



U Y U N I

Installation Guide

Uyuni '2020.07'

July 24, 2020

Table of Contents

Introduction	1
Installing Uyuni	2
Requirements	3
Network Requirements	3
Network Ports	4
Supported Client Systems	9
Public Cloud Requirements	11
Instance Requirements	11
Network Requirements	12
Separate Storage Volumes	12
Installation	14
Install Uyuni Server with openSUSE	14
Install Uyuni on openSUSE Leap 15.1	14
Install Uyuni Proxy with openSUSE	14
Install Uyuni Proxy on openSUSE Leap 15.1	15
Installing on IBM Z	15
System Requirements	16
Install Uyuni on IBM Z	17
Setting Up	18
Uyuni Server Setup	18
Set up Uyuni with YaST	18
Create the Main Administration Account	19
Optional: Synchronizing Products from SUSE Customer Center	19
Proxy Registration	22
Uyuni Proxy Setup	23
Install the <code>uyuni_proxy</code> pattern	23
Copy Server Certificate and Key	24
Run <code>configure-proxy.sh</code>	24
Enable PXE Boot	26
Replace a Uyuni Proxy	27
Web Interface Setup	28
Web Interface Navigation	29
Public Cloud Setup	31
Account Credentials	32
Setup Wizard	33
Configure the HTTP Proxy	33
Configure Organization Credentials	33
Configure Products	33
GNU Free Documentation License	35

Introduction

Publication Date: 2020-07-24

This book provides guidance on installing Uyuni.

Requirements

The following table specifies the minimum requirements.

Table 1. Software and Hardware Requirements

Software and Hardware	Recommended
Operating System:	openSUSE Leap 15.1: Clean installation, up-to-date
CPU:	Minimum 4 dedicated 64-bit CPU cores (x86_64)
RAM:	<i>Test Server</i> Minimum 8 GB
	<i>Base Installation</i> Minimum 16 GB
	<i>Production Server</i> Minimum 32 GB
Disk Space:	Disk space depends on your channel requirements, at least 100 GB
	50 GB per SUSE or openSUSE product and 360 GB per Red Hat product
Swap space:	3 GB

Network Requirements

This section details the networking and port requirements for Uyuni.

Fully Qualified Domain Name (FQDN)

The Uyuni server must resolve its FQDN correctly. If the FQDN cannot be resolved, it can cause serious problems in a number of different components.

For more information about configuring the hostname and DNS, see <https://documentation.suse.com/sles/15-SP1/html/SLES-all/cha-network.html#sec-network-yast-change-host>.

Hostname and IP Address

To ensure that the Uyuni domain name can be resolved by its clients, both server and client machines must be connected to a working DNS server. You also need to ensure that reverse lookups are correctly configured.

For more information about setting up a DNS server, see <https://documentation.suse.com/sles/15-SP1/html/SLES-all/cha-dns.html>.

Using a Proxy When Installing from SUSE Linux Enterprise Media

If you are on an internal network and do not have access to SUSE Customer Center, you can set up and use a proxy during installation.

For more information about configuring a proxy for access to SUSE Customer Center during a SUSE Linux Enterprise installation, see <https://documentation.suse.com/sles/15-SP1/html/SLES-all/cha-boot-parameters.html#sec-boot-parameters-advanced-proxy>.



The hostname of Uyuni must not contain uppercase letters as this may cause *jabberd* to fail. Choose the hostname of your Uyuni server carefully. Although changing the server name is possible, it is a complex process and unsupported.

In a production environment, the Uyuni Server and clients should always use a firewall. For a comprehensive list of the required ports, see [**Installation > Ports >**].

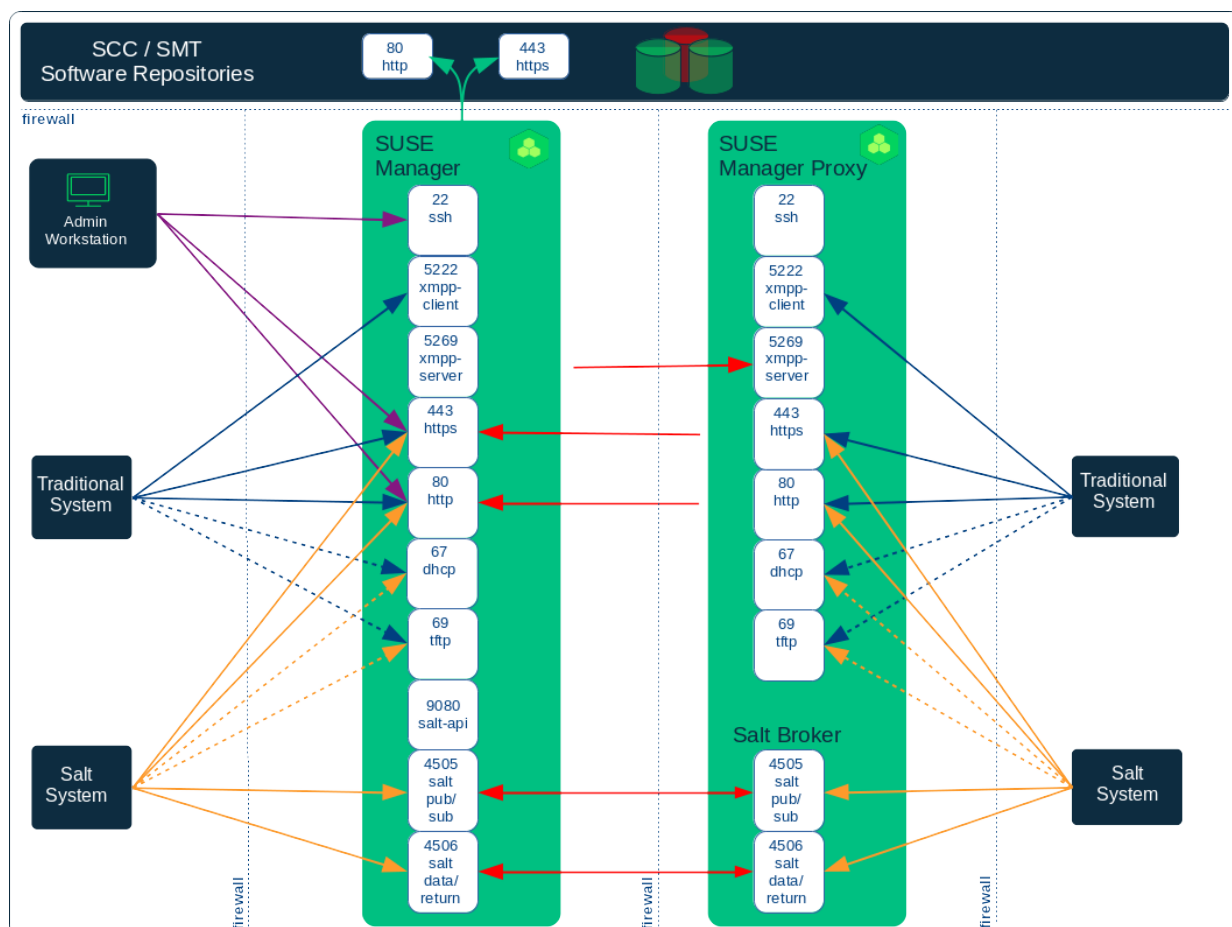
For more information on disconnected setup and port configuration, see [administration:disconnected-setup.pdf](#).

Network Ports

This section contains a comprehensive list of ports that are used for various communications within Uyuni.

You will not need to open all of these ports. Some ports only need to be opened if you are using the service that requires them.

This image shows the main ports used in Uyuni:



External Inbound Server Ports

External inbound ports must be opened to configure a firewall on the Uyuni Server to protect the server from unauthorized access.

Opening these ports allows external network traffic to access the Uyuni Server.

Table 2. External Port Requirements for Uyuni Server

Port number	Protocol	Used By	Notes
67	TCP/UDP	DHCP	Required only if clients are requesting IP addresses from the server.
69	TCP/UDP	TFTP	Required if server is used as a PXE server for automated client installation.
80	TCP	HTTP	Required temporarily for some bootstrap repositories and automated installations. Port 80 is not used to serve the Web UI.
443	TCP	HTTPS	Web UI, client, and proxy requests.
4505	TCP	salt	Required to accept communication requests from clients. The client initiates the connection, and it stays open to receive commands from the Salt master.
4506	TCP	salt	Required to accept communication requests from clients. The client initiates the connection, and it stays open to report results back to the Salt master.
5222	TCP	osad	Required to push OSAD actions to clients.

