SUSE Multi-Linux Manager 5.1

Specialized Guides

Chapter 1. Preface

Specialized Guides

SUSE Multi-Linux Manager 5.1

This guide provides an overview of specialized topics and functionalities within SUSE Multi-Linux Manager.

It is designed to help users with basic, routine, and advanced tasks, explaining each step's purpose and outlining the various options available to customize your approach.

For more in-depth information, refer to the following specialized guides:

- **Specialized-guides › Public-cloud-guide**

- **Specialized-guides › Salt**

- **Specialized-guides › Large-deployments**

- **Specialized-guides › Qs-sap**

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Chapter 2. Public Cloud Guide

This guide shows you the fastest way to get SUSE Multi-Linux Manager up and running in a public cloud environment using on-demand, Pay-as-you-go (PAYG), or Bring-your-own-subscription (BYOS) services. SUSE Multi-Linux Manager Proxy in a public cloud is only supported using BYOS services.

Additionally, it assumes that you are installing the SUSE Multi-Linux Manager Server on a single cloud instance. These procedures have been tested on Amazon Web Services, Microsoft Azure, and Google Cloud Compute.

> ℹ️ Pay-as-you-go or Bring-your-own-subscription services currently work on both Amazon Web Services and Microsoft Azure.

For more information on using SUSE Multi-Linux Manager, see the official SUSE Multi-Linux Manager documentation at https://documentation.suse.com/MLM.

2.1. BYOS Guide

2.1.1. Bring-your-own-subscription (BYOS)

Bring-your-own-subscription (BYOS) images are useful if you already have a support contract with SUSE and want to move your workloads to the public cloud. An instance launched from a BYOS image is equivalent to a physical machine that just received a SUSE Linux Enterprise Server installation from the SUSE Linux Enterprise Server installation image.

After creation:

- use registercloudguest to register the instance with the SUSE-operated update infrastructure in the cloud framework, or

- use the command SUSEConnect to register the system with SUSE Customer Center using the entitlements you already have.

Connect your system to your own running RMT or SUSE Multi-Linux Manager infrastructure in the same way you connect systems in your data center.

BYOS instances make it easier to manage extensions such as LTSS or kernel live-patching. Extensions for PAYG instances can only be used in conjunction with SUSE Multi-Linux Manager.

2.1.2. Initial Setup

2.1.2.1. Introduction

This guide shows you the fastest way to get SUSE Multi-Linux Manager up and running in a public cloud using

on-demand or BYOS services. We have tested using SUSE Multi-Linux Manager on Amazon EC2, Google Compute Engine, and Microsoft Azure, but these procedures should work with other public cloud providers as well, with some variation.

There are three main methods of using SUSE Multi-Linux Manager on a public cloud service.

Bring-your-own-subscription (BYOS)

Most public cloud providers make a BYOS image of SUSE Multi-Linux Manager available. This means you do not need to install SUSE Multi-Linux Manager, just set up the server or proxy. You will need to have SUSE product entitlements before you begin, and there are some additional setup steps required. The public cloud documentation in the SUSE Multi-Linux Manager documentation suite assumes you are using this method.

Virtual machine on public cloud

In this method, you subscribe to a public cloud service, and install SUSE Multi-Linux Manager in a virtual machine, using the Unified Installer. You will need to have SUSE product entitlements before you begin. You can do this by following all the same instructions as you would for any local SUSE Multi-Linux Manager installation.

On-demand SUSE Linux Enterprise Server Pay-as-you-go (PAYG) image

Most public cloud providers make SUSE Linux Enterprise Server available as a BYOS image. This means that SUSE Linux Enterprise Server is pre-installed, and you can install SUSE Multi-Linux Manager on top, using the Unified Installer. You can do this by following all the same instructions as you would for any local SUSE Multi-Linux Manager installation. You will need to have SUSE product entitlements before you begin. Be careful with this method, because you might end up requiring additional product entitlements that could drive up your costs.

2.1.2.2. SUSE Multi-Linux Manager Server

If you are using the BYOS method, start by logging in to your chosen public cloud provider, and launching a SUSE Multi-Linux Manager instance. Depending on the public cloud you are using, you can usually locate the SUSE Multi-Linux Manager Server BYOS images by searching for `suse manager`. In EC2, you need to search within the Community AMIs. In GCE and Azure, search the marketplace.

Select a public cloud instance type that meets the hardware and networking requirements in **Installation-and-upgrade › Pubcloud-requirements**.

When you have your virtual machine ready, and the BYOS image installed, you need to set up SUSE Multi-Linux Manager Server. This is done in the same way as a local installation, using YaST. When you have completed SUSE Multi-Linux Manager setup, you need to activate the public cloud module. You can then complete the setup in the SUSE Multi-Linux Manager Web UI.

2.1.2.3. SUSE Multi-Linux Manager Proxy

You must use the BYOS method. Start by logging in to your chosen public cloud provider, and launch a SUSE Multi-Linux Manager Proxy instance. Depending on the public cloud you are using, you can usually locate the SUSE Multi-Linux Manager Proxy BYOS images by searching for `suse manager proxy`. In EC2, you need to search within the Community AMIs. In GCE and Azure, search the marketplace.

Select a public cloud instance type that meets the hardware and networking requirements in **Installation-and-upgrade › Pubcloud-requirements**.

When you have your virtual machine ready, and the BYOS image installed, you need to set up SUSE Multi-Linux Manager Proxy. This is done in the same way as a local installation, using SUSE setup tools. When you have completed SUSE Multi-Linux Manager Proxy setup, you need to activate the public cloud module.

2.1.3. Client Registration

When you have your SUSE Multi-Linux Manager Server and, optionally, your SUSE Multi-Linux Manager Proxy set up, you are ready to start registering clients.

For instructions on registering clients on a public cloud, see **Client-configuration › Clients-pubcloud**.

For instructions on connecting PAYG instances, see **Installation-and-upgrade › Connect-payg**.

2.1.3.1. Additional Resources

For more information on using SUSE products in the public cloud see: SUSE Linux Enterprise Public Cloud Guide.

For more SUSE Multi-Linux Manager product documentation, see https://documentation.suse.com/MLM.

To raise an issue or propose a change to the documentation, use the links under the `Resources` menu on the documentation site.

2.2. PAYG Guide

2.2.1. PAYG Overview

PAYG does not require a long-term subscription. Users can leverage the images of SUSE Multi-Linux Manager on a Pay-as-you-go basis, paying only for the time of use, and the number of managed and monitored systems. PAYG with SUSE Multi-Linux Manager is an optimal solution for those seeking control, convenience, and cost savings when managing and monitoring their infrastructure on AWS, Azure, and GCP.

2.2.1.1. Introduction to PAYG

SUSE Multi-Linux Manager PAYG or Pay-as-you-go is a flexible and cost-effective solution that allows users to manage and monitor their systems from several cloud services. PAYG does not require a long-term subscription through the SUSE Customer Center. Users can leverage images of SUSE Multi-Linux Manager on a Pay-as-you-go basis, paying only for the time of use, and the number of **managed** and **monitored** systems.

PAYG with SUSE Multi-Linux Manager is an optimal solution for those seeking control, convenience, and cost savings when managing and monitoring their infrastructure on Amazon Web Services, Microsoft Azure, and Google Cloud Compute.

> **Obtaining a SUSE Multi-Linux Manager Server Subscription (optional)**
>
> For customers running 10 or more PAYG SLES for SAP Applications instances who also wish to access the SUSE Multi-Linux Manager BYOS Lifecycle subscription, an email must be sent to susemanagerkey@suse.com. The email should include proof of at least 10 active SLES for SAP PAYG instances, such as a screenshot of the relevant section of their cloud console. The subscription key is valid for one year and can be renewed by providing updated proof of the instances at the end of the subscription period.

2.2.1.2. Benefits of Using PAYG

The SUSE Multi-Linux Manager PAYG instance offers a flexible solution tailored to the modern business landscape. Key benefits include:

- **Cost Efficiency:** Pay only for what you use, aligning costs with the actual system management needs.

- **No Subscription Required:** Eliminate the need for ongoing commitments or long-term subscriptions, allowing for budget flexibility.

- **Ease of Use:** Utilize SUSE Multi-Linux Manager's powerful features on a **PAYG** or **Pay-as-you-go** basis, streamlining initial setup and ongoing systems management.

- **Scalability:** Easily scale the number of systems managed according to your requirements, without worrying about subscription limitations.

- **Rapid Deployment:** Quickly run the image of your choice and begin managing your systems, enhancing responsiveness to your needs.

- **Integration with Cloud Services:** Leverage SUSE Multi-Linux Manager PAYG on AWS, Microsoft Azure, or GCP taking advantage of cloud infrastructure for an agile systems management experience.

2.2.2. PAYG Limitations

2.2.2.1. Onboarded BYOS Instances without SCC Credentials

Valid SUSE Customer Center credentials are needed to manage Bring-your-own-subscription (BYOS) instances of SUSE products in SUSE Multi-Linux Manager PAYG. This applies to all SUSE products except SUSE Multi-Linux Manager Proxy BYOS. Without any SCC credentials, SUSE Multi-Linux Manager PAYG will not allow onboarding any of the mentioned BYOS instances. The user will get an error.

There is a possibility that the user has valid SCC credentials set with already synced-up channels and the BYOS onboarded, but at some point decides to delete those credentials.

In the scenario of having already onboarded BYOS instances but no SCC credentials set, the following restrictions apply:

- A warning message will be shown to the user to let them know that they will not be able to manage those instances.

- Non-compliant BYOS instances will not be able to be managed neither through Salt or Salt-SSH. This applies to individual server management, SSM and action-chains. When dealing with several servers at once, as long as there is one non-compliant BYOS instance among them, the entire action/action-chain will be aborted for all servers.

- Non-compliant BYOS instances will not be able to access any repository hosted in SUSE Multi-Linux Manager PAYG as long as SCC credentials are not set. SUSE Multi-Linux Manager PAYG will return HTTP 401 Unauthorized until the situation is amended, that is trying to install or upgrade packages using zypper from those machines directly will not work.

2.2.3. PAYG on AWS

2.2.3.1. AWS System Requirements

When setting up a SUSE Multi-Linux Manager PAYG instance on AWS, it is essential to consider system requirements for optimal performance and functionality. The default requirements outlined below have been tailored for smooth deployment and operation.

Table 1. AWS System Requirements

Requirement	Details
root storage	100 GB
spacewalk storage	500 GB

Requirement	Details
database storage	80 GB
CPU	4 cores; Use the **m5a**, **m5i**, **m6a**, **m6i** systems or newer
Memory	32 GB (minimum 16 GB)
Network Configuration	Typically configured by your organization

2.2.3.2. Obtaining the SUSE Multi-Linux Manager Server PAYG Public Cloud Image on AWS

Follow these step-by-step instructions to locate the SUSE Multi-Linux Manager 5.1 PAYG image on AWS. You can also review the latest available images for the public cloud using Pint (Public Cloud Information Tracker).

For more information see: pint.suse.com

Procedure: Obtaining the SUSE Multi-Linux Manager PAYG Image on AWS

1. In your browser navigate to the AWS Management Console.

2. Enter your AWS credentials and login.

3. From the AWS Management Console dashboard, locate the **Services** dropdown.

4. From the menu select **EC2** under the **Compute** section.

5. In the EC2 dashboard, in the main content section, you'll find the **[Launch Instance]** button. Click it.

6. From the **Choose an Amazon Machine Image (AMI)** page. Select **Browse more AMIs**.

7. Search for **SUSE Multi-Linux Manager**.

8. Depending on your location select your AMI image.

    ◦ **SUSE Multi-Linux Manager Server Family (EU and UK only)**

    ◦ **SUSE Multi-Linux Manager Server Family (non-EU and non-UK-only)**.

9. Click **[Select]**.

10. Proceed for image configuration.

2.2.3.3. AWS Image Preparation and Configuration

This section covers initial preparation and configuration of the image on AWS.

2.2.3.3.1. The IAM Role

To ensure seamless operation, proper AWS permissions for the IAM (Identity and Access Management) role are essential. This role must be attached to the instance, otherwise disconnection errors will be thrown after one hour.

You can pre-create the role on your AWS account and then select it from the existing **[IAM role]** drop-down during the instance configuration process.

If you create the role during the creation of an instance, the role will not be attached automatically. The role should be added post setup.

A role can be assigned to a running instance through the following steps: **Actions › Security › Modify IAM-role**. It needs to have the following policy attached in order to be used:

```
{
    "AttachedPolicies": [
        {
            "PolicyName": "AWSMarketplaceMeteringFullAccess",
            "PolicyArn": "arn:aws:iam::aws:policy/AWSMarketplaceMeteringFullAccess"
        }
    ]
}
```

To allow the **EC2** service to assume such role:

```
"AssumeRolePolicyDocument": {
        "Version": "2012-10-17",
        "Statement": [
            {
                "Effect": "Allow",
                "Principal": {
                    "Service": "ec2.amazonaws.com"
                },
                "Action": "sts:AssumeRole"
            }
        ]
    }
```

> ℹ️ IAM role can be attached to an **EC2** instance by means of an instance profile, which acts as a container for the role itself.

For detailed information on IAM roles, see: docs.aws.amazon.com/IAM

2.2.3.3.2. Configure SUSE Multi-Linux Manager Instance

Procedure: Configuring your SUSE Multi-Linux Manager instance

1. Select the AMI image and provide a meaningful **name** for your server. Review the details and pricing

information provided.

2. You have the option to configure additional instance details in subsequent steps, such as storage, tags, security groups, and the required **IAM role**.

    a. The image automatically suggests a **default CPU configuration**.

    b. Choose an existing key pair or create a new one to grant access to the instance.

    c. Your organization should provide the necessary security groups and network configuration.

    d. If an IAM role has been previously created, you can attach it by selecting it from the existing **IAM role** drop-down. Otherwise, attach this role after the instance has been launched.

    e. Create the following partitions

- **100 GB** for the root partition

- **500 GB** for spacewalk storage

- **80 GB** for the database.

       For more information see: AWS requirements

    f. Follow the prompts from AWS to complete the configuration as needed.

3. After reviewing your configuration click the **[Launch instance]** dropdown.

4. Click on the **[Launch Instances]** button.

5. You will be redirected to the **EC2** Dashboard.

6. Verify that the instance has successfully launched by selecting **Instances** on the left sidebar. The SUSE Multi-Linux Manager PAYG instance should be running in the main content area.

