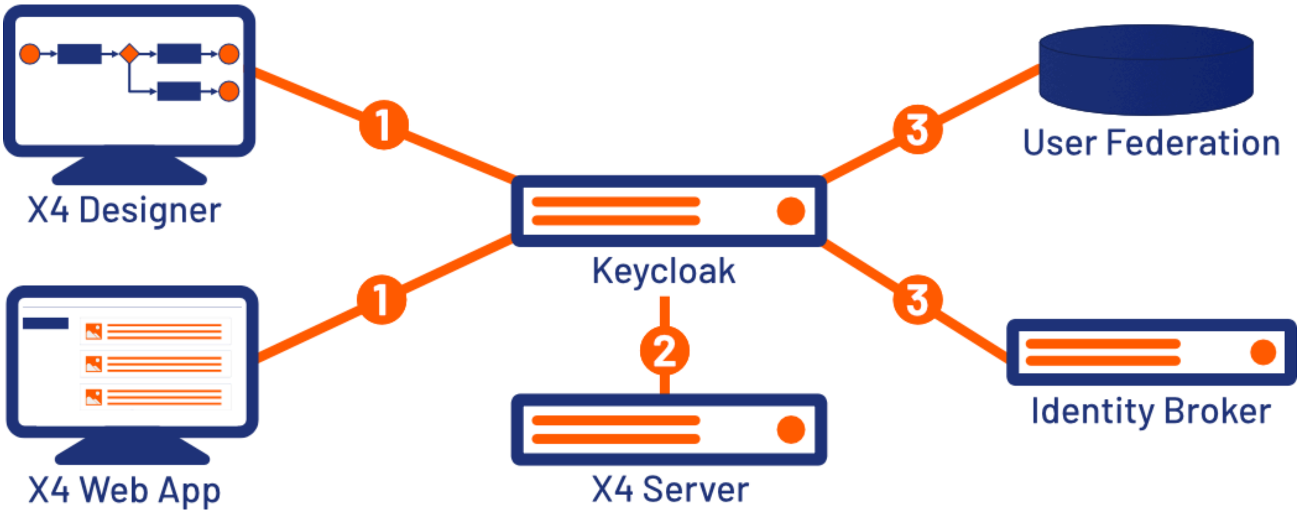
In addition to the scheduler included in the X4 Server, an external service can also start processes automatically. This service addresses the processes to be executed directly on the server on which *project A* is installed.

6 Keycloak

⚠ The authentication provider Keycloak has to be installed to use the X4 BPMS.

All components of X4 BPMS use the authentication provider Keycloak for authentication and authorization. The users, groups and roles are managed in Keycloak. The included Keycloak is already connected using a central configuration.

However, you also have the possibility of connecting existing identity providers such as LDAP or Active Directory using the included Keycloak. Keycloak also supports the integration of external providers such as Microsoft, Google or Facebook.



1	Authenticate
2	Token creation and validation
3	Connect

The Keycloak administration console can be opened via the URL http://localhost:8085/auth/admin/.

⚠ **Potential security risk**
In the test version of the X4 BPMS, a default user with administration permissions is pre-installed. The default user can be a potential security risk if the system goes live, so it is mandatory to secure the default user. Disable the default user or change the password in the Keycloak administration console.

ⓘ **Keycloak**

Default user

- Username: admin
- Password: demo

Available roles

Role	Description
x4_admin_access	Gives access to the X4 ReST API.
x4_dev_access	Gives access to the X4 Designer.
x4_dev_access_*	Gives access to all X4Repositories.

ⓘ **X4 Designer**

Default user

- Username: demo
- Password: demo

ⓘ **X4 Web Apps**

Default user

- Username: demo
- Password: demo

The official Keycloak documentation can be accessed via the URL https://www.keycloak.org/documentation.html.

6.1 About the used database

Keycloak is shipped with an H2 database by default so that Keycloak can be used without further configuration. However, the H2 database is not suitable for productive operation due to security weaknesses and limited scalability. Therefore, we recommend the use of an alternative database. Before using the Keycloak productively, you should therefore connect an alternative database.

How to connect databases to Keycloak is described in the official Keycloak documentation.

✓ For more information, visit https://www.keycloak.org/docs/latest/server_installation/index.html#_database.

6.2 Set up

6.2.1 Loading Docker image and launching container

In this section, you can find information on how to load the authentication provider Keycloak into Docker and start it as a container.

Requirements

- Docker must be installed and set up on the system. Information on this can be found in the Docker documentation at https://docs.docker.com/.
- Knowledge of how Docker works is assumed.

1. Load the installation package `keycloak-image.tar` provided by SoftProject onto your system using the command `docker load -i keycloak-image.tar`.
2. Run Docker with the command `docker run -d -p 8085:8085 --name keycloak softprojectgmbh/keycloak`.

6.2.2 Connecting your own Keycloak installation

If the included Keycloak installation is to be replaced by your own Keycloak installation, a Keycloak configuration file must be created in the server directory under **\configuration\keycloak_config.json**.

The configuration is done in the `connection` element.

Example

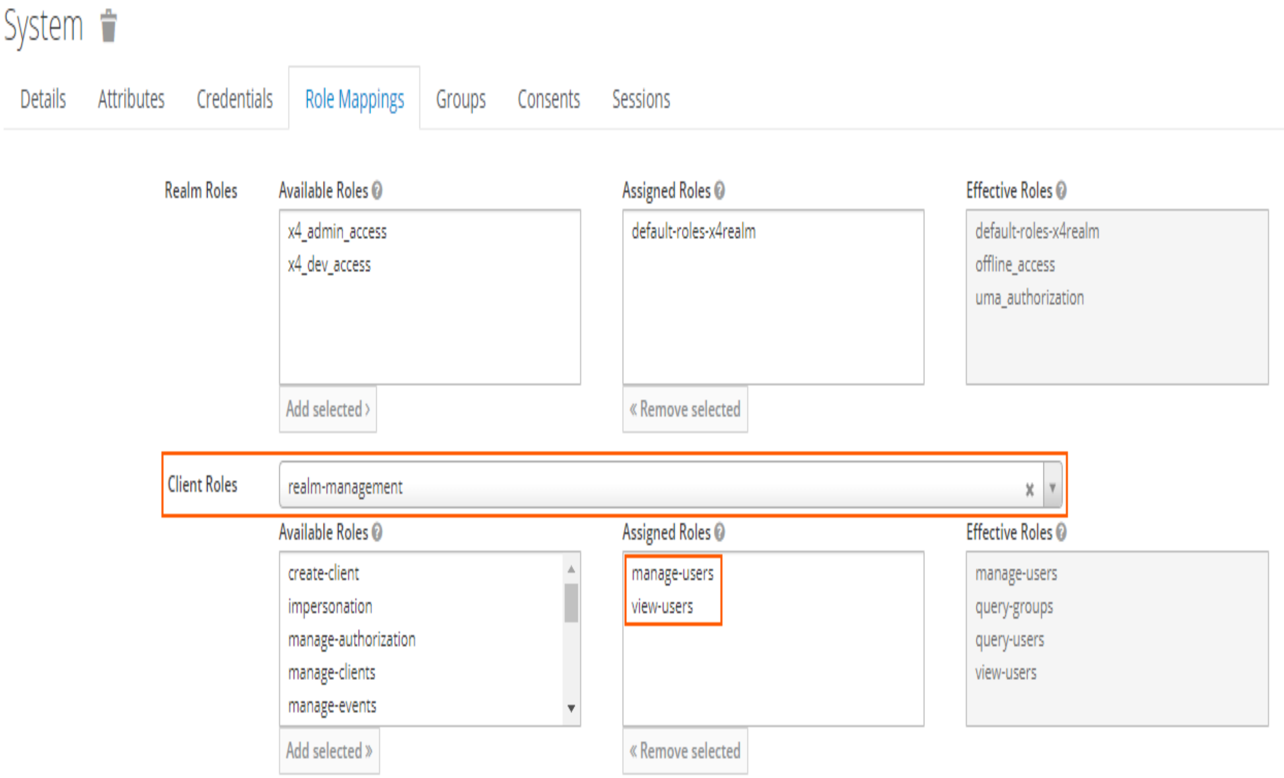
```
{
"connection": {
  "realm": "X4Realm",
  "auth-server-url": "http://<host>:<port>/auth/",
  "resource": "X4",
  "credentials": {
    "secret": "XXXX"
  }},
   "rest-api-credentials": {
     "username": "username",
     "password": "password"
    }
}
```

The following roles must be created in Keycloak:

Role	Description
x4_admin_access	Gives access to the X4 ReST API.
x4_dev_access	Gives access to the X4 Designer.
x4_dev_access_*	Gives access to all X4Repositories.

To use the X4 ReST API, the following rights must be granted to the corresponding user:

Client Roles	• realm-management
Assigned Roles	• manage-users • view-users

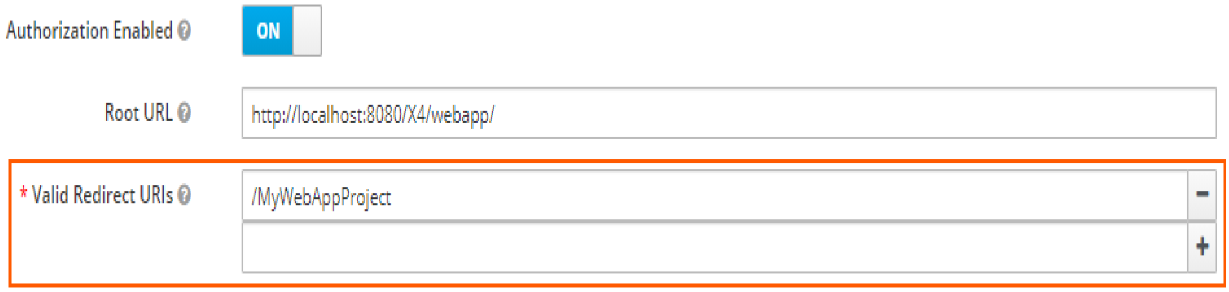


For more information on the configuration file, see https://www.keycloak.org/docs/latest/securing_apps/index.html#_java_adapter_config.

6.3 Configure

6.3.1 Applying Authorization Code Flow

The X4 BPMS supports different authorization code flows and the single sign-on authentication procedure. To apply the authorization code flows for X4 Web Apps, you must enter the path to the Web App in **Valid Redirect URIs** in the **Client** section of the Keycloak administration console.



Authorization Enabled: ON

Root URL: http://localhost:8080/X4/webapp/

* Valid Redirect URIs: /MyWebAppProject

For more information, see Configuration.

6.3.2 Restricting access to X4 repository

Access to individual workspaces can be restricted using roles. To do this, a new role with the name **x4_dev_access_<workspace name>** has to be created in the Keycloak Administrator console. The link to the workspace is established using the role name.

6.3.2.1 Sample

To restrict workspace **2** using a role, the **x4_dev_access_2** role is created in Keycloak. Only users assigned to the **x4_dev_access_2** role have access to the workspace.

6.3.3 Default configuration

This section describes the default configuration of the authentication provider in the delivery state.

6.3.3.1 Realm Settings

General

Label	Value
Name	X4Realm
Enabled	ON

Login

Label	Value
User registration	OFF
Edit username	OFF
Forgot password	OFF
Remember Me	OFF
Verify email	OFF
Login with email	ON
Require SSL	external requests

Tokens

Label	Value
Default Signature Algorithm	RS256
Revoke Refresh Token	OFF
SSO Session Idle	30 Minutes
SSO Session Max	10 Hours
SSO Session Idle Remember Me	0 Minutes
SSO Session Max Remember Me	0 Minutes
Offline Session Idle	30 Days
Offline Session Max Limited	OFF
Client Session Idle	0 Minutes
Client Session Max	0 Minutes
Access Token Lifespan	5 Minutes
Access Token Lifespan For Implicit Flow	15 Minutes
Client login timeout	1 Minutes
Login timeout	30 Minutes
Login action timeout	5 Minutes
User-Initiated Action Lifespan	5 Minutes
Default Admin-Initiated Action Lifespan	12 Hours
OAuth 2.0 Device Code Lifespan	10 Minutes
OAuth 2.0 Device Polling Interval	5

Security Defenses

Label	Value
X-Frame-Options	SAMEORIGIN
Content-Security-Policy	frame-src 'self'; frame-ancestors 'self'; object-src 'none';
X-Content-Type-Options	nosniff
X-Robots-Tag	none
X-XSS-Protection	1; mode=block
HTTP Strict Transport Security (HSTS)	max-age=31536000; includeSubDomains

6.3.3.2 Clients

Settings

Label	Value
Client ID	X4
Name	X4

Description	X4
Enabled	`ON`
Always Display in Console	`OFF`
Consent Required	`OFF`
Client Protocol	`openid-connect`
Access Type	`confidential`
Standard Flow Enabled	`ON`
Implicit Flow Enabled	`OFF`
Direct Access Grants Enabled	`ON`
Service Accounts Enabled	`ON`
OAuth 2.0 Device Authorization Grant Enabled	`OFF`
OIDC CIBA Grant Enabled	`OFF`
Authorization Enabled	`ON`
Root URL	http://localhost:8080/X4
Valid Redirect URIs	/*
Backchannel Logout Session Required	`ON`
Backchannel Logout Revoke Offline Sessions	`OFF`

Fine Grain OpenID Connect Configuration

Label	**Value**
User Info Signed Response Algorithm	`unsigned`
Request Object Signature Algorithm	`any`
Request Object Encryption Algorithm	`any`
Request Object Content Encryption Algorithm	`any`
Request Object Required	`not required`

OpenID Connect Compatibility Modes

Label	**Value**
Exclude Session State From Authentication Response	`OFF`
Use Refresh Tokens	`ON`
Use Refresh Tokens For Client Credentials Grant	`OFF`

Advanced Settings

Label	**Value**
OAuth 2.0 Mutual TLS Certificate Bound Access Tokens Enabled	`OFF`
Pushed Authorization Request Enabled	`OFF`

Credentials

Label	Value
Client Authenticator	`Client Id and Secret`

Client Scopes

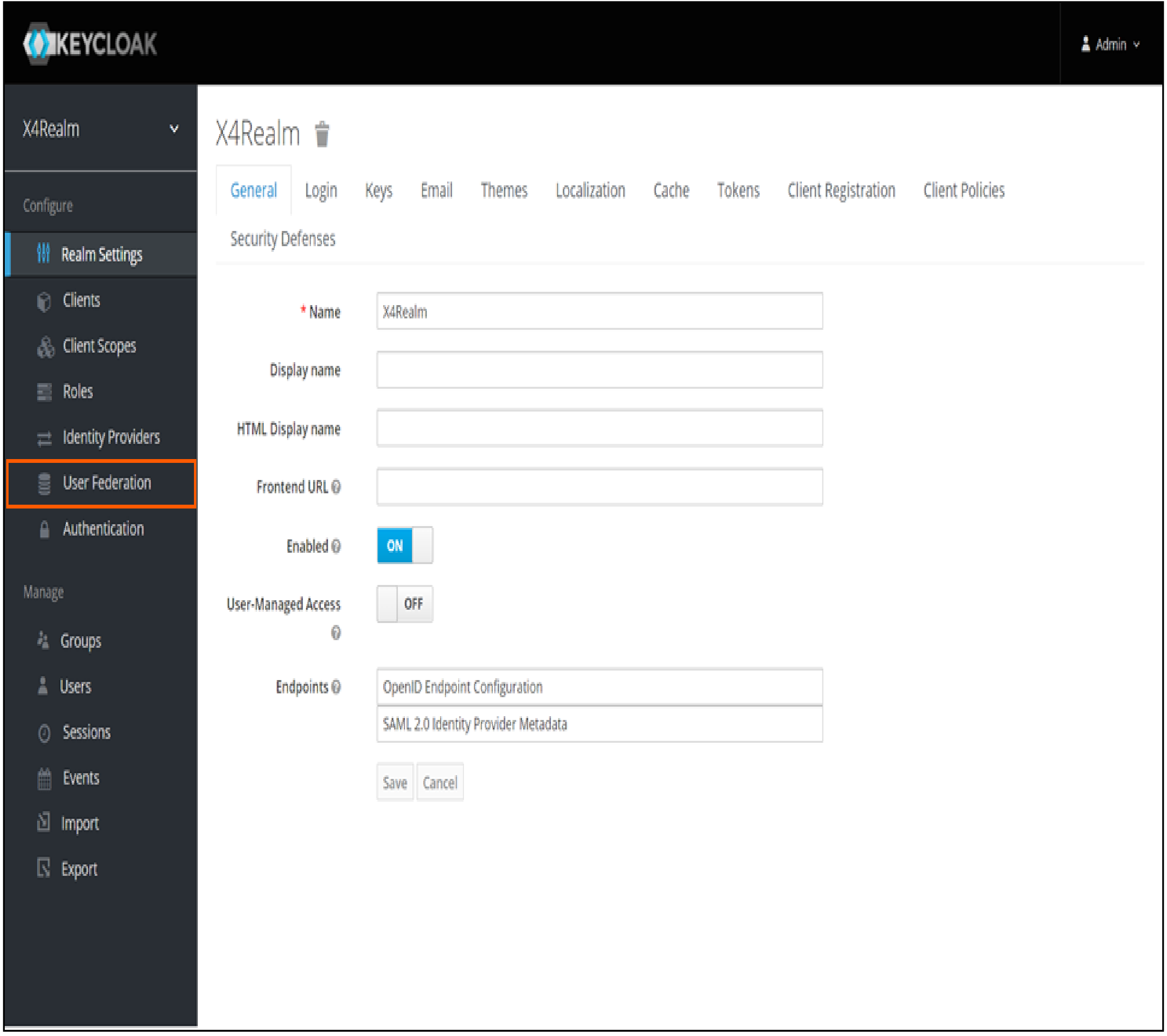
Label	Value
Assigned Default Client Scopes	• `email` • `profile` • `roles` • `web-origins`
Assigned Optional Client Scopes	• `address` • `microprofile-jwt` • `offline_access` • `phone`

6.3.4 Connect LDAP

In Keycloak you can connect an existing LDAP. Keycloak has a built-in LDAP/AD provider. It is possible to connect several different LDAP servers to the same Keycloak realm.

1. Open the **Keycloak Administration Console**.

2. In the **Manage** section, click **User Federation**.



* Name: X4Realm

Display name:

HTML Display name:

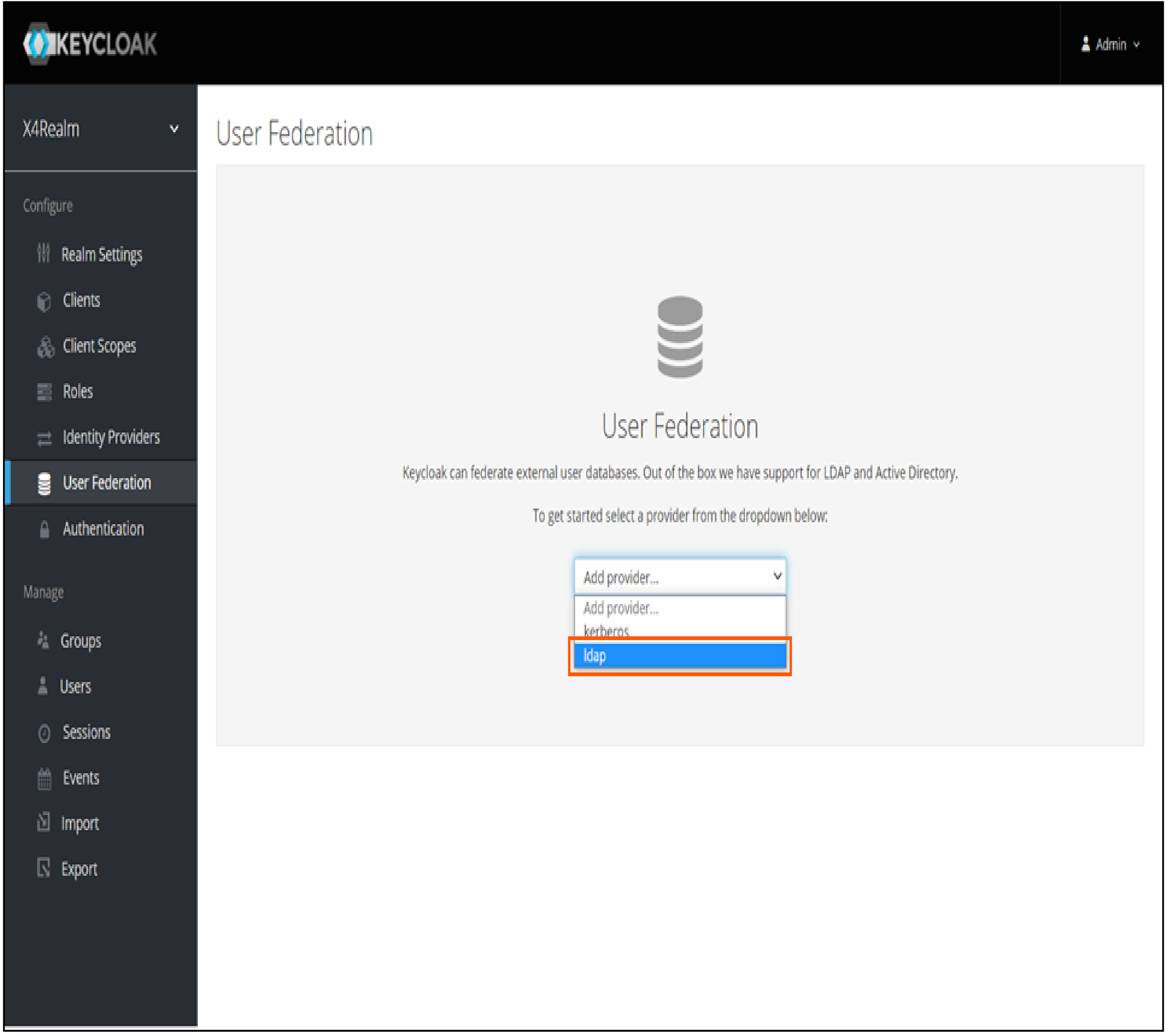
Frontend URL:

Enabled: ON

User-Managed Access: OFF

Endpoints: OpenID Endpoint Configuration
SAML 2.0 Identity Provider Metadata

3. From the drop-down list, choose the **ldap** option.



Keycloak can federate external user databases. Out of the box we have support for LDAP and Active Directory.