Port number	Protocol	Used By	Notes
5269	TCP	jabberd	Required to push actions to and from a proxy.
25151	TCP	Cobbler	

External Outbound Server Ports

External outbound ports must be opened to configure a firewall on the Uyuni Server to restrict what the server can access.

Opening these ports allows network traffic from the Uyuni Server to communicate with external services.

Table 3. External Port Requirements for Uyuni Server

Port number	Protocol	Used By	Notes Port 80 is not used to serve the Web UI.
80	TCP	HTTP	Required for SUSE Customer Center.
443	TCP	HTTPS	Required for SUSE Customer Center.
5269	TCP	jabberd	Required to push actions to and from a proxy.
25151	TCP	Cobbler	

Internal Server Ports

Internal port are used internally by the Uyuni Server. Internal ports are only accessible from **localhost**.

In most cases, you will not need to adjust these ports.

Table 4. Internal Port Requirements for Uyuni Server

Port number	Notes
2828	Satellite-search API, used by the RHN application in Tomcat and Taskomatic.
2829	Taskomatic API, used by the RHN application in Tomcat.
8005	Tomcat shutdown port.
8009	Tomcat to Apache HTTPD (AJP).

Port number	Notes
8080	Tomcat to Apache HTTPD (HTTP).
9080	Salt-API, used by the RHN application in Tomcat and Taskomatic.
32000	Port for a TCP connection to the Java Virtual Machine (JVM) that runs Taskomatic and satellite-search.

Port 32768 and higher are used as ephemeral ports. These are most often used to receive TCP connections. When a TCP connection request is received, the sender will choose one of these ephemeral port numbers to match the destination port. You can use this command to find out which ports are ephemeral ports:

```
cat /proc/sys/net/ipv4/ip_local_port_range
```

External Inbound Proxy Ports

External inbound ports must be opened to configure a firewall on the Uyuni Proxy to protect the proxy from unauthorized access.

Opening these ports allows external network traffic to access the Uyuni proxy.

Table 5. External Port Requirements for Uyuni Proxy

Port number	Protocol	Used By	Notes
22			Required for ssh-push and ssh-push-tunnel contact methods. Clients connected to the proxy initiate check in on the server and hop through to clients.
67	TCP/UDP	DHCP	Required only if clients are requesting IP addresses from the server.
69	TCP/UDP	TFTP	Required if the server is used as a PXE server for automated client installation.

Port number	Protocol	Used By	Notes
443	TCP	HTTPS	Web UI, client, and proxy requests.
4505	TCP	salt	Required to accept communication requests from clients. The client initiates the connection, and it stays open to receive commands from the Salt master.
4506	TCP	salt	Required to accept communication requests from clients. The client initiates the connection, and it stays open to report results back to the Salt master.
5222	TCP		Required to push OSAD actions to clients.
5269	TCP		Required to push actions to and from the server.

External Outbound Proxy Ports

External outbound ports must be opened to configure a firewall on the Uyuni Proxy to restrict what the proxy can access.

Opening these ports allows network traffic from the Uyuni Proxy to communicate with external services.

Table 6. External Port Requirements for Uyuni Proxy

Port number	Protocol	Used By	Notes
80			Used to reach the server.
443	TCP	HTTPS	Required for SUSE Customer Center.
5269	TCP		Required to push actions to and from the server.

External Client Ports

External client ports must be opened to configure a firewall between the Uyuni Server and its clients.

In most cases, you will not need to adjust these ports.

Table 7. External Port Requirements for Uyuni Clients

Port number	Direction	Protocol	Notes
22	Inbound	SSH	Required for ssh-push and ssh-push-tunnel contact methods.
80	Outbound		Used to reach the server or proxy.
5222	Outbound	TCP	Required to push OSAD actions to the server or proxy.
9090	Outbound	TCP	Required for Prometheus user interface.
9093	Outbound	TCP	Required for Prometheus alert manager.
9100	Outbound	TCP	Required for Prometheus node exporter.
9117	Outbound	TCP	Required for Prometheus Apache exporter.
9187	Outbound	TCP	Required for Prometheus PostgreSQL.

Required URLs

There are some URLs that Uyuni must be able to access in order to register clients and perform updates. In most cases, allowing access to these URLs is sufficient:

- scc.suse.com
- updates.suse.com

If you are using non-SUSE clients you might also need to allow access to other servers that provide specific packages for those operating systems. For example, if you have Ubuntu clients, you will need to be able to access the Ubuntu server.

Supported Client Systems

Supported operating systems for traditional and Salt clients are listed in this table.

In this table, ✓ indicates that clients running the operating system are supported by SUSE, and ✗ indicates that it is not supported. Fields marked as ? are under consideration, and may or may not be

supported at a later date.



Supported Versions and SP Levels

Client operating system versions and SP levels must be under general support (normal or LTSS) to be supported with Uyuni. For details on supported product versions, see <https://www.suse.com/lifecycle>.

Table 8. Supported Client Systems

Operating System	Architecture	Traditional Clients	Salt Clients
SUSE Linux Enterprise 15	x86_64, POWER, IBM Z, ARM	✓	✓
SUSE Linux Enterprise 12	x86_64, POWER, IBM Z, ARM	✓	✓
SUSE Linux Enterprise 11	x86, x86_64, Itanium, IBM POWER, IBM Z	✓	✓
SUSE Linux Enterprise Server-ES 8	x86_64	✓	✓
SUSE Linux Enterprise Server-ES 7	x86_64	✓	✓
SUSE Linux Enterprise Server-ES 6	x86_64	✓	✓
SUSE Linux Enterprise Server for SAP	x86_64, POWER	✓	✓
Red Hat Enterprise Linux 8	x86_64	?	?
Red Hat Enterprise Linux 7	x86_64	✓	✓
Red Hat Enterprise Linux 6	x86, x86_64	✓	✓
CentOS 8	x86, x86_64	?	?
CentOS 7	x86, x86_64	?	?
CentOS 6	x86, x86_64	?	?
openSUSE Leap 15.1	x86_64	✗	✓
Ubuntu 20.04	x86_64	✗	✓
Ubuntu 18.04	x86_64	✗	✓

Operating System	Architecture	Traditional Clients	Salt Clients
Ubuntu 16.04	x86_64	✗	✓

When you are setting up your client hardware, you need to ensure you have enough for the operating system and for the workload you want to perform on the client, with these additions for Uyuni:

Table 9. Client Additional Hardware Requirements

Hardware	Additional Size Required
RAM	512 MB
Disk Space:	200 MB

Public Cloud Requirements

You can run Uyuni Server on a public cloud instance from a third-party provider such as Amazon EC2, or Microsoft Azure.

This section details the requirements for using Uyuni on a public cloud instance.



Public clouds provide Uyuni under a Bring Your Own Subscription (BYOS) model. This means that you must register instances with the SUSE Customer Center. For more information about registering Uyuni with SUSE Customer Center, see [[Installation > General-requirements >](#)].

Depending on the public cloud framework you are using, you can locate the Uyuni images by searching for the keywords [suse](#), [manager](#), [proxy](#), or [BYOS](#).

Instance Requirements

Select a public cloud instance type that meets the hardware requirements in [[Installation > Hardware-requirements >](#)].

Before you begin, here are some other considerations:

- The Uyuni setup procedure performs a forward-confirmed reverse DNS lookup. This must succeed in order for the setup procedure to complete and for Uyuni to operate as expected. It is important to perform hostname and IP configuration before you set up Uyuni.
- Uyuni Server and Proxy instances need to run in a network configuration that provides you control over DNS entries, but cannot be accessed from the internet at large.
- Within this network configuration DNS resolution must be provided: [hostname -f](#) must return the fully-qualified domain name (FQDN).
- DNS resolution is also important for connecting clients.

- DNS is dependent on the cloud framework you choose. Refer to the cloud provider documentation for detailed instructions.
- We recommend that you locate software repositories, the server database, and the proxy squid cache on an external virtual disk. This prevents data loss if the instance is unexpectedly terminated. This section includes instructions for setting up an external virtual disk.