> **(i)** **Usage and Costs**
>
> Because this is a PAYG image, you will be billed according to your actual usage, including the number of systems you **manage** and **monitor** with this instance. It is essential to regularly track and review your usage to prevent unexpected costs and ensure alignment with your needs.

2.2.3.4. Server Setup

Procedure: Log in and Update the System

1. SSH into your AWS instance.

2. Switch to the root user and update the system.

```
sudo -i
```

```
transactional-update
```

3. Reboot the system.

4. Configure storage with the `mgr-storage-server` tool or in the case of the proxy use `mgr-storage-proxy`.

   ○ For more information, see `mgr-storage-server --help` or `mgr-storage-proxy --help`.

This tool simplifies creating the container storage and database volumes.

Procedure

1. Format the command in the following manner:

   ```
   mgr-storage-server <storage-disk-device> [<database-disk-device>]
   ```

   For example:

   ```
   mgr-storage-server /dev/nvme1n1 /dev/nvme2n1
   ```

   > **ℹ** This command will create the following persistent storage volumes at /var/lib/containers/storage/volumes:
   >
   > For more information, see **Installation-and-upgrade › Container-management**.

2. Run `mgradm install podman <FQDN>` as root.

2.2.3.5. SUSE Multi-Linux Manager PAYG Web UI Configuration

2.2.3.5.1. Requirements

SUSE Multi-Linux Manager must be setup and running on AWS. For more information on finding and setting up SUSE Multi-Linux Manager, see **Specialized-guides › Public-cloud-guide**.

> **ℹ** **The instance-flavor-check tool and PAYG Schedule Check**
>
> **instance-flavor-check Tool**
>
> The **instance-flavor-check** tool is an essential component that comes pre-installed by default. Its presence is crucial, as it determines the status of PAYG instances. When invoked, this tool identifies and categorizes the system as a PAYG instance. By default this tool is configured to run on a schedule named **update-payg-default**.
>
> **update-payg-default Schedule Task**
>
> Navigate to the **Admin › Task Schedules** to find the **update-payg-default** task. By

default, this task is set to run at 10-minute intervals. Its primary function is to monitor the presence of all running PAYG instances by executing the **instance-flavor-check tool**.

2.2.3.5.2. Log in to the Web UI

Procedure: Logging in

1. Login to the SUSE Multi-Linux Manager Server Web UI. Use the username and password you have defined during the setup with mgradm install podman.

2. Select **Admin › Setup Wizard**.

2.2.3.5.3. Configure the PAYG Credentials and Product List

On a new server, the organization credentials table is listed at **Admin › Setup Wizard › Organization Credentials**. The Products table listed under **Admin › Setup Wizard › Products** will be empty.

Procedure: Verify Credentials for PAYG and Refreshing the Product List

1. On your new server navigate to the **Admin › Setup Wizard › Pay-as-you-go** tab to view and manage PAYG credentials. Localhost should provide the description SUSE Multi-Linux Manager Pay-as-you-go and the status should read Credentials successfully updated.

2. Navigate to the **Admin › Products** tab and click **[Refresh]**.

3. Once the refresh completes the following products are listed:

   ○ **SUSE Multi-Linux Manager Proxy**

   ○ **SUSE Multi-Linux Manager Server**

   ○ **Free products**

   ### Ubuntu and Debian

   Ubuntu and Debian are not currently supported by our RMT servers.

   ### Red Hat Linux Enterprise Clients

   SUSE Multi-Linux Manager offers support for Red Hat Enterprise Linux clients. However, it is important to note that content still needs to be added manually and is not available through the cloud-based RMT service.

   For more information see: **Client-configuration › Registration-overview-redhat**.

2.2.3.6. Connecting PAYG Clients and Client Registration

2.2.3.6.1. Managing Connections and Registering PAYG and BYOS images

PAYG (Pay-as-you-go) Images

Connecting and registering PAYG images is supported and can be done without additional prerequisites.

BYOS (Bring-your-own-subscription) Images

Registering BYOS images requires SCC (SUSE Customer Center) credentials beforehand. If a user attempts to onboard a BYOS image without providing SCC credentials, the operation will fail, as these credentials are required to verify your subscription.

- Always verify the type of image (PAYG or BYOS) prior to initiating the registration process with SUSE Multi-Linux Manager to ensure a smooth and error-free connection.

- If you have SCC credentials ensure your SCC credentials are valid and have the necessary permissions for utilizing BYOS images.

Do not register PAYG instances with the SUSE Customer Center. Only BYOS instances should be registered against the SUSE Customer Center.

Registering PAYG instances with the SUSE Customer Center or your own RMT server will create conflicts that are not easily solved. PAYG instances are automatically registered against the correct update server when added to your cloud service provider SUSE Multi-Linux Manager instance.

2.2.3.6.2. Starting Up Additional PAYG SUSE Products in AWS

For more information on using SUSE PAYG products such as SUSE Linux Enterprise in the public cloud see: SUSE Linux Enterprise Public Cloud Guide

2.2.3.6.3. Establishing a PAYG SUSE Linux Enterprise Connection with SUSE Multi-Linux Manager PAYG

It is important to recognize that there is a difference between **Pay-as-you-go connections** and **bootstrapping**. Bootstrapping is also known as **client registration**.

Once you have started up your SUSE Multi-Linux Manager PAYG instance and refreshed products you can add **Pay-as-you-go connections** via the **Admin › Setup Wizard › Pay-as-you-go [+Add Pay-as-you-go]** button. This action links your SUSE Multi-Linux Manager

PAYG instance with additional PAYG products on AWS.

Bootstrapping or **client registration** is the process of onboarding clients in SUSE Multi-Linux Manager. The registration process installs the appropriate client tools and provides full management functionality.

To manage your clients, start by **establishing connections** and then proceed to **bootstrap** your clients. These two actions are the steps required for initiating and completing the client onboarding process.

Procedure: Connecting SUSE Linux Enterprise PAYG Instances to SUSE Multi-Linux Manager PAYG

1. Return to the SUSE Multi-Linux Manager Server Web UI.

2. Navigate to **Admin › Setup Wizard › Pay-as-you-go** and click the **[+Add Pay-as-you-go]** button.

3. Add a description.

4. Complete the instance SSH connection data:

   ○ Host: CSP URL of the machine

   ○ SSH Port: 22

   ○ User: root

   ○ Password: <password>

   ○ SSH Private Key

5. Click **[Create]** and wait for the sync to finish.

6. Proceed to **Admin › Setup Wizard › Products** to access your PAYG SUSE Linux Enterprise products.

2.2.3.6.4. Registering Clients

Now that you have established connections to the SUSE Multi-Linux Manager PAYG instance you can register them as clients. To learn how to register various clients see: **Client-configuration › Registration-methods**

2.2.4. PAYG on Azure

2.2.4.1. Azure System Requirements

The SUSE Multi-Linux Manager PAYG offering in Azure need to communicate with the Azure Billing API, therefore it is not a simple virtual machine (VM) offering.

Azure has created the Managed Application offering for this use case. For more information, see

https://learn.microsoft.com/en-us/azure/azure-resource-manager/managed-applications/overview.
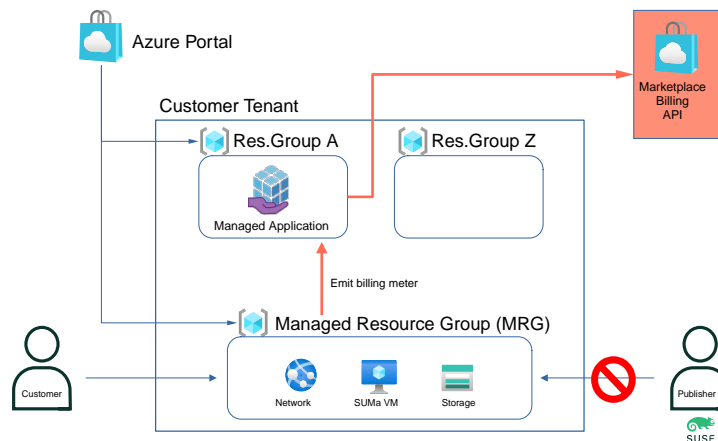
Figure 1. Architecture Diagram of a managed application

2.2.4.1.1. Application resource group

This resource group (in the diagram ResGroup A) holds the managed application instance, which could be translated as the metadata or definition of the offering. It can only contain a single resource.

A customer has full access to the resource group and uses it to manage the life cycle of the managed application.

2.2.4.1.2. Managed resource group (MRG)

This resource group (in the diagram MRG) holds all the resources that are required by the managed application. For example, an application's virtual machines, storage accounts, and virtual networks.

A managed application is similar to a solution template in Azure Marketplace, with a few key differences:

- The resources are deployed into a managed resource group that is normally managed by the application's publisher.

- It is present in the customer's subscription, but an identity in the publisher's tenant can be given access to the managed resource group.

- The publisher's management access and the customers deny assignment are optional.

  There are different permission scenarios available. SUSE is using here the Customer managed to give our customers of SUSE Manager full control.

  Customer managed

- Customer

  - Customer has full access to the solution (in the managed resource group)

  - The customer manages the solution

- Publisher

  - The publisher has no access to manage the solution.

  - The publisher develops the application and publishes on Azure Marketplace but does not manage the application.

  - The publisher licenses the application for billing through Azure Marketplace.

2.2.4.1.3. Instance requirements

When setting up a SUSE Multi-Linux Manager PAYG instance on Microsoft Azure, it's essential to consider system requirements for optimal performance and functionality. The default requirements outlined below have been tailored for smooth deployment and operation.

By default, certain disks are automatically generated when establishing a SUSE Multi-Linux Manager PAYG instance on Microsoft Azure. To complete the setup of these disks, use the **mgr-storage-server** tool.

Table 2. Microsoft Azure System Requirements

Requirement	Details
root storage	100 GB
spacewalk storage	500 GB
database storage	80 GB
CPU	4 cores
Memory	32 GB (minimum 16 GB)
Network Configuration	Typically configured by your organization

2.2.4.2. Obtaining the SUSE Multi-Linux Manager Server PAYG Public Cloud Image on Microsoft Azure

Follow these step-by-step instructions to locate the SUSE Multi-Linux Manager 5.1 PAYG image on Microsoft Azure.

1. Firstly, log in to your Azure account, via https://portal.azure.com

This makes sure that the Azure system is able to identify in which country your account get billed.

It is important, as billing for SUSE Multi-Linux Manager PAYG is handled via the Azure Marketplace. As there are restrictions on which countries this listing can be billed, the account you will transact to should be the one you are logged into.

There are currently two offers for SUSE Multi-Linux Manager PAYG on Microsoft Azure:

- **SUSE Multi-Linux Manager 5.1 with 24x7 Support (EMEA Orders only)**

- **SUSE Multi-Linux Manager 5.1 with 24x7 Support**

    Pick the listing that reflects in which country your Azure account gets billed. It depends on the sold to address of the account, see https://learn.microsoft.com/azure/cost-management-billing/manage/change-azure-account-profile.

    Do **not** go directly to the Azure Marketplace and get the offer. Even if the offers are visible, they should not be selected from here, as the Azure Web page is not able to identify your billing account. **Always log into the portal first**

2. After you are logged into the Azure Portal, click **[Create a resource]**.

3. Enter SUSE Multi-Linux Manager 5.1 into the search field on the top and press `RETURN`

    You get a list of offerings and need to select the version of SUSE Multi-Linux Manager 5.1 with 24x7 Support depending on your billing country.

    For example, for an account billed in Germany, it would be SUSE Multi-Linux Manager 5.1 with 24x7 Support (EMEA Orders Only).

    The offer show up as Azure Application and not as a Virtual Machine

4. Click the description text to get the Product description and then on **[Plans + Pricing]**. If this is shown with a description and plan, you have chosen the right offer. If there is nothing shown you selected the wrong one.

5. Next, click on the **[Create_ button]**

    This will bring you to a form similar you may know from creating other Azure resources. There are two tabs you need to fill Basic and Virtual Machine Settings

2.2.4.3. Initial Preparation and Configuration of the Microsoft Azure Managed Application

This section covers initial preparation and configuration of the Managed Application on Microsoft Azure.

2.2.4.3.1. Configuring your SUSE Multi-Linux Manager instance

There are two tabs you need to fill out: Basics and Virtual Machine Settings.

Fill Out the Basics Tab

a. Project Details

    i. As with every resource in Azure, you need to provide a Resource Group (RG). This can be an existing RG or you can create a new RG for this deployment.

b. Instance Details

    i. Region – where the instance should run.

    ii. Virtual Machine Name – the name of the VM in which SUSE Multi-Linux Manager will run.

    iii. Username – the administrator account for the SUSE Multi-Linux Manager VM.

    iv. SSH Key Source and Key – needed to access the machine.

> **i** We do not allow the use of a password here. This is to reduce the risk of brute force attacks.

c. Managed Application Details

    i. Application Name – the name of the Managed Application.

    ii. Managed Resource Group (MRG) – where the SUSE Multi-Linux Manager VM and its resources will be deployed into.

Switch to the Virtual Machine Settings Tab

a. Instance Size

    i. The default for the instance size is D8as v5, which is a good baseline for a production server. It provides enough resources for more data disks and IOPS throughput for disk and network. https://learn.microsoft.com/en-us/azure/virtual-machines/dasv5-dadsv5-series

> **i** If you only need a test instance, you can go smaller and choose an instance size with 4 vCPUs and 16GB memory or use a B-Series (Burstable) instance with a similar configuration.

b. Diagnostic Storage Account

    i. If you normally create a VM in the Azure portal, boot diagnostics are enabled by default using a managed storage account. You can choose an existing storage account or create a new one (default).

c. OS Disk Size

   i. This is the root disk of the SUSE Multi-Linux Manager installation, which holds:

      A. The OS and the SUSE Multi-Linux Manager application.

      B. /var/cache – where you need to provide storage space for each product you want to manage.

The proposed default of 100GB should be accepted.

  d. Database Disk Size

   i. This holds the Database for SUSE Multi-Linux Manager and needs a minimum of 50GB. The proposed value of 80GB is a good default suggestion.

  e. Spacewalk Disk Size

   i. This holds the package repositories and should have at least 100GB. Additional requirements include:

      A. 50GB for every SUSE product.

      B. >360GB for every RedHat or other Linux product.

The proposed default of 500GB is a safe default to start with.

> **ⓘ** Repository synchronization will fail if this directory runs out of disk space.

  f. Public IP Address for the VM

   i. By default, a Public IP Address is created to access the SUSE Multi-Linux Manager VM and Application.