To get started select a provider from the dropdown below:

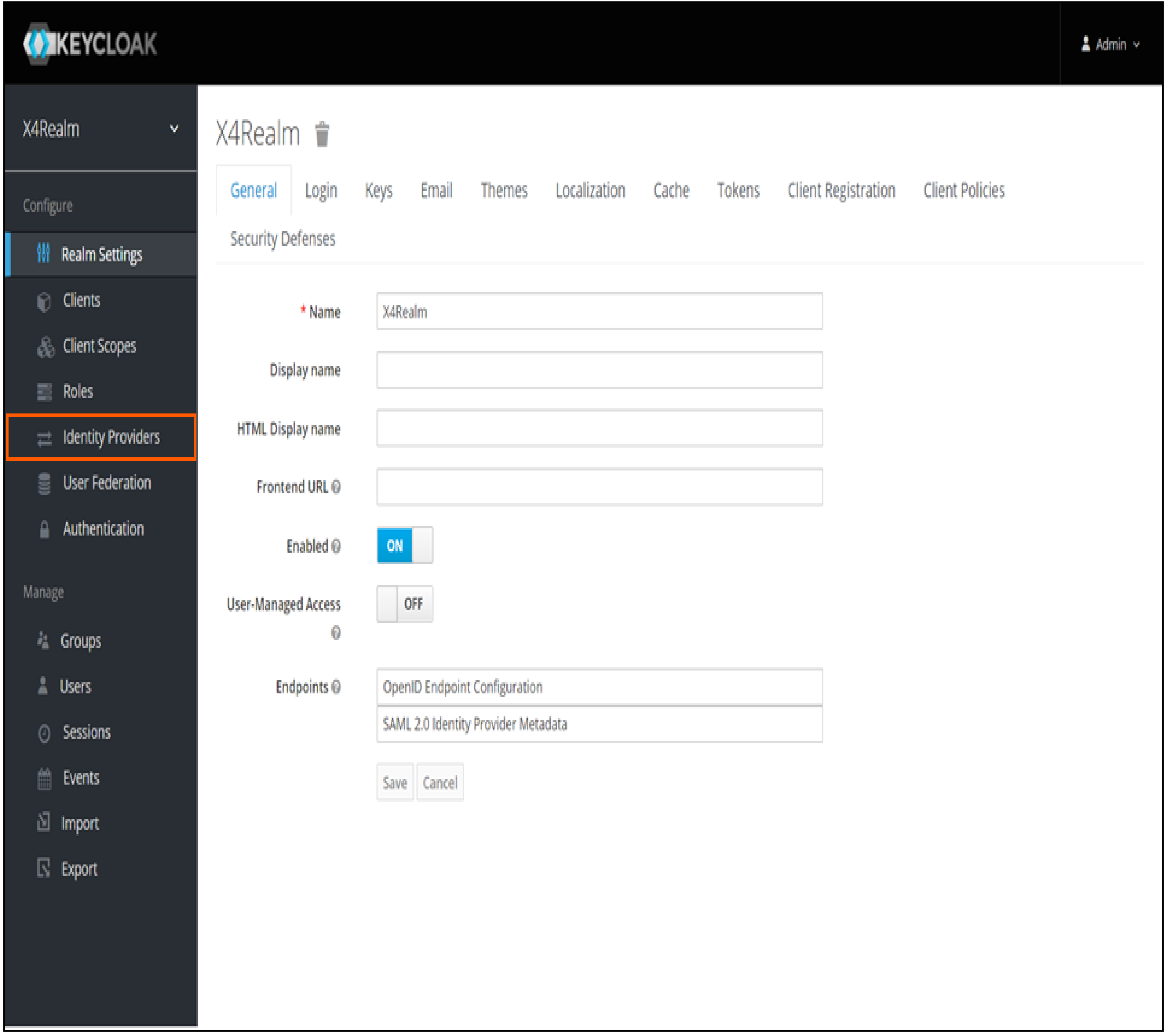
For more information, visit https://www.keycloak.org/docs/latest/server_admin/#_ldap.

6.3.5 Connect SAML v2.0

In Keycloak, you can connect an existing SAML v2.0. Keycloak can broker identity providers based on the SAML v2.0 protocol.

1. Open the **Keycloak Administration Console**.

2. In the **Manage** section, click **Identity Providers**.



* Name: X4Realm

Display name:

HTML Display name:

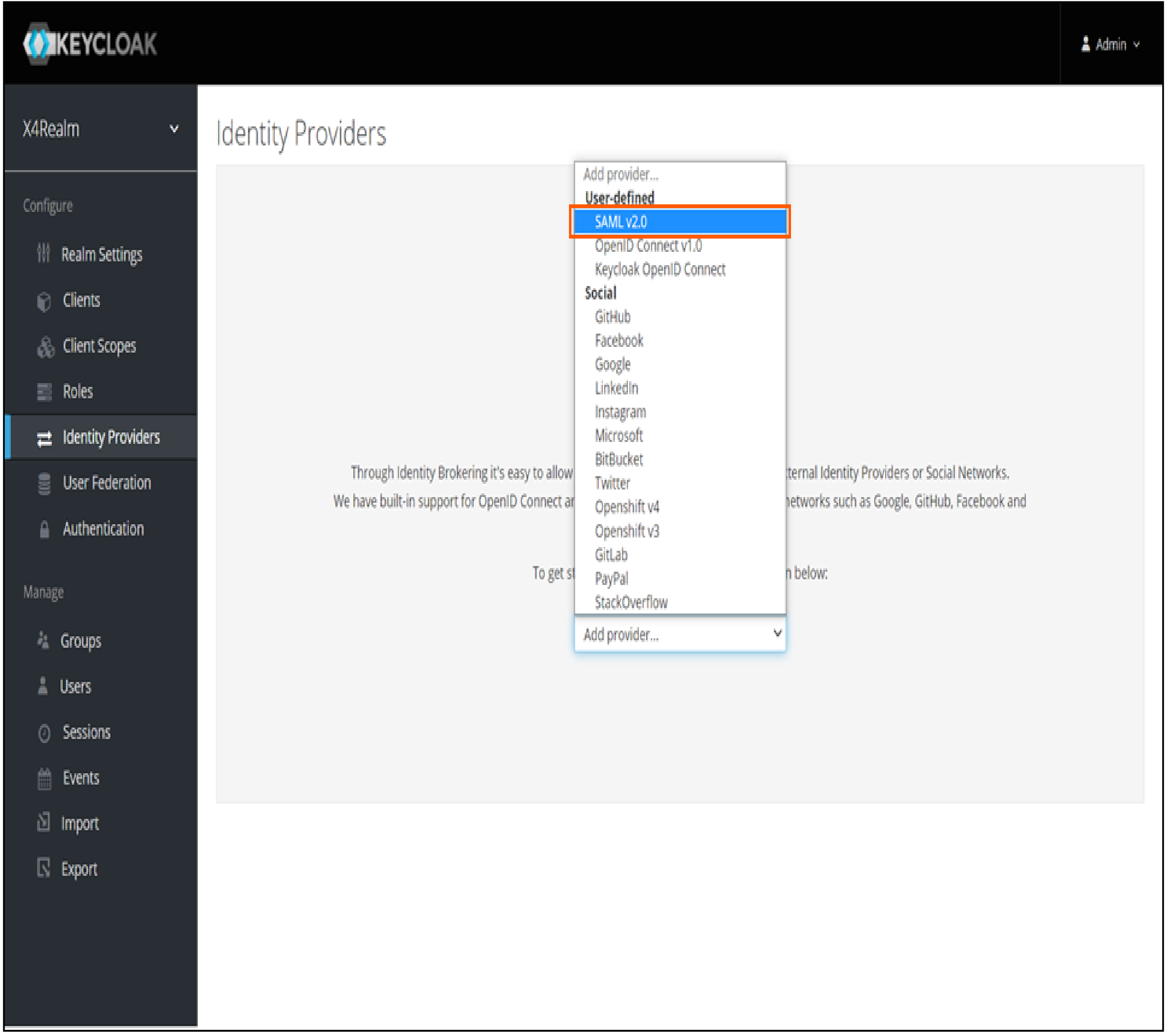
Frontend URL:

Enabled: ON

User-Managed Access: OFF

Endpoints: OpenID Endpoint Configuration
SAML 2.0 Identity Provider Metadata

3. From the drop-down list, choose the **SAML v2.0** option.



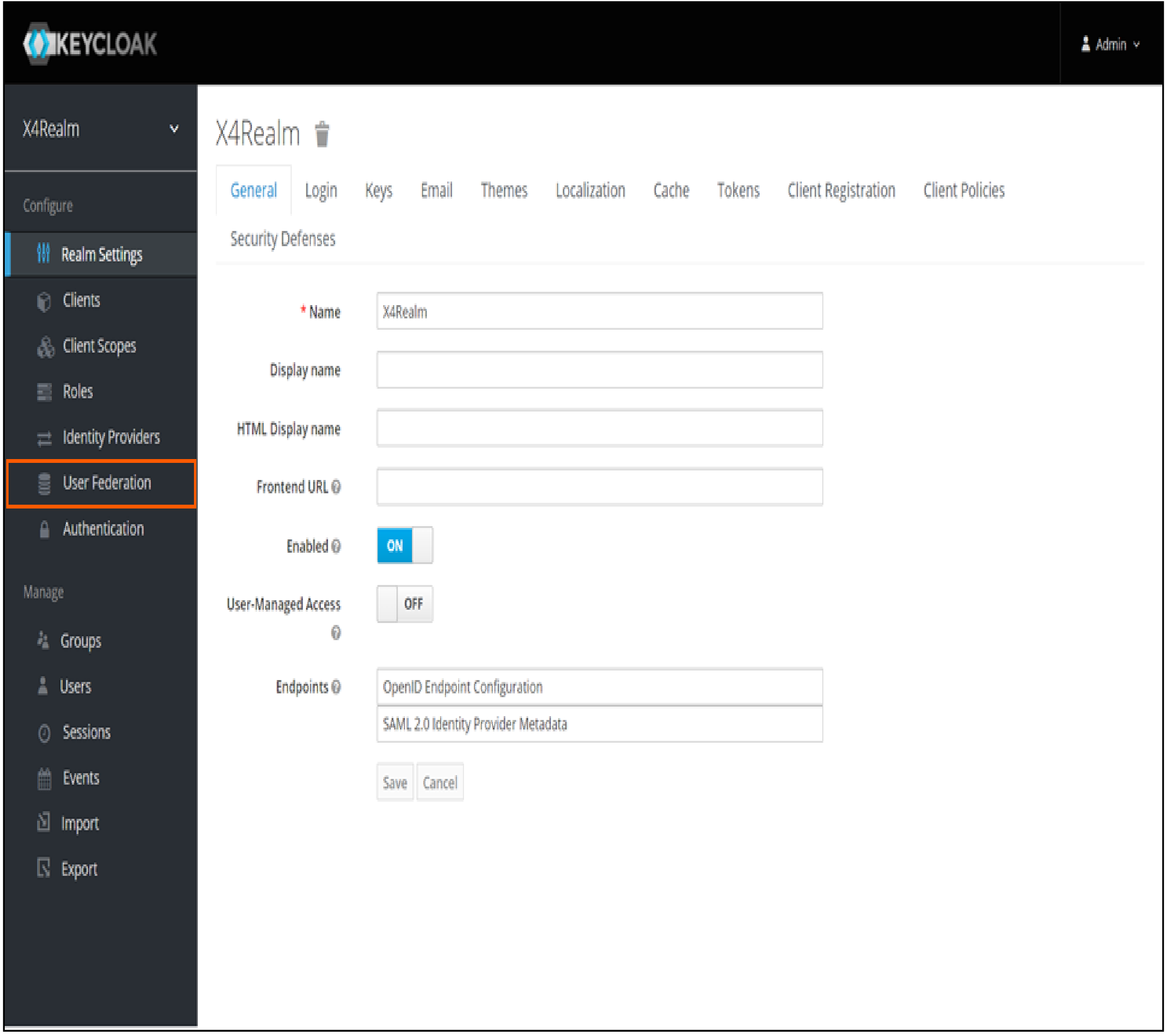
For more information, visit https://www.keycloak.org/docs/latest/server_admin/#saml-v2-0-identity-providers.

6.3.6 Connect Kerberos

In Keycloak, you can connect an existing Kerberos. Keycloak supports logging in with a Kerberos ticket using the SPNEGO protocol.

1. Open the **Keycloak Administration Console**.

2. In the **Manage** section, click **User Federation**.



* Name: X4Realm

Display name:

HTML Display name:

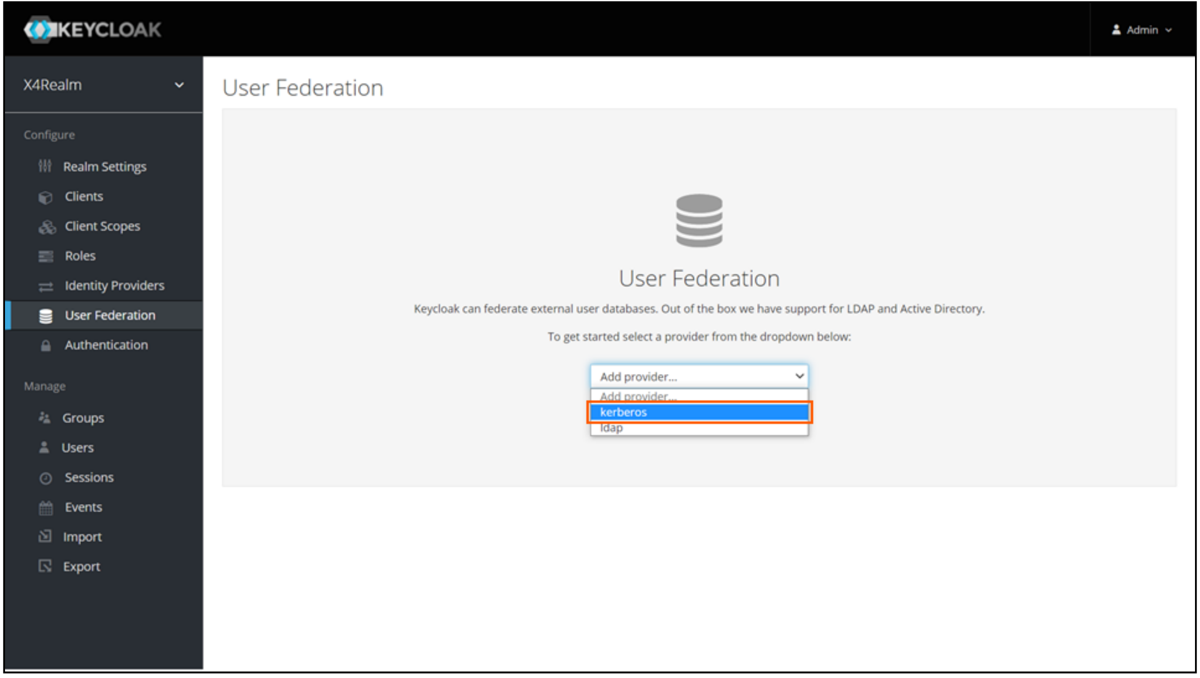
Frontend URL:

Enabled: ON

User-Managed Access: OFF

Endpoints: OpenID Endpoint Configuration
SAML 2.0 Identity Provider Metadata

3. From the drop-down list, choose the **kerberos** option.



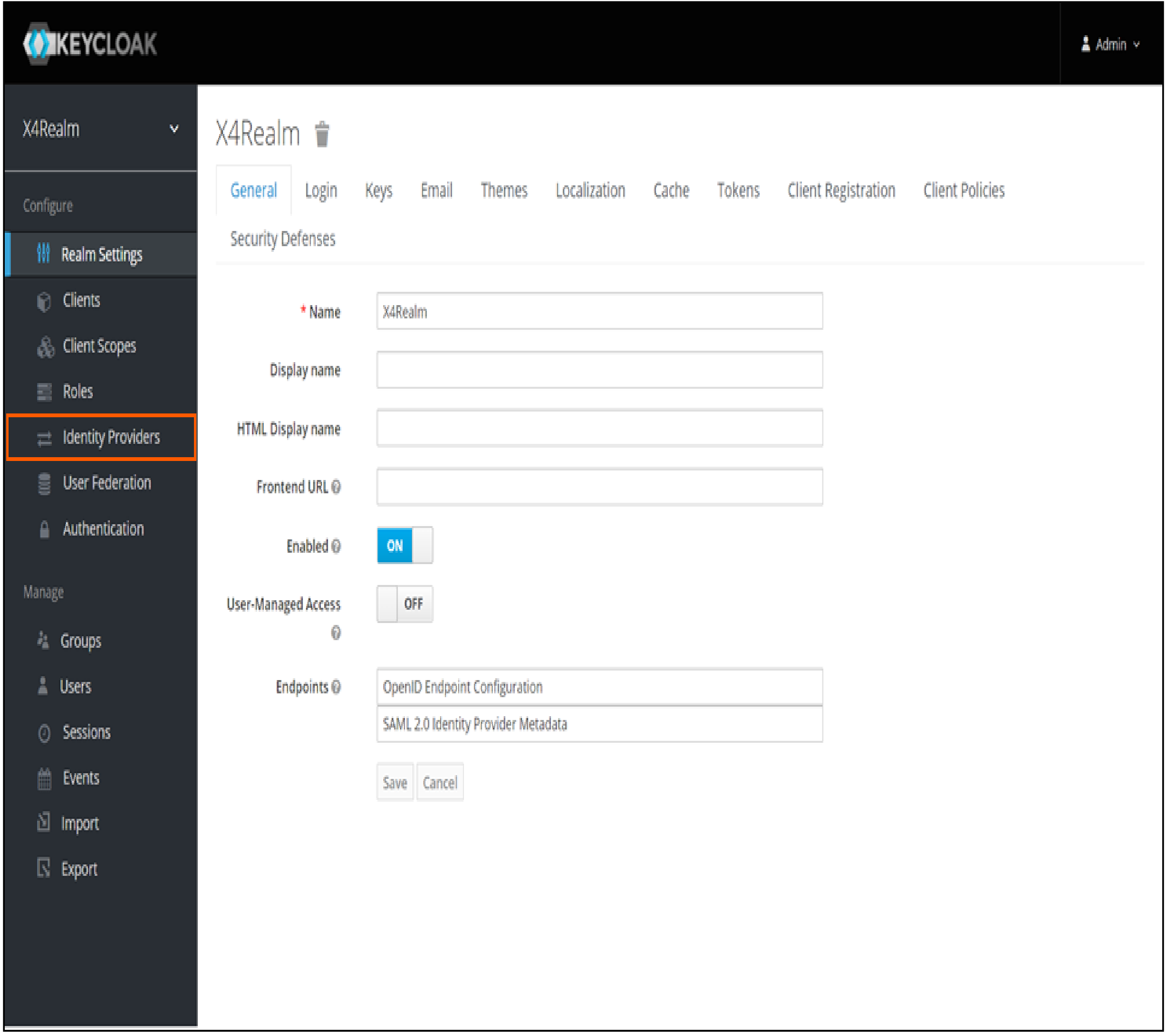
For more information, visit https://www.keycloak.org/docs/latest/server_admin/#_kerberos.

6.3.7 Connect social identity providers

In Keycloak, you can connect to various social identity providers. Keycloak provides built-in support for the most popular social networks, such as Google, Facebook, Twitter, GitHub, LinkedIn, Microsoft, and Stack Overflow.

1. Open the **Keycloak Administration Console**.

2. In the **Manage** section, click **Identity Providers**.



* Name: X4Realm

Display name:

HTML Display name:

Frontend URL:

Enabled: ON

User-Managed Access: OFF

Endpoints: OpenID Endpoint Configuration, SAML 2.0 Identity Provider Metadata

3. Select the desired social identity provider from the drop-down list.

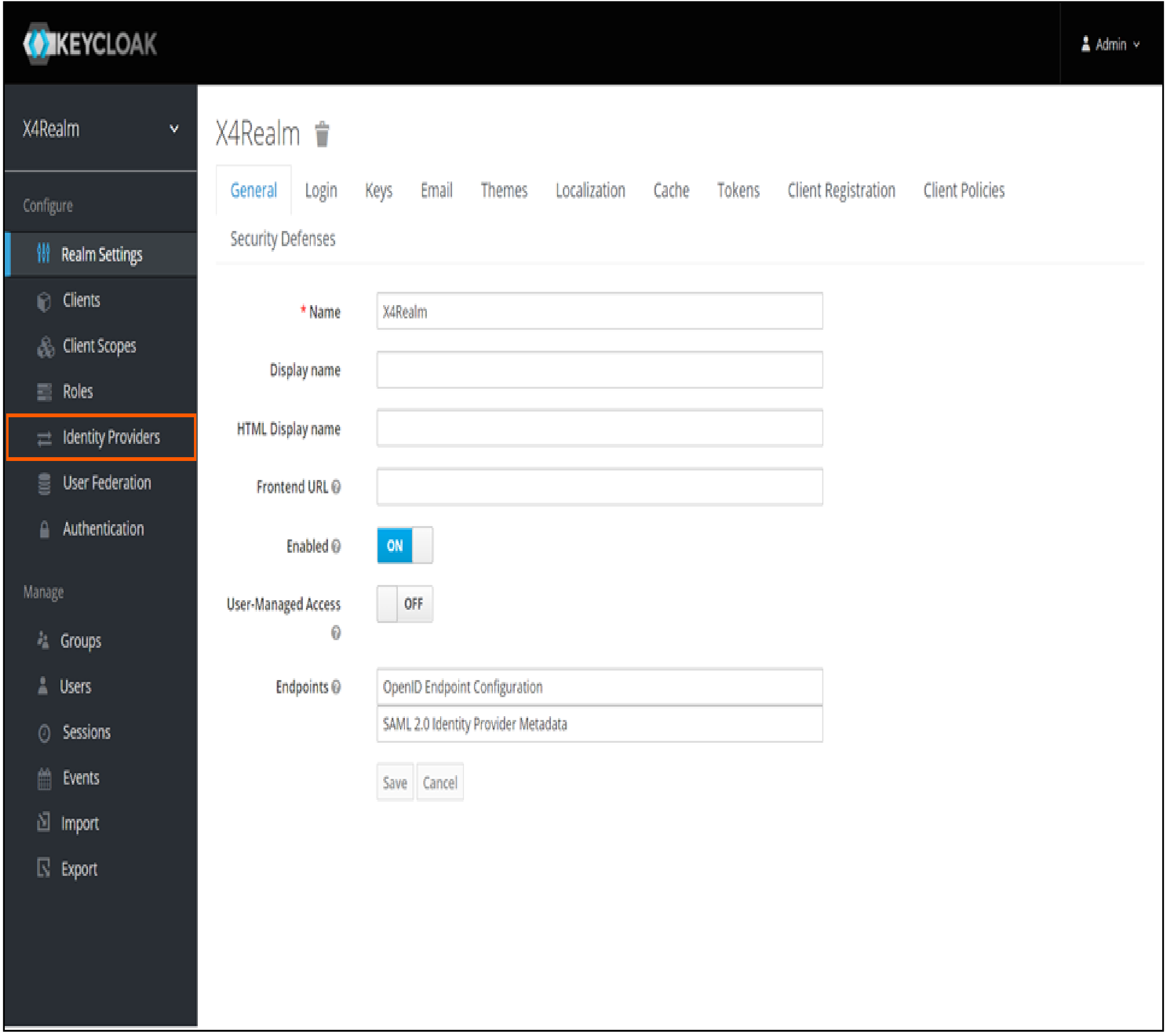
> For more information, visit https://www.keycloak.org/docs/latest/server_admin/#social-identity-providers.

6.3.8 Connect OpenID Connect

In Keycloak, you can connect to an existing OpenID Connect provider. The identity provider has to support the Authorization Code Flow to authenticate the user and authorize access.

1. Open the **Keycloak Administration Console**.

2. In the **Manage** section, click **Identity Providers**.



* Name: X4Realm

Display name:

HTML Display name:

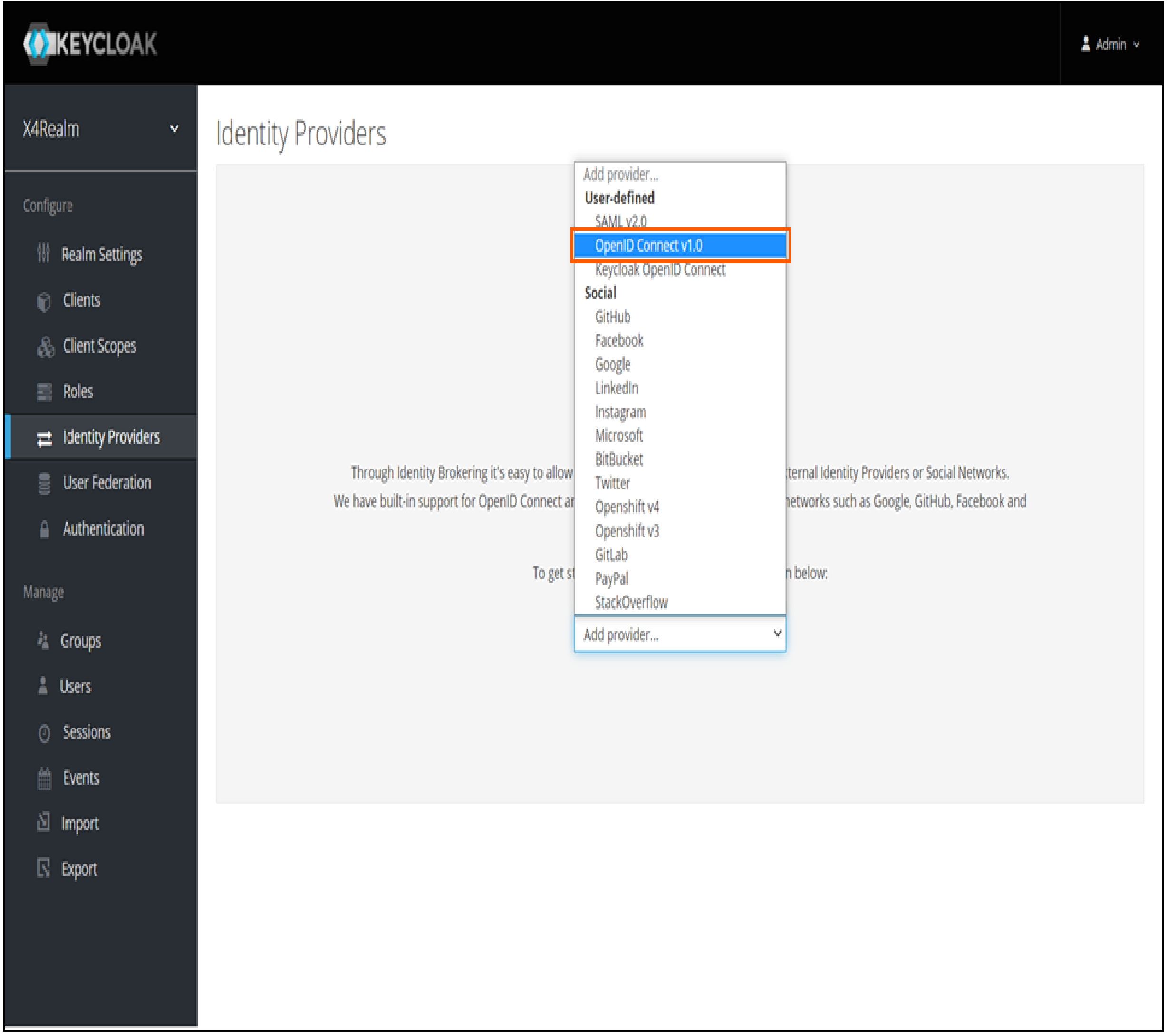
Frontend URL:

Enabled: ON

User-Managed Access: OFF

Endpoints: OpenID Endpoint Configuration
SAML 2.0 Identity Provider Metadata

3. From the drop-down list, choose the **OpenID Connect v1.0** option.



For more information, visit https://www.keycloak.org/docs/latest/server_admin/#_identity_broker_oidc.