If you are attempting to bootstrap traditional clients, check that you can resolve the host name of the server while you are logged in to the client. You might need to add the FQDN of the server to `/etc/hosts` local resolution file on the client. Check using the `hostname -f` command with the local IP address of the server.

Network Requirements

When you use Uyuni on a public cloud, you must use a restricted network. We recommend using a VPC private subnet with an appropriate firewall setting. Only machines in your specified IP ranges must be able to access the instance.



When you run Uyuni on public clouds, you must apply security measures to limit access to the instance. A world-accessible Uyuni instance violates the terms of the Uyuni EULA, and is not supported by SUSE.

To access the Uyuni Web UI, allow HTTPS when configuring the network access controls.

Separate Storage Volumes

We recommend that the repositories and the database for Uyuni are stored on separate storage devices. This will help to avoid data loss in cases when the Uyuni instance is terminated. You must set up the storage devices before you run the YaST Uyuni setup procedure.

Provision two disk devices in the public cloud environment, according the cloud provider's documentation. The size of the disk for repositories storage is dependent on the number of distributions and channels you intend to manage with Uyuni. For recommended minimum sizes for the database volume (`/var/lib/pgsql`) and channel volume (`/var/lib/spacewalk`), see [**Installation > Hardware-requirements >**].

When you attach the virtual disks, they will appear in your instance as Unix device nodes. The names of the device nodes will vary depending on your provider, and the instance type selected.

On your Uyuni Server, use this command to find all available storage devices:

```
hwinfo --disk | grep -E "Device File:"
```

Use the `lsblk` command to see the name and size of each device. Choose the name that matches with the size of the virtual disk you are looking for.

Use the **suma-storage** command with the device names to set up the external disks as the locations for the database and repositories:

```
suma-storage <channel_devicename> [<database_devicename>]
```

The external storage volumes are set up as XFS partitions mounted at **/manager_storage** and **/pgsql_storage**.

It is possible to use the same storage device for both channel data and database. This is not recommended, as growing channel repositories might fill up the storage, which poses a risk to database integrity. Using separate storage devices may also increase performance. If you want to use a single storage device, run **suma-storage** with a single device name parameter.

If you are installing a proxy, the **suma-storage** command only takes a single device name parameter and will set up the external storage location as the Squid cache.

Installation

Install Uyuni Server with openSUSE

Uyuni Server can be installed on openSUSE.

For requirements, see [**Installation** > **Uyuni-install-requirements** >].

Install Uyuni on openSUSE Leap 15.1

Procedure: Installing openSUSE Leap 15.1 with Uyuni

1. As the base system, install openSUSE Leap 15.1 with all available package updates applied.
2. Configure a resolvable fully qualified domain name (FQDN) with **yast** > **System** > **Network Settings** > **Hostname/DNS**.
3. Add the repository for installing the Uyuni Server software as **root**:

```
repo=repositories/systemsmanagement:/  
repo=${repo}Uyuni:/Stable/images/repo/Uyuni-Server-P00L-x86_64-Media1/  
zypper ar https://download.opensuse.org/$repo uyuni-server-stable
```

4. Refresh metadata from the repositories as **root**:

```
zypper ref
```

5. Install the pattern for the Uyuni Server as **root**:

```
zypper in patterns-uyuni_server
```

6. Reboot.
 - For more information about the stable version of Uyuni, see <https://www.uyuni-project.org/pages/stable-version.html>.
 - For more information about the development version of Uyuni, see <https://www.uyuni-project.org/pages/devel-version.html>.

When this installation is complete, you can continue with Uyuni setup. For more information, see [**Installation** > **Uyuni-server-setup** >].

Install Uyuni Proxy with openSUSE

Uyuni Proxy can be installed on openSUSE.

Install Uyuni Proxy on openSUSE Leap 15.1

Procedure: Installing openSUSE Leap 15.1 with Uyuni

1. Install openSUSE Leap 15.1 and apply all package updates available.
2. Configure a resolvable fully qualified domain name (FQDN) with **yast** > **System** > **Network Settings** > **Hostname/DNS**.
3. Add the repository with the Uyuni Proxy software. As **root** enter:

```
repo=repositories/systemsmanagement:/
repo=${repo}Uyuni:/Stable/images/repo/Uyuni-Proxy-P00L-x86_64-Media1/
zypper ar https://download.opensuse.org/$repo uyuni-proxy-stable
```

4. Refresh metadata from the repositories. As **root** enter:

```
zypper ref
```

5. Install the pattern for the Uyuni Proxy: As **root** enter:

```
zypper in patterns-uyuni_proxy
```

6. Reboot the Uyuni Proxy.
 - For more information about the stable version of Uyuni, see <https://www.uyuni-project.org/pages/stable-version.html>.
 - For more information about the development version of Uyuni, see <https://www.uyuni-project.org/pages/devel-version.html>.

When the installation is complete, you can continue with Uyuni setup. For more information, see [**Installation** > **Uyuni-proxy-registration** >].

Installing on IBM Z

This section is intended for z/VM systems programmers responsible for operating the IBM Z mainframes. It assumes that you are a z/VM systems programmer trained on IBM Z operating protocols, and steps you through installing Uyuni onto an existing mainframe system. This section does not cover the variety of hardware configuration profiles available on IBM Z, but provides a foundational overview of the procedure and requirements necessary for a successful Uyuni Server deployment on IBM Z.

This section describes how to install SUSE Manager Server using SUSE Linux Enterprise installation media. You must have already registered your SUSE Manager product with SUSE Customer Center, and have obtained a registration code.

For information on registering with SUSE Customer Center, retrieving your organization credentials from SUSE Customer Center, or obtaining installation media, see [general-requirements.pdf](#).

System Requirements

Before you begin, check that your environment meets the base system requirements.

Compatible IBM Z Systems:

- IBM zEnterprise System z196
- IBM zEnterprise System z114
- IBM zEnterprise EC12
- IBM zEnterprise EC12
- IBM zEnterprise BC12
- IBM z13
- LinuxOne Rockhopper
- LinuxOne Emperor

Table 10. Hardware Requirements

Hardware	Recommended
CPU	Minimum 4 dedicated 64-bit CPU cores
RAM:	Test Server: Minimum 3 GB RAM and 2 GB Swap space
	Base Installation: Minimum 16 GB
	Production Server: Minimum 32 GB
Disk Space:	Root Partition: Minimum 100 GB
	<code>/var/lib/pgsql</code> : Minimum 50 GB
	<code>/var/spacwalk</code> : Minimum 50 GB per SUSE product and 360 GB per Red Hat product



Memory should be split across available RAM, VDISK, and swap to suit your environment. On a production system the ratio of physical memory to VDISK will need to be evaluated based on the number of clients you will be installing.

You will require an additional disk for database storage. This should be an **zFCP** or **DASD** device as these are preferred for use with **HYPERPAV**. The database storage disk should have:

- At least 50 GB for `/var/lib/pgsql`
- At least 50 GB for each SUSE product in `/var/spacwalk`
- At least 360 GB for each Red Hat product in `/var/spacwalk`

You will need to ensure you have sufficient disk storage for Uyuni before running **yast2 susemanager_setup**. By default, the Uyuni file system, including the embedded database and patch directories, reside within the root directory. While adjustments are possible when installation is complete, it is important that you specify and monitor these adjustments closely. For information on storage management and reclaiming disk space, see the troubleshooting section in the Uyuni Administration Guide.



If your Uyuni runs out of disk space, this can have a severe impact on its database and file structure. A full recovery is only possible with a previous backup or a new Uyuni installation. SUSE technical services will not be able to provide support for systems suffering from low disk space conditions.

Network Requirements:

- OSA Express Ethernet (including Fast and Gigabit Ethernet)
- HiperSockets or Guest LAN
- 10 GBE, VSWITCH
- RDMA over Converged Ethernet (RoCE)

These interfaces are still included but no longer supported:

- CTC or virtual CTC
- IP network interface for IUCV

The z/VM guest you want to run Uyuni from will require a static IP address and hostname before you begin, as these cannot easily be changed after initial installation. The hostname should contain less than eight characters and must not contain any upper case letters.

Media Requirements:

For media requirements, see [\[installation:general-requirements\]](#).

Install Uyuni on IBM Z

This section covers the installation of Uyuni as a product of the SUSE Linux Enterprise family. For general information about deploying a product on IBM Z hardware, see <https://documentation.suse.com/sles/15-SP1/html/SLES-all/cha-zseries.html>.