      A. **If you use it, please ensure this is secure and access is limited.**

> **❗** Running SUSE Multi-Linux Manager on the public cloud means implementing robust security measures. It is essential to limit, filter, monitor, and audit access to the instance. SUSE strongly advises against a globally accessible SUSE Multi-Linux Manager instance that lacks adequate perimeter security.

You should carefully consider this, as the SUSE Multi-Linux Manager Server will have access to all managed nodes. If someone gains access to SUSE Multi-Linux Manager, it would mean access to all managed nodes as well. Threat actors actively scan for accessible machines with open management ports (e.g., SSH or RDP), especially on cloud providers.

A Network Security Group (NSG) is created by default if you choose to create a Public IP. It only allows inbound SSH access via port 22 as a minimal protection for the public IP.

It is recommended to additionally restrict access to a defined list of networks and allow Azure's

virtual network to drop requests originating from other networks.

Furthermore, you can add Just-in-Time access and/or use the Azure Bastion Service, Firewall, VPN, or private network methods to secure public access.

You can choose not to create a Public IP address (which is more secure), but you will need to use other methods to access the created SUSE Multi-Linux Manager VM and its Web UI for further configuration. Additionally, you must take care of the DNS and ensure a correct FQDN.

g. DNS Prefix for the Public IP Address

   i. The SUSE Multi-Linux Manager server must resolve its FQDN correctly. If the FQDN cannot be resolved, it can cause issues in several SUSE Multi-Linux Manager components.

   ii. To ensure that the SUSE Multi-Linux Manager 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.

   If you use the Public IP address, a DNS name is automatically created from Azure. You only need to ensure that a unique name is used. The default suggestion creates one by including a random number to make the domain name unique.

If you do not use the Public IP, you need to make sure that your setup can resolve the FQDN correctly as mentioned above.

h. Virtual Network / Subnet

   i. You will see a default proposal for a virtual network where SUSE Multi-Linux Manager will reside. By clicking edit, you can adjust it to your needs.

   ii. Remember that a Managed Application will be deployed from SUSE to your Azure tenant. Therefore, this network is the network in the Managed Resource Group (MRG) and cannot overlap with existing networks.

   At a later stage, you need to peer this network to the network with the nodes you want to manage. Alternatively, you can create the managed nodes within this network.

   With all fields filled out, press Next or Create. The Azure portal will perform a final check and provide a summary screen of this deployment.

If everything is correct, press Create to deploy the Managed Application for SUSE Multi-Linux Manager.

After Deployment

After the VM is deployed, you can access it via SSH.

> **Usage and Costs**
>
> Keep in mind that since this is a PAYG image, you will be billed according to your actual usage, including the number of systems you **manage** and **monitor** with this instance. It's essential to regularly track and review your usage to prevent unexpected costs and ensure alignment with your needs.

2.2.4.4. Initial Setup

Procedure: Log in and Update the System

1. Within the Managed Resource group you have set up, you will find the virtual machine. To get the details, click on the name of the virtual machine. Here you can see the (public) IP address which you need to connect to the running instance. SSH into your Microsoft Azure instance.

2. Switch to the root user and update the system .

   ```
   sudo -i
   transactional-update
   ```

3. Reboot the system.

2.2.4.4.1. Network Configuration

Remember, the SUSE Multi-Linux Manager PAYG setup requires, that a new Virtual Network and a new subnet is configured, which was performed in the previous step.

Because SUSE Multi-Linux Manager PAYG is deployed as a 'Managed Application' it is not possible to deploy into an existing network.

Before moving on to the next step, ensure the network is correctly configured:

When you setup new clients which should be managed, take care that you put them into the private subnet which is configured with SUSE Multi-Linux Manager PAYG or peer your networks.

> If you want to manage systems in an already existing network, you must configure **peering**.
>
> For more information, see Azure documentation.

Procedure: Network Configuration

1. Ensure the network configuration aligns such that hostname -f yields the identical name as the reverse DNS lookup of the private IP address. For instance, when executing nslookup 10.0.0.X.

2. Insert the private IP with its Fully Qualified Domain Name (FQDN) into /etc/hosts.

For example:

10.0.0.4 instancename.location.internal.cloudapp.azure.com

3. Edit /etc/sysconfig/network/config and append internal.cloudapp.azure.com to NETCONFIG_DNS_STATIC_SEARCHLIST.

4. Execute netconfig update.

5. Subsequently, hostname -f should return the same FQDN as obtained from nslookup 10.0.0.X.

> ⊗ When adding new virtual machines (VMs), such as SUSE Linux Enterprise Server, it's crucial to ensure that they are configured within the same subnet as the SUSE Multi-Linux Manager instance, or that you have setup network peering. This step is essential for successful network setup and integration.
>
> Additionally, be mindful of the geographical restrictions associated with your plans. Make sure to utilize the appropriate Azure accounts which correspond to the specific geographic zones of your project.

2.2.4.4.2. Configure Storage

Procedure: Configuring Storage

1. SSH into your Microsoft Azure instance.

2. Switch to the root user and update the system:

```
sudo -i
transactional-update
```

3. Reboot the system.

4. Configure storage using the appropriate tool:

   ○ For a standard setup, use mgr-storage-server.

   ○ For a proxy configuration, use mgr-storage-proxy.

   For more details, run:

   ```
   mgr-storage-server --help
   mgr-storage-proxy --help
   ```

These tools simplify the creation of container storage and database volumes.

5. Identify the block devices:

```
ls /dev/disk/azure/scsi1/
```

This command lists the disks created during deployment. Typically:

- lun3 is the storage disk.

- lun4 is the database disk.

6. Configure storage using the identified devices:

```
mgr-storage-server /dev/disk/azure/scsi1/lun3 /dev/disk/azure/scsi1/lun4
```

> ℹ️ This command creates persistent storage volumes at:
>
> /var/lib/containers/storage/volumes
>
> For more details, see **Installation-and-upgrade › Container-management**.

7. Deploy using mgradm as root:

```
mgradm install podman <FQDN>
```

2.2.4.5. SUSE Multi-Linux Manager PAYG Web UI Setup

2.2.4.5.1. Requirements

SUSE Multi-Linux Manager must be setup and running on Microsoft Azure. For more information on finding and setting up SUSE Multi-Linux Manager, see **Specialized-guides › Public-cloud-guide**.

> ℹ️ **The instance-flavor-check Tool and PAYG Schedule Check**
>
> **instance-flavor-check Tool**
>
> The **instance-flavor-check** tool is an essential component that comes pre-installed by default. Its presence is crucial, as it determines the status of PAYG instances. When invoked, this tool identifies and categorizes the system as a PAYG instance. By default this tool is configured to run on a schedule named **update-payg-default**.
>
> **update-payg-default schedule task**
>
> Navigate to the **Admin › Task Schedules** to find the **update-payg-default** task. By default, this task is set to run at 10-minute intervals. Its primary function is to monitor the presence of all running PAYG instances by executing the **instance-flavor-check tool**.

2.2.4.5.2. Log in to the Web UI

Procedure: Logging in

1. Login to the SUSE Multi-Linux Manager Server Web UI. Use the username and password you have defined during the setup with `mgradm install podman`.

2. Select **Admin › Setup Wizard**.

2.2.4.5.3. Configure the PAYG credentials and product list

> On a new server, the organization credentials table is listed at **Admin › Setup Wizard › Organization Credentials**. The Products table listed under **Admin › Setup Wizard › Products** will be empty.

Procedure: Verify credentials for PAYG and refreshing the product list

1. On your new server navigate to the **Admin › Setup Wizard › Pay-as-you-go** tab to view and manage PAYG credentials. Localhost should provide the description SUSE Multi-Linux Manager Pay-as-you-go and the status should read Credentials successfully updated.

2. Navigate to the **Admin › Products** tab and click **[Refresh]**.

3. Once the refresh completes the following products are listed:

   - **SUSE Multi-Linux Manager Proxy**

   - **SUSE Multi-Linux Manager Server**

   - **Free products**

     > ### Ubuntu and Debian
     >
     > Ubuntu and Debian are not currently supported by our RMT servers.
     >
     > ### Red Hat Linux Enterprise Clients
     >
     > SUSE Multi-Linux Manager offers support for Red Hat Enterprise Linux clients; however it is important to note that content still needs to be added manually and is not available through the cloud-based RMT service.
     >
     > For more information, see **Client-configuration › Registration-overview-redhat**.

2.2.4.6. PAYG Client connections and Client Registration

2.2.4.6.1. Managing Connections and Registering PAYG and BYOS Images

PAYG (Pay-as-you-go) Images

Connecting and registering PAYG images is supported and can be done without additional prerequisites.

BYOS (Bring-your-own-subscription) Images

Registering BYOS images requires SCC (SUSE Customer Center) credentials beforehand. If a user attempts to onboard a BYOS image without providing SCC credentials, the operation will fail, as these credentials are required to verify your subscription.

> - Always verify the type of image (PAYG or BYOS) prior to initiating the registration process with SUSE Multi-Linux Manager to ensure a smooth and error-free connection.
>
> - If you have SCC credentials ensure your SCC credentials are valid and have the necessary permissions for utilizing BYOS images.
>
> **Do not** register PAYG instances with the SUSE Customer Center. Only BYOS instances should be registered against the SUSE Customer Center.
>
> **Registering PAYG instances with the SUSE Customer Center or your own RMT server will create conflicts that are not easily solved**. PAYG instances are automatically registered against the correct update server when added to your cloud service provider SUSE Multi-Linux Manager instance.

2.2.4.6.2. Starting Up Additional PAYG SUSE Products in Microsoft Azure

For more information on using SUSE PAYG products such as SUSE Linux Enterprise in the public cloud see:
SUSE Linux Enterprise Public Cloud Guide

2.2.4.6.3. Establishing a PAYG SUSE Linux Enterprise Connection With SUSE Multi-Linux Manager PAYG

> It is important to recognize that there is a difference between **Pay-as-you-go connections** and **bootstrapping**. Bootstrapping is also known as **client registration**.
>
> Once you have started up your SUSE Multi-Linux Manager PAYG instance and refreshed products you can add **Pay-as-you-go connections** via the **Admin › Setup Wizard › Pay-as-you-go [+Add Pay-as-you-go]** button. This action links your SUSE Multi-Linux Manager PAYG instance with additional PAYG products on Microsoft Azure.

> **Bootstrapping** or **client registration** is the process of onboarding clients in SUSE Multi-Linux Manager. The registration process installs the appropriate client tools and provides full management functionality.
>
> To manage your clients, start by **establishing connections** and then proceed to **bootstrap** your clients. These two actions are the steps required for initiating and completing the client onboarding process.

Procedure: Connecting SUSE Linux Enterprise PAYG Instances to SUSE Multi-Linux Manager PAYG

1. Return to the SUSE Multi-Linux Manager Server Web UI.

2. Navigate to **Admin › Setup Wizard › Pay-as-you-go** and click the **[+Add Pay-as-you-go]** button.

3. Add a description.

4. Complete the instance SSH connection data:

   ° Host: CSP URL of the machine

   ° SSH Port: 22

   ° User: root

   ° Password: <password>

   ° SSH Private Key

5. Click **[Create]** and wait for the sync to finish.

6. Proceed to **Admin › Setup Wizard › Products** to access your PAYG SUSE Linux Enterprise products.

2.2.4.6.4. Register Clients

Now that you have established connections to the SUSE Multi-Linux Manager PAYG instance you can register them as clients. To learn how to register various clients see: **Client-configuration › Registration-methods**

Minion Timeouts

Inbound and outbound connections to Microsoft Azure are released after 4 minutes of being idle. This affects minion connectivity, especially when your SUSE Multi-Linux Manager server is in Microsoft Azure and you have some on-premises minions. If a connection is idle for more than 4 minutes, connectivity is lost.

To resolve this issue on your minions:

Procedure:

1. Create a new configuration file at i.a. /etc/venv-salt-minion/minion.d/keepalive.conf and enable

keepalive:

```
tcp_keepalive: True
tcp_keepalive_intvl: 5
tcp_keepalive_idle: 10
tcp_keepalive_cnt: 3
```

2. Restart the venv-salt-minion service.

2.3. SUSE Multi-Linux Manager PAYG on the Cloud: FAQ

Last updated: October 2023

Introduction

To support customers that prefer a cloud centric billing model, SUSE has recently published a new listing to the AWS & Azure Marketplaces, SUSE Multi-Linux Manager

This brings the value of running SUSE Multi-Linux Manager to cloud customers, with the benefit of a new pay-monthly pricing model via the cloud.

Documents in this FAQ

- **Specialized-guides › Public-cloud-guide**

- **Specialized-guides › Public-cloud-guide**

- **Specialized-guides › Public-cloud-guide**

- **Specialized-guides › Public-cloud-guide**

- **Specialized-guides › Public-cloud-guide**

- **Specialized-guides › Public-cloud-guide**

Public Cloud Listings

Last updated: October 2023

What is the SUSE Multi-Linux Manager PAYG listing on the cloud marketplaces?

By selecting the SUSE Multi-Linux Manager PAYG listing from the cloud marketplace, customers can deploy SUSE Multi-Linux Manager to their cloud environment with the advantage of having monthly billing via the cloud provider.

Customers still have the option of using SUSE Multi-Linux Manager BYOS (Bring-your-own-subscription), for which subscriptions and billing is handled directly by SUSE.

Where do I find the SUSE Multi-Linux Manager PAYG listings?

The listings can be found in the AWS & Azure Marketplaces. There are two listings:

On the AWS Marketplace, you will find the following:

- SUSE Multi-Linux Manager Server Family (Non-EU and non-UK only)

- SUSE Multi-Linux Manager Server Family (EU and UK only)

On the Microsoft Azure Marketplace, you will find:

- SUSE Multi-Linux Manager with 24x7 Support

- SUSE Multi-Linux Manager with 24x7 Support (EMEA Orders Only)

For the purposes of this FAQ, we will refer to these listings as SUSE Multi-Linux Manager PAYG.

Why are there 2 listings and which one should I use?

We have 2 listings for SUSE Multi-Linux Manager:

- **EU and UK only / EMEA Orders Only**

- **non-EU and non-UK only**.

You should pick the listing that reflects in which country your AWS & Azure account gets billed.

Are these listings available in all countries?

The SUSE Multi-Linux Manager PAYG listing on the cloud is not available to purchase in all countries. In case it is not available in your country you can still use the BYOS option.