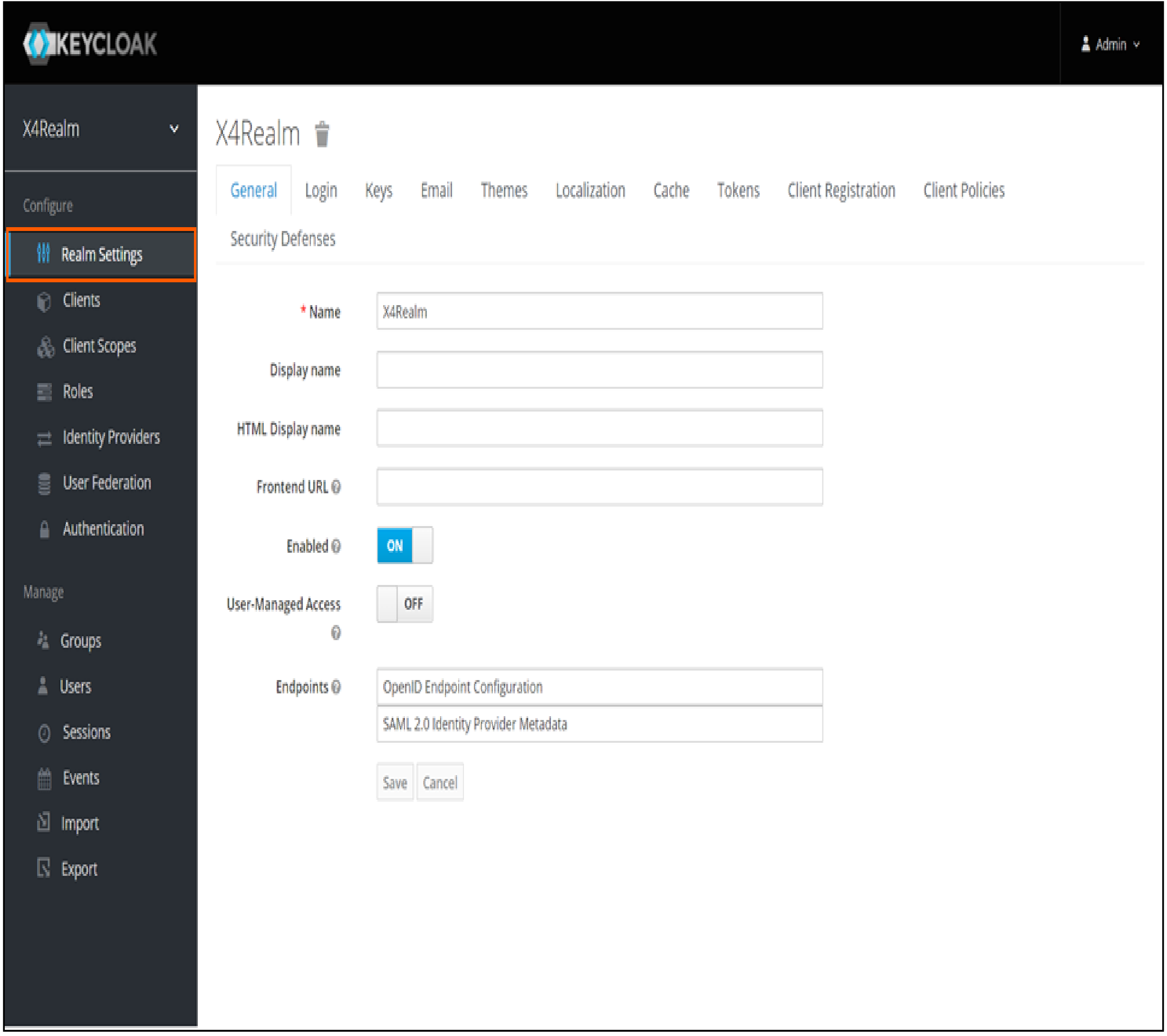
6.3.9 Login page

6.3.9.1 Remember Me button

The Remember Me button can be enabled in the Keycloak Administration Console in the Realm Settings menu.

1. Open the **Keycloak Administration Console**.

2. In the **Configure** section, click **Realm Settings**.



X4Realm

* Name: X4Realm

Display name:

HTML Display name:

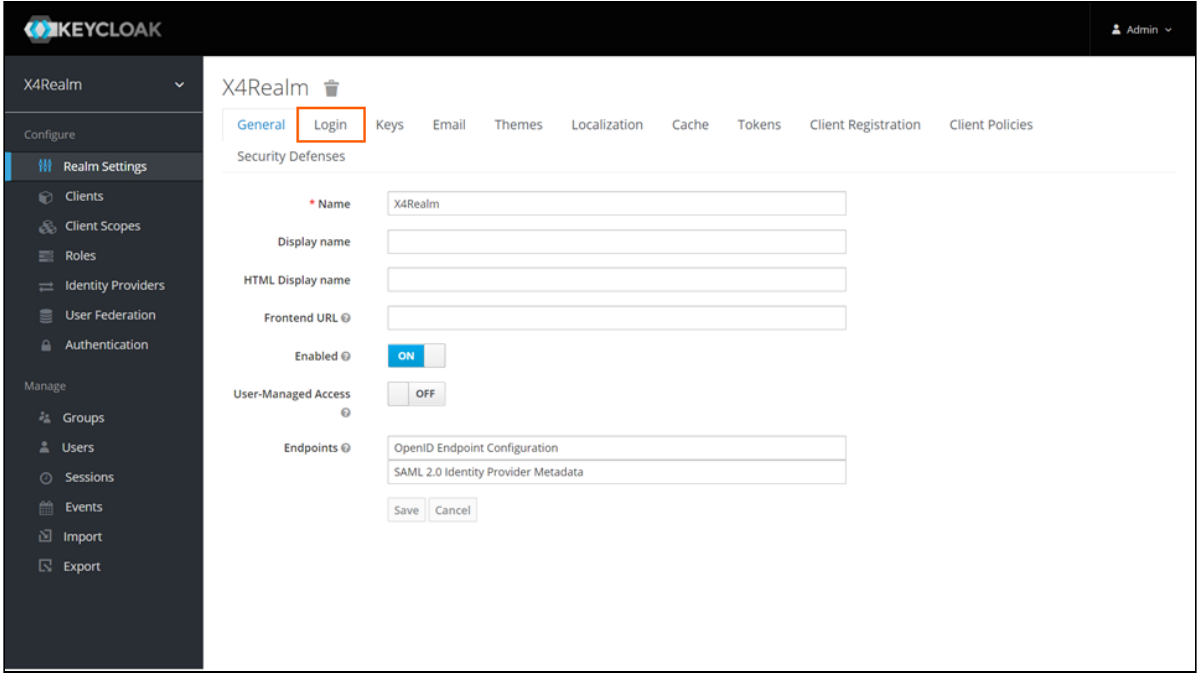
Frontend URL:

Enabled: ON

User-Managed Access: OFF

Endpoints: OpenID Endpoint Configuration; SAML 2.0 Identity Provider Metadata

3. Switch to the **Login** tab.



* Name: X4Realm

Display name:

HTML Display name:

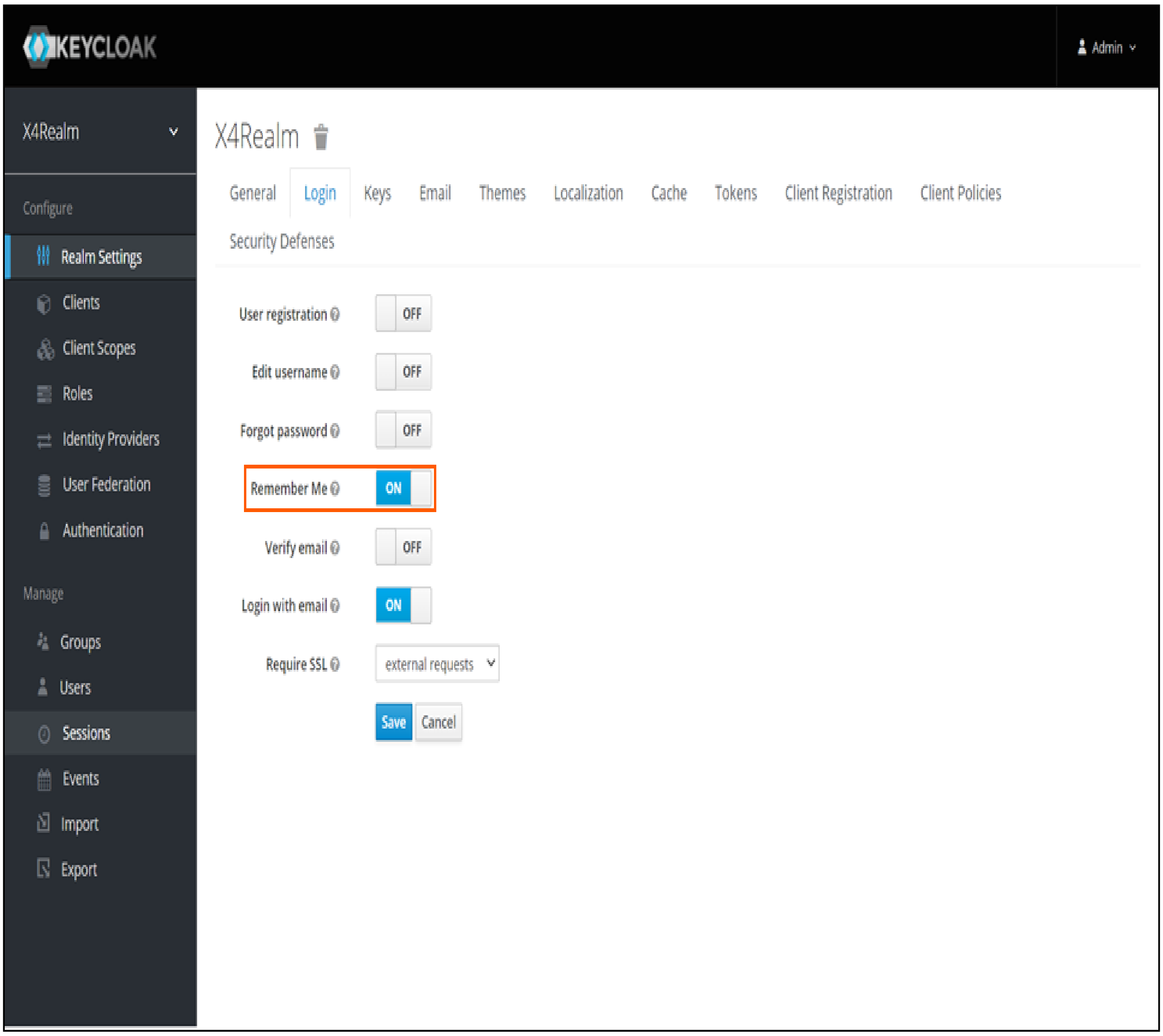
Frontend URL:

Enabled: ON

User-Managed Access: OFF

Endpoints: OpenID Endpoint Configuration, SAML 2.0 Identity Provider Metadata

4. Set the **Remember Me** slider value to **ON**.



User registration: OFF

Edit username: OFF

Forgot password: OFF

Remember Me: ON

Verify email: OFF

Login with email: ON

Require SSL: external requests

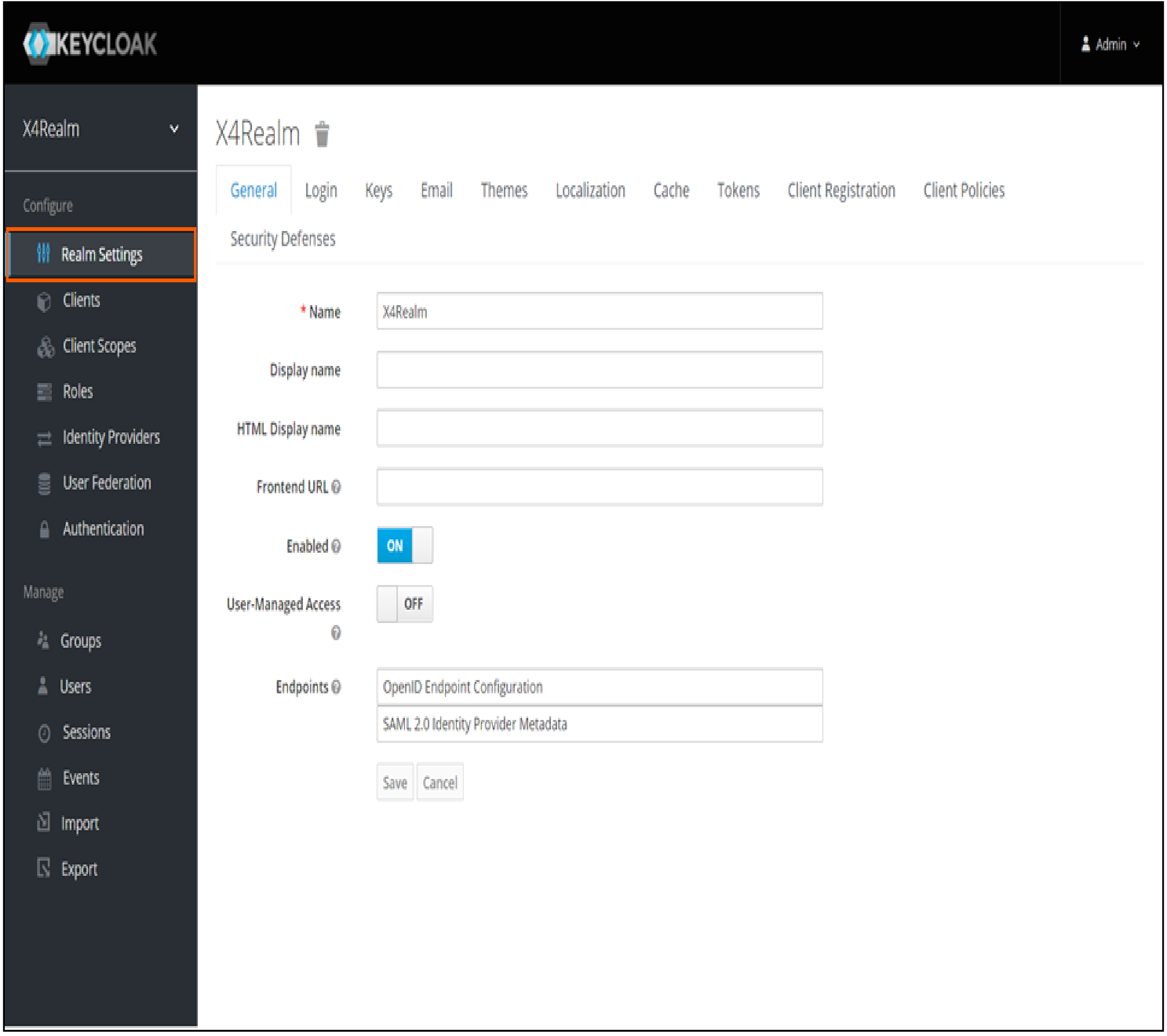
5. Click **Save**.

6.3.9.2 Create Forgot Password button

The Forgot Password button can be enabled in the Keycloak Administration Console in the Realm Settings menu.

1. Open the **Keycloak Administration Console**.

2. In the **Configure** section, click **Realm Settings**.



* Name: X4Realm

Display name:

HTML Display name:

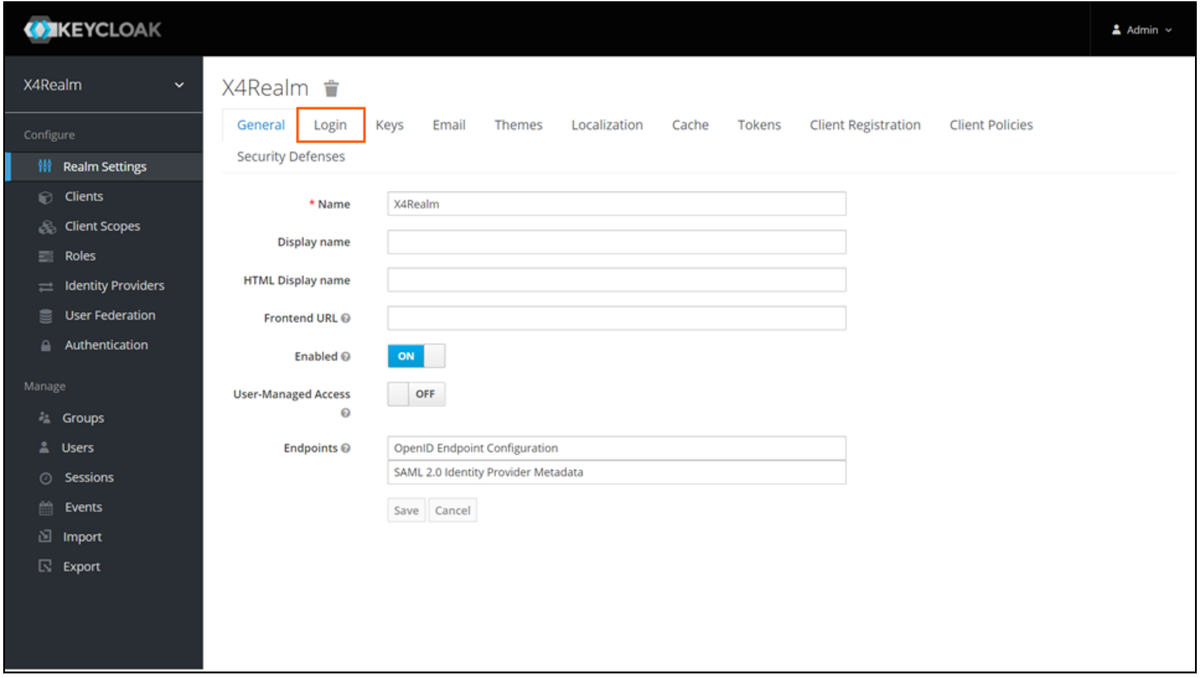
Frontend URL:

Enabled: ON

User-Managed Access: OFF

Endpoints: OpenID Endpoint Configuration, SAML 2.0 Identity Provider Metadata

3. Switch to the **Login** tab.



* Name: X4Realm

Display name:

HTML Display name:

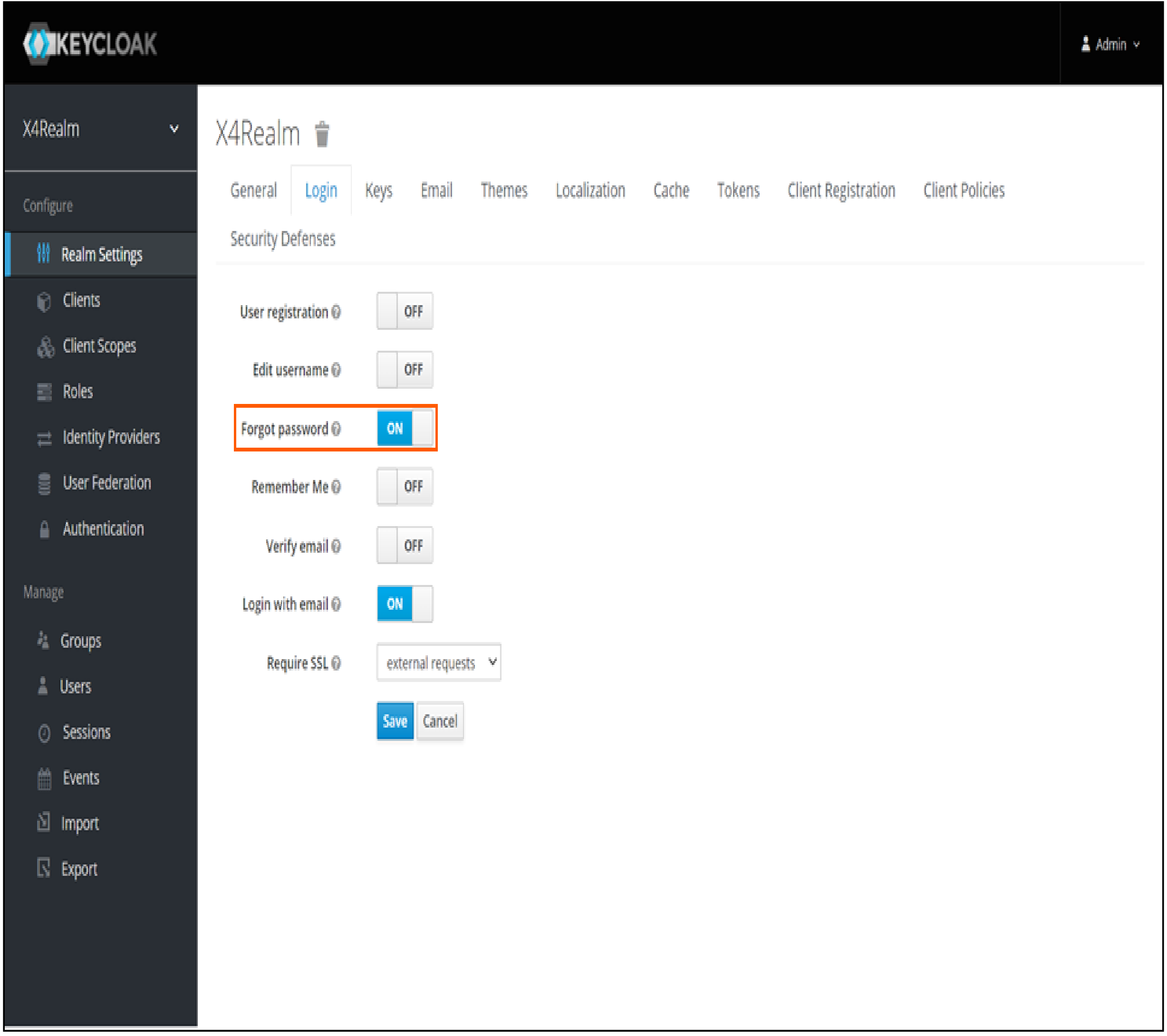
Frontend URL:

Enabled: ON

User-Managed Access: OFF

Endpoints: OpenID Endpoint Configuration, SAML 2.0 Identity Provider Metadata

4. Set the **Forgot password** slider value to **ON**.



User registration OFF

Edit username OFF

Forgot password ON

Remember Me OFF

Verify email OFF

Login with email ON

Require SSL external requests

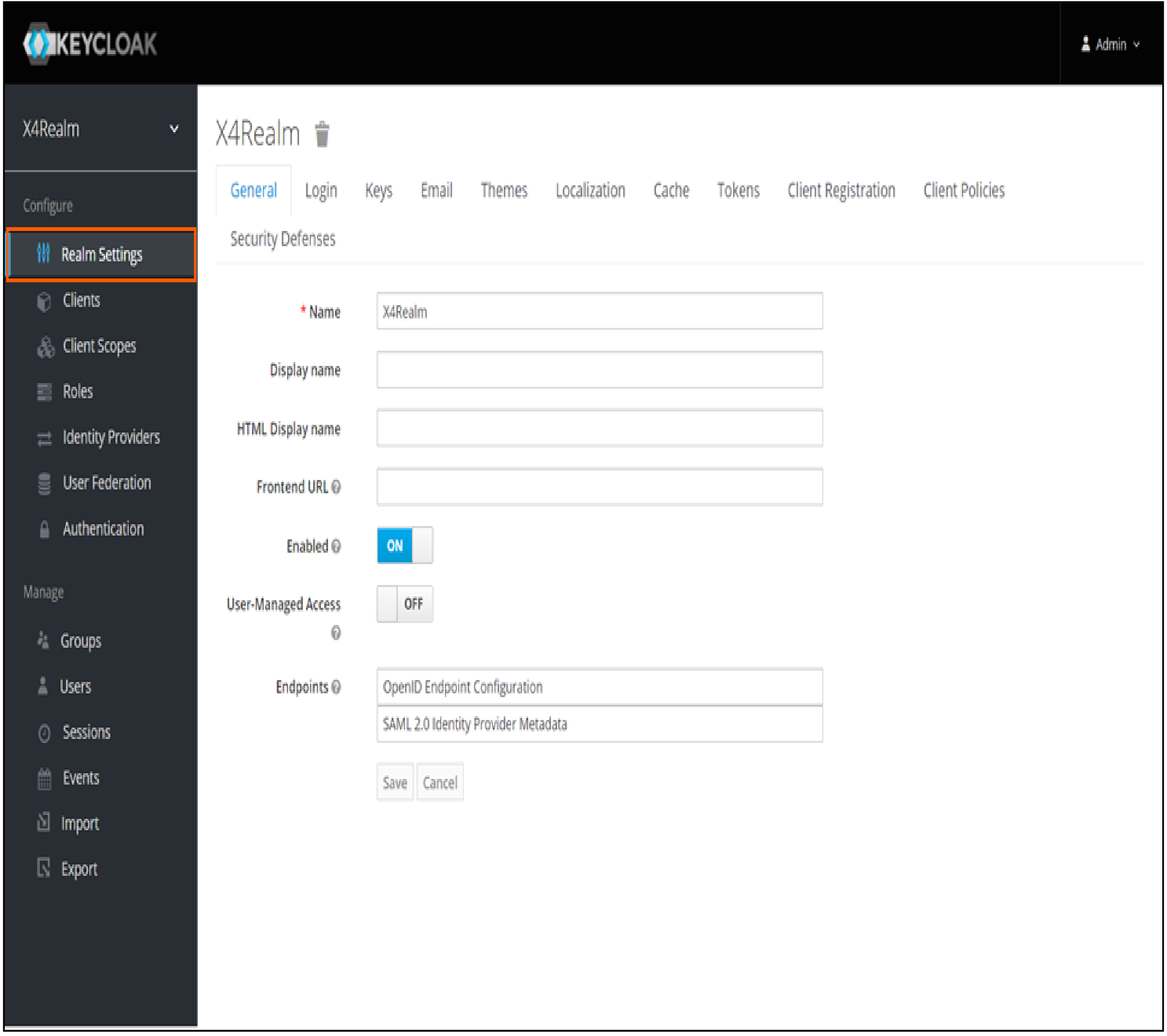
5. Click **Save**.

6.3.9.3 Activate user registration

The Register button can be enabled in the Keycloak Administration Console in the Realm Settings menu.

1. Open the **Keycloak Administration Console**.

2. In the **Configure** section, click **Realm Settings**.



X4Realm

* Name: X4Realm

Display name:

HTML Display name:

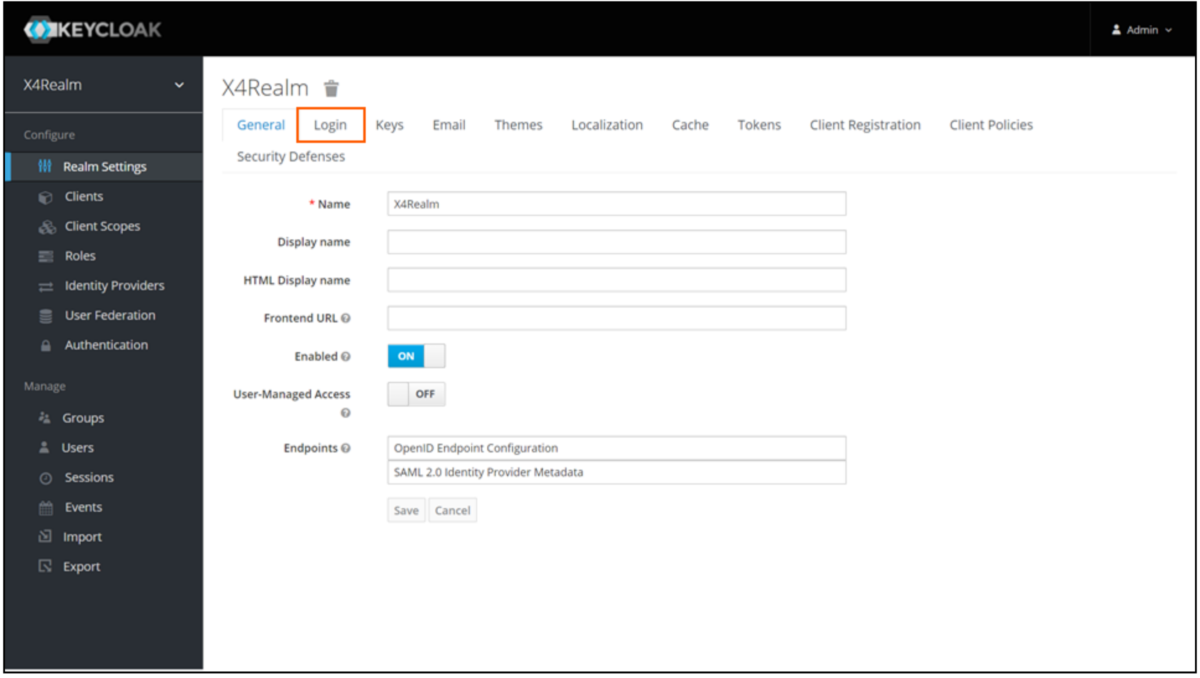
Frontend URL:

Enabled: ON

User-Managed Access: OFF

Endpoints: OpenID Endpoint Configuration
SAML 2.0 Identity Provider Metadata

3. Switch to the **Login** tab.



* Name: X4Realm

Display name:

HTML Display name:

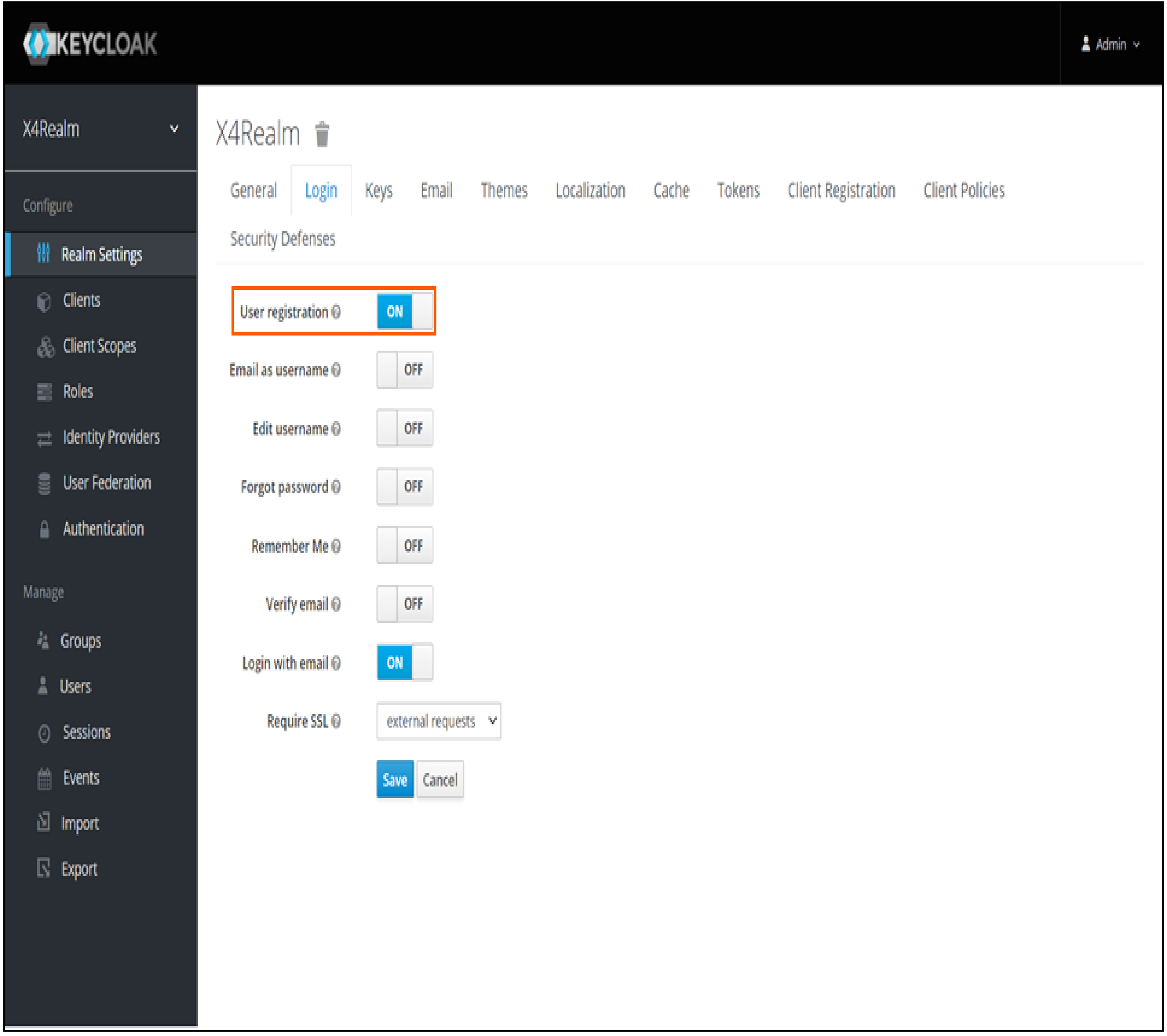
Frontend URL:

Enabled: ON

User-Managed Access: OFF

Endpoints: OpenID Endpoint Configuration
SAML 2.0 Identity Provider Metadata

4. Set the value of the **User registration** slider to **ON**.



User registration: ON

Email as username: OFF

Edit username: OFF

Forgot password: OFF

Remember Me: OFF

Verify email: OFF

Login with email: ON

Require SSL: external requests

The **Email as username** slider will appear.

5. If the email used for registration is to be used as the username, set the value of the **Email as username** slider to **ON**.
6. Click **Save**.

6.3.10 Passwords

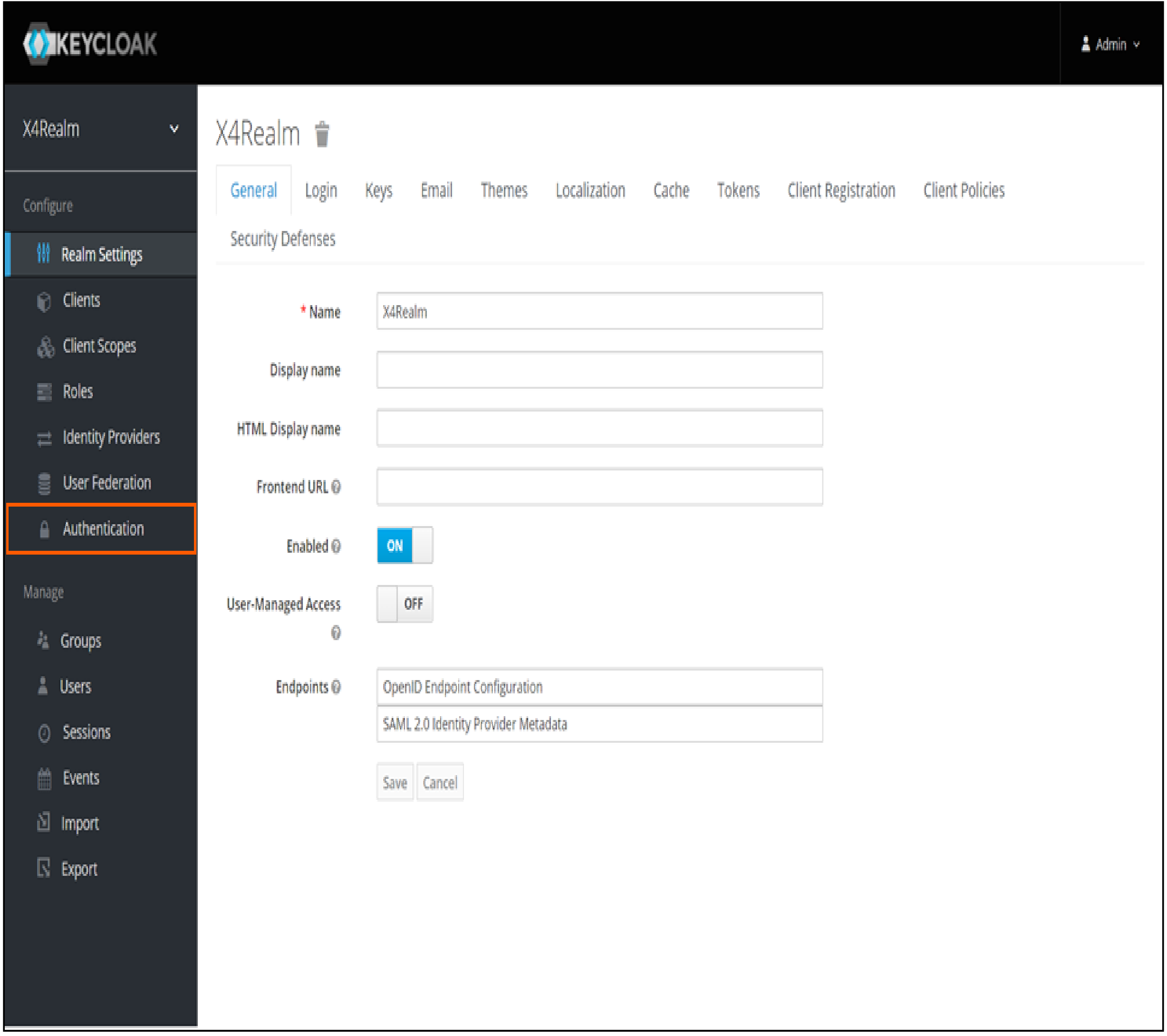
In Keycloak you can define various settings for passwords, for instance, password policies.

6.3.10.1 Set password policies

In Keycloak you can set different password policies.

1. Open the **Keycloak Administration Console**.

2. In the **Configure** section, click **Authentication**.



* Name: X4Realm

Display name:

HTML Display name:

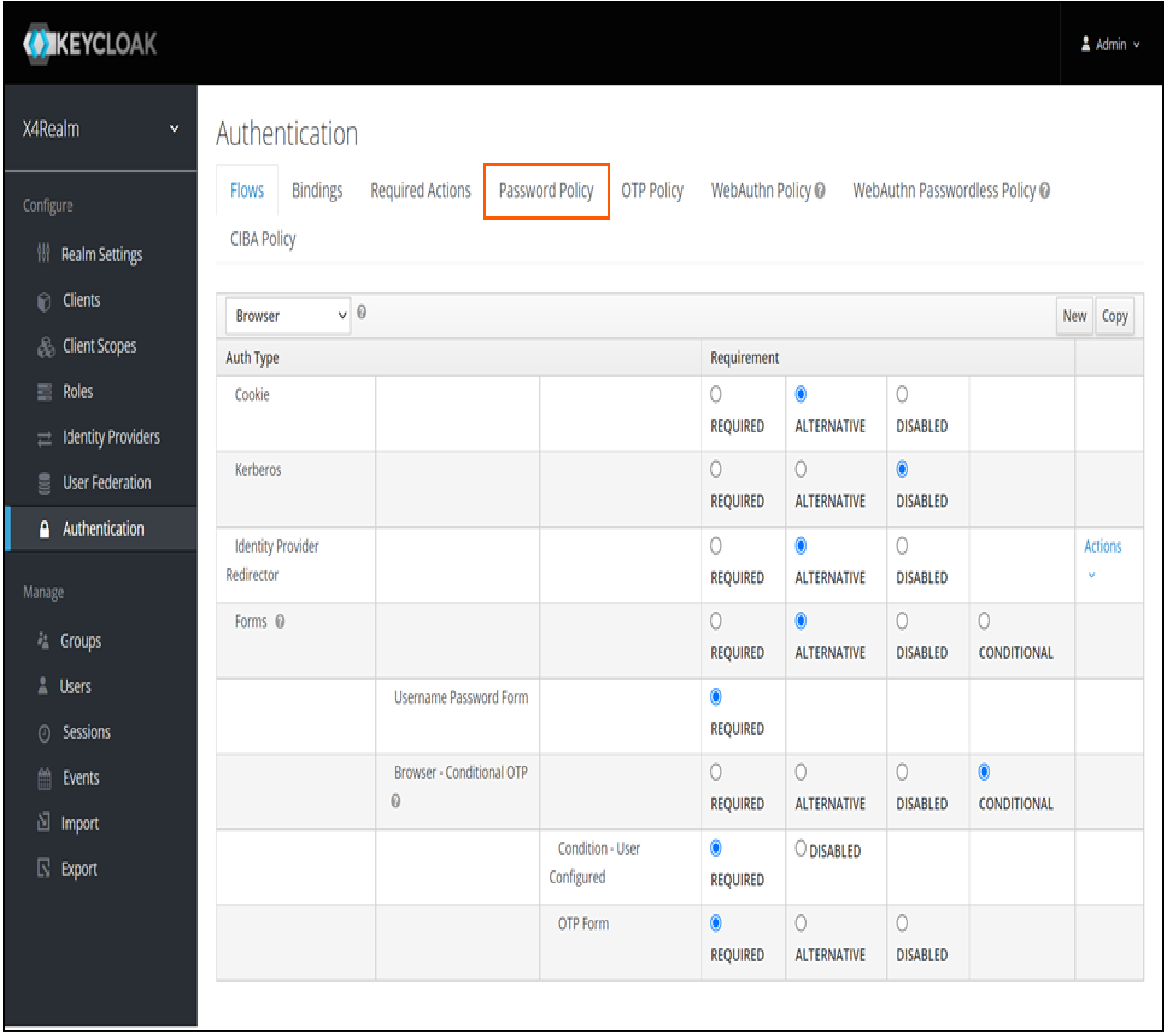
Frontend URL:

Enabled: ON

User-Managed Access: OFF

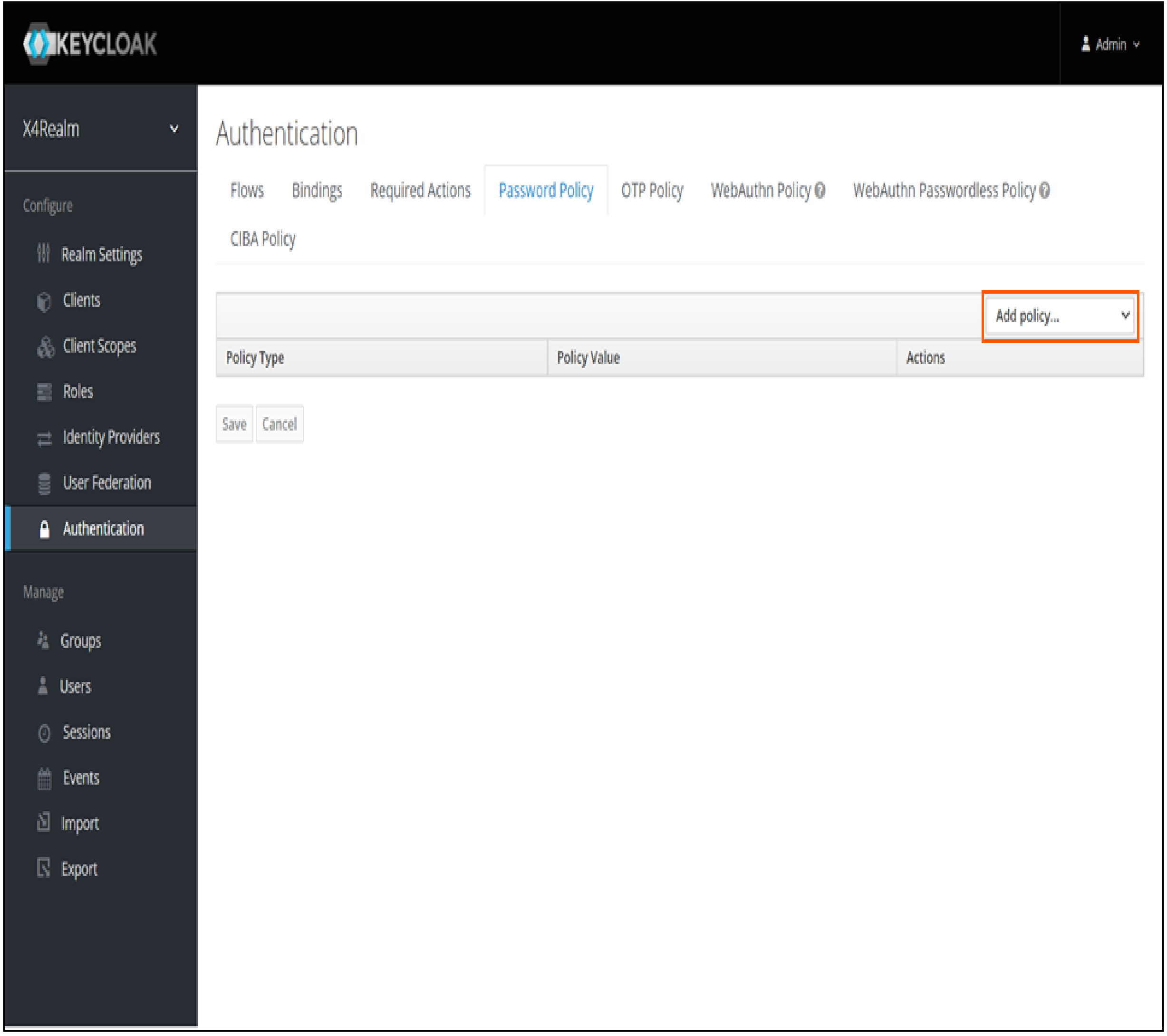
Endpoints: OpenID Endpoint Configuration
SAML 2.0 Identity Provider Metadata

3. Switch to the **Password Policy** tab.



Auth Type			Requirement				
Cookie			○ REQUIRED	● ALTERNATIVE	○ DISABLED		
Kerberos			○ REQUIRED	○ ALTERNATIVE	● DISABLED		
Identity Provider Redirector			○ REQUIRED	● ALTERNATIVE	○ DISABLED		Actions
Forms			○ REQUIRED	● ALTERNATIVE	○ DISABLED	○ CONDITIONAL	
	Username Password Form		● REQUIRED				
	Browser - Conditional OTP		○ REQUIRED	○ ALTERNATIVE	○ DISABLED	● CONDITIONAL	
		Condition - User Configured	● REQUIRED	○ DISABLED			
		OTP Form	● REQUIRED	○ ALTERNATIVE	○ DISABLED		

4. From the **Add policy** drop-down list, select the password policies you want to add.



5. Click **Save**.

✓ For more information, visit https://www.keycloak.org/docs/latest/server_admin/#password-policy-types.

6.3.11 Themes

You can use a predefined theme for the login page in Keycloak or design a custom login page.