Procedure: Installing SUSE Manager Server from a DVD Image

1. Boot your system with the Unified Installer. If booting fails you might need to adjust the boot order in the BIOS.
2. When prompted, select **Installation**.

Then continue as described in [**Installation** > **Install-server-unified** >].

To finalize the Uyuni installation see [**Installation** > **Server-setup** >].

Setting Up

Uyuni Server Setup

This section covers Uyuni Server setup, using these procedures:

- Start Uyuni setup with YaST
- Create the main administration account with the Uyuni Web UI
- Name your base organization and add login credentials
- Synchronize the SUSE Linux Enterprise product channel from SUSE Customer Center

Set up Uyuni with YaST

This section will guide you through Uyuni setup procedures.

Procedure: Uyuni Setup

1. Log in to the Uyuni Server and start YaST.
2. In YaST, navigate to **Network Services** > **Uyuni Setup** to begin the setup.
3. From the introduction screen select **Uyuni Setup** > **Set up Uyuni from scratch** and click **[Next]** to continue.
4. Enter an email address to receive status notifications and click **[Next]** to continue. Uyuni can sometimes send a large volume of notification emails. You can disable email notifications in the Web UI after setup, if you need to.
5. Enter your certificate information and a password. Passwords must be at least seven characters in length, and must not contain spaces, single or double quotation marks (' or "), exclamation marks (!), or dollar signs (\$). Always store your passwords in a secure location.



You must have the certificate password to set up a Uyuni Proxy Server.

6. Click **[Next]** to continue.
7. From the **Uyuni Setup** > **Database Settings** screen, enter a database user and password and click **[Next]** to continue. Passwords must be at least seven characters in length, and must not contain spaces, single or double quotation marks (' or "), exclamation marks (!), or dollar signs (\$). Always store your passwords in a secure location.
8. Click **[Next]** to continue.
9. Click **[Yes]** to run setup when prompted.
10. When setup is complete, click **[Next]** to continue. You will see the address of the Uyuni Web UI.
11. Click **[Finish]** to complete Uyuni setup.

Create the Main Administration Account

This section covers how to create your organization's main administration account for Uyuni.



The main administration account has the highest authority within Uyuni. Ensure you keep access information for this account secure.

We recommend that you create lower level administration accounts for organizations and groups. Do not share the main administration access details.

Procedure: Setting Up the Main Administration Account

1. In your web browser, enter the address for the Uyuni Web UI. This address was provided after you completed setup. For more information, see [uyuni-server-setup.pdf](#).
2. Log in to the Web UI, navigate to the **Create Organization** > **Organization Name** field, and enter your organization name.
3. In the **Create Organization** > **Desired Login** and **Create Organization** > **Desired Password** fields, enter your username and password.
4. Fill in the Account Information fields including an email for system notifications.
5. Click [**Create Organization**] to finish creating your administration account.

When you have completed the Uyuni Web UI setup, you are taken to the **Home** > **Overview** page.

Optional: Synchronizing Products from SUSE Customer Center

SUSE Customer Center (SCC) maintains a collection of repositories which contain packages, software and updates for all supported enterprise client systems. These repositories are organized into channels each of which provide software specific to a distribution, release, and architecture. After synchronizing with SCC, clients can receive updates, be organized into groups, and assigned to specific product software channels.

This section covers synchronizing with SCC from the Web UI and adding your first client channel.



For Uyuni, synchronizing products from SUSE Customer Center is optional.

Before you can synchronize software repositories with SCC, you will need to enter organization credentials in Uyuni. The organization credentials give you access to the SUSE product downloads. You will find your organization credentials in <https://scc.suse.com/organization>.

Enter your organization credentials in the Uyuni Web UI:

Procedure: Entering Organization Credentials

1. In the SUSE Manager Web UI, navigate to **Main Menu** > **Admin** > **Setup Wizard**.
2. In the **Setup Wizard** page, navigate to the [**Organization Credentials**] tab.

-
3. Click [**Add a new credential**].
 4. Enter a username and password, and click [**Save**].

A check mark icon is shown when the credentials are confirmed. When you have successfully entered the new credentials, you can synchronize with SUSE Customer Center.

Procedure: Synchronizing with SUSE Customer Center

1. In the Uyuni Web UI, navigate to **Admin > Setup Wizard**.
2. From the **Setup Wizard** page select the [**SUSE Products**] tab. Wait a moment for the products list to populate. If you previously registered with SUSE Customer Center a list of products will populate the table. This table lists architecture, channels, and status information. For more information, see [**Reference > Admin > Wizard**].

Setup Wizard

HTTP Proxy Organization Credentials **SUSE Products**

25 items per page

Items 1 - 25 of 94

Product Description	Arch	Channels
<input type="checkbox"/> Open Enterprise Server 2018	x86_64	
<input type="checkbox"/> RHEL Expanded Support 5	i386	
<input type="checkbox"/> RHEL Expanded Support 5	x86_64	
<input type="checkbox"/> > RHEL Expanded Support 6	i386	
<input type="checkbox"/> > RHEL Expanded Support 6	x86_64	
<input type="checkbox"/> > RHEL Expanded Support 7	x86_64	
<input type="checkbox"/> SUSE Container as a Service Platform 1.0	x86_64	
<input type="checkbox"/> SUSE Container as a Service Platform 2.0	x86_64	
<input type="checkbox"/> > SUSE Linux Enterprise Desktop 11 SP2	i586	
<input type="checkbox"/> > SUSE Linux Enterprise Desktop 11 SP2	x86_64	
<input type="checkbox"/> > SUSE Linux Enterprise Desktop 11 SP3	i586	
<input type="checkbox"/> > SUSE Linux Enterprise Desktop 11 SP3	x86_64	
<input type="checkbox"/> > SUSE Linux Enterprise Desktop 11 SP4	i586	
<input type="checkbox"/> > SUSE Linux Enterprise Desktop 11 SP4	x86_64	
<input type="checkbox"/> > SUSE Linux Enterprise Desktop 12	x86_64	
<input type="checkbox"/> > SUSE Linux Enterprise Desktop 12 SP1	x86_64	
<input type="checkbox"/> > SUSE Linux Enterprise Desktop 12 SP2	x86_64	
<input type="checkbox"/> > SUSE Linux Enterprise Desktop 12 SP3	x86_64	
<input checked="" type="checkbox"/> > SUSE Linux Enterprise Desktop 15	x86_64	100%
<input type="checkbox"/> > SUSE Linux Enterprise High Performance Computing 15	aarch64	include recommended
<input type="checkbox"/> > SUSE Linux Enterprise High Performance Computing 15	x86_64	include recommended
<input type="checkbox"/> > SUSE Linux Enterprise Server 10 SP3	i586	
<input type="checkbox"/> > SUSE Linux Enterprise Server 10 SP3	ia64	
<input type="checkbox"/> > SUSE Linux Enterprise Server 10 SP3	ppc	
<input type="checkbox"/> > SUSE Linux Enterprise Server 10 SP3	s390x	

Page 1 of 4

First Prev Next Last

Refresh the product catalog from SUSE Customer Center

☐ Channels
☐ Channel Families
☐ Products
☐ Product Channels
☐ Subscriptions

Refresh

Why aren't all SUSE products displayed in the list?

The products displayed on this list are directly linked to your Organization credentials (Mirror credentials) as well as your SUSE subscriptions.

If you believe there are products missing, make sure you have added the correct Organization credentials in the previous wizard step.

3. If your SUSE Linux Enterprise client is based on **x86_64** architecture scroll down the page and select the check box for this channel now.
 - Add channels to Uyuni by selecting the check box to the left of each channel. Click the arrow symbol to the left of the description to unfold a product and list available modules.
 - Click **[Add Products]** to start product synchronization.

After adding the channel, Uyuni will schedule the channel to be synchronized. This can take a long time as Uyuni will copy channel software sources from the SUSE repositories located at SUSE Customer

Center to local `/var/spacewalk/` directory of your server.



In some environments, transparent huge pages provided by the kernel can slow down PostgreSQL workloads significantly.

To disable transparent huge pages, set the `transparent_hugepage` kernel parameter to `never`. You will also need to open the `/etc/default/grub` file and add or edit the line `GRUB_CMDLINE_LINUX_DEFAULT`. For example:

```
GRUB_CMDLINE_LINUX_DEFAULT="resume=/dev/sda1 splash=silent quiet
showopts elevator=noop transparent_hugepage=never"
```

To write the new configuration run `grub2-mkconfig -o /boot/grub2/grub.cfg`.