Your billing country is based on the AWS & Azure Account ID used to do the deployment.

You can find out more about confirming your tax location as follows:

- For Amazon Web Services, it depends on the **tax address** of the account, see Tax help based on location

- For Microsoft Azure, it depends on the **sold to** address of the account, see Azure account profile

Please see the link at the end of this FAQ for a list of countries that can and cannot transact SUSE Multi-Linux

Manager PAYG via the cloud marketplaces.

My cloud account is in the USA, but I want to deploy SUSE Multi-Linux Manager PAYG in another region, a region that is in a country where I currently cannot transact, is this possible?

If your cloud provider account is billed to one of the allowed countries, it is possible to deploy SUSE Multi-Linux Manager in any region.

Is this listing available in China?

It is not possible to transact/bill SUSE Multi-Linux Manager PAYG via AWS & Azure Marketplaces in China. It is possible to deploy into regions in China.

This means you can deploy SUSE Multi-Linux Manager in a region in China if your billing is performed in a country that has the PAYG option available. Please see the addendum at the end of this FAQ for a list of countries that can and cannot transact SUSE Multi-Linux Manager PAYG via the cloud.

Is there still a BYOS listing for SUSE Multi-Linux Manager in the marketplace?

Yes, for customers that wish to use an existing annual SUSE Multi-Linux Manager subscription, the BYOS SUSE Multi-Linux Manager listing is available.

Is there a PAYG listing available for the SUSE Multi-Linux Manager Proxy Server?

If a SUSE Multi-Linux Manager Proxy is required as part of the architecture, it is suggested to use the containerized proxy. See the SUSE documentation at: documentation.suse.com

Select › SUSE Multi-Linux Manager › SUSE Multi-Linux Manager {5.1} › Installation and Upgrade guide › Installation › SUSE Multi-Linux Manager Proxy › Install Containerized Proxy

From the subscription point of view, SUSE Multi-Linux Manager Proxy is a managed client.

The listing shows pricing information for SUSE Multi-Linux Manager node management and a separate price for monitoring. Do I need to subscribe twice if I need monitoring?

There is no need to subscribe twice. Subscribing to the listing in the cloud provider marketplace allow the SUSE

Multi-Linux Manager PAYG instance to perform metered billing for SUSE Multi-Linux Manager usage.

If you onboard an instance and enable SUSE Multi-Linux Manager monitoring, there is a monthly charge for management and another charge for monitoring.

Billing

Billing - General

Last updated: October 2023

I have an existing SUSE Multi-Linux Manager BYOS subscription; can I use this on the cloud?

BYOS Bring-your-own-subscription SUSE Multi-Linux Manager deployments are supported on the cloud, however, billing will not be via the cloud marketplace.

Once the existing subscription term ends, you can purchase SUSE Multi-Linux Manager PAYG via the cloud provider marketplace and manage your instances with a SUSE Multi-Linux Manager deployment that is billed via the cloud.

I have an existing deployment covered by a BYOS SUSE Multi-Linux Manager subscription; can I use this new listing in the cloud for a separate deployment of SUSE Multi-Linux Manager PAYG?

Yes, the listing works independently from your existing BYOS SUSE Multi-Linux Manager subscriptions. Please remember that support processes may be different for deployments using your existing BYOS subscription and those billed via the cloud and note that there is currently no process for migrating deployments between BYOS and PAYG versions.

Tell me more about how the billing for SUSE Multi-Linux Manager PAYG works via the cloud?

When purchasing SUSE Multi-Linux Manager via the AWS & Azure Marketplaces, the billing is as follows:

- Billing is monthly and handled via cloud marketplace.

- Managed instances are recorded hourly.

- The peak usage total is recorded for the month.

- There is a monthly usage charge for each instance in the count.

I have existing SLES for SAP instances procured via the cloud provider marketplace, is there a cost to manage these instance with SUSE Multi-Linux Manager PAYG?

SLES for SAP Applications PAYG/on-demand instances, when purchased via the cloud marketplace, include Lifecycle Management(LCM) entitlements for SUSE Multi-Linux Manager.

The SUSE Multi-Linux Manager PAYG billing engine recognizes the embedded LCM entitlements and does not include them in the count. This means there are no additional charges to manage these with the SUSE Multi-Linux Manager PAYG listing.

However, if SUSE Multi-Linux Manager Monitoring is required for these instances, additional charges will apply for this feature.

Is there a way to try SUSE Multi-Linux Manager PAYG before purchasing?

If using the SUSE Multi-Linux Manager PAYG listing in the cloud marketplace, billing will commence from the time of deployment and when applicable client instances are on-boarded to SUSE Multi-Linux Manager.

There is the SUSE Multi-Linux Manager BYOS listing in the cloud marketplace that can be used, a trial subscription key can be obtained via the SUSE Website. This deployment cannot be directly converted to allow billing via cloud marketplaces.

To benefit from monthly billing via the cloud marketplace, SUSE Multi-Linux Manager needs to be redeployed using the version from the PAYG listing in the cloud marketplace.

How does SUSE calculate the amount of managed instances to bill for?

Billing is based on the number of managed instances.

Below are 3 examples of how the node count is calculated, check the table below for the detail.

Static usage

> Using SUSE Multi-Linux Manager with 10 instances registered for management, for 1 month with no additional managed clients added in the month.

Bursting Model

> Using SUSE Multi-Linux Manager with 10 instances registered for management for 3 weeks in the month,

bursting to 30 managed instances for 1 week.

Transient model

A temporary deployment of SUSE Multi-Linux Manager with 20 managed instances, for 2 weeks (336 hours)

The total is calculated by counting number of active nodes (checked hourly). There is a monthly charge for each managed node under management in the billing cycle.

Below are 3 examples of how the average node count is calculated.

Table 3. Usage calculations for different scenarios

	Managed Instances	Peak Usage	Billed for
Static Usage	10	10	10
Bursting Model	10 - 3 Weeks, 30 - 1 Week	30	30
Transient Cluster	20 - 2 Weeks	20	20

Are special commercial terms available?

It is dependent on the deployment and the cloud provider, as every Cloud Service Provider (CSP) has its own commercial terms and offers.

It may be possible to secure special commercial terms such as an annual subscription. For example, AWS can offer SUSE Multi-Linux Manager PAYG via a Private Offer. Please contact SUSE for more information.

Can my spending on SUSE Multi-Linux Manager PAYG count towards my committed spend with the cloud provider?

There are such programs at the cloud providers:

- Azure MACC Program
- AWS Enterprise Discount Program
- Google CUD

Yes, it can. Please contact your cloud provider sales team for more details.

How do I purchase SUSE Multi-Linux Manager / LCM subscriptions for additional managed instances?

Once SUSE Multi-Linux Manager PAYG has been deployed from the marketplace listing and billing is active, there is no need to make a specific purchase to manage additional instances. Billing is dynamic and based on the number of instances SUSE Multi-Linux Manager is managing. Just on-board additional instances to SUSE Multi-Linux Manager as needed, this will be reflected in your cloud marketplace bill.

Is this an annual commitment, will it auto-renew?

By default, the SUSE Multi-Linux Manager PAYG listing on the cloud is billed on a monthly cycle, based on usage. Billing is ongoing for as long as SUSE Multi-Linux Manager is deployed and instances are registered.

Is there a volume discount / tiered pricing built into the Cloud Listing?

Currently, there is no volume discount available.

I no longer require support; how can I end the SUSE Multi-Linux Manager PAYG subscription?

If you no longer require support, there are 2 options:

- Unregister all systems from the SUSE Multi-Linux Manager Server

- Terminate the SUSE Multi-Linux Manager instance.

Billing - Technical

Last updated: October 2023

Do I need any special or additional infrastructure to set up SUSE Multi-Linux Manager billing via the cloud marketplaces?

No, all components needed to handle the billing are part of the SUSE Multi-Linux Manager PAYG code base.

What is the deployment mechanism for SUSE Multi-Linux Manager PAYG on the cloud marketplace?

The cloud marketplace listing for SUSE Multi-Linux Manager PAYG will deploy a SUSE Multi-Linux Manager instance, together with the embedded billing engine.

What version of SUSE Multi-Linux Manager is installed when using the marketplace listing?

The cloud marketplace listing for SUSE Multi-Linux Manager PAYG is tied to a specific version of SUSE Multi-Linux Manager (4.3.8 at launch). Future listings will typically include the latest version available at the time of product/image creation. Please check the listing for further information.

I need a prior version of SUSE Multi-Linux Manager installed; can I still use the listing?

No, there is no choice over the SUSE Multi-Linux Manager version when deploying using the cloud marketplace listing. If a prior version of SUSE Multi-Linux Manager is required, this will need to be installed manually using the standard documentation and BYOS billing.

How often is the listing updated (including the version of SUSE Multi-Linux Manager etc.)?

The Marketplace listing is tied to a specific version of SUSE Multi-Linux Manager, which is the latest version available at the time of the listing.

Typically, the listing in the cloud marketplace is updated quarterly, or more frequently if there are security issues.

It is worth noting that the image update process may not be fully aligned to the SUSE Multi-Linux Manager product maintenance releases (every 6-8 weeks), so SUSE Multi-Linux Manager PAYG instances should be patched regularly after deployment.

I have purchased multiple PAYG - Pay-as-you-go SUSE products from the cloud provider marketplace (i.e. Rancher, NeuVector and SUSE Multi-Linux Manager), does the marketplace billing method still work?

Yes, the billing mechanism for the products is independent. Each deployment will be billed separately via the cloud marketplace.

I already have an existing SUSE Multi-Linux Manager deployment; how can I get this deployment to bill via the cloud marketplace?

Existing deployments **cannot** be directly converted or updated to provide billing via the cloud marketplace. To

benefit from monthly billing, SUSE Multi-Linux Manager PAYG must be deployed directly from the cloud marketplace listing.

Billing - Products

How do I migrate an existing SUSE Multi-Linux Manager BYOS instance to the PAYG - Pay-as-you-go version?

Currently, it is **not possible** to migrate an existing instance to the PAYG version.

Customers can simply deploy a new SUSE Multi-Linux Manager PAYG instance from the cloud marketplace and re-onboard all instances using the standard process.

Client configuration overview

How do I get support?

It is simple to open a support case with SUSE for SUSE Multi-Linux Manager PAYG.

Create a 'supportconfig' via SUSE Multi-Linux Manager PAYG instance CLI and upload the output to the SUSE Customer Center (SCC) at the following link:

https://scc.suse.com/cloudsupport

Providing marketplace billing is active, a support case will be opened.

Are there any differences between the SUSE Multi-Linux Manager PAYG product on the cloud marketplaces compared to the versions I can run in my own data center?

The SUSE Multi-Linux Manager PAYG product available in the cloud marketplace is the same product, with similar functionality that you would run on-premises or with a manual installation.

The only exceptions being the ability to bill via the cloud marketplace and connect to the SUSE Update Infrastructure for SUSE Multi-Linux Manager product updates.

It is also worth checking the list of supported client operating systems to ensure your needs are met.

Does the SUSE Multi-Linux Manager PAYG instance need to run 24/7?

It is recommended that the SUSE Multi-Linux Manager instance always remains active.

How do I get fixes and updates for SUSE Multi-Linux Manager PAYG? Do I need a subscription key?

SUSE Multi-Linux Manager PAYG, when deployed via the cloud marketplace will automatically connect to the SUSE Update Infrastructure, no separate SUSE Multi-Linux Manager subscription key is required.

Updates to the SUSE Multi-Linux Manager instance can be applied from those channels using standard SUSE tooling (i.e. zypper).

Is the use of SUSE Multi-Linux Manager Hub supported with this listing?

Yes, SUSE Multi-Linux Manager Hub is recommended for customers with more than 10,000 managed clients. If the SUSE Multi-Linux Manager Hub instance has no connected clients, there will be no charge for the SUSE Multi-Linux Manager Hub software components.

Billing will occur from the downstream SUSE Multi-Linux Manager PAYG Server instance, where managed instances are connected.

Can I manage Bring-your-own-subscription - BYOS SLES instances in the cloud with SUSE Multi-Linux Manager PAYG?

To manage BYOS instances, SUSE Customer Center (SCC) credentials with entitlement to valid SLES or SLES for SAP subscriptions will be required. These credentials should be added to the SUSE Multi-Linux Manager configuration to enable this functionality.

I have a hybrid setup. Can I manage instances (workloads) outside of the cloud?

Yes, it is possible to manage instances, in the cloud, on premises or both.

To enable management of SUSE workloads in an on-premises data center, SCC credentials with entitlement to valid SLES or SLES for SAP subscriptions will be required.

These credentials should be added to the SUSE Multi-Linux Manager configuration to enable this functionality.

> ℹ️ Egress data charges may apply when managing workloads outside of the
> cloud provider's network.

Are there additional charges for using a SUSE Multi-Linux Manager Proxy?

With a hybrid landscape, egress data charges may apply when managing workloads outside of the cloud provider. To reduce these costs, SUSE recommend the use of the containerized proxy.

Please note: Whilst the SUSE Manger Proxy usage is included as part of the SUSE Multi-Linux Manager PAYG subscription, an LCM+ subscription will be billed if the proxy is also a managed workload, so in other words it counted as a managed client.

Can I have a SUSE Multi-Linux Manager PAYG Server on premises and bill via the Cloud Marketplace?

No, to benefit from cloud marketplace billing, the SUSE Multi-Linux Manager PAYG instance must reside on the cloud. Any SUSE Multi-Linux Manager instances on premises will require their own subscriptions.

What client Operating Systems are supported with SUSE Multi-Linux Manager PAYG?

Please refer to the product documentation for a full list of supported clients. PAYG Overview

Miscellaneous

Where can I find out more about the Cloud Marketplace listing for SUSE Multi-Linux Manager?

You can use the following resources to learn more about the SUSE Multi-Linux Manager listing and how to deploy.

- New dawn for SUSE Multi-Linux Manager

- documentation.suse.com//

Where can I find out more about SUSE Multi-Linux Manager?

- SUSE Multi-Linux Manager

- Training courses

Appendix

Countries that can transact SUSE Multi-Linux Manager PAYG through the cloud marketplace

Countries that can transact via the cloud marketplaces: Supported Country List

Public Cloud Support

BYOS and PAYG Support

Regardless of the public cloud service you use or the plan you choose, SUSE has you covered with support. Where you get support is dependent on whether you **Bring-your-own-subscription** (BYOS) or you use SUSE products **on-demand Pay-as-you-go** (PAYG).