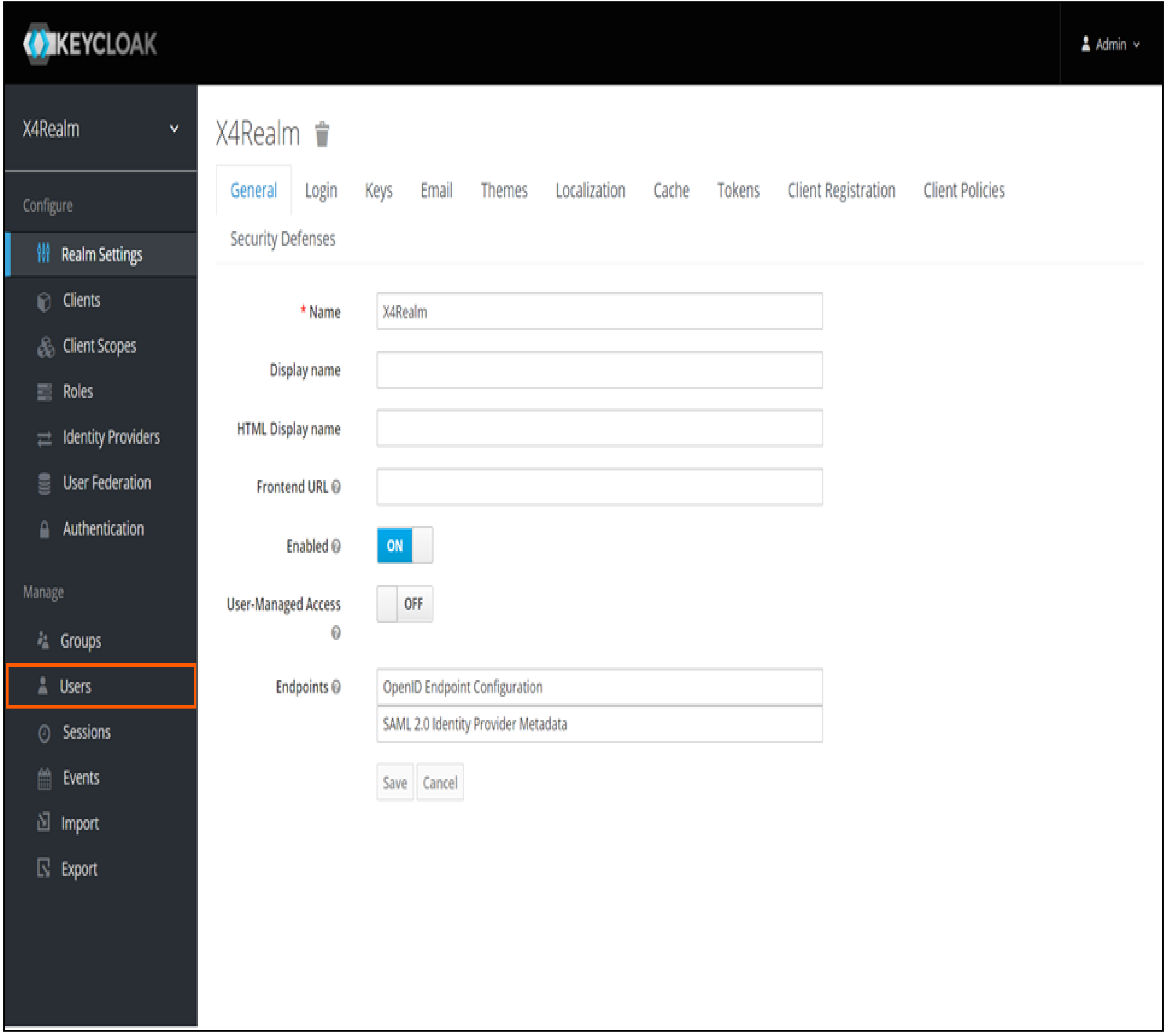
✓ For more information, visit https://www.keycloak.org/docs/latest/server_admin/#_themes.

6.4 Users

6.4.1 Create user

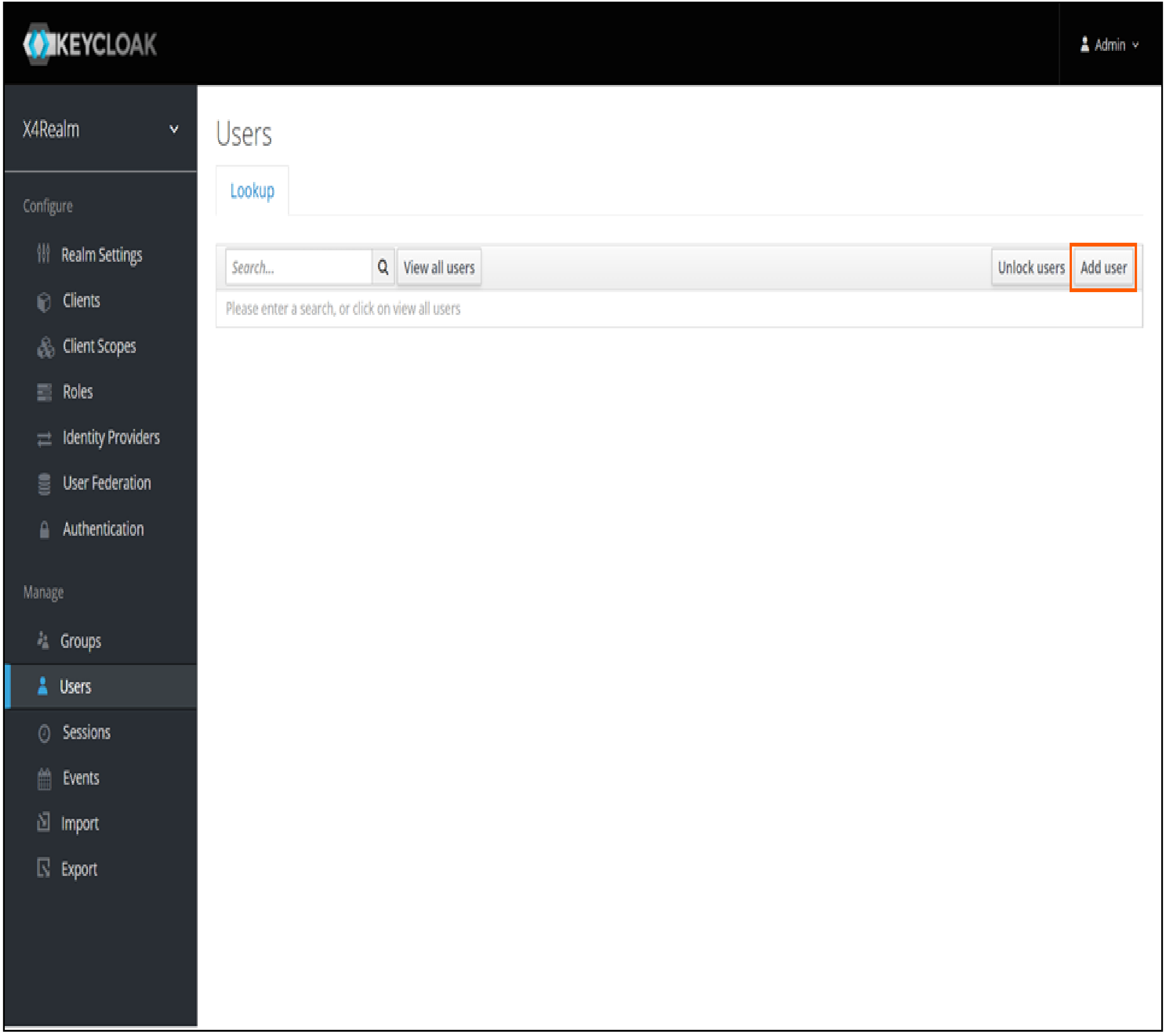
> ⚠ If a Web App uses the `Resource Owner Password Flow` authorization flow, a user with a temporary password cannot log in to that Web App.
> If you want to use temporary passwords, use the `Authorization Code Flow`.

1. Open the **Keycloak Administration Console**.
2. In the **Manage** section, click **Users**.



* Name	X4Realm
Display name	
HTML Display name	
Frontend URL	
Enabled	ON
User-Managed Access	OFF
Endpoints	OpenID Endpoint Configuration SAML 2.0 Identity Provider Metadata

3. On the **Lookup** tab, click **Add user**.



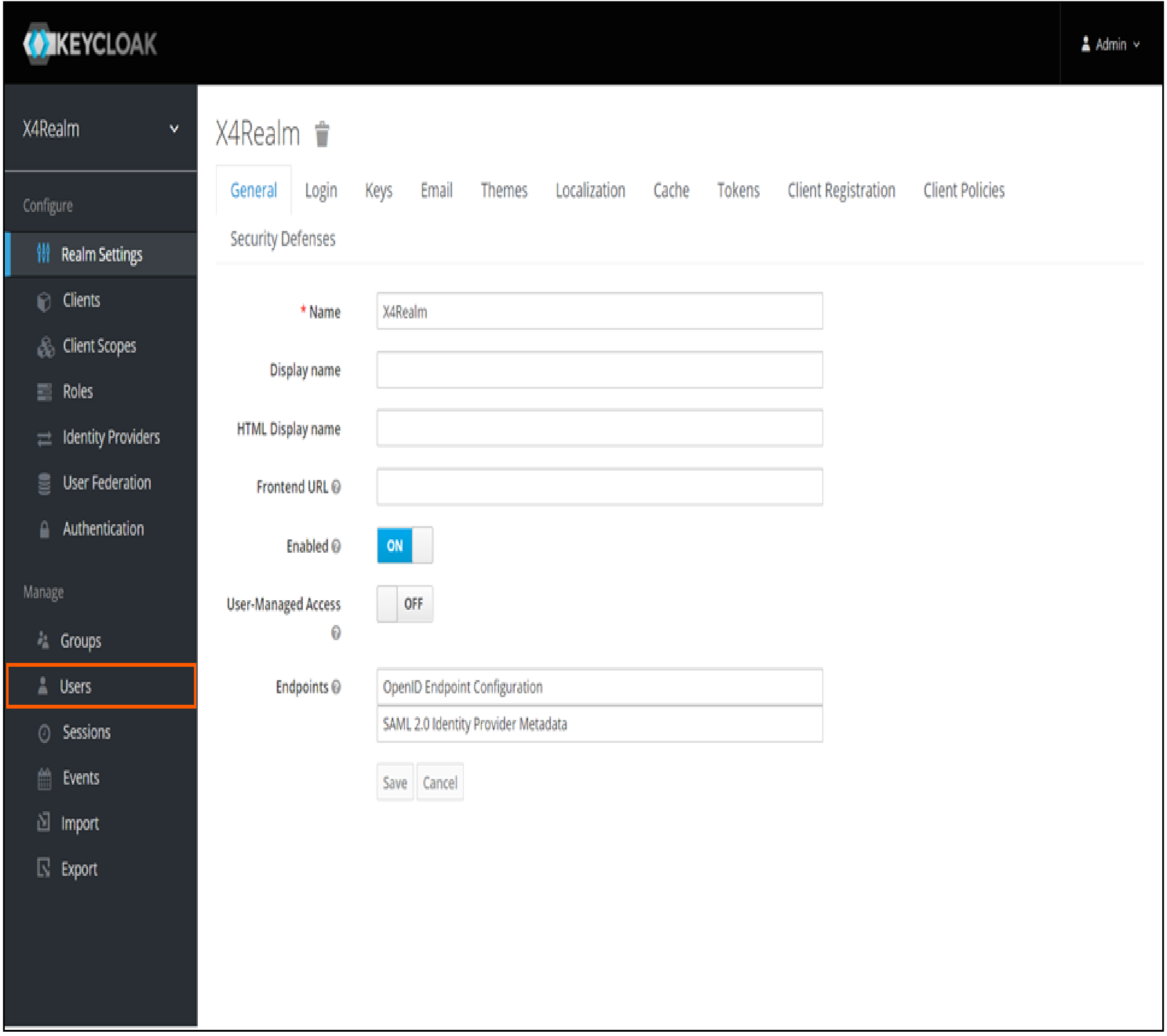
Please enter a search, or click on view all users

4. Enter the relevant data.
5. Click **Save**.

6.4.2 Assign a role to a user

1. Open the **Keycloak Administration Console**.

2. In the **Manage** section, click **Users**.



* Name: X4Realm

Display name:

HTML Display name:

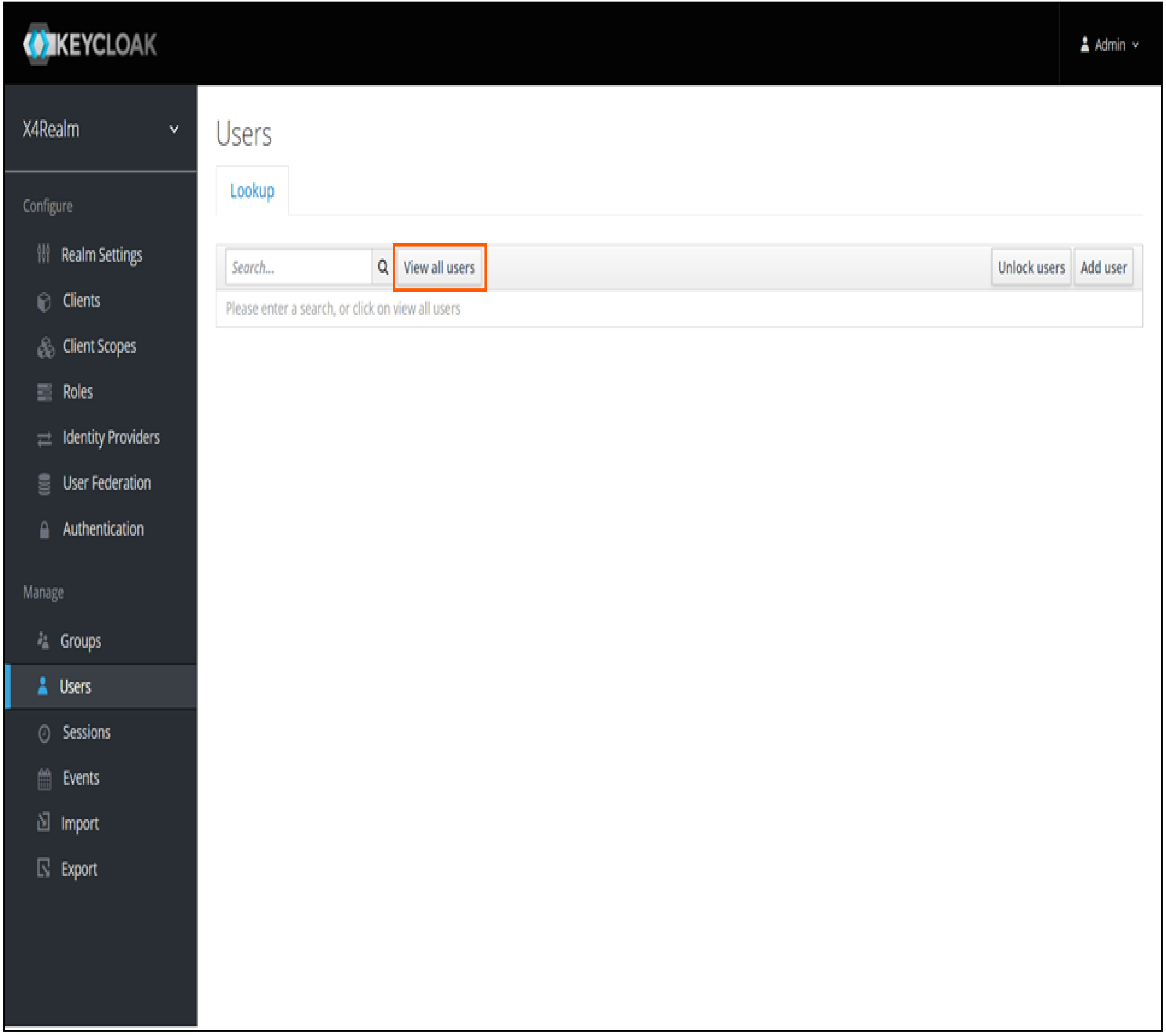
Frontend URL:

Enabled: ON

User-Managed Access: OFF

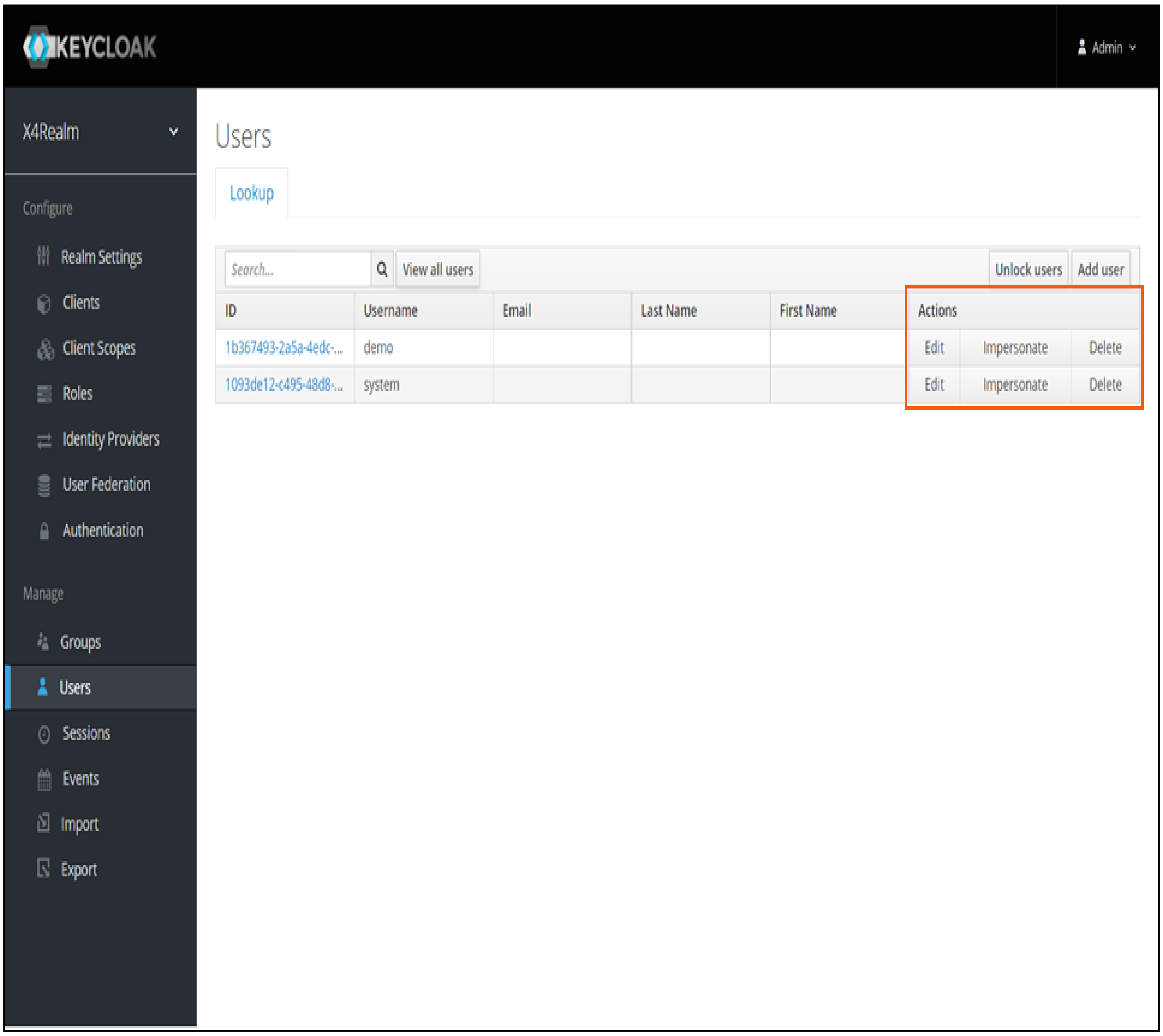
Endpoints: OpenID Endpoint Configuration
SAML 2.0 Identity Provider Metadata

3. To list all users, click **View all users** in the **Lookup** tab.



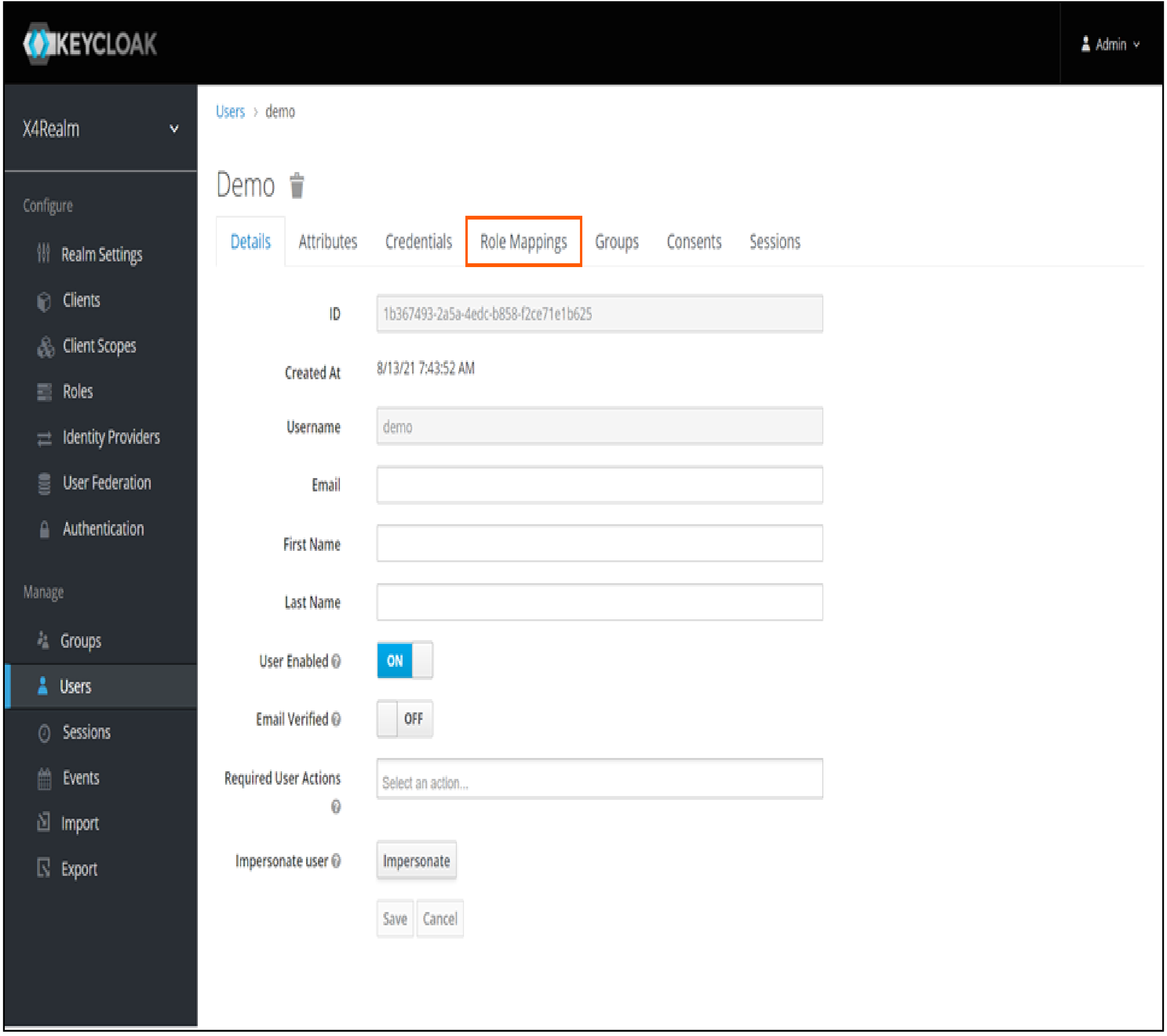
Please enter a search, or click on view all users

4. In the row of the desired user, click **Edit** in the **Actions** column.



ID	Username	Email	Last Name	First Name	Actions		
1b367493-2a5a-4edc-...	demo				Edit	Impersonate	Delete
1093de12-c495-48d8-...	system				Edit	Impersonate	Delete