Monitor the channel synchronization process in real-time by viewing channel log files located in the directory `/var/log/rhn/reposync`:

```
tail -f /var/log/rhn/reposync/<CHANNEL_NAME>.log
```

When the channel synchronization process is complete, you can continue with client registration. For more instructions, see [[Client-configuration](#) > [Registration-overview](#) >].

Proxy Registration

Proxy systems are registered as Salt clients using a bootstrap script.

This procedure describes software channel setup and registering the installed proxy with an activation key as a Uyuni client.



Before you can select the correct child channels while creating the activation key, ensure you have properly synchronized the openSUSE Leap channel with all the needed child channels and the Uyuni Proxy channel.

Procedure: Registering the Proxy

1. First create openSUSE Leap and the Uyuni Proxy channels with the `spacewalk-common-channels` command. `spacewalk-common-channels` is part of the `spacewalk-utils` package:


```
spacewalk-common-channels \
opensuse_leap15_1 \
opensuse_leap15_1-non-oss \
opensuse_leap15_1-non-oss-updates \
opensuse_leap15_1-updates \
opensuse_leap15_1-uyuni-client \
uyuni-proxy-stable-leap-151
```

Instead of **uyuni-proxy-stable-leap-151** you can also try **uyuni-proxy-devel-leap** that is the current development version.

For more information, see [**Client-configuration** > **Clients-opensuse** >].

2. Create the openSUSE Leap 15 Uyuni Client Tools Repository for bootstrapping. For more information about bootstrapping, see [**Client-configuration** > **Bootstrap-repository** >].
3. Create an activation key with openSUSE Leap as a base channel and the other channels as child channels. For more information about activation keys, see [**Client-configuration** > **Activation-keys** >].
4. Modify a bootstrap script for the proxy.
 - Add the GPG key to the **ORG_GPG_KEY=** parameter. For more information, see [**Client-configuration** > **Clients-opensuse** >].
 - OPTIONAL: If you want to run the proxy on a traditional client (system type **Management**) uncheck **Bootstrap using Salt**. Using Salt is the default. For more information about bootstrap scripts, see [**Client-configuration** > **Registration-bootstrap** >].
5. Bootstrap the client using the script. For more information, see [**Client-configuration** > **Registration-bootstrap** >].
6. For Salt clients, navigate to **Salt** > **Keys** and accept the key. When the key is accepted, it will show in **Systems** > **Overview**.
7. Navigate to **System Details** > **Software** > **Software Channels**, and check that your proxy channel is selected. For setting up a registered Uyuni Proxy, see [uyuni-proxy-setup.pdf](#).

Uyuni Proxy Setup

Uyuni Proxy requires additional configuration.

Install the **uyuni_proxy** pattern

Check that the Proxy pattern is installed correctly. On the server select the **pattern_uyuni_proxy** package for installation, or make sure the **uyuni_proxy** pattern is installed using this command on the proxy as root:

```
zypper in -t pattern uyuni_proxy
```

The salt-broker service will be automatically started after installation is complete. This service forwards the Salt interactions to the Uyuni server.



Proxy Chains

It is possible to arrange Salt proxies in a chain. In such a case, the upstream proxy is named **parent**.

Make sure the TCP ports **4505** and **4506** are open on the proxy. The proxy must be able to reach the Uyuni Server or a parent proxy on these ports.

Copy Server Certificate and Key

The proxy will share some SSL information with the Uyuni Server. Copy the certificate and its key from the Uyuni 4 Server or the parent proxy.

As root, enter the following commands on the proxy using your Uyuni 4 Server or parent Proxy 4 (named **PARENT**):

```
mkdir -m 700 /root/ssl-build
cd /root/ssl-build
scp root@PARENT:/root/ssl-build/RHN-ORG-PRIVATE-SSL-KEY .
scp root@PARENT:/root/ssl-build/RHN-ORG-TRUSTED-SSL-CERT .
scp root@PARENT:/root/ssl-build/rhn-ca-openssl.cnf .
```



To keep the security chain intact, the Uyuni Proxy functionality requires the SSL certificate to be signed by the same CA as the Uyuni Server certificate. Using certificates signed by different CAs for proxies and server is not supported.

Run `configure-proxy.sh`

The `configure-proxy.sh` script will finalize the setup of your SUSE Manager Proxy.

Execute the interactive `configure-proxy.sh` script. Pressing *Enter* without further input will make the script use the default values provided between brackets `[]`. Here is some information about the requested settings:

Uyuni Parent

A Uyuni parent can be either another proxy or a Uyuni Server.

HTTP Proxy

A HTTP proxy enables your Uyuni proxy to access the Web. This is needed if direct access to the Web is prohibited by a firewall.

Proxy Version to Activate

Normally, the correct value should be offered as a default.

Traceback Email

An email address where to report problems.

Use SSL

For safety reasons, press **Y**.

Do You Want to Import Existing Certificates?

Answer **N**. This ensures using the new certificates that were copied previously from the Uyuni server.

Organization

The next questions are about the characteristics to use for the SSL certificate of the proxy. The organization might be the same organization that was used on the server, unless of course your proxy is not in the same organization as your main server.

Organization Unit

The default value here is the proxy's hostname.

City

Further information attached to the proxy's certificate.

State

Further information attached to the proxy's certificate.

Country Code

In the **country code** field, enter the country code set during the Uyuni installation. For example, if your proxy is in the US and your Uyuni is in DE, enter **DE** for the proxy.



The country code must be two upper case letters. For a complete list of country codes, see <https://www.iso.org/obp/ui/#search>.

Cname Aliases (Separated by Space)

Use this if your proxy can be accessed through various DNS CNAME aliases. Otherwise it can be left empty.

CA Password

Enter the password that was used for the certificate of your Uyuni Server.

Do You Want to Use an Existing SSH Key for Proxying SSH-Push Salt Minion?

Use this option if you want to reuse a SSH key that was used for SSH-Push Salt clients on the server.

Create and Populate Configuration Channel `rhnp_proxy_config_1000010001?`

Accept default **Y**.

SUSE Manager Username

Use same user name and password as on the Uyuni server.

If parts are missing, such as CA key and public certificate, the script prints commands that you must execute to integrate the needed files. When the mandatory files are copied, run `configure-proxy.sh` again. If you receive an HTTP error during script execution, run the script again.

`configure-proxy.sh` activates services required by Uyuni Proxy, such as `squid`, `apache2`, `salt-broker`, and `jabberd`.

To check the status of the proxy system and its clients, click the proxy system's details page on the Web UI (**Systems** > **Proxy**, then the system name). **Connection** and **Proxy** subtabs display various status information.

Enable PXE Boot

Synchronize Profiles and System Information

To enable PXE boot through a proxy, additional software must be installed and configured on both the Uyuni Proxy and the Uyuni Server.

1. On the Uyuni Proxy, install `susemanager-tftpsync-recv`:

```
zypper in susemanager-tftpsync-recv
```

2. On the Uyuni Proxy, run the `configure-tftpsync.sh` setup script and enter the requested information:

```
configure-tftpsync.sh
```

You will need to provide the hostname and IP address of the Uyuni Server and of the proxy. You will also need to enter the path to the tftpboot directory on the proxy.

3. On the Uyuni Server, install `susemanager-tftpsync`:

```
zypper in susemanager-tftpsync
```

1. On the Uyuni Server, run `configure-tftpsync.sh`. This creates the configuration, and uploads it to the Uyuni Proxy:

```
configure-tftpsync.sh FQDN_of_Proxy
```

2. Start an initial synchronization on the Uyuni Server:

```
cobbler sync
```

The **cobbler sync** command is also useful after changing internal Cobbler settings. If you do not run Cobbler synchronization manually, it will run automatically when needed and thus may delay normal operation. For more information about Cobbler, see [[Client-configuration > Cobbler > Cobbler](#)].

Configure DHCP for PXE through Proxy

Uyuni uses Cobbler for client provisioning. PXE (tftp) is installed and activated by default. Clients must be able to find the PXE boot on the Uyuni Proxy using DHCP. Use this DHCP configuration for the zone which contains the clients to be provisioned:

```
next-server: <IP_Address_of_Proxy>
filename: "pxelinux.0"
```

Replace a Uyuni Proxy

A proxy does not contain any information about the clients that are connected to it. Therefore, a proxy can be replaced by a new one at any time. The replacement proxy must have the same name and IP address as its predecessor.