BYOS

BYOS instances are supported by SUSE under the terms of your SUSE subscription. For an overview of SUSE's support subscriptions, refer to https://www.suse.com/support/.

PAYG

SUSE Multi-Linux Manager PAYG instances include support by SUSE. To open a ticket for PAYG, see https://scc.suse.com/cloudsupport.

Public Cloud Guide

For more information on cloud products and support, see SUSE Public Cloud Guide.

Public Cloud Information Tracker (PINT)

The Public Cloud Information Tracker (PINT) provides information about the images SUSE publishes and servers that are part of the SUSE operated update infrastructure. PINT is available at pint.suse.com and provided as an API and command-line tool with the python3-susepubliccloudinfo package from the Public Cloud Module repository.

Collecting System Information with supportconfig

To create a TAR archive with detailed system information that you can hand over to Global Technical Support, use the command supportconfig. The command-line tool is provided by the package supportutils which is installed by default.

Depending on which packages are installed on your system, some of these packages integrate supportconfig plug-ins. When supportconfig is executed, all plug-ins are executed as well, creating one or more result files for the archive. This has the benefit that the only topics checked are those that contain a specific plug-in for them.

supportconfig plug-ins are stored in directory /usr/lib/supportconfig/plugins/.

The following procedure shows how to create a supportconfig archive, but without submitting it to support directly.

Procedure: Creating a supportconfig **Archive**

1. Run supportconfig as root. Usually, it is enough to run this tool without any options. Some options are very common and are displayed in the following list:

   Listing 1. Options:

   ```
   -E MAIL, -N NAME, -O COMPANY, -P PHONE

   Sets your contact data: e-mail address (-E)
   Company name (-O)
   Your name (-N)
   Your phone number (-P)

   -i KEYWORDS, -F
   Limits the features to check.
   The placeholder KEYWORDS is a comma-separated list of case-sensitive keywords.
   Get a list of all keywords with supportconfig -F.
   ```

2. Wait for the tool to complete the operation.

3. The default archive location is /var/log, with the file name format being **scc_HOST_DATE_TIME.txz**

Opening a New Support Case

To open a new support case for your cloud Pay-as-you-go instance, you need to generate a **supportconfig** file and then follow the steps listed on:

SUSE Customer Center Cloudsupport

Billing Services and Troubleshooting

billing-data-service

This service serves billing data from SUSE Multi-Linux Manager for the **CSP-billing-adapter**. The service is reachable at:

- http://localhost:18888/

- http://localhost:18888/metering

This service is maintained by the SUSE Multi-Linux Manager team. This service only logs to **systemd journal**.

Billing services must be running or **spacewalk** will refuse to start.

csp-billing-adapter-service

This service reports the billing data to the cloud provider (AWS, AZURE, GCP). These logs are stored in:

- /var/log/csp_billing_adapter.log

Additional status information can be located in:

- /var/lib/csp-billing-adapter/csp-config.json

This service is maintained by public cloud team.

mgr-check-payg.service

This service checks if **billing-data-service** is installed and running. It also checks if the **csp-billing-adapter-service** is installed and running. If these services are not running or installed it will attempt to install and start the service.

Consequences

> If one of the previous billing services is not running and cannot be installed or started **spacewalk** will refuse to start.

Check journalctl -u mgr-check-payg.service for additional issues.

Continuous Compliance Checks

Procedure: Compliance Checks

1. The **payg-dimension-computation** taskomatic task must be active.

2. Is the billing server running at http://localhost:18888/ ?

3. Is the **csp-billing-adapter.service** running?

4. What is the status of the **csp-billing-adapter** located in /var/lib/csp-billing-adapter/csp-config.json?

   The following files and packages are checked for tampering

   - Billing-data-service

   - Csp-billing-adapter-service

   - Python3-csp-billing-adapter

   - Python3-csp-billing-adapter-local

- Python3-csp-billing-adapter-amazon

- python3-csp-billing-adapter-azure

Failed Checks

Failed checks are logged in:

- /var/log/rhn/rhn_web_ui.log

- /var/log/hrn/rhn_taskomatic_daemon.log

Consequences

- No more actions will be executed.

- reposync will stop synchronizing channels.

Troubleshooting Public Cloud

Last updated: March 2024

This section is dedicated to some common problems you might encounter with SUSE Multi-Linux Manager in Public Cloud, and solutions to resolving them.

For all other troubleshooting topics, see **Administration Guide > Administration › Troubleshooting**.

Configure Pay-as-you-go Behind Proxy

To identify if a machine is PAYG or not, SUSE Multi-Linux Manager needs to use sudo to run instance-flavor-checktool.

If the customer is using a http proxy, they need to make sure this setting is correctly managed by sudo, because by default most environment variables are disregarded.

One way to do it, is to add a file /etc/sudoers.d/keep_proxy.conf with the following content:

```
# Preserve any possible proxy configuration
Defaults env_keep += "http_proxy https_proxy no_proxy"
```

This ensures the proxy related environment variables are preserved during the privileges escalation.

Set up SUSE Multi-Linux Manager with Separate Disk for BYOS

Issue

SUSE Multi-Linux Manager setup results with an error while restarting services during setup. The setup fails on

restarting tomcat.

```
Write Settings
                                                                    Setup failed.
 Setup script output

 ** Database: Shutting down spacewalk services that may be using DB.
 ** Database: Services stopped.  Clearing DB.
 *** Progress: #
 * Setting up users and groups.
 * Performing initial configuration.
 * Configuring apache SSL virtual host.
 ** /etc/apache2/vhosts.d/vhost-ssl.conf has been backed up to vhost-ssl.conf-swsave
 * Configuring jabberd.
 * Creating SSL certificates.
 ** SSL: Generating CA certificate.
 ** SSL: Generating server certificate.
 ** Database: Setting up report database.
 ** Database: --clear-db option used.  Clearing report database.
 *** Progress: #
 ** Database: Installation complete.
 * Report DB Configured.
 * Update configuration in database.
 * Setting up Cobbler..
 * Deploying configuration files.
 * Restarting services.
 Tomcat failed to start properly or the installer ran out of tries.  Please check /var/log/tomcat/catalina.out or /var/log/tomcat/catalina.$(date +%Y-%m-%d).log for errors.

 Error output

 Warning: ALREADY_ENABLED: suse-manager-server
 ERROR: spacewalk-setup failed
```

Reason

When SUSE Multi-Linux Manager is set up using separate disks for cache, PostgreSQL and spacewalk, the existing data within these partitions are covered under the new mount point.

```
suma:~ # df -h | grep vg
/dev/mapper/vg--suma-spacewalk  1.5T   459G  1.1T   30% /var/spacewalk
/dev/mapper/vg--suma-pgsql      100G    17G   84G   17% /var/lib/pgsql
/dev/mapper/vg--suma-cache       50G   211M   50G    1% /var/cache
```

Because of this, data for certain services like tomcat go missing due to a broken symbolic link.

```
suma:~ # ll /etc/tomcat
total 236
lrwxrwxrwx 1 root root        26 Oct 16 08:36 Catalina -> /var/cache/tomcat/Catalina
-rw-r--r-- 1 root tomcat   13497 Oct 16 08:36 catalina.policy
-rw-r--r-- 1 root tomcat    7630 Oct 16 08:36 catalina.properties
drwxr-xr-x 2 root tomcat      83 Dec 13 18:48 conf.d
-rw-r--r-- 1 root tomcat    1400 Oct 16 08:36 context.xml
-rw-r--r-- 1 root tomcat    1149 Oct 16 08:36 jaspic-providers.xml
-rw-r--r-- 1 root tomcat    4450 Oct 16 08:36 logging.properties
-rw-r--r-- 1 root root      8124 Dec 13 18:48 server.xml
-rw-r--r-- 1 root root      7856 Dec 13 18:48 server.xml.2023-12-13T18:48:12.661
-rw-r----- 1 root tomcat    3224 Oct 16 08:36 tomcat-users.xml
-rw-r--r-- 1 root tomcat    1829 Oct 16 08:36 tomcat.conf
-rw-r--r-- 1 root tomcat  172577 Oct 16 08:36 web.xml
```

As SUSE Multi-Linux Manager instance of cloud already has some services set up, when the data is not available during set up it causes the service to not restart as expected. Therefore the setup fails.

```
suma:~ # ll /var/cache
total 4
drwx------  3 root root   24 Jan 14 18:25 apparmor
drwxr-xr-x 36 man  man  4096 Jan 15 02:21 man
drwx------  2 root root    6 Jan 14 18:25 private
suma:~ # 
```

Actual data which should be present:

```
suma:~ # umount /var/cache
suma:~ # ll /var/cache/
total 0
drwxr-x--- 2 wwwrun root       6 Oct 30 14:43 apache2
drwxr-xr-x 3 root    root    24 Jan 14 17:30 apparmor
drwxr-xr-x 2 root    root     6 Nov 24 12:20 cloudregister
   cups         drwxrwx--- 2 root         6 Sep
:48 fontconfig  drwxr-xr-x 2 root    root  144 Dec 13 18
:47 gio-2.0     drwxr-xr-x 2 root    root  115 Dec 13 18
:48 ldconfig    drwx------ 2 root    root   23 Dec 13 18
:48 man         drwxr-xr-x 2 man     man     6 Dec 13 18
:47 private     drwx------ 2 root    root    6 Dec 13 18
:48 rhn         drwxr-xr-x 3 wwwrun  www    21 Dec 13 18
:48 salt        drwxr-x--- 4 root    salt   34 Dec 13 18
:47 tomcat      drwxrwx--- 5 root    tomcat 46 Dec 13 18
:41 zypp        drwxr-xr-x 5 root    root   45 Jan 14 17
             suma:~ # ll /var/cache/tomcat/
             total 0
Catalina     drwxrwxr-x 2 root tomcat 6 Oct 16 08:36
temp         drwxrwx--- 2 root tomcat 6 Oct 16 08:36
work         drwxrwx--- 2 root tomcat 6 Oct 16 08:36
```

How to Recreate

Procedure: Recreating the issue

1. SUSE Multi-Linux Manager Server provisioned in AWS uses relevant AMI for BYOS

2. Separate storage for spacewalk, PostgreSQL and cache. The size of the partition depends on the repository to be synchronized.

3. Set up SUSE Multi-Linux Manager using yast2 susemanager_setup.

Resolution

To resolve or avoid the issue, copy the data of the underlying partition into the new partition by following the steps below:

Procedure: Resolving the issue

1. Create a backup partition

```
mkdir /bkp
```

2. Unmount the affected partition for example /var/cache.

```
umount /var/cache
```

3. Check the underlying data in the partition. This should list the actual data present in the directory.

```
ls -l /var/cache
```

4. Copy the data onto the backup partition created in step 1.

```
cp -prav /var/cache/* /bkp/
```

5. Mount the partition again using option 1 or 2:

```
(option 1)   /dev/nvme0nxx /var/cache
(option 2)   mount -a (if you have the entries under /etc/fstab)
```

6. Copy the backed up data from step 4 to the mounted partition

```
cp -prav /bkp/* /var/cache/
```

7. Verify the data is present

```
ls -l /var/cache/
```

8. Repeat the SUSE Multi-Linux Manager setup

```
yast2 susemanager_setup
```

Conclusion

When using SUSE Multi-Linux Manager in public cloud with separate data partitions, make sure that the existing data in those directories are copied onto the new partition.

PAYG Checks

Checking the credentials

- If the script fails to collect the credentials, it should provide a proper error message in the logs and in the Web UI.

- If the credentials are not working, reposync should show the proper error.

Using registercloudguest

- Refreshing or changing the registercloudguest connection to the public cloud update infrastructure should not interfere with the credentials usage.

- Running `registercloudguest --clean will cause problems if no new cloud connection is registered with the cloud guest command.

Salt Guide Overview

Salt is a remote execution engine, configuration management and orchestration system used by SUSE Multi-Linux Manager to manage clients.

In SUSE Multi-Linux Manager, the Salt master runs on the SUSE Multi-Linux Manager Server, allowing you to register and manage Salt clients.

This book is designed to be a primer for using Salt with SUSE Multi-Linux Manager.

For more information about Salt, see the Salt documentation at https://docs.saltproject.io/en/latest/contents.html.

The current version of Salt in SUSE Multi-Linux Manager is '3006.0'.

Terminology

Beacon

Beacons allow you to use the Salt event system to monitor non-Salt processes. Clients can use beacons to connect to various system processes for constant monitoring. When a monitored activity occurs, an event is sent on the Salt event bus that can then trigger a reactor.

> **i** To use beacons on SUSE Linux Enterprise Server Salt clients, install the python-pyinotify package. For Red Hat Enterprise Linux systems, install the python-inotify package.

For more information on beacons, see https://docs.saltproject.io/en/latest/topics/beacons/

Broker

The Salt broker allows clients to pass commands to each other. The broker acts like a switch, therefore peer communication will only work for clients on the same network, or connected to the same proxy.

For more information on Salt and peer communication, see https://docs.saltproject.io/en/latest/ref/peer.html.

Environment

SUSE Multi-Linux Manager implements Salt with a single environment. Multiple Salt environments are not supported.

Formulas

Formulas are collections of Salt States that contain generic parameter fields. Formulas are used within SUSE Multi-Linux Manager to assist with configuring Salt clients. Some formulas have extensive configuration options, and use forms to help organize them in the SUSE Multi-Linux Manager Web UI.

For more information about formulas, see **Specialized-guides › Salt**.

Grains

Grains provide information about the hardware of a client. This includes the operating system, IP addresses, network interfaces, and memory. When you run a Salt command any modules and functions are run locally from the system being called.

For more information on grains, see https://docs.saltproject.io/en/latest/topics/grains/.

Highstate

This term is used when you apply all outstanding states to all targeted clients at the same time. The highstate must be applied when doing changes to systems, including enabling and disabling formulas.

Key Fingerprints

Key fingerprints are exchanged between the SUSE Multi-Linux Manager Server and Salt clients to verify the identity of the server and the client. This prevents Salt clients from connecting to the wrong server. You can see the fingerprints of your Salt clients by navigating to **Salt › Keys**.

Master

The Salt master issues commands to its attached clients. In SUSE Multi-Linux Manager, the Salt master must be the SUSE Multi-Linux Manager Server.

Minions

Salt clients that are connected to and controlled by the Salt master on the SUSE Multi-Linux Manager Server. In SUSE Multi-Linux Manager, these are sometimes referred to as Salt clients. This is a difference in terminology only.