5. Switch to the **Role Mappings** tab.



ID: 1b367493-2a5a-4edc-b858-f2ce71e1b625

Created At: 8/13/21 7:43:52 AM

Username: demo

Email:

First Name:

Last Name:

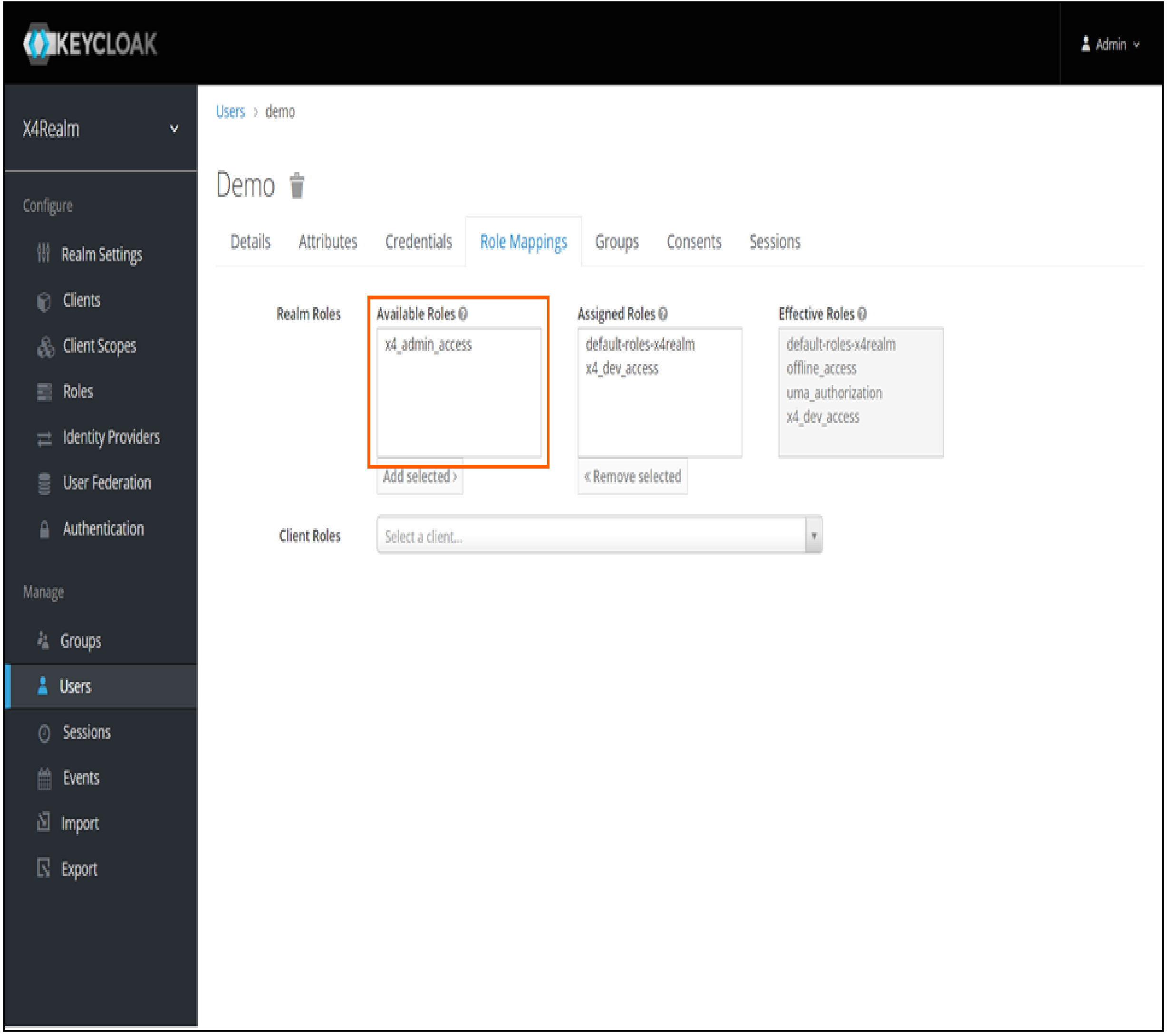
User Enabled: ON

Email Verified: OFF

Required User Actions: Select an action...

Impersonate user: Impersonate

6. In the **Available Roles** area, select the role to be assigned to the user.



Realm Roles

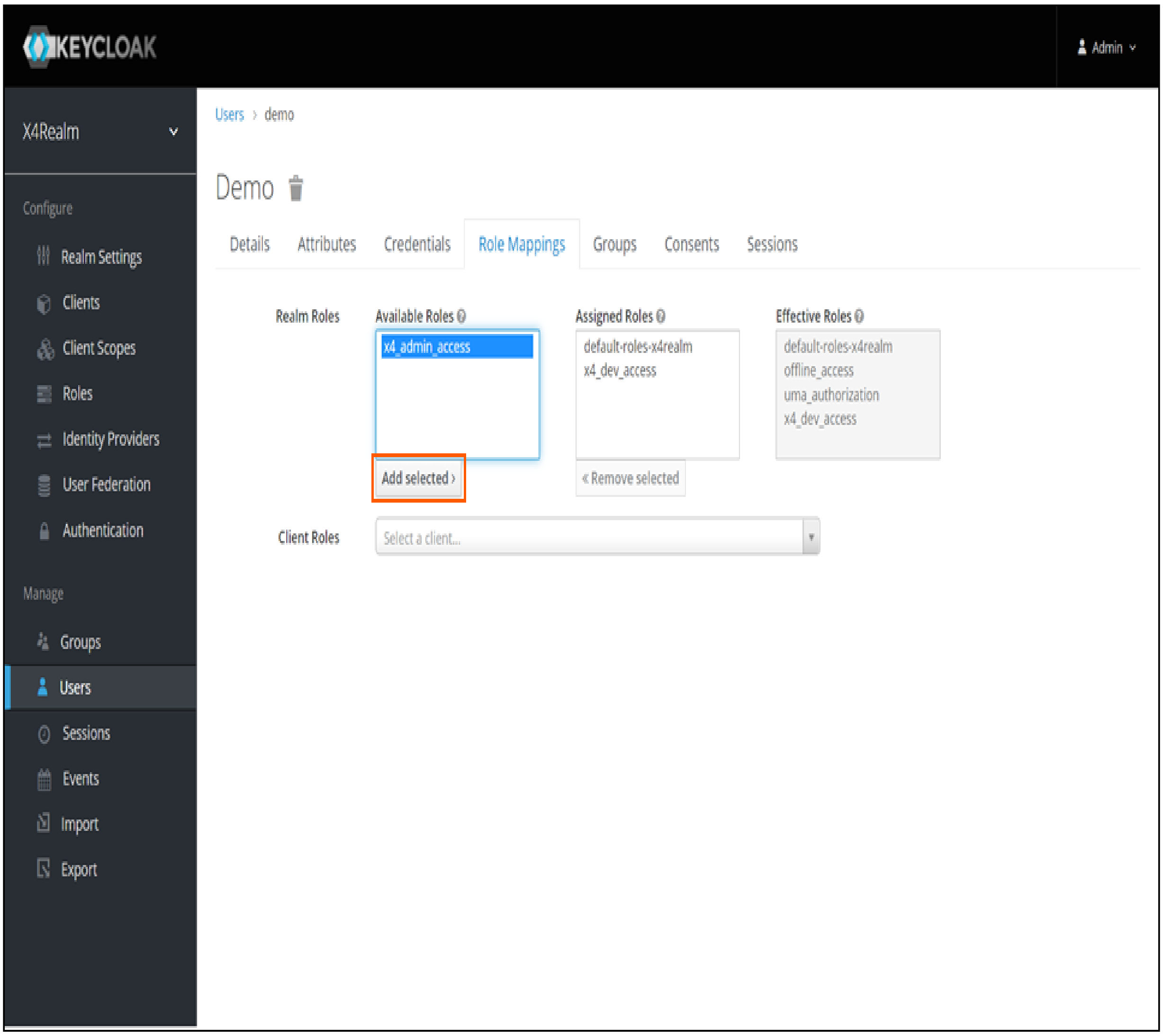
Available Roles: x4_admin_access

Assigned Roles: default-roles-x4realm, x4_dev_access

Effective Roles: default-roles-x4realm, offline_access, uma_authorization, x4_dev_access

Client Roles

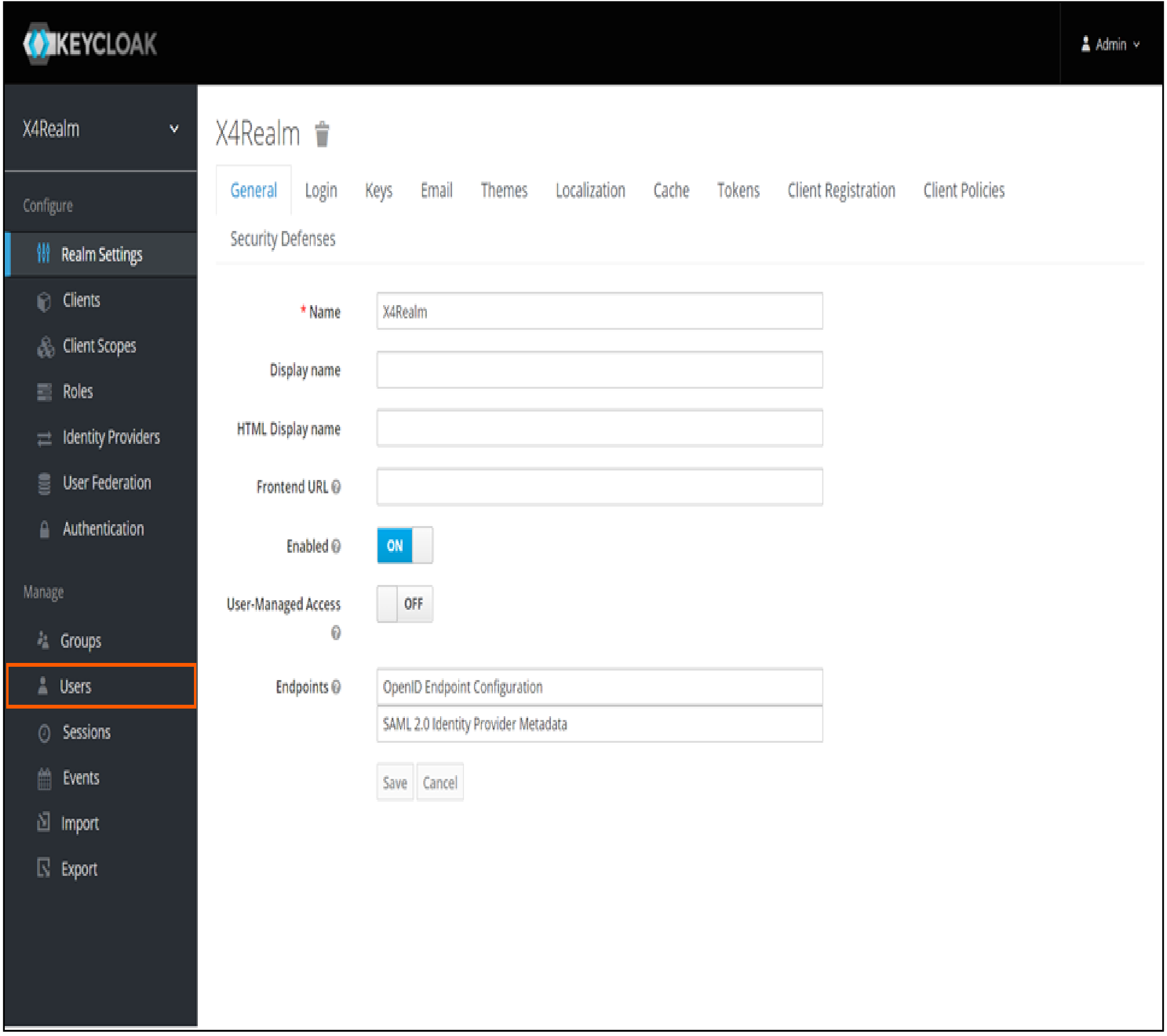
7. Click **Add selected**.



6.4.3 Assign user to a group

1. Open the **Keycloak Administration Console**.

2. In the **Manage** section, click **Users**.



* Name: X4Realm

Display name:

HTML Display name:

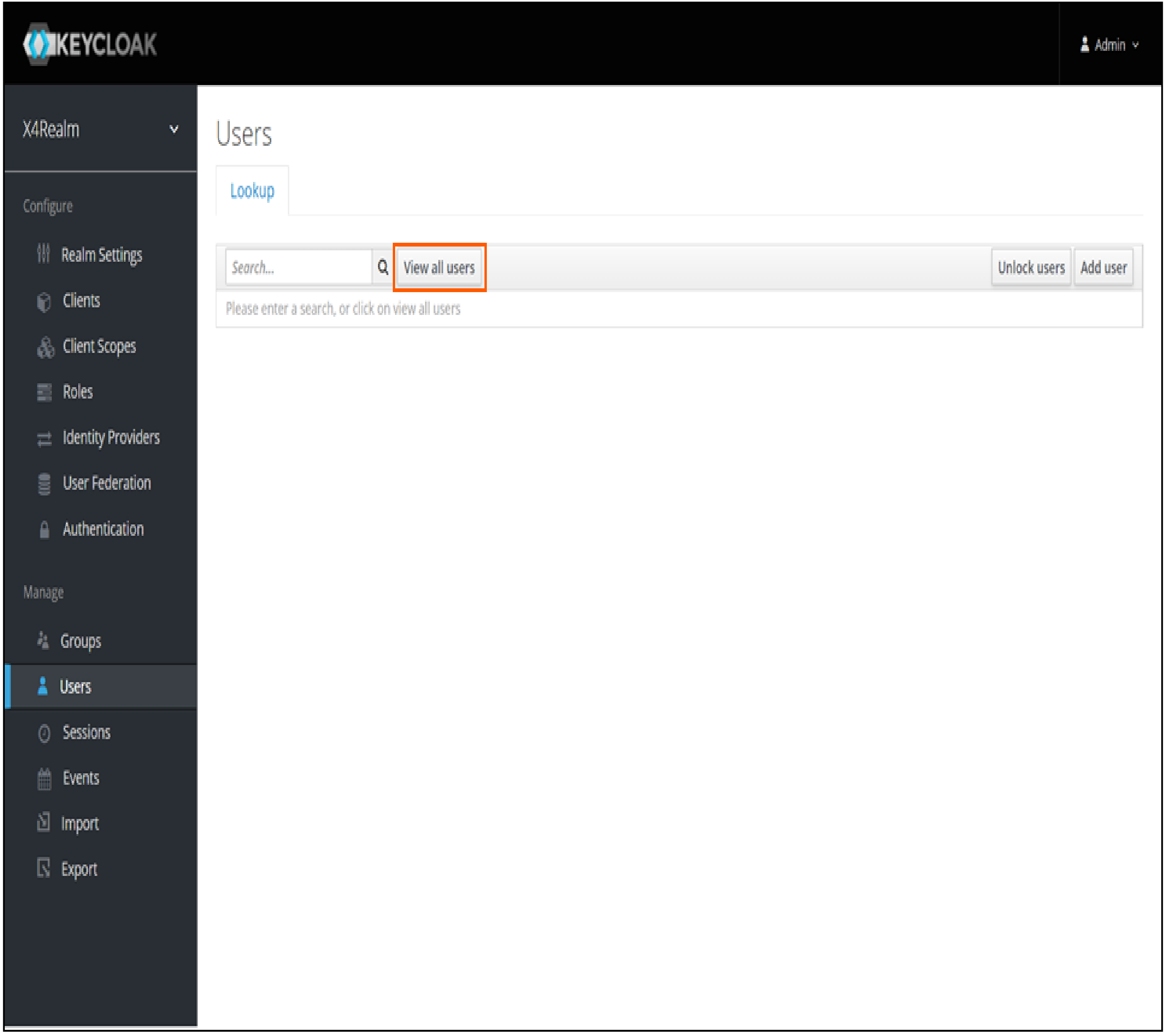
Frontend URL:

Enabled: ON

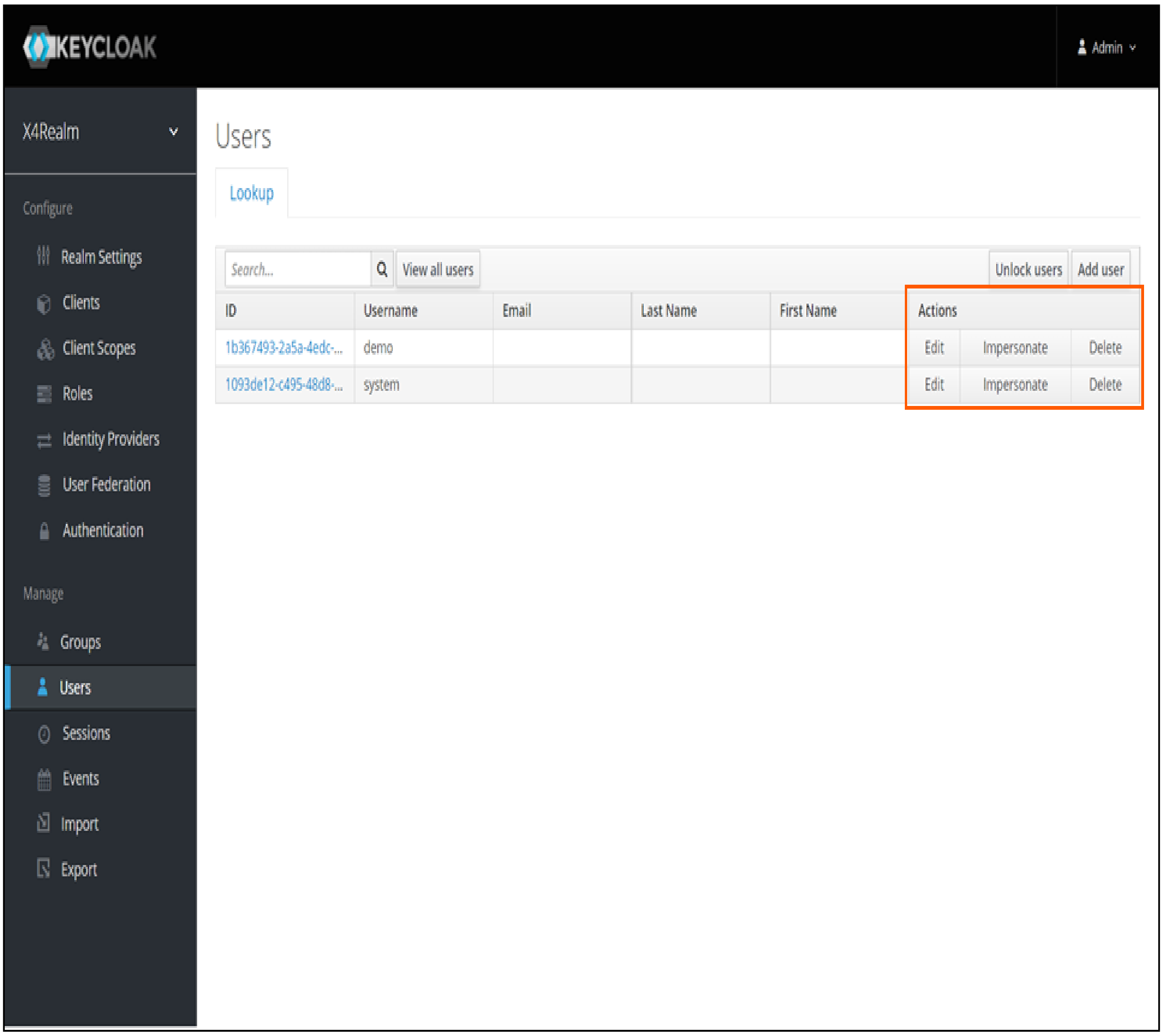
User-Managed Access: OFF

Endpoints: OpenID Endpoint Configuration, SAML 2.0 Identity Provider Metadata

3. To list all users, click **View all users** in the **Lookup** tab.

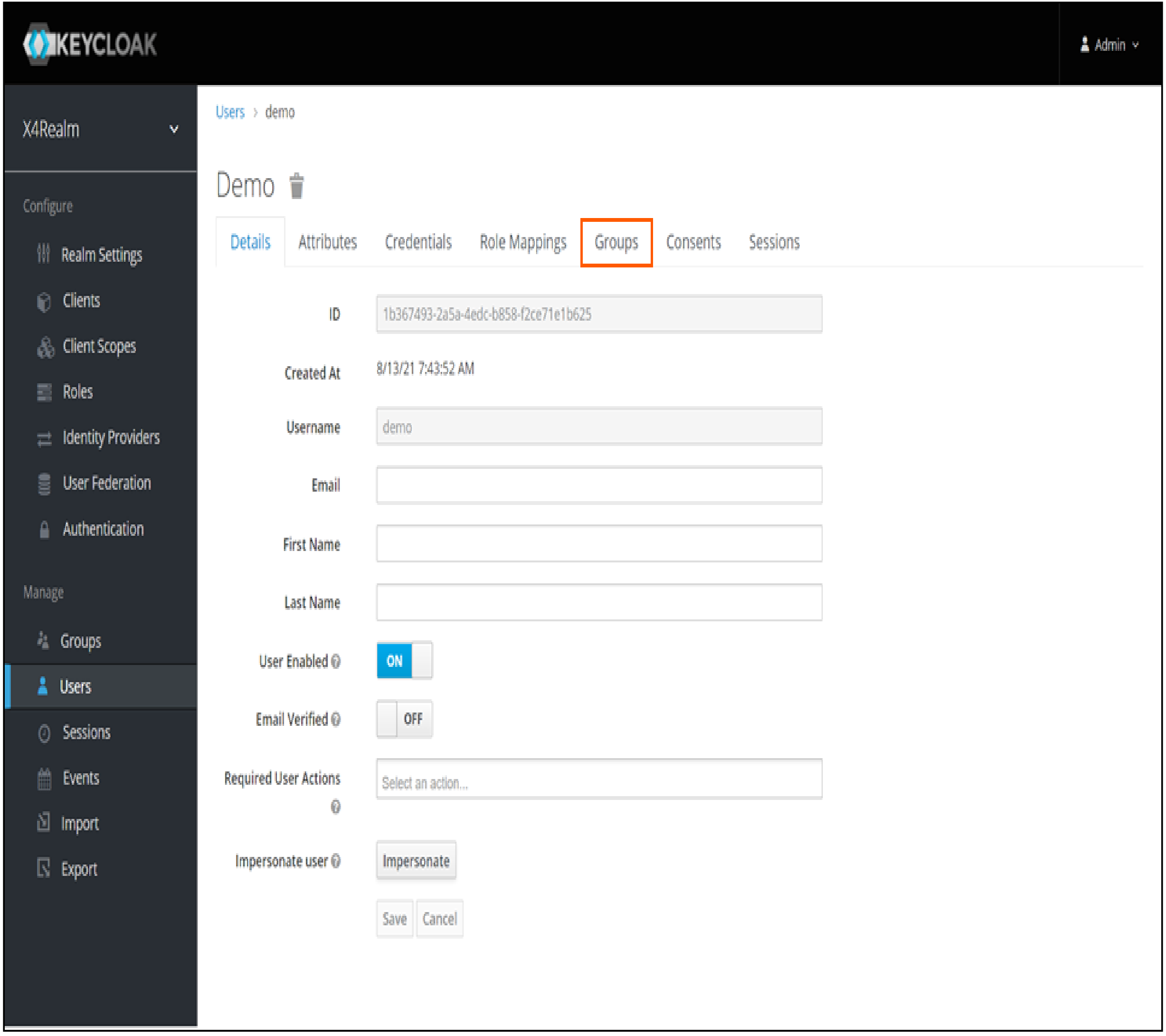


4. In the row of the desired user, click **Edit** in the **Actions** column.



ID	Username	Email	Last Name	First Name	Actions		
1b367493-2a5a-4edc-...	demo				Edit	Impersonate	Delete
1093de12-c495-48d8-...	system				Edit	Impersonate	Delete

5. Switch to the **Groups** tab.



ID: 1b367493-2a5a-4edc-b858-f2ce71e1b625

Created At: 8/13/21 7:43:52 AM

Username: demo

Email:

First Name:

Last Name:

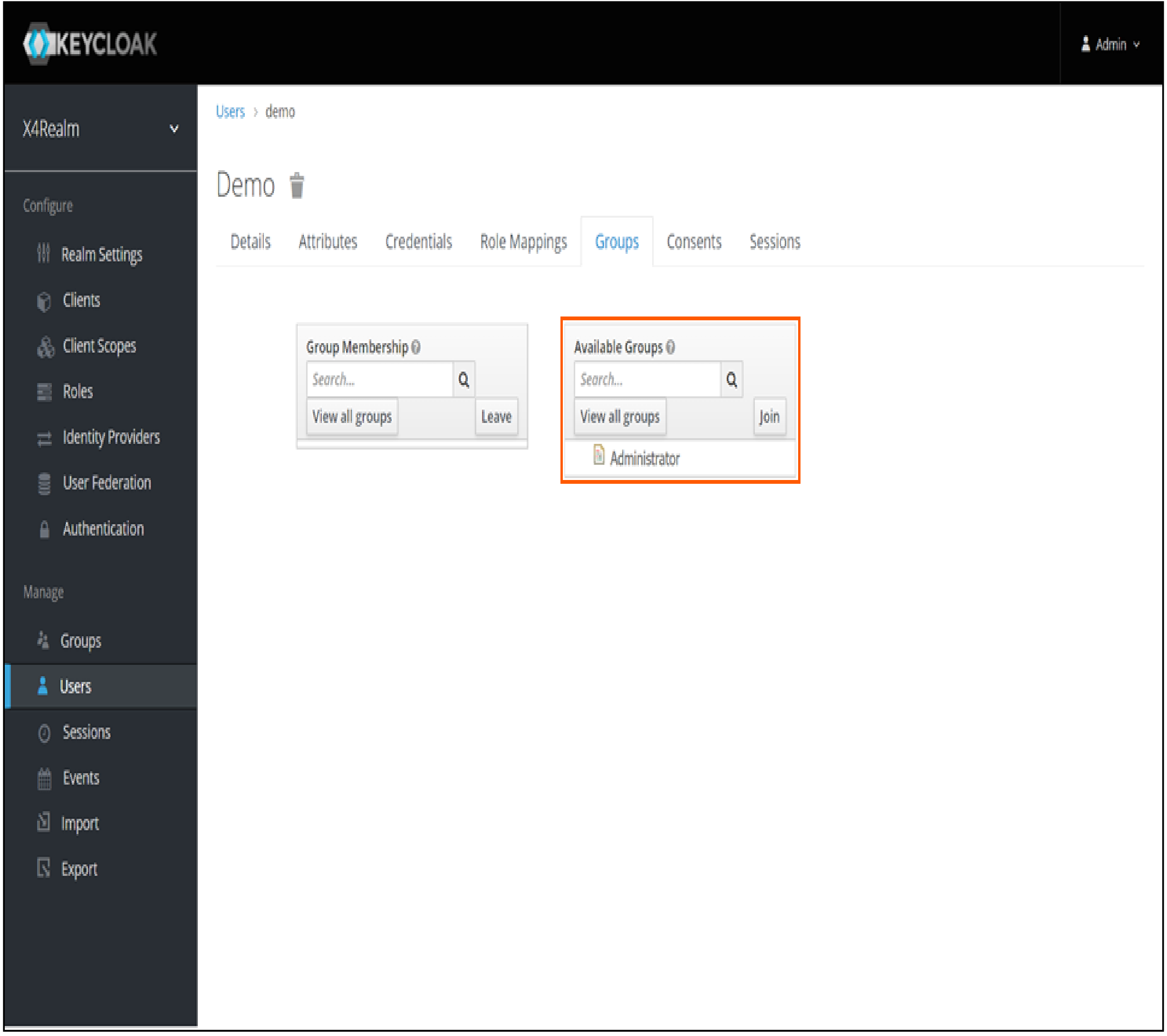
User Enabled: ON

Email Verified: OFF

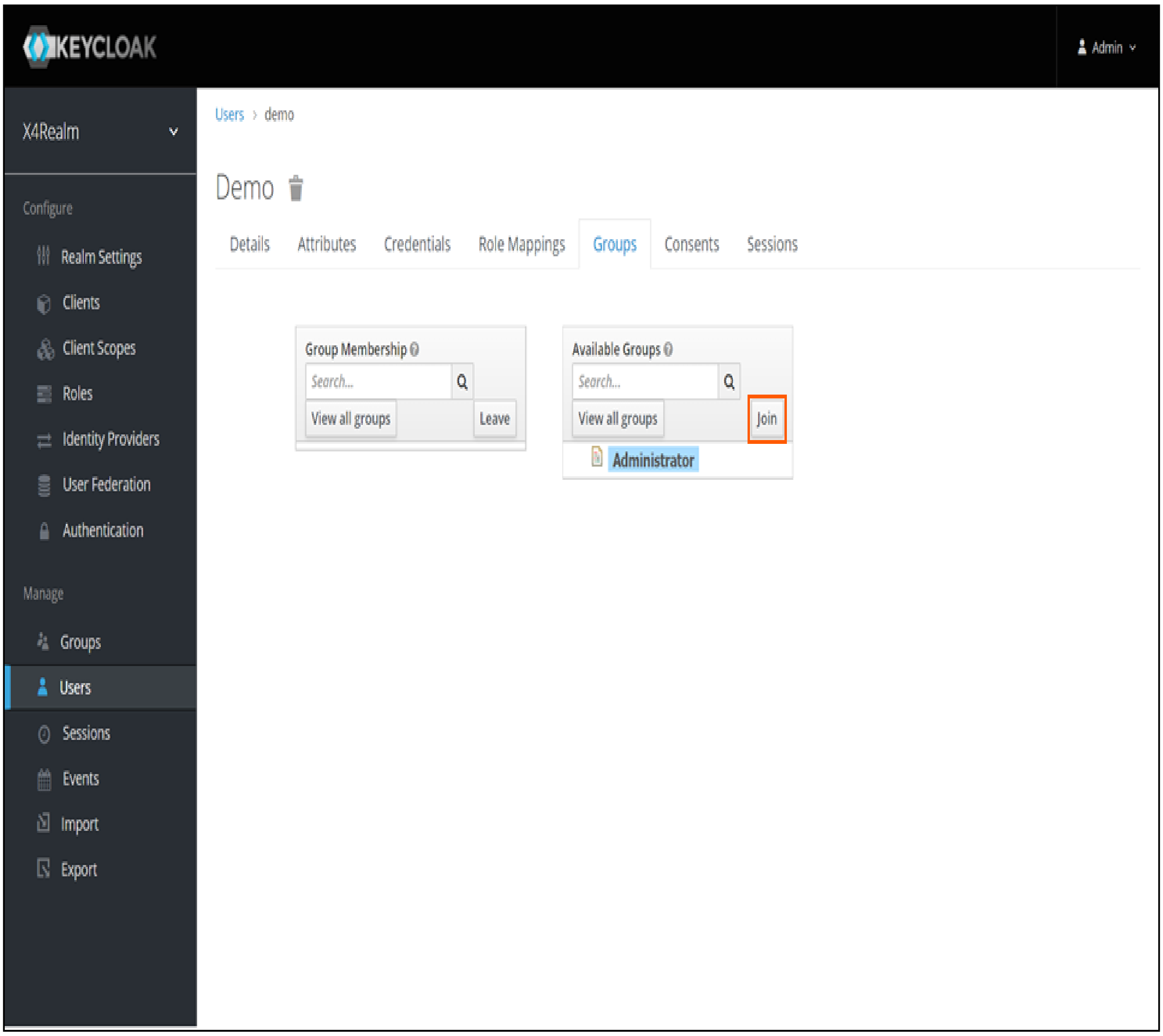
Required User Actions: Select an action...

Impersonate user: Impersonate

6. In the **Available Groups** area, select the group to be assigned to the user.



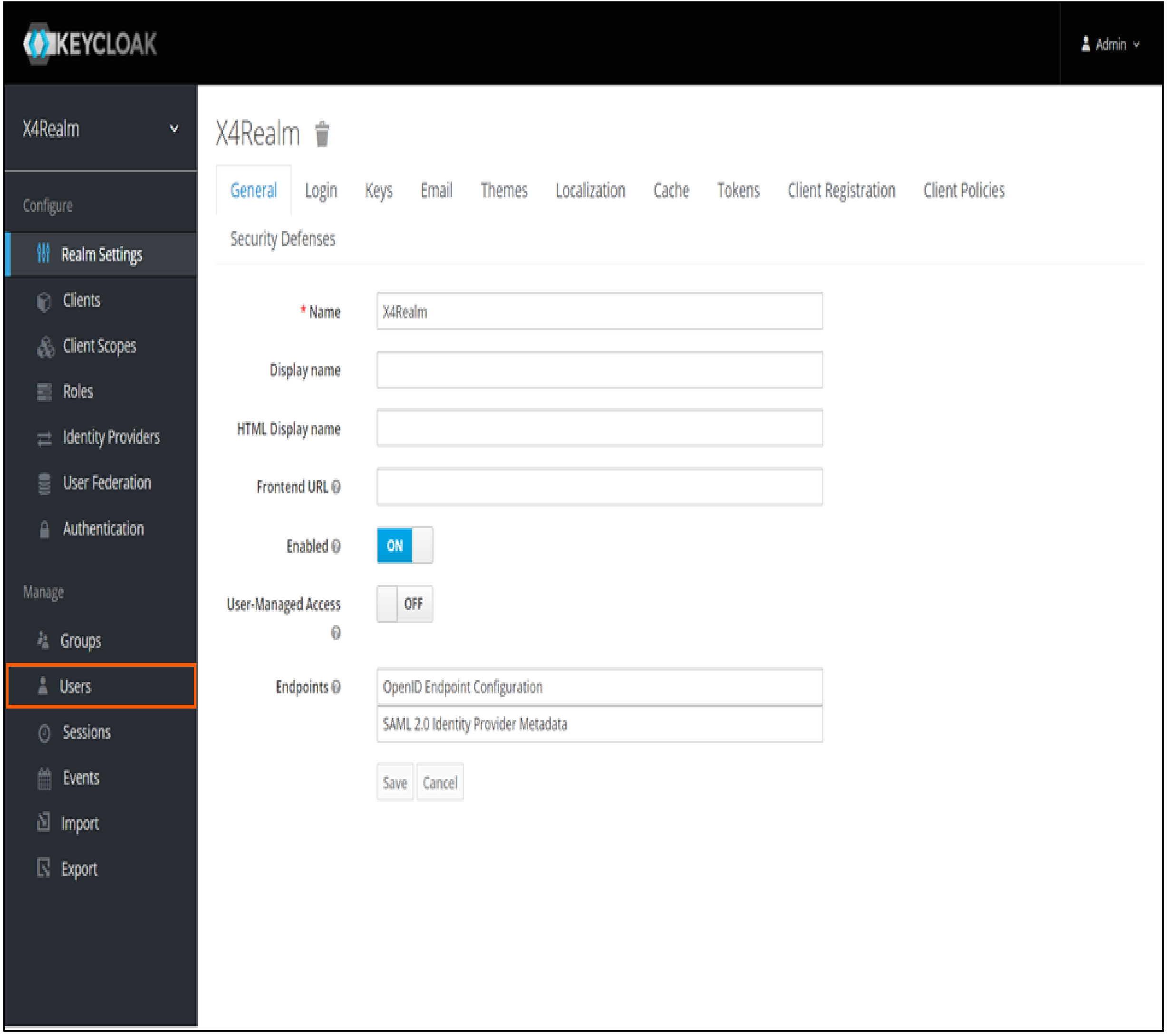
7. Click **Join**.



6.4.4 Remove user from a group

1. Open the **Keycloak Administration Console**.

2. In the **Manage** section, click **Users**.



* Name: X4Realm

Display name:

HTML Display name:

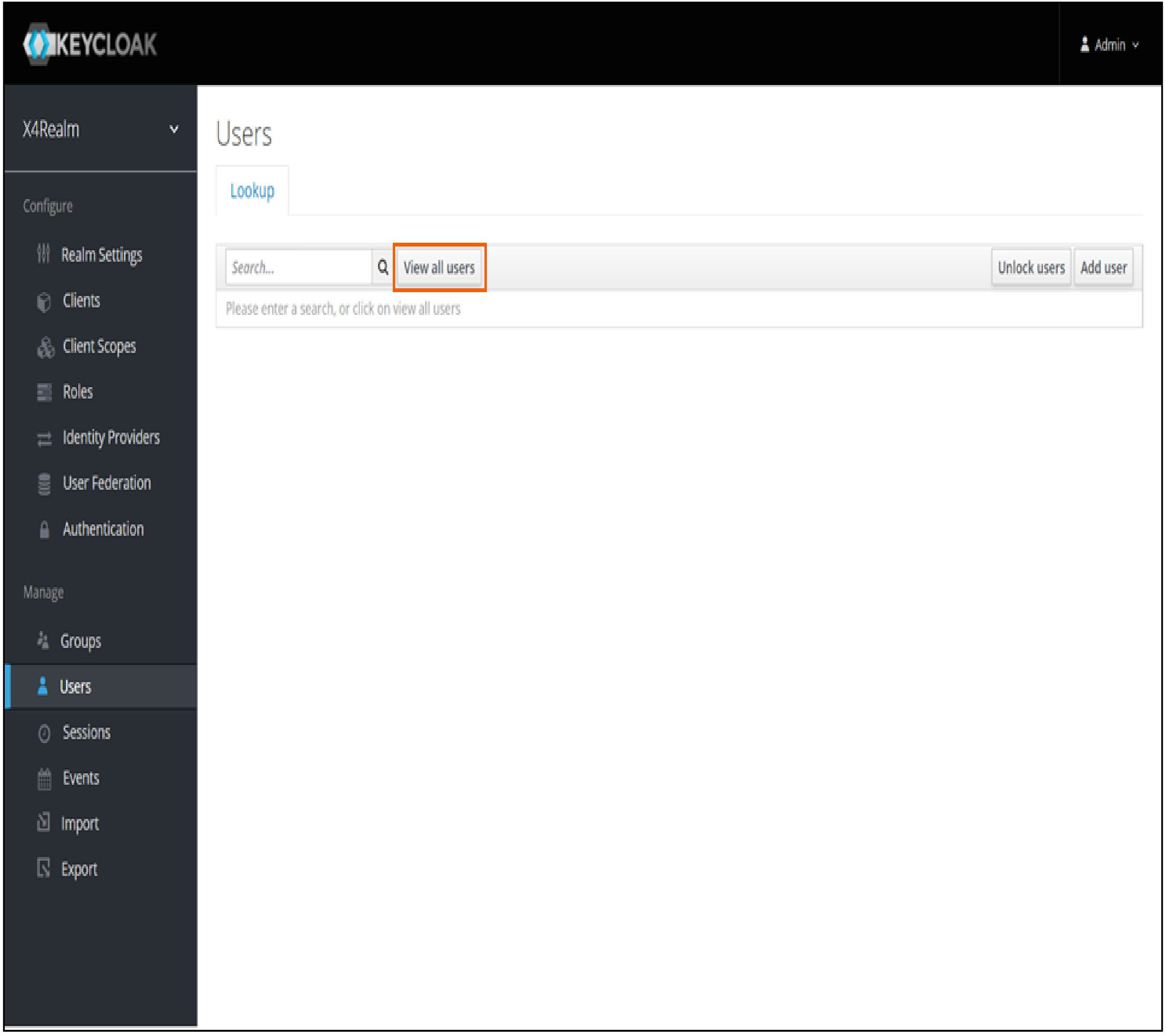
Frontend URL:

Enabled: ON

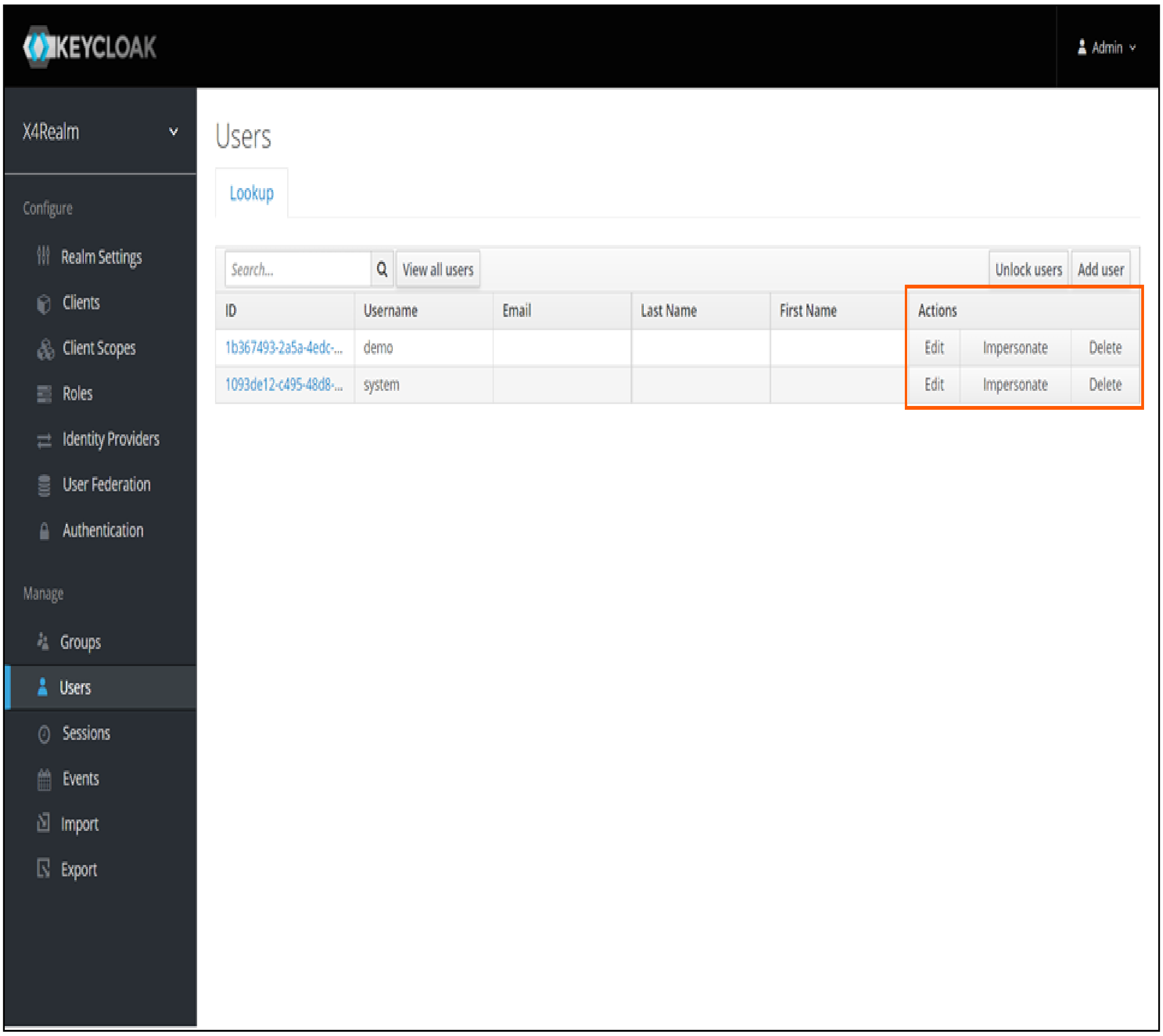
User-Managed Access: OFF

Endpoints: OpenID Endpoint Configuration; SAML 2.0 Identity Provider Metadata

3. To list all users, click **View all users** in the **Lookup** tab.

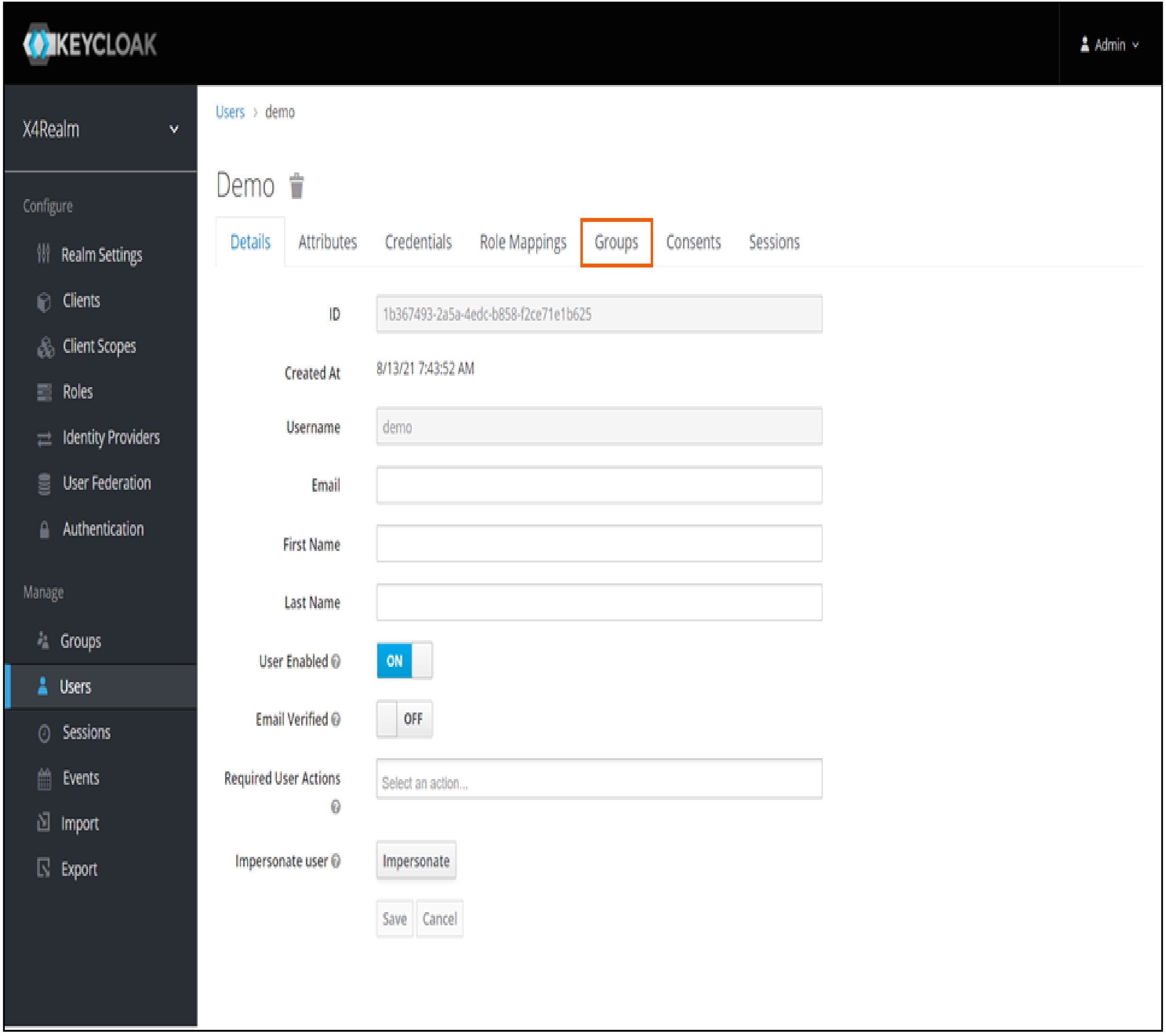


4. In the row of the desired user, click **Edit** in the **Actions** column.



ID	Username	Email	Last Name	First Name	Actions		
1b367493-2a5a-4edc-...	demo				Edit	Impersonate	Delete
1093de12-c495-48d8-...	system				Edit	Impersonate	Delete

5. Switch to the **Groups** tab.



ID: 1b367493-2a5a-4edc-b858-f2ce71e1b625

Created At: 8/13/21 7:43:52 AM

Username: demo

Email:

First Name:

Last Name:

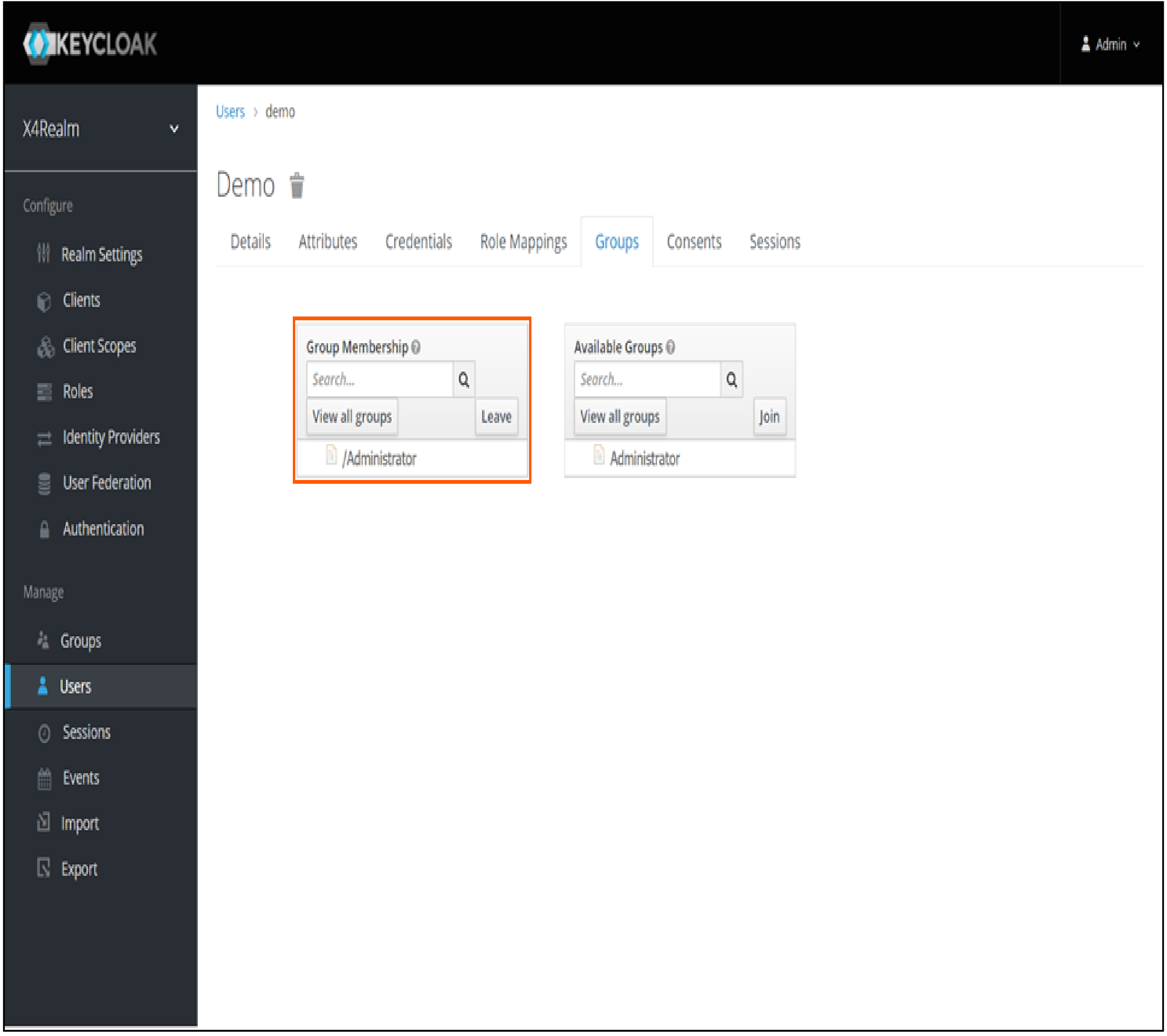
User Enabled: ON

Email Verified: OFF

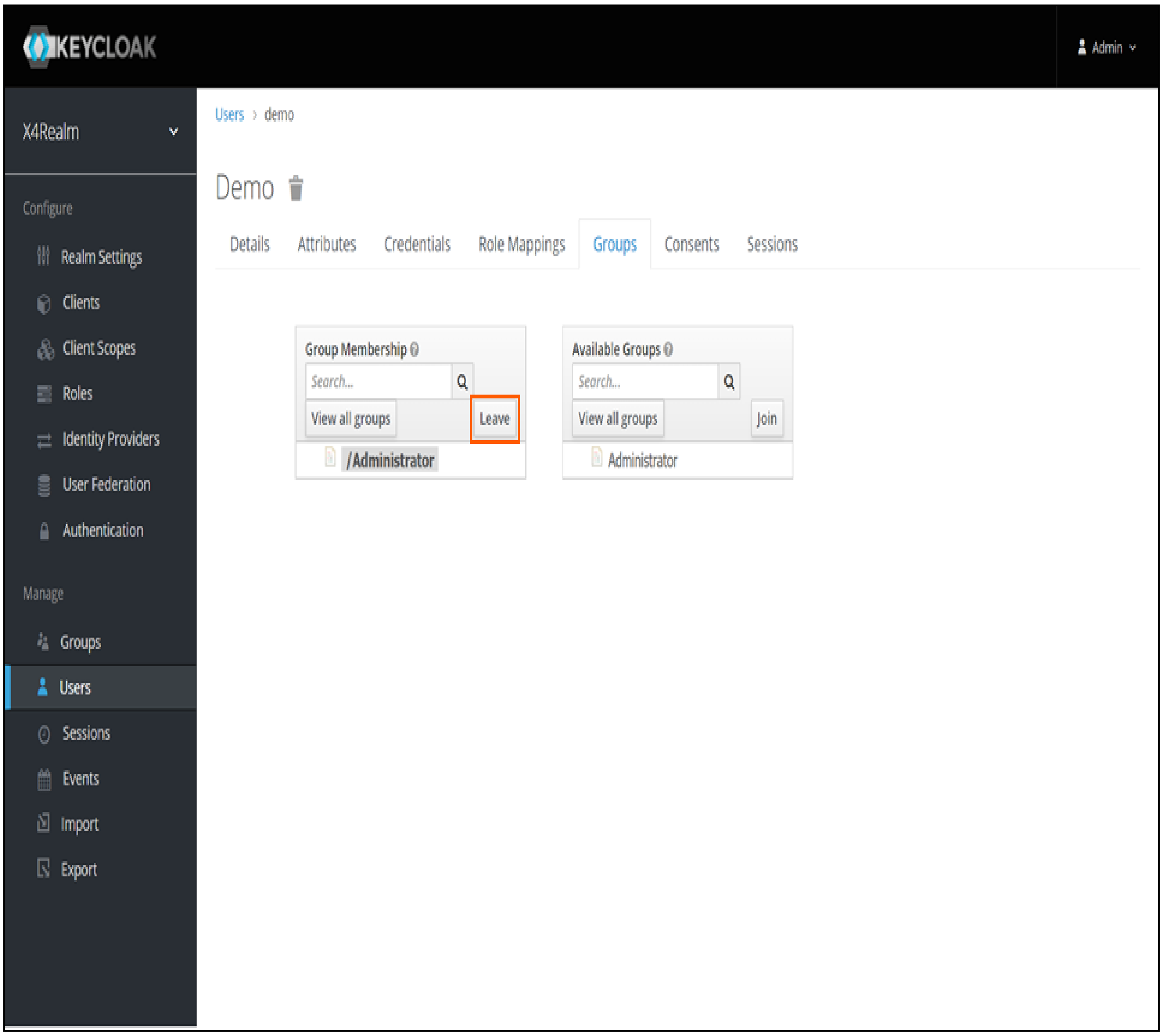
Required User Actions: Select an action...

Impersonate user

6. In the **Group Membership** area, select the group from which the user should be removed.



7. Click **Leave**.



6.5 Roles

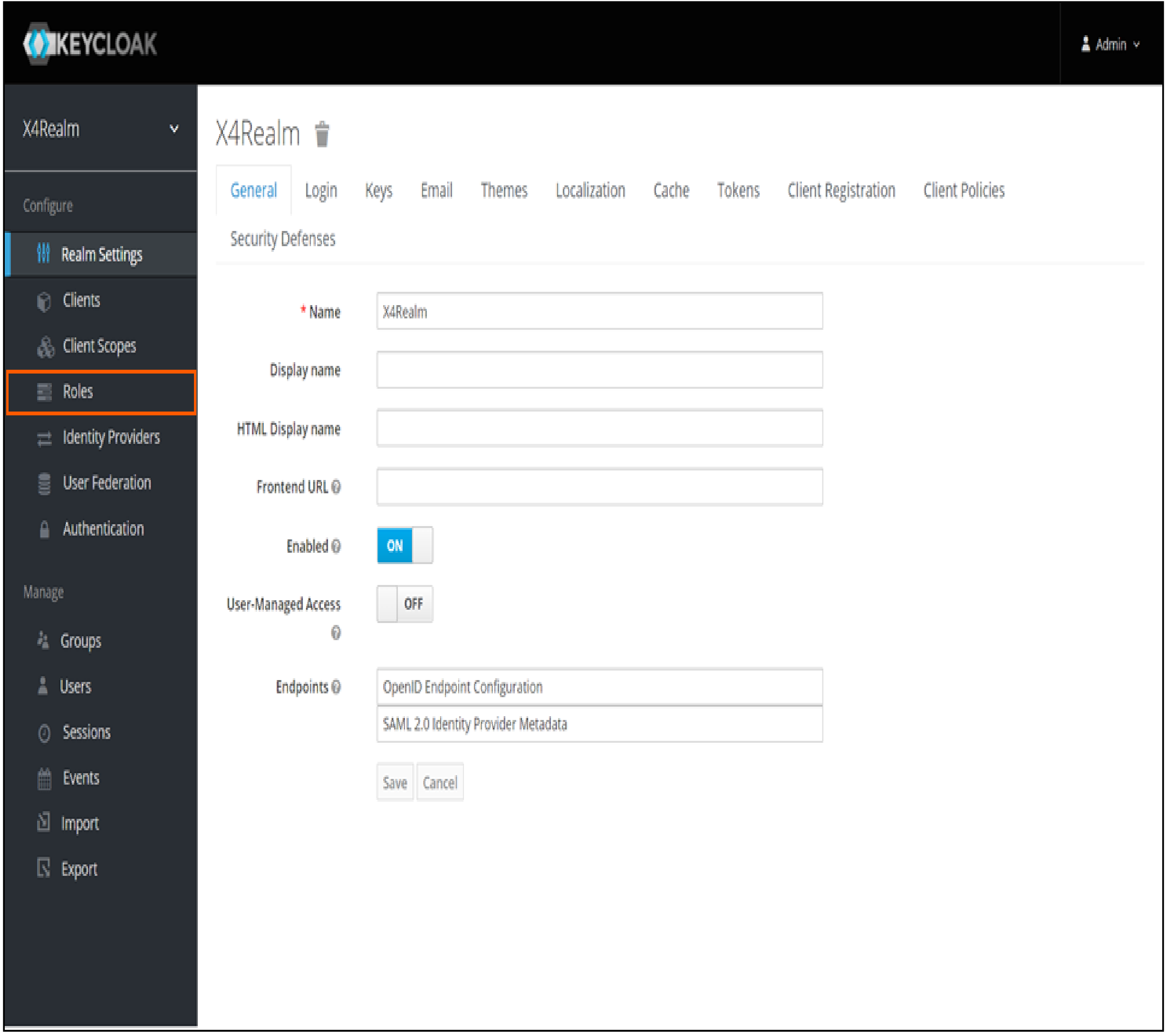
Client roles are basically a namespace dedicated to a client. Each client gets its own namespace.

Source: https://www.keycloak.org/docs/latest/server_admin/#client-roles

6.5.1 Create role

1. Open the **Keycloak Administration Console**.

2. In the **Configure** section, click **Roles**.



* Name: X4Realm

Display name:

HTML Display name:

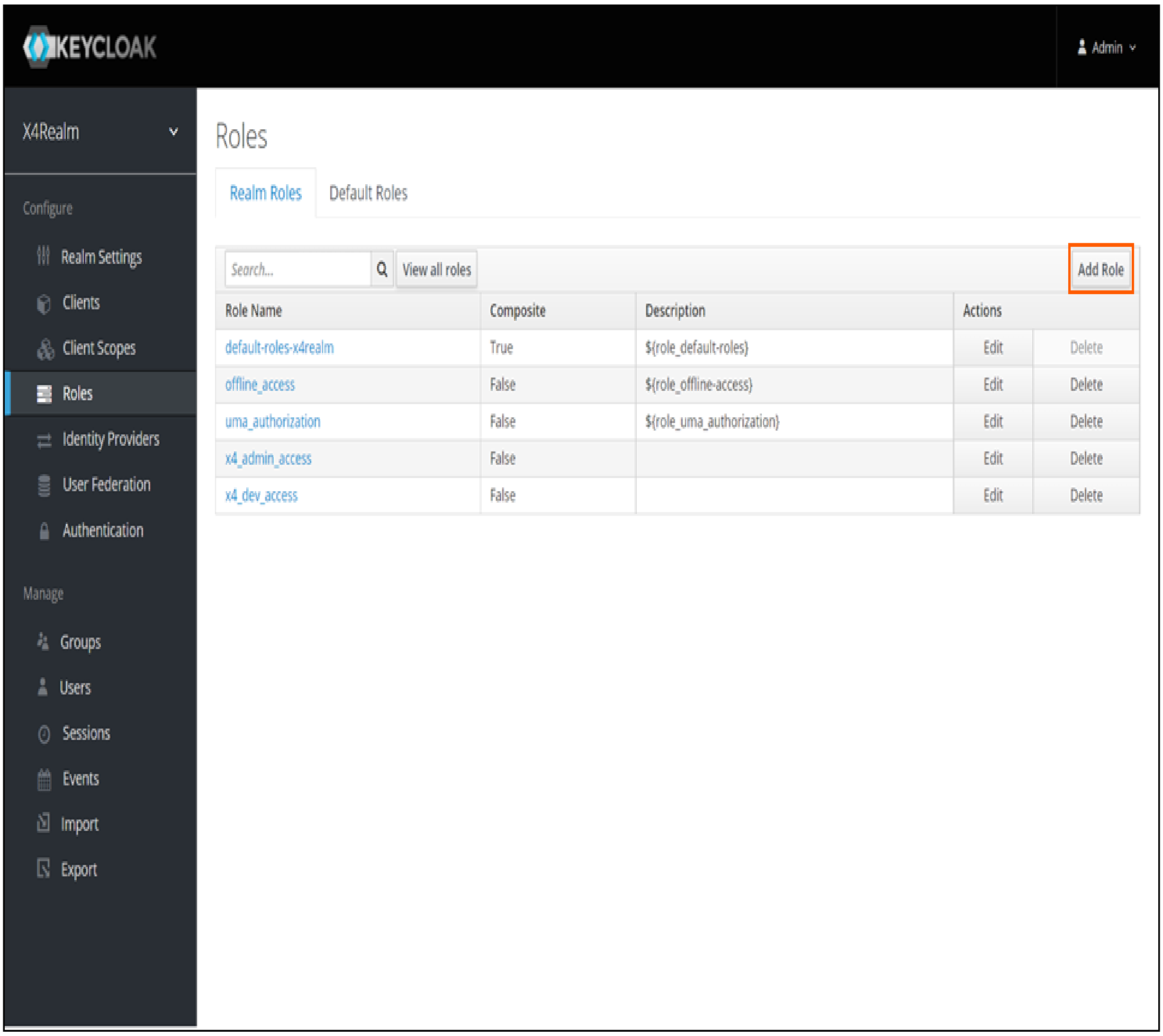
Frontend URL:

Enabled: ON

User-Managed Access: OFF

Endpoints: OpenID Endpoint Configuration
SAML 2.0 Identity Provider Metadata

3. On the **Realm Roles** tab, click **Add Role**.



Role Name	Composite	Description	Actions	
default-roles-x4realm	True	${role_default-roles}	Edit	Delete
offline_access	False	${role_offline-access}	Edit	Delete
uma_authorization	False	${role_uma_authorization}	Edit	Delete
x4_admin_access	False		Edit	Delete
x4_dev_access	False		Edit	Delete

4. Enter a name in the **Role Name** text box.
5. Click **Save**.

6.6 Groups

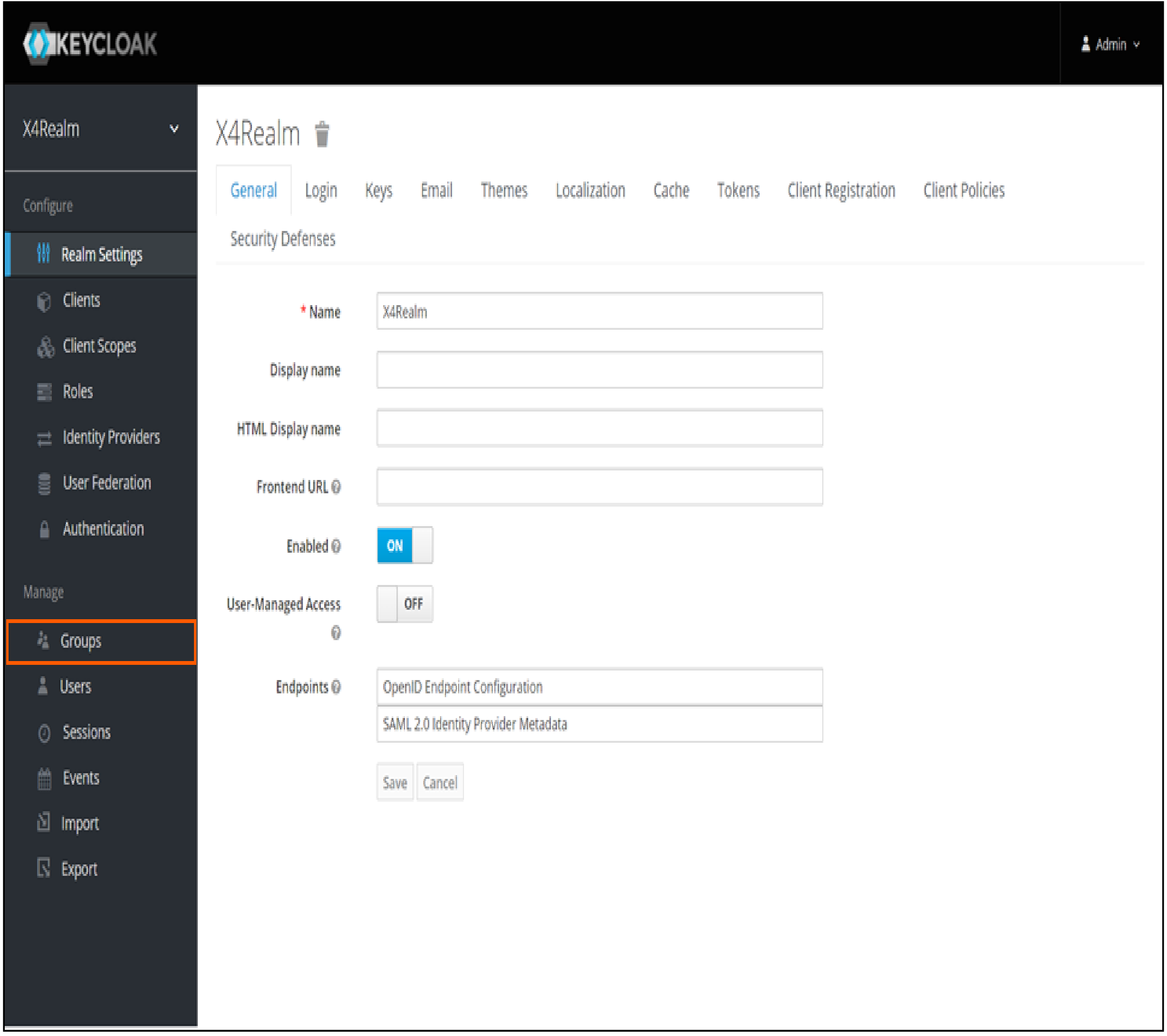
Groups in Keycloak allow you to manage a common set of attributes and role mappings for a set of users. Users can be members of zero or more groups. Users inherit the attributes and role mappings assigned to each group.

Source: https://www.keycloak.org/docs/latest/server_admin/#groups

6.6.1 Create group

1. Open the **Keycloak Administration Console**.

2. In the **Manage** section, click **Groups**.



* Name: X4Realm

Display name:

HTML Display name:

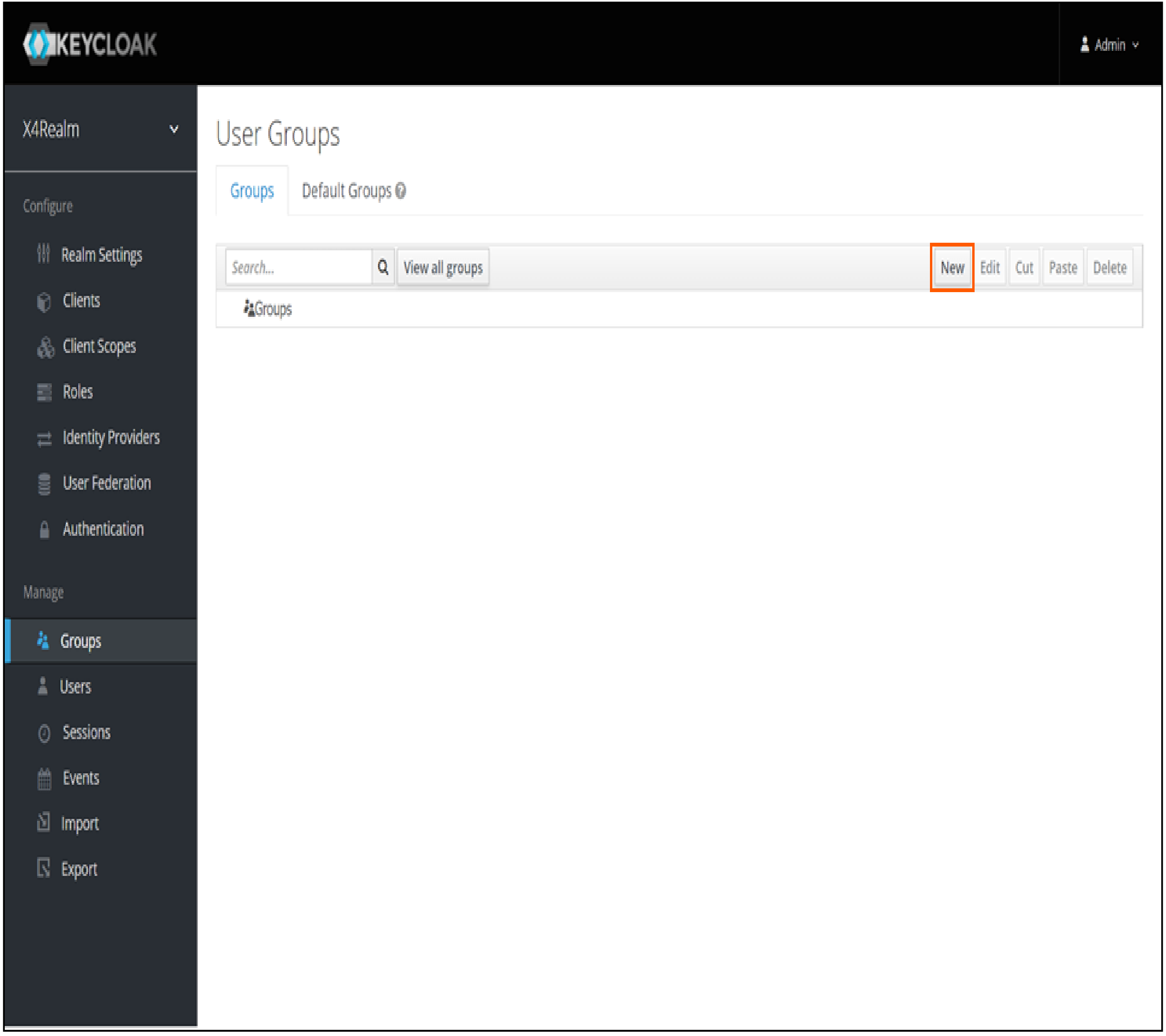
Frontend URL:

Enabled: ON

User-Managed Access: OFF

Endpoints: OpenID Endpoint Configuration, SAML 2.0 Identity Provider Metadata

3. On the **Groups** tab, click **New**.



4. Enter a name in the **Name** text box.
5. Click **Save**.