Shut down the old proxy, and leave it installed while you prepare the replacement. Create a reactivation key for this system and then register the new proxy using the reactivation key. If you do not use the reactivation key, you will need to re-register all the clients against the new proxy.



The reactivation key is only needed if you do not want to lose the history of the machine. If you do not use a reactivation key, the replacement proxy will become a "new" one with a new ID.

Procedure: Replacing a Proxy and Keeping the Clients Registered

1. Before starting the actual migration procedure, save the data from the old proxy, if needed. Consider copying important or manually created data to a central place that can also be accessed by the new proxy.
2. Shut down the proxy.
3. Install a new Uyuni Proxy. For installation instructions, see [Proxy Installation](#).
4. In the Uyuni Web UI select the newly installed SUSE Manager Proxy and delete it from the systems list.
5. In the Web UI, create a reactivation key for the old proxy system: On the System Details tab of the old proxy click **Reactivation**. Click **Generate New Key**, and make a note of the new key, as you will need it later. For more information about reactivation keys, see [[Reference > Systems >](#)

Reactivation Keys].

6. After the installation of the new proxy, you might also need to:
 - Copy the centrally saved data to the new proxy system
 - Install any other needed software
 - Set up TFTP synchronization if the proxy is used for autoinstallation



During the installation of the proxy, clients will not be able to reach the Uyuni Server. After a proxy system has been deleted from the systems list, all clients connected to this proxy will be (incorrectly) listed as **directly connected** to the Uyuni Server. After the first successful operation on a client, such as execution of a remote command or installation of a package or patch, this information will automatically be corrected. This may take some hours.

Web Interface Setup

To use the Uyuni Web UI, navigate to your Uyuni URL in a browser. Sign in to the Web UI using your Uyuni Administration account.

While you are using the Web UI, click the  icon to access the documentation for that section.

The first time you sign in to the Web UI, complete the setup wizard to set your user preferences. You can access the setup wizard at any time by navigating to **Admin > Setup Wizard**.

After the initial setup is complete, signing in will take you the **Home > Overview** section. This section contains summary panes that provide important information about your systems.

The **Tasks** pane provides shortcuts to the most common Web UI tasks.

The **Inactive Systems** pane shows any clients that have stopped checking in to the Uyuni Server. You will need to check these clients.

The **Most Critical Systems** pane shows any clients that require software updates. Click the name of a client in the list to be taken to the **Systems > System Details** section for that client. From this page, you can apply any required updates.

The **Recently Scheduled Actions** pane shows all recent actions that have been run, and their status. Click the label of an action to see more detail.


The **Relevant Security Patches** pane shows all available security patches that need to be applied to your clients. It is critical that you apply security patches as soon as possible to keep your clients secure.

The **System Groups** pane shows any system groups you have created, and if the clients in those groups are fully updated.

The **Recently Registered Systems** pane shows all clients registered in the past thirty days. Click

the name of a client in the list to be taken to the **Systems > System Details** section for that client.

Web Interface Navigation

The Uyuni Web UI uses some standard elements to help you navigate. While you are using the Web UI, click the  icon to access the documentation for that section.

Top Navigation Bar

The top navigation bar gives access to system-wide functions.

Notifications

The notification bell icon displays the number of unread notification messages in a circle. Click the notification icon to go to **Home > Notification Messages**.

Overview Legend

Click the eye icon to see commonly used icons for the currently active section of the Web UI.

Search

Click the search magnifying glass icon to open the search box. You can search for systems (clients), packages, patches, or documentation. Click **[Search]** to go to the relevant **Advanced Search** page, and see your search results.

Systems Selected

The systems selected icon displays the number of currently selected systems in a circle. Click the systems selected icon to go to **Systems > System Set Manager > Overview**. Click the eraser icon to unselect all systems. For more information about the system set manager, see [**Client-configuration > Using-ssm >**].

User Account

The user account icon is displayed with the name of the currently signed-in user. Click the user account icon to go to **Home > User Account > My Account**.

Organization

The organization icon is displayed with the name of the currently active organization. Click the organization icon to go to **Home > My Organization > Configuration**.

Preferences

Click the cogs icon to go to **Home > My Preferences**.

Sign Out

Click the exit icon to sign out the current user and return to the sign in screen.



If you add a distribution, newly synchronize channels, or register a system with a Uyuni server, it can take several minutes for it to be indexed and appear in search results. If you need to force a rebuild of the search index, use this command at the command prompt:

```
rhns-search cleanindex
```

Left Navigation Bar

The left navigation bar is the main menu to the Uyuni Web UI.

Expand

If you click the icon or the down-arrow of a menu entry, it expands this part of the menu tree without actually loading a page.

Collapse

To collapse an open part of the menu system, click the up-arrow of a menu entry.

Autoload

If you click the name of a menu entry, the first available page of that menu entry will get loaded and displayed automatically.

Search

Enter a search string in the **Search page** field to find an entry of the menu tree. Available menu entries depend on the roles of the user.



Only Uyuni Administrators can access these sections:

- **Images**
- **Users**
- **Admin`**

Tables


Many sections present information in tables. You can navigate through most tables by clicking the back and next arrows above and below the right side of the table. Change the default number of items shown on each page by navigating to **Home > My Preferences**.

You can filter the content in most tables using the search bar at the top of the table. Sort table entries by clicking on the column header you want to sort by. Click the column header again to reverse the sort.

Patch Alert Icons

Patches are represented by three main icons, depending on the type of patch. Icons are coloured either green, yellow, or red, depending on the severity.

 The shield icon is a security alert. A red shield is the highest priority security alert.

 The bug icon is a bug fix alert.

• The squares icon is an enhancement alert.

Some additional icons are used to give extra information:

 The circling arrows icon indicates that applying a patch will require a reboot.

 The archive box icon indicates that a patch will have an effect on package management.

Public Cloud Setup

Public Cloud providers pre-install Uyuni, so you do not need to perform any installation steps. However, Uyuni Server needs to be registered with SUSE Customer Center to receive updates before you can log in.

For detailed instructions on registering Uyuni to SUSE Customer Center, see [**Installation > Server-setup >**].

When you have registered, all SUSE Linux Enterprise modules will be activated. You will also need to activate the public cloud module.

Procedure: Activating the Public Cloud Module

1. On the Uyuni Server, open the YaST management tool, and navigate to **Software > Software Repositories**.
2. Click [**Add**] and select **Extensions and Modules from Registration Server**.
3. In the **Available extensions** field, select **Public Cloud Module**.

If you prefer to use the command line, you can add the module with this command:

```
SUSEConnect -p sle-module-public-cloud/15.2/x86_64
```

When the installation procedure has finished, you can check that you have all the required modules. At the command prompt, enter:

```
SUSEConnect --status-text
```

For Uyuni Server on a public cloud, the expected modules are:

- SUSE Linux Enterprise Server Basesystem Module
- Python 2 Module
- Server Applications Module
- Web and Scripting Module
- SUSE Manager Server Module
- Public Cloud Module

Account Credentials

An administrator account is created by default. The username and password varies depending on your provider.

Table 11. Default Administrator Account Details

Provider	Default Username	Default Password
Amazon EC2	admin	<instance-ID>
Google Compute Engine	admin	<instance-ID>
Microsoft Azure	admin	<instance-name>-suma

You can retrieve the instance name or ID from the public cloud instance web console, or from the command prompt:

Amazon EC2:

```
ec2metadata --instance-id
```

Google Compute Engine:

```
gcmetadata --query instance --id
```

Microsoft Azure:

```
azuremetadata --instance-name
```



When you have logged in to the administrator account for the first time, change the default password to protect your account.

Setup Wizard

When you have completed your Uyuni installation, you can use the setup wizard to complete the last few steps. The setup wizard allows you to configure the HTTP proxy, organization credentials, and SUSE products.

The setup wizard is displayed by default when you log in the Uyuni Web UI for the first time. You can access the setup wizard directly by navigating to **Admin > Setup Wizard**.

Configure the HTTP Proxy

Uyuni can connect to the SUSE Customer Center (SCC) or other remote servers using a proxy. Navigate to the **HTTP Proxy** tab to configure the proxy.