Modules

Functions within Salt are stored in modules. Salt modules are stored on clients and the SUSE Multi-Linux Manager Server within the /usr/lib/python*/site-packages/salt/ directory. There are many types of Salt modules, including state and execution modules. You can write your own Salt modules using Python.

For a complete list of available Salt modules, see https://docs.saltproject.io/en/latest/ref/index.html.

Pillars

Pillars are created on the SUSE Multi-Linux Manager Server. They contain information about a client or group of clients. Pillars allow you to send confidential information to a targeted client or group of clients. Pillars are useful for sensitive data, configuration of clients, variables, and any arbitrary data.

For more information on pillars, see https://docs.saltproject.io/en/latest/topics/tutorials/pillar.html.

States

States are configuration templates. They allow you to describe what each of your systems should look like, including the applications and services that are installed and running. States are applied to the target client. This automates the process of bringing a large number of systems into a known state, and then maintaining them.

> ⚠️ Do not update the salt package using states. Update all other system packages using states. You can then update the salt package from the SUSE Multi-Linux Manager Web UI as a separate step.

For more information on states, see https://docs.saltproject.io/en/latest/topics/tutorials/ starting_states.html.

For more Salt terminology, see https://docs.saltproject.io/en/latest/glossary.html.

Salt Command

Salt commands have three main components: target, function, and arguments. The calls are constructed in this format:

```
salt 'target' <function> [arguments]
```

The target defines the client, or group of clients, on which to run the function.

The function is the particular task to be run.

Arguments provide any extra data required by the function.

Salt Targets

Salt command targets allow you to specify a client or group of clients. There are several different targets you can use.

General Targeting

List available grains on all clients:

```
salt '*' grains.ls
```

Target a specific client:

```
salt 'web1.example.com' test.ping
```

Glob Targeting

Target all clients using a particular domain:

```
salt '*example.com' test.ping
```

Target all clients using a particular label:

```
salt 'label*' test.ping
```

List Targeting

Specify a flat list of clients, using their IDs:

```
salt -L 'client_ID1, client_ID2, client_ID3' test.ping
```

Regular Expression Targeting

You can also define targets with PCRE-compliant regular expressions:

```
salt -E '(?!web)' test.ping
```

IP Address Targeting

List available client IP addresses:

```
salt '*' network.ip_addrs
```

Target a specific client IP address:

```
salt -S '172.31.60.74' test.ping
```

Target all clients on a subnet:

```
salt -S 172.31.0.0/16 test.ping
```

For more on targeting, see https://docs.saltproject.io/en/latest/topics/targeting/.

Salt Execution Modules

When you have specified a target, provide the module and function to execute on the target.

Find which modules can be executed on the target:

```
salt '*' sys.doc
```

For a full list of callable modules, see https://docs.saltproject.io/en/latest/ref/modules/all/index.html.

Salt Function Arguments

Functions accept arguments for any extra data.

For example, the pkg.install function requires an argument specifying which package to install:

```
salt '*' pkg.install yast2
```

You can provide more than one argument to a function, with spaces between them. For example:

```
salt '*' cmd.run 'echo "Hello: $FIRST_NAME"' env='{FIRST_NAME: "John"}'
```

Often Used Salt Commands

This section contains the most commonly used Salt commands. For a complete list of available Salt commands, see https://docs.saltproject.io/en/latest/ref/cli/index.html.

salt-run

Display all clients that are running:

```
salt-run manage.up
```

Display all clients that are not running:

```
salt-run manage.down
```

Display the current status of all Salt clients:

```
salt-run manage.status
```

Check the version of Salt running on the SUSE Multi-Linux Manager Server and active clients:

```
salt-run manage.versions
```

salt-cp

Copy a file to a client or set of clients:

```
salt-cp '*' foo.conf /root
```

salt-key -l

List public keys:

```
salt-key -l all
```

salt-key -a my-minion

Accept pending key for a minion:

```
salt-key -a my-minion
```

salt-key -A

Accept all pending keys:

```
salt-key -A
```

salt grains

List all available grains:

```
salt '*' grains.ls
```

List collected grain system data:

```
salt '*' grains.items
```

Salt States and Pillars

States are configuration templates. They allow you to describe what each of your systems should look like, including the applications and services that are installed and running. Salt state files are referred to as SLS (SaLt State) files.

States are applied to the target systems by matching relevant state data to clients. The state data comes from SUSE Multi-Linux Manager in the form of package and custom states.

You can target clients at three specific levels of hierarchy and priority: individual clients, system groups, and organization. Individual clients have priority over groups, and groups have priority over the organization.

For example:

- The Organization requires that version 1 is installed. All clients are part of the same Organization.

- Group A requires that version 2 is installed. Client1, Client2, and Client3 are part of Group A.

- Group B requires any version installed. Client4 is part of Group B.

Leading to these possible scenarios:

- Client1 wants package removed, package is removed (Client Level)

- Client2 wants version 2, gets version 2 (Client Level)

- Client3 wants any version, gets version 2 (Group Level)

- Client4 wants any version, gets version 1 (Organization Level)

For more information on Salt states, see https://docs.saltproject.io/en/latest/topics/states/.

You can create custom Salt states with SUSE Multi-Linux Manager. For more information, see **Specialized-guides › Salt**.

Group States

Pillar data can be used to perform bulk actions, like applying all assigned states to clients within the group. This section contains some examples of bulk actions that you can take using group states.

To perform these actions, you will need to determine the ID of the group that you want to manipulate. You can determine the Group ID by using the spacecmd command:

```
spacecmd group_details
```

These examples use an example Group ID of GID.

To apply all states assigned to the group:

```
salt -I 'group_ids:GID' state.apply custom.group_GID
```

To apply any state (whether or not it is assigned to the group):

```
salt -I 'group_ids:GID' state.apply ``state``
```

To apply a custom state:

```
salt -I 'group_ids:2130' state.apply manager_org_1.``customstate``
```

Apply the highstate to all clients in the group:

```
salt -I 'group_ids:GID' state.apply
```

Salt Pillars

SUSE Multi-Linux Manager exposes a small amount of internal data as pillars which can be used with custom states. Pillars are created on the SUSE Multi-Linux Manager Server, and contain information about a client or group of clients. For custom information in pillars, see **Client-configuration › Custom-info**. Pillars are useful for sensitive data, configuration of clients, variables, and any arbitrary data.

Pillars are managed either automatically by SUSE Multi-Linux Manager, or manually by the user.

> If you change pillar data on the server (Salt master) the actual pillar data on the client (minion) is updated only after calling saltutil.refresh_pillar for the client.
>
> Otherwise it could happen that pillar.items and pillar.get calls would produce different results with different values of pillars that were not refreshed.

To avoid hard-coding organization IDs within SUSE Linux Enterprise Server files, a pillar entry is added for each organization:

```
org-files-dir: relative_path_to_files
```

The specified file is available for all clients which belong to the organization.

This is an example of a pillar located at /etc/motd:

```
file.managed:
    - source: salt://{{ pillar['org-files-dir']}}/motd
    - user: root
    - group: root
    - mode: 644
```

For more information on Salt pillars, see https://docs.saltproject.io/en/latest/topics/pillar/.

Download Endpoint

By default, SUSE Multi-Linux Manager assumes that the download endpoint to use is the FQDN of the SUSE Multi-Linux Manager Server or Proxy. However, there are some cases where you might like to use a different FQDN as the download endpoint. The most common example is if you need to use load balancing, caching proxies, or in environments with complicated networking requirements.

To change the package download endpoint, you can manually adjust three Salt pillars: * pkg_download_point_protocol, defaults to https. * pkg_download_point_host, defaults to the FQDN of the SUSE Multi-Linux Manager Server (or Proxy, if in use). * pkg_download_point_port, defaults to 443.

If you do not adjust these pillars directly, SUSE Multi-Linux Manager will fall back to the default values.

Procedure: Changing the Package Download Endpoint Pillar

1. Navigate to /srv/pillar/ and create a file called top.sls with these contents:

```
base:
  '*':
    - pkg_download_points
```

This example directs Salt to look at the pkg_download_points.sls file to determine the base URL to use. You can adjust this file to target different clients or groups, depending on your environment.

2. Remain in /srv/pillar/ and create a file called pkg_download_points.sls with the base URLs you want to use. For example:

```
pkg_download_point_protocol: http
pkg_download_point_host: example.com
pkg_download_point_port: 444
```

3. OPTIONAL: If you want to use external pillars, for example Group IDs, open the master configuration file and set the ext_pillar_first parameter to true. You can then use Group IDs to set conditional values, for example:

```
{% if pillar['group_ids'] is defined and 8 in pillar['group_ids'] %}
  pkg_download_point_protocol: http
  pkg_download_point_host: example.com
  pkg_download_point_port: 444
{% else %}
  pkg_download_point_protocol: ftp
  pkg_download_point_host: example.com
  pkg_download_point_port: 445
{%- endif %}
```

4. OPTIONAL: You can also use grains to set conditional values, for example:

```
{% if grains['fqdn'] == 'client1.example.com' %}
  pkg_download_point: example1.com
{% elif grains['fqdn'] == 'client2.example.com'' %}
  pkg_download_point: example2.com
{% else %}
  pkg_download_point: example.com
{% endif %}
```

GPG Encrypted Pillars

Salt has support to transparently decrypt GPG-encrypted Pillar data built-in. The decryption happens on the Salt Master.

Generate GPG keyring for Salt Master

The GPG keyring can be specified in /etc/salt/master or in its own file under /etc/salt/master.d/, for example /etc/salt/master.d/gpg-pillar.conf.

Always create a separate keyring for the Salt Master.

Procedure: Generating key pair

1. On the Salt Master create GPG home directory and restrict its permissions:

```
mkdir /etc/salt/gpgkeys
chmod 700 /etc/salt/gpgkeys
```

2. Generate a key pair interactively.

   > **!** The password must be empty.

```
gpg --gen-key --homedir /etc/salt/gpgkeys
```

3. Salt does not run with root permissions on SUSE Linux Enterprise and openSUSE distributions.

```
chown -R salt:salt /etc/salt/gpgkeys
```

4. Configure Salt Master to use the new GPG home directory

```
echo 'gpg_keydir: /etc/salt/gpgkeys' >/etc/salt/master.d/gpg-pillar.conf
systemctl reload-or-restart salt-master
```

Use GPG for encrypting Pillar secrets

Salt GPG renderer decrypts GPG encrypted contents that are ASCI-armored. To use the GPG renderer in a Pillar YAML file, change

```
#!yaml
```

to

```
#!yaml|gpg
```

Encrypting pillar secrets can be done anywhere as long as the GPG and the public key generated in Procedure: Generating key pair are available.

In this example, "MLM Salt Master" is the GPG key's UID created earlier.

```
echo 't0ps3cr3t' | gpg --armor --batch --encrypt --recipient "MLM Salt Master"
```

When the GPG encrytped contents are created and available as ASCII-armored output, this output can be used as a multi-line string in a pillar YAML file:

```
#!yaml|gpg

secret:
  my-secret: |
    -----BEGIN PGP MESSAGE-----

    hQEMA3OrmRaWrqgqAQf/ej8xV+nO3HVbQRCeJgCmt5ZjnogT++HHeFzXymfr1SgT
    XySyAqpIZB2N6MjZXtupO2sCmG6fzqtmnW+vRsZhQG8PAqzRtAekFuVbXzgkigBk
    338yOdyltVBtMONnkHFQ+7EP1tfJnWLCVrJ1I42vGFLZf2AD1xhbjewCcoaK82J4
    f8u9U/dxgV0N6na28WG5m6YU5Reu1Ca37PXHuqA/0XZl65DY63xaMPMDHZEi1wkU
    GXU7OsiL1dO0/sST1Awo5i99kVt/kA6DCGDuxTNpLrauNLOKUbtwcxvavtNZGwdQ
    yI9zWVx8qerWE0aO3M7zVDJftv77faV2ENiqzaadvtJHAZynW4GW7rSuP1RXFzlB
    DOAmzdRuIJwiLC9R2BKu3x+avReQb6xoz7eF7WthC0H0dz4mYakwPlVZ5yqYa/+G
    83i951rqAGI=
    =g+ji
    -----END PGP MESSAGE-----
```

When the pillar is assigned to a system with top.sls, the GPG encrypted pillar data is available in a decrypted format.

> **ℹ** The client's in-memory cache is only updated on startup or when running execution module functions that trigger a cache refresh such as saltutil.refresh_pillar, pillar.items, or state.apply.

```
MLM-sles15sp1.tf.local:
    ----------
    my-secret:
        t0p s3cr3t!
```

Export the GPG key

To export the GPG key, use the command:

```
gpg --export 'MLM Salt Master' --homedir /etc/salt/gpgkeys --output MLM-salt-master.gpg
```

Here 'MLM Salt Master' is the name used during key generation.

The MLM-salt-master.gpg public key can be freely shared.

Custom Salt States

You can create your own custom Salt states with SUSE Multi-Linux Manager as centrally managed configuration channels. Custom states are stored as Salt state files on the SUSE Multi-Linux Manager Server with a .sls extension.

Create a New Custom Salt Channel

You can use the SUSE Multi-Linux Manager Web UI to create and edit custom Salt state files. You must create a state channel first, with an initial state named init.sls. The init.sls file is used to reference all other state files within the channel. The custom states that you create using the Web UI are stored on the SUSE Multi-Linux Manager Server in the the /srv/susemanager/salt/<organization>/ directory.

After the channel is created with an init.sls file, you can write additional state files in the Web UI. Alternatively, you can upload existing state files to use within your state channel, or import them from other channels or clients.

Procedure: Creating a Custom Salt Channel and Initial State

1. In the SUSE Multi-Linux Manager Web UI, navigate to **Configuration › Channels**.

2. Click **[Create State Channel]**.

3. In the Name field, type a name for your state.

4. In the Label field, type a label. Use alphanumeric characters, hyphens, and underscores. Do not use spaces.

5. In the Description field, type a short description of the configuration your state performs.

6. In the SLS Contents field, type the contents of your init.sls state. If you want to reference file templates in this configuration channel, ensure your file starts by specifying the source of the managed file, using this syntax:

```
file.managed:
  - source: salt://<org_name>/<channel_name>/etc/<ID>/<filename>
```

```
  Example custom state files are given later in this section.
. Click btn:[Update Channel] to save your state.
```

Procedure: Adding Additional Files to a Custom State Channel

1. In the SUSE Multi-Linux Manager Web UI, navigate to **Configuration › Channels**. . Click the name of the channel you want to add files to.