You will need to provide the hostname of the proxy. Use the syntax **<hostname>:<port>**. For example: **<example.com>:8080**.

You can disable use of the proxy by clearing the fields.



When choosing a username or password for your Uyuni Proxy, ensure it does not contain an **@** or **:** character. These characters are reserved.

Configure Organization Credentials

Your SUSE Customer Center account is associated with the administration account of your organization. You can share your SUSE Customer Center access with other users within your organization. Navigate to the **Organization Credentials** tab to grant users within your organization access to your SUSE Customer Center account.

Click **[Add a new credential]**, enter the username and password of the user to grant access to, and click **[Save]**. A new credential card is shown for the user you have granted access to. Use these buttons on the card to edit or revoke access:

- Check credential validation status (green tick or red cross icon). To re-check the credential with SCC, click the icon.
- Set the primary credentials for inter-server synchronization (yellow star icon).
- List the subscriptions related to a certain credential (list icon).
- Edit the credential (pencil icon).
- Delete the credential (trash can icon).

Configure Products

Your SUSE subscription entitles you to access a range of products. Navigate to the **Products** tab to browse the products available to you and synchronize Uyuni with SUSE Customer Center.

Filters help you search for products by description or architecture.

The list is organized by product name. For each product, you can see the architecture it can be used on. Click the arrow next to the product name to see associated channels and extensions. Click the **[Channels]** icon to see the complete list of channels associated with each product.

For products based on SUSE Linux Enterprise 15 and above, you can choose to only synchronize required packages, or to also include recommended products. Toggle the **[include recommended]** switch on to synchronize all products, and toggle the switch off to synchronize only required products.

You can further refine which products you want to synchronize by selecting or deselecting individual product.

When you have completed your selection, click **[Add products]**, and click **[Refresh]** to schedule the synchronization.

Synchronization progress for each product is shown in a progress bar next to the product name. Depending on the products you have chosen, synchronization can take up to several hours. New products will be available for you to use in Uyuni when synchronization is complete.

If your synchronization fails, it could be because of a third party GPG key. For more information about troubleshooting product synchronization, see **[Administration > Tshoot-sync >]**.

GNU Free Documentation License

Copyright © 2000, 2001, 2002 Free Software Foundation, Inc. 51 Franklin St, Fifth Floor, Boston, MA 02110-1301 USA. Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed.

0. PREAMBLE

The purpose of this License is to make a manual, textbook, or other functional and useful document "free" in the sense of freedom: to assure everyone the effective freedom to copy and redistribute it, with or without modifying it, either commercially or noncommercially. Secondly, this License preserves for the author and publisher a way to get credit for their work, while not being considered responsible for modifications made by others.

This License is a kind of "copyleft", which means that derivative works of the document must themselves be free in the same sense. It complements the GNU General Public License, which is a copyleft license designed for free software.

We have designed this License in order to use it for manuals for free software, because free software needs free documentation: a free program should come with manuals providing the same freedoms that the software does. But this License is not limited to software manuals; it can be used for any textual work, regardless of subject matter or whether it is published as a printed book. We recommend this License principally for works whose purpose is instruction or reference.

1. APPLICABILITY AND DEFINITIONS

This License applies to any manual or other work, in any medium, that contains a notice placed by the copyright holder saying it can be distributed under the terms of this License. Such a notice grants a world-wide, royalty-free license, unlimited in duration, to use that work under the conditions stated herein. The "Document", below, refers to any such manual or work. Any member of the public is a licensee, and is addressed as "you". You accept the license if you copy, modify or distribute the work in a way requiring permission under copyright law.

A "Modified Version" of the Document means any work containing the Document or a portion of it, either copied verbatim, or with modifications and/or translated into another language.

A "Secondary Section" is a named appendix or a front-matter section of the Document that deals exclusively with the relationship of the publishers or authors of the Document to the Document's overall subject (or to related matters) and contains nothing that could fall directly within that overall subject. (Thus, if the Document is in part a textbook of mathematics, a Secondary Section may not explain any mathematics.) The relationship could be a matter of historical connection with the subject or with related matters, or of legal, commercial, philosophical, ethical or political position regarding them.

The "Invariant Sections" are certain Secondary Sections whose titles are designated, as being those of Invariant Sections, in the notice that says that the Document is released under this License. If a section does not fit the above definition of Secondary then it is not allowed to be designated as Invariant. The Document may contain zero Invariant Sections. If the Document does not identify any Invariant Sections

then there are none.

The "Cover Texts" are certain short passages of text that are listed, as Front-Cover Texts or Back-Cover Texts, in the notice that says that the Document is released under this License. A Front-Cover Text may be at most 5 words, and a Back-Cover Text may be at most 25 words.

A "Transparent" copy of the Document means a machine-readable copy, represented in a format whose specification is available to the general public, that is suitable for revising the document straightforwardly with generic text editors or (for images composed of pixels) generic paint programs or (for drawings) some widely available drawing editor, and that is suitable for input to text formatters or for automatic translation to a variety of formats suitable for input to text formatters. A copy made in an otherwise Transparent file format whose markup, or absence of markup, has been arranged to thwart or discourage subsequent modification by readers is not Transparent. An image format is not Transparent if used for any substantial amount of text. A copy that is not "Transparent" is called "Opaque".

Examples of suitable formats for Transparent copies include plain ASCII without markup, Texinfo input format, LaTeX input format, SGML or XML using a publicly available DTD, and standard-conforming simple HTML, PostScript or PDF designed for human modification. Examples of transparent image formats include PNG, XCF and JPG. Opaque formats include proprietary formats that can be read and edited only by proprietary word processors, SGML or XML for which the DTD and/or processing tools are not generally available, and the machine-generated HTML, PostScript or PDF produced by some word processors for output purposes only.

The "Title Page" means, for a printed book, the title page itself, plus such following pages as are needed to hold, legibly, the material this License requires to appear in the title page. For works in formats which do not have any title page as such, "Title Page" means the text near the most prominent appearance of the work's title, preceding the beginning of the body of the text.

A section "Entitled XYZ" means a named subunit of the Document whose title either is precisely XYZ or contains XYZ in parentheses following text that translates XYZ in another language. (Here XYZ stands for a specific section name mentioned below, such as "Acknowledgements", "Dedications", "Endorsements", or "History".) To "Preserve the Title" of such a section when you modify the Document means that it remains a section "Entitled XYZ" according to this definition.

The Document may include Warranty Disclaimers next to the notice which states that this License applies to the Document. These Warranty Disclaimers are considered to be included by reference in this License, but only as regards disclaiming warranties: any other implication that these Warranty Disclaimers may have is void and has no effect on the meaning of this License.

2. VERBATIM COPYING

You may copy and distribute the Document in any medium, either commercially or noncommercially, provided that this License, the copyright notices, and the license notice saying this License applies to the Document are reproduced in all copies, and that you add no other conditions whatsoever to those of this License. You may not use technical measures to obstruct or control the reading or further copying of the copies you make or distribute. However, you may accept compensation in exchange for copies. If you distribute a large enough number of copies you must also follow the conditions in section 3.

You may also lend copies, under the same conditions stated above, and you may publicly display copies.

3. COPYING IN QUANTITY

If you publish printed copies (or copies in media that commonly have printed covers) of the Document, numbering more than 100, and the Document's license notice requires Cover Texts, you must enclose the copies in covers that carry, clearly and legibly, all these Cover Texts: Front-Cover Texts on the front cover, and Back-Cover Texts on the back cover. Both covers must also clearly and legibly identify you as the publisher of these copies. The front cover must present the full title with all words of the title equally prominent and visible. You may add other material on the covers in addition. Copying with changes limited to the covers, as long as they preserve the title of the Document and satisfy these conditions, can be treated as verbatim copying in other respects.

If the required texts for either cover are too voluminous to fit legibly, you should put the first ones listed (as many as fit reasonably) on the actual cover, and continue the rest onto adjacent pages.

If you publish or distribute Opaque copies of the Document numbering more than 100, you must either include a machine-readable Transparent copy along with each Opaque copy, or state in or with each Opaque copy a computer-network location from which the general network-using public has access to download using public-standard network protocols a complete Transparent copy of the Document, free of added material. If you use the latter option, you must take reasonably prudent steps, when you begin distribution of Opaque copies in quantity, to ensure that this Transparent copy will remain thus accessible at the stated location until at least one year after the last time you distribute an Opaque copy (directly or through your agents or retailers) of that edition to the public.

It is requested, but not required, that you contact the authors of the Document well before redistributing any large number of copies, to give them a chance to provide you with an updated version of the Document.

4. MODIFICATIONS

You may copy and distribute a Modified Version of the Document under the conditions of sections 2 and 3 above, provided that you release the Modified Version under precisely this License, with the Modified Version filling the role of the Document, thus licensing distribution and modification of the Modified Version to whoever possesses a copy of it. In addition, you must do these things in the Modified Version:

- A. Use in the Title Page (and on the covers, if any) a title distinct from that of the Document, and from those of previous versions (which should, if there were any, be listed in the History section of the Document). You may use the same title as a previous version if the original publisher of that version gives permission.
- B. List on the Title Page, as authors, one or more persons or entities responsible for authorship of the modifications in the Modified Version, together with at least five of the principal authors of the Document (all of its principal authors, if it has fewer than five), unless they release you from this requirement.
- C. State on the Title page the name of the publisher of the Modified Version, as the publisher.

-
- D. Preserve all the copyright notices of the Document.
 - E. Add an appropriate copyright notice for your modifications adjacent to the other copyright notices.
 - F. Include, immediately after the copyright notices, a license notice giving the public permission to use the Modified Version under the terms of this License, in the form shown in the Addendum below.
 - G. Preserve in that license notice the full lists of Invariant Sections and required Cover Texts given in the Document's license notice.
 - H. Include an unaltered copy of this License.
 - I. Preserve the section Entitled "History", Preserve its Title, and add to it an item stating at least the title, year, new authors, and publisher of the Modified Version as given on the Title Page. If there is no section Entitled "History" in the Document, create one stating the title, year, authors, and publisher of the Document as given on its Title Page, then add an item describing the Modified Version as stated in the previous sentence.
 - J. Preserve the network location, if any, given in the Document for public access to a Transparent copy of the Document, and likewise the network locations given in the Document for previous versions it was based on. These may be placed in the "History" section. You may omit a network location for a work that was published at least four years before the Document itself, or if the original publisher of the version it refers to gives permission.
 - K. For any section Entitled "Acknowledgements" or "Dedications", Preserve the Title of the section, and preserve in the section all the substance and tone of each of the contributor acknowledgements and/or dedications given therein.
 - L. Preserve all the Invariant Sections of the Document, unaltered in their text and in their titles. Section numbers or the equivalent are not considered part of the section titles.
 - M. Delete any section Entitled "Endorsements". Such a section may not be included in the Modified Version.
 - N. Do not retile any existing section to be Entitled "Endorsements" or to conflict in title with any Invariant Section.
 - O. Preserve any Warranty Disclaimers.

If the Modified Version includes new front-matter sections or appendices that qualify as Secondary Sections and contain no material copied from the Document, you may at your option designate some or all of these sections as invariant. To do this, add their titles to the list of Invariant Sections in the Modified Version's license notice. These titles must be distinct from any other section titles.

You may add a section Entitled "Endorsements", provided it contains nothing but endorsements of your Modified Version by various parties—for example, statements of peer review or that the text has been approved by an organization as the authoritative definition of a standard.

You may add a passage of up to five words as a Front-Cover Text, and a passage of up to 25 words as a Back-Cover Text, to the end of the list of Cover Texts in the Modified Version. Only one passage of Front-Cover Text and one of Back-Cover Text may be added by (or through arrangements made by) any one entity. If the Document already includes a cover text for the same cover, previously added by you or by arrangement made by the same entity you are acting on behalf of, you may not add another; but you may replace the old one, on explicit permission from the previous publisher that added the old one.

The author(s) and publisher(s) of the Document do not by this License give permission to use their names for publicity for or to assert or imply endorsement of any Modified Version.

5. COMBINING DOCUMENTS

You may combine the Document with other documents released under this License, under the terms defined in section 4 above for modified versions, provided that you include in the combination all of the Invariant Sections of all of the original documents, unmodified, and list them all as Invariant Sections of your combined work in its license notice, and that you preserve all their Warranty Disclaimers.

The combined work need only contain one copy of this License, and multiple identical Invariant Sections may be replaced with a single copy. If there are multiple Invariant Sections with the same name but different contents, make the title of each such section unique by adding at the end of it, in parentheses, the name of the original author or publisher of that section if known, or else a unique number. Make the same adjustment to the section titles in the list of Invariant Sections in the license notice of the combined work.

In the combination, you must combine any sections Entitled "History" in the various original documents, forming one section Entitled "History"; likewise combine any sections Entitled "Acknowledgements", and any sections Entitled "Dedications". You must delete all sections Entitled "Endorsements".

6. COLLECTIONS OF DOCUMENTS

You may make a collection consisting of the Document and other documents released under this License, and replace the individual copies of this License in the various documents with a single copy that is included in the collection, provided that you follow the rules of this License for verbatim copying of each of the documents in all other respects.

You may extract a single document from such a collection, and distribute it individually under this License, provided you insert a copy of this License into the extracted document, and follow this License in all other respects regarding verbatim copying of that document.

7. AGGREGATION WITH INDEPENDENT WORKS

A compilation of the Document or its derivatives with other separate and independent documents or works, in or on a volume of a storage or distribution medium, is called an "aggregate" if the copyright resulting from the compilation is not used to limit the legal rights of the compilation's users beyond what the individual works permit. When the Document is included in an aggregate, this License does not apply to the other works in the aggregate which are not themselves derivative works of the Document.

If the Cover Text requirement of section 3 is applicable to these copies of the Document, then if the Document is less than one half of the entire aggregate, the Document's Cover Texts may be placed on covers that bracket the Document within the aggregate, or the electronic equivalent of covers if the Document is in electronic form. Otherwise they must appear on printed covers that bracket the whole aggregate.

8. TRANSLATION

Translation is considered a kind of modification, so you may distribute translations of the Document under the terms of section 4. Replacing Invariant Sections with translations requires special permission from their copyright holders, but you may include translations of some or all Invariant Sections in addition to the original versions of these Invariant Sections. You may include a translation of this License, and all the license notices in the Document, and any Warranty Disclaimers, provided that you also include the original English version of this License and the original versions of those notices and disclaimers. In case of a disagreement between the translation and the original version of this License or a notice or disclaimer, the original version will prevail.

If a section in the Document is Entitled "Acknowledgements", "Dedications", or "History", the requirement (section 4) to Preserve its Title (section 1) will typically require changing the actual title.

9. TERMINATION

You may not copy, modify, sublicense, or distribute the Document except as expressly provided for under this License. Any other attempt to copy, modify, sublicense or distribute the Document is void, and will automatically terminate your rights under this License. However, parties who have received copies, or rights, from you under this License will not have their licenses terminated so long as such parties remain in full compliance.

10. FUTURE REVISIONS OF THIS LICENSE

The Free Software Foundation may publish new, revised versions of the GNU Free Documentation License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns. See <http://www.gnu.org/copyleft/>.

Each version of the License is given a distinguishing version number. If the Document specifies that a particular numbered version of this License "or any later version" applies to it, you have the option of following the terms and conditions either of that specified version or of any later version that has been published (not as a draft) by the Free Software Foundation. If the Document does not specify a version number of this License, you may choose any version ever published (not as a draft) by the Free Software Foundation.

ADDENDUM: How to use this License for your documents

Copyright (c) YEAR YOUR NAME.

Permission is granted to copy, distribute and/or modify this document under the terms of the GNU Free Documentation License, Version 1.2 or any later version published by the Free Software Foundation; with no Invariant Sections, no Front-Cover Texts, and no Back-Cover Texts. A copy of the license is included in the section entitled "GNU Free Documentation License".

If you have Invariant Sections, Front-Cover Texts and Back-Cover Texts, replace the "with...Texts." line with this:

with the Invariant Sections being LIST THEIR TITLES, with the
Front-Cover Texts being LIST, and with the Back-Cover Texts being LIST.

If you have Invariant Sections without Cover Texts, or some other combination of the three, merge those two alternatives to suit the situation.

If your document contains nontrivial examples of program code, we recommend releasing these examples in parallel under your choice of free software license, such as the GNU General Public License, to permit their use in free software.