2. To create a new file, click **[Create configuration file]** and type the contents of the file.

3. To upload an existing file, click **[Upload Configuration Files]** and select the file to upload.

4. To copy an existing file, click **[Import a File from Another Channel or System]** and select the file to copy.

Procedure: Editing a Custom Salt State

1. In the SUSE Multi-Linux Manager Web UI, navigate to **Configuration › Channels**.

2. Click **[View/Edit <filename>.sls File]**.

3. Make your changes to the file.

4. Click **[Update Configuration File]** to save your state.

You can also manage revisions, compare the state to others in your organization, and download the .sls file from this dialog.

Procedure: Assigning a Client to a Custom Salt State

1. In the SUSE Multi-Linux Manager Web UI, navigate to **Configuration › Channels**.

2. Click the name of the state you want to assign a client to.

3. Navigate to the **Systems › Target Systems** tab.

4. Check the clients you want to assign.

5. Click **[Subscribe systems]**.

For more information about Salt state modules, see https://docs.saltproject.io/en/latest/ref/states/all/index.html.

Example Custom State Files

This section contains some example custom state files. Use these as a basis for writing your own custom states.

Listing 2. Example: Manage a File

```
my_config_change_id:
  file.managed:
    - name: /etc/my.conf
    - source: salt://example_org/example_channel/etc/my.conf
    - user: root
    - group: root
    - mode: 644
    - template: jinja
```

Listing 3. Example: Package Management

```
my_pkg_id:
  pkg.installed:
```

```
    - refresh: True
  - pkgs:
    - glibc
    - kernel-default
    - hello: 1.0-42
```

Listing 4. Example: Remote Command

```
ip_forward-on:
  cmd.run:
    - name: echo "1" > /proc/sys/net/ipv4/ip_forward
    - onlyif:
      - test `cat /proc/sys/net/ipv4/ip_forward` -eq 0
```

Listing 5. Example: Service Management

```
time_service_id:
  service.running:
    - name: chronyd
    - enable: True
```

Custom State to Trust a GPG Key

By default, operating systems trust only their own GPG keys when they are installed, and do not trust keys provided by third party packages. The clients can be successfully bootstrapped without the GPG key being trusted. However, you cannot install new third party packages or update them until the keys are trusted.

Salt clients are set to trust SUSE tools channels GPG keys when they are bootstrapped. For all other clients and channels, you need to manually trust third party GPG keys.

If you are bootstrapping Salt clients from the SUSE Multi-Linux Manager Web UI, you can use a custom Salt state to trust the GPG key.

Procedure: Trusting a GPG Key With a Custom Salt State

1. Locate the key that you need to trust. Ensure you have the correct key, and that you also have the fingerprint used to verify the key. This information is available from the vendor or, in some cases, from a key server.

2. Copy the key to a file location where the client can access it. We recommend saving it in the /srv/www/htdocs/pub/ directory, where all user public files must be saved.

3. In the SUSE Multi-Linux Manager Web UI, navigate to **Configuration › Channels**.

4. Click **[Create State Channel]**.

5. In the Name field, type a name for your state. For example, GPG Key Trusts.

6. In the Label field, type a label. For example, GPG_Key_Trusts.

7. In the Description field, type a short description of the configuration your state performs. For example, Trusts GPG Keys for CentOS.

8. In the SLS Contents field, create a state to retrieve the appropriate key from the SUSE Multi-Linux Manager Server and trust it on the client. The exact contents of your state varies depending on your client operating system. For example:

```
rpm_trust_gpg_key:
  cmd.run:
    - name: rpm --import https://{{ salt['pillar.get']('mgr_server') }}/pub/<third-
party-gpg>.key
    - unless: rpm -q gpg-pubkey-<key_id>

deb_trust_gpg_key:
  mgrcompat.module_run:
    - name: pkg.add_repo_key
    - path: https://{{ salt['pillar.get']('mgr_server') }}/pub/<third-party-gpg>.key
```

```
  Alternatively, you can add GPG keys to a configuration channel, using a managed
file to deploy them directly on the client.
  In this case, you would use a local path to the key, rather than a URL.
. Click btn:[Update Channel] to save your state.
. Navigate to menu:Configuration[Channels] and click the name of the state you want
to assign a client to.
. Navigate to the menu:Systems[Target Systems] tab and check the clients you want to
assign.
. Click btn:[Subscribe systems].
 When the configuration file is next run on the client, the GPG key is trusted.
```

Alternatively, you can manage your GPG keys from your own repository hosted on an external file management system.

Apply a custom state at highstate

To apply a custom state at highstate create a mapping in /srv/salt/top.sls. This short example maps the test state to the system group 12:

```
# /srv/salt/top.sls
base:
  'group_ids:12':
    - match: pillar
    - test
```

Salt File Locations and Structure

There are several ways to set up the Salt file structure. This section describes how Salt is supported and set up as part of SUSE Multi-Linux Manager Server. The main configuration file is /etc/salt/master.d/susemanager.conf.

ⓘ ⋮ Do not edit the /etc/salt/master.d/susemanager.conf configuration file. This file belongs

> to the spacewalk-setup package and is marked as %config. When SUSE updates the spacewalk-setup package, the susemanager.conf file is overwritten, and any customization is lost. Instead, add your own configuration file to the /etc/salt/master.d/ directory. This prevents the update process from deleting your settings from the main susemanager.conf configuration file.

Some settings from /etc/salt/master.d/susemanager.conf that can help with finding configuration options:

```
# Configure different file roots. Custom salt states should only be placed in
# /srv/salt.
# Users should not touch other directories listed here.
file_roots:
  base:
    - /usr/share/susemanager/salt
    - /usr/share/salt-formulas/states
    - /usr/share/susemanager/formulas/states
    - /srv/susemanager/salt
    - /srv/salt

# Configure different pillar roots. Custom pillar data should only be placed
# in /srv/pillar.
# Users should not touch other directories listed here.
pillar_roots:
  base:
    - /srv/pillar
```

When you are working with /etc/salt/master.d/susemanager.conf, be aware that:

- Files listed are searched in the order they appear

- The first matching file found is called

The SUSE Multi-Linux Manager Server reads Salt state data from five root directories:

/usr/share/susemanager/salt

> This directory is shipped and updated with SUSE Multi-Linux Manager and includes certificate setup and common state logic to be applied to packages and channels.

> ⚠️ Do not edit or add custom Salt data to this directory.

/usr/share/salt-formulas/states

/usr/share/susemanager/formulas/states

> These directories are shipped and updated with SUSE Multi-Linux Manager or additional extensions. They include states for Salt formulas.

> ⚠️ Do not edit or add custom Salt data to this directory.

/srv/susemanager/salt

> This directory is generated by SUSE Multi-Linux Manager, based on assigned channels and packages for

clients, groups, and organizations. This directory will be overwritten and regenerated. It is the Salt equivalent of the SUSE Multi-Linux Manager database.

> ⚠️ Do not edit or add custom Salt data to this directory.

Within this directory, each organization has a sub-directory.

Listing 6. Example: SLS File Directory Structure

```
├────── manager_org_<org id>
│   ├────── files
│   │   ... files needed by states (uploaded by users)...
│   └────── state.sls
        ... other SLS files (created by users)...
For example:
├────── manager_org_TESTING
│   ├────── files
│   │   └────── motd     # user created
│   │   ... other files needed by states ...
│   └────── motd.sls     # user created
        ... other SLS files ...
```

/srv/salt

This directory is used for custom state data, modules, and related data. SUSE Multi-Linux Manager does not operate or use this directory directly. The state data in this directory is used by the client highstate, and is merged with the total state result generated by SUSE Multi-Linux Manager. Use this directory for custom Salt data.

The SUSE Multi-Linux Manager Server reads Salt pillar data from two root directories:

/usr/share/susemanager/pillar

This directory is generated by SUSE Multi-Linux Manager. It is shipped and updated together with SUSE Multi-Linux Manager.

> ⚠️ Do not edit or add custom Salt data to this directory.

/srv/pillar

By default, SUSE Multi-Linux Manager does not operate or use this directory directly. The custom pillar data in this directory is merged with the pillar result created by SUSE Multi-Linux Manager. Use this directory for custom Salt pillar data.

> ℹ️ You can use the gitfs fileserver backend to serve Salt data from git repositories. For more information, see **Specialized-guides › Salt**.

The gitfs Fileserver Backend

In SUSE Multi-Linux Manager, pygit2 is the supported Python interface to git. When pygit2 is installed the gitfs fileserver backend is available and it is a supported feature.

Configuration options are set in the /etc/salt/master file, or in a separate configuration file in the /etc/salt/master.d/ directory. The basic settings are:

fileserver_backend

List of fileserver backends that the Salt master checks for files in the order they are defined. Options:

- roots: Files local on the Salt master (SUSE Multi-Linux Manager Server). roots is required to keep the product running. You can only enable gitfs optionally. Additionally, SUSE strongly recommends to prefer roots (local files) over gitfs. The standard backend.

- gitfs: Files stored in one or more git repositories. The repositories are defined with gitfs_remotes.

  Example:

  ```
  fileserver_backend:
    - roots
    - git
  ```

gitfs_remotes

List of git repositories. git://, https://, file://, or ssh:// URLs can be configured. For SSH remotes, a scp-like syntax is also supported; for example: gitlab@gitlab.example.com:universe/setup.git. Then you can also specify options for credentials, file locations, or branches such as pubkey, privkey, root,base.

Example:

```
gitfs_remotes:
  - https://example.com/myformulas/formula.git
  - gitlab@gitlab.example.com:universe/setup.git:
    - pubkey: /var/lib/salt/.ssh/id_rsa_gitlab.pub
    - privkey: /var/lib/salt/.ssh/id_rsa_gitlab
    - root: srv/salt
    - base: master
```

ext_pillar

List of external pillar interfaces. Salt can also serve pillar data from one or more git repositories. For syntax and options, also see the gitfs_remotes setting.

Example:

```
ext_pillar:
  - git:
    - master gitlab@gitlab.example.com:universe/setup.git:
```

```
      - root: srv/pillar
      - pubkey: /var/lib/salt/.ssh/id_rsa_gitlab.pub
      - privkey: /var/lib/salt/.ssh/id_rsa_gitlab
```

For more information, see:

- https://docs.saltproject.io/en/latest/topics/tutorials/gitfs.html

- https://docs.saltproject.io/en/latest/ref/configuration/master.html

Install Using Yomi

Yomi (yet one more installer) is an installer for SUSE and openSUSE operating systems. Yomi is designed as a Salt state, and can be used for installing SUSE operating systems on new systems.

In SUSE Multi-Linux Manager, Yomi can be used as part of provisioning new clients, as an alternative to AutoYaST.

Yomi consists of two components:

- The Yomi formula, which contains the Salt states and modules required to perform the installation.

- The operating system image, which includes the pre-configured salt-minion service.

Both components can be used independently of SUSE Multi-Linux Manager, or integrated with it. This section describes how to use it with SUSE Multi-Linux Manager.

- For more information about using Yomi independently, see https://github.com/openSUSE/yomi.

- For build assets, see https://build.opensuse.org/project/show/systemsmanagement:yomi.

To use Yomi for installing a client operating system, follow this process:

- Install the yomi-formula package.

- Prepare the Salt pillar for the new installation.

- Boot the new client using the PXE boot image for Yomi.

> To use Yomi with SUSE Multi-Linux Manager, ensure you have enough available memory. To boot from USB or DVD image, you need at least 512 MB. To boot from a PXE server, you need at least 2 GB.

Install the Yomi Formula

Before you begin, you need to install the Yomi formula, which is available as a package in SUSE Multi-Linux Manager.

The yomi-formula package contains the Salt states and modules that describe the Yomi state, and the formulas with forms to create the pillar. It also contains documentation about the different sections of the pillar, and some examples about how to parameterize installations based on openSUSE, MicroOS, or SLE.

The formula package performs these actions:

- Adds a new configuration file called yomi-formula.conf in the /etc/salt/master.d/ directory. This configuration file defines the Python module and Salt states required by Yomi.

- Installs the Yomi Salt states in the /usr/share/salt-formulas/states/ directory.

- Provides some example configuration files in the /usr/share/yomi/ directory.

- Installs the required forms and sub-forms in the /usr/share/salt-formulas/metadata/ directory.

- Provides some pillar examples in the /usr/share/yomi/pillar/ directory.

Procedure: Installing the Yomi Formula

1. On the SUSE Multi-Linux Manager Server, at the command prompt, as root, install the yomi-formula package:

```
zypper in yomi-formula
```

2. Restart services:

```
systemctl restart salt-master.service
```

For more information about the Yomi formula, see **Specialized-guides › Salt**.

Install the PXE Image

To provision a new client, you need an operating system image to boot from. You can use any image that contains a salt-minion service enabled, together with a minimal set of tools that are required during the installation, for example parted or btrfstools.

Yomi provides an already prepared image, based on openSUSE Tumbleweed, openSUSE Leap (for Uyuni), or SLE (for SUSE Multi-Linux Manager). For SUSE Multi-Linux Manager, the image is packaged as an RPM. This is done in a similar way to how pxe-default-image is distributed.

The package installs a standard PXE OEM image generated by Kiwi, the initial kernel and initrd in the /srv/pxe-yomi-image/ directory, and the second stage kernel, initrd and image in the /srv/pxe-yomi-image/image directory.

Procedure: Installing the PXE Image

1. On the SUSE Multi-Linux Manager Server, at the command prompt, as root, install the `pxe-yomi-image` service:

```
zypper in pxe-yomi-image-sle15
```

When you have the package installed, you can register Yomi in Cobbler.

Register Yomi in Cobbler

SUSE Multi-Linux Manager uses Cobbler to manage the PXE boot service, so you will need to register the image in Cobbler.

Procedure: Registering the Yomi Image in Cobbler

1. On the SUSE Multi-Linux Manager Server, at the command prompt, as root, create a directory for the Yomi image:

```
mkdir /srv/tftpboot/pxe-yomi-image
```

2. Define a distribution in Cobbler, including the path to install the second stage kernel and initrd, the location of the full image, and any further kernel options. Adjust this command to include the correct version of the product, and the TFTP server address:

```
cobbler distro add \
  --name=pxe-yomi-image \
  --kernel=/srv/pxe-yomi-image/linux \
  --initrd=/srv/pxe-yomi-image/initrd \
  --boot-files='/srv/tftpboot/pxe-yomi-image/image.initrd=/srv/pxe-yomi
-image/image/pxe-yomi-image-sle15.x86_64-1.0.0.initrd /srv/tftpboot/pxe-yomi-
image/image.kernel=/srv/pxe-yomi-image/image/pxe-yomi-image-sle15.x86_64-1.0.0.kernel
/srv/tftpboot/pxe-yomi-image/image.md5=/srv/pxe-yomi-image/image/pxe-yomi-image-
sle15.x86_64-1.0.0.md5 /srv/tftpboot/pxe-yomi-
image/image.config.bootoptions=/srv/pxe-yomi-image/image/pxe-yomi-image-sle15-x86_64-
1.0.0.config.bootoptions /srv/tftpboot/pxe-yomi-image/image.xz=/srv/pxe-yomi-
image/image/pxe-yomi-image-sle15.x86_64-1.0.0.xz' \
  --kernel-options='rd.kiwi.install.pxe rd.kiwi.install.image=tftp://<server-
address>/pxe-yomi-image/image.xz rd.kiwi.ramdisk ramdisk_size=2097152 net.ifnames=1'
```

By default, the salt-minion service in `pxe-yomi-image` is configured to find the Salt master under the salt address. If the DNS server is not able to resolve this address, you need to adjust the `kernel-options` parameter from the Cobbler command that register the distribution, and add a new kernel command line of `ym.master=master_address`. This will override the default configuration for the salt-minion.

Procedure: Registering the Yomi Profile in Cobbler

1. On the SUSE Multi-Linux Manager Server, at the command prompt, as root, define a profile in Cobbler based on the image.

```
cobbler profile add \
   --name pxe-yomi-profile \
   --distro=pxe-yomi-image
```

2. OPTIONAL: Create a system in Cobbler. If you know the MAC address for the new client to be provisioned, you can have it boot directly from the Yomi image.

```
cobbler system add \
    --name=yomi \
    --mac=00:11:22:33:44:55 \
    --profile=pxe-yomi-profile
```

3. When the new node has been provisioned, remove the temporary Cobbler system:

```
cobbler system remove --name=yomi
```

Example Salt Pillar Preparation

The parameters of the new installation are defined with a Salt pillar. The pillar includes parameters that the Yomi state requires during the installation, including the partitions, file systems, repositories, packages installed, and services enabled.

The pillar is defined using the formulas with forms. In this example, we prepare the pillar for a minimal openSUSE Tumbleweed installation. You can find examples for MicroOS or SLES in the example directory /usr/share/yomi/pillar/.

To begin, boot the client that you want to provision using the Yomi PXE boot image, using the Cobbler procedures described earlier in this section.

When the salt-minion service is running on the new client, accept the key by navigating to **Salt › Keys**. When the key is accepted, you can view and manage the client by navigating to **Systems › Overview**. Navigate to the Formulas tab, and add all the Yomi Installer formulas to the client. When you have added all the formulas, complete the forms and sub-forms. This section outlines each form and provides example settings for a minimal installation. For a detailed explanation of every option, see **Specialized-guides › Salt**.

Yomi

The Yomi form contains some general configuration options. For example, the keyboard language and layout, the locale information, and the option to perform a full reset of the system after provisioning.

For this example, set the Reboot parameter to yes.

Yomi Storage

This sub-form provides information about the devices, partitioning, file system (including the BtrFS subvolumes, for example), and LVM and RAID configuration.

For this example, we assume that the new client has a single device named /dev/sda, and that it belongs to a non-UEFI system. In this case, we have only three partitions: one for the boot loader, one for swap and one for the system. We also expect to have an ext4 file system for the root directory.

Device 1:

- Device: /dev/sda

- Label: GPT

- Initial Gap: 1 MB

Create three partitions:

- Partition 1:

  ○ Partition Number: 1

  ○ Partition Size: 1 MB

  ○ Partition Type: boot

- Partition 2:

  ○ Partition Number: 2

  ○ Partition Size: 1024 MB

  ○ Partition Type: swap

- Partition 3:

  ○ Partition Number: 3

  ○ Partition Size: rest

  ○ Partition Type: linux

Create two file systems:

- Filesystem 1:

  ○ Partition: /dev/sda2

  ○ Filesystem: swap

- Filesystem 2:

  ○ Partition: /dev/sda3

  ○ Filesystem: ext4

  ○ Mountpoint: /

Yomi Bootloader

This sub-form provides details required for GRUB.

Set these parameters:

- Device: /dev/sda

- Theme: selected

The Kernel parameter can be used for the GRUB append section.

Yomi Software

This form provides the different repositories and packages to install. You can also register the product in this form, using SUSEConnect, and install the different modules after registering.

For this example we are going to install a very minimal openSUSE Tumbleweed distribution, using publicly available repositories. For production deployments, you will need to provide a local repository.

Add a new repository: * Repository Name: repo-oss * Repository URL: http://download.opensuse.org/tumbleweed/repo/oss/

Add these packages: * pattern:enhanced_base * glibc-locale * kernel-default

You can also add patterns and products, together with packages, by using the correct prefix.

Yomi Services

By default Yomi is installed with the salt-minion service, but you must enable it.

Add a new enabled service:

- Service 1:

  - Service: salt-minion

    Yomi Users

    This form sets out the system users. In this example, we have a single root user. To provide a password, you must use the hashed version of the password, not the plain text. This behavior is set to be changed in future versions of Yomi.

- User 1:

  - Username: root

  - Password Hash: 1wYJUgpM5$RXMMeASDc035eXNbYWFl0

Monitor the Installation

You can monitor the installation as it progresses, using the monitor tool from Yomi. You can continue monitoring as the highstate is applied to the new client. To use the tool, you will need to have enabled Events in the Yomi formula, and have the salt-api service activated.

For more information about the salt-api service, and how to use the monitor tool, see https://github.com/openSUSE/yomi.

Configuration Modules

Salt uses execution and state modules to define, apply, and orchestrate configuration of your devices. SUSE Multi-Linux Manager provides a set of modules called Uyuni configuration modules, that you can use to configure both SUSE Multi-Linux Manager and Uyuni Servers.

You can use the Uyuni configuration modules directly or using SLS files. They are are especially useful if you have multiple SUSE Multi-Linux Manager Servers, for example in Hub installations, but they are also useful for smaller installations.

For more information about using Hub, see **Specialized-guides › Large-deployments**.

You can use Uyuni configuration modules to configure:

- Organizations

- Users

- User permissions

- System groups

- Activation Keys

For more information about Salt execution modules, see https://docs.saltproject.io/en/latest/topics/tutorials/modules.html.

For more information about Salt state modules, see https://docs.saltproject.io/en/latest/topics/tutorials/starting_states.html.

Install Configuration Modules

The Uyuni configuration modules are available in the uyuni-config-modules package. On the SUSE Multi-Linux Manager Server, at the command prompt, as root, use this command:

```
zypper in uyuni-config-modules
```

This package also installs detailed API descriptions, indications on pillar settings, and examples. When you have installed the package, navigate to /usr/share/doc/packages/uyuni-config-modules/.

Salt Formulas

Formulas are collections of Salt States that contain generic parameter fields. Formulas allow for reliable reproduction of a specific configuration. Some formulas are supplied by SUSE, or you can install formulas from RPM packages or an external git repository.

Formulas work best for large, non-trivial, configurations. For smaller tasks, use a state rather than a formula. Formulas and states both act as a kind of configuration documentation. When you have written and stored the configuration, they provide a snapshot of your infrastructure.

Formula data can be managed using the XMLRPC API.

You can use the SUSE Multi-Linux Manager Web UI to apply SUSE Multi-Linux Manager formulas. The most commonly used formulas are documented in this section.

Alternatively, you can use pre-written formulas as a starting point for your own custom formulas. Pre-written formulas are available from https://github.com/saltstack-formulas.

For more information on custom formulas, see **Specialized-guides › Salt**.

Formulas Provided by SUSE Multi-Linux Manager

Some formulas are installed by default with SUSE Multi-Linux Manager. Other official formulas can be installed as RPM packages. When the formula is installed, you can activate them using the SUSE Multi-Linux Manager Web UI.

For information about writing custom formulas, see **Specialized-guides › Salt**.

Install Formulas with Zypper

Formulas are provided in the SUSE Multi-Linux Manager pool software channel.

> If a formula uses the same name as an existing Salt state, the two names will collide, and could result in the formula being used instead of the state. Always check states and formulas to avoid name clashes.

Procedure: Installing Formulas with Zypper

1. On the SUSE Multi-Linux Manager Server, at the command prompt, search for available formulas:

```
zypper se --type package formula
```

2. Get more information about a formula:

```
zypper info <formula_name>
```

3. On the SUSE Multi-Linux Manager Server, at the command prompt, as root, install the formula:

```
zypper in <formula_name>
```

Activate Formulas from the Web UI

Formulas provided by SUSE Multi-Linux Manager, or formulas that you have installed, can be activated using the SUSE Multi-Linux Manager Web UI.

Procedure: Activate Formulas from the Web UI

1. In the SUSE Multi-Linux Manager Web UI, navigate to **Systems › List**, select the client you want to activate the formula for.

2. Navigate to the **Systems › Formulas** tab, and check the formula you want to activate.

3. Click **[Save]**.

4. Navigate to the new subtab for the formula, and configure the formula as required.

5. Apply the highstate.

Bind Formula

The Bind formula is used to configure the Domain Name System (DNS) on the branch server. POS terminals will use the DNS on the branch server for name resolution of Saltboot specific hostnames.

When you are configuring the Bind formula for a branch server with a dedicated internal network, check that you are using the same fully qualified domain name (FQDN) on both the external and internal branch networks. If the FQDN does not match on both networks, the branch server will not be recognized as a proxy server.

> ℹ️ The following procedure outlines a standard configuration with two zones. Adjust it to suit your own environment.

Zone 1 is a regular domain zone. Its main purpose is to resolveSaltboot hostnames such as TFTP, FTP, or Salt. It can also resolve the terminal names if configured.

Zone 2 is the reverse zone of Zone 1. Its main purpose is to resolve IP addresses back to hostnames. Zone 2 is primarily needed for the correct determination of the FQDNs of the branch.

Procedure: Configuring Bind with Two Zones

1. Check the Bind formula, click Save, and navigate to the **Formulas › Bind** tab.

2. In the Config section, select Include Forwarders.

3. In the Configured Zones section, use these parameters for Zone 1:

   ◦ In the Name field, enter the domain name of your branch network (for example: branch1.example.com).

   ◦ In the Type field, select master.

4. Click Add item to add a second zone, and set these parameters for Zone 2:

   ◦ In the Name field, use the reverse zone for the configured IP range (for example: com.example.branch1).

   ◦ In the Type field, select master

5. In the Available Zones section, use these parameters for Zone 1:

   ◦ In the Name field, enter the domain name of your branch network (for example: branch1.example.org).

   ◦ In the File field, type the name of your configuration file.

6. In the Start of Authority (SOA) section, use these parameters for Zone 1:

   ◦ In the Nameserver (NS) field, use the FQDN of the branch server (for example: branchserver.branch1.example.org).

   ◦ In the Contact field, use the email address for the domain administrator.

   ◦ Keep all other fields as their default values.

7. In the Records section, in subsection A, use these parameters to set up an A record for Zone 1:

   ◦ In the Hostname field, use the hostname of the branch server (for example: branchserver).

   ◦ In the IP field, use the IP address of the branch server (for example, 192.168.1.5).

8. In the Records section, subsection NS, use these parameters to set up an NS record for Zone 1:

   ◦ In the input box, use the hostname of the branch server (for example: branchserver).

9. In the Records section, subsection CNAME, use these parameters to set up CNAME records for Zone 1:

   ◦ In the Key field, enter tftp, and in the Value field, type the hostname of the branch server (for example: branchserver).

   ◦ Click Add Item. In the Key field, enter ftp, and in the Value field, type the hostname of the branch server.

   ◦ Click Add Item. In the Key field, enter dns, and in the Value field, type the hostname of the branch server.

- Click Add Item. In the Key field, enter dhcp, and in the Value field, type the hostname of the branch server.

- Click Add Item. In the Key field, enter salt, and in the Value field, type the FQDN of the branch server (for example: branchserver.branch1.example.org).

10. Set up Zone 2 using the same parameters as for Zone 1, but ensure you use the reverse details:

- The same SOA section as Zone 1.

- Empty A and CNAME records.

- Additionally, configure in Zone 2:

  - Generate Reverse field by the network IP address set in branch server network formula (for example, 192.168.1.5/24).

  - For Zones should specify the domain name of your branch network (for example, branch1.example.org).

11. Click **[Save Formula]** to save your configuration.

12. Apply the highstate.

> Reverse name resolution on terminals might not work for networks that are inside one of these IPv4 private address ranges:
>
> - 10.0.0.0/8
>
> - 172.16.0.0/12
>
> - 192.168.0.0/16
>
> If you encounter this problem, go to the Options section of the Bind formula, and click **[Add item]**:
>
> - In the Options field, enter empty-zones-enable.
>
> - In the Value field, select No.

Branch Network Formula

The Branch Network formula is used to configure the networking services required by the branch server, including DHCP, DNS, TFTP, PXE, and FTP.

> The formula is used only for connecting SUSE Multi-Linux Manager Proxy 4.3. with SUSE Multi-Linux Manager Server 5.0. Do not use this formula if you want to connect SUSE Multi-Linux Manager Proxy 5.0.

Set Up a Branch Server Networking

The branch server can be configured to use networking in many different ways. The most common ways provide either a dedicated or shared LAN for terminals.

Set Up a Branch Server with a Dedicated LAN

In this configuration, the branch server requires at least two network interfaces: one acts as a WAN to communicate with the SUSE Multi-Linux Manager server, and the other one acts as an isolated LAN to communicate with terminals.

This configuration allows for the branch server to provide DHCP, DNS, TFTP, PXE, and FTP services to terminals. These services can be configured with Salt formulas in the SUSE Multi-Linux Manager Web UI.

Procedure: Setting Up a Branch Server with a Dedicated LAN

1. In the SUSE Multi-Linux Manager Web UI, open the details page for the branch server, and navigate to the Formulas tab.

2. In the Branch Network section, set these parameters:

   ◦ Keep Dedicated NIC checked.

   ◦ In the NIC field, enter the name of the network device that is connected to the internal LAN.

   ◦ In the IP field, enter the static IP address to be assigned to the branch server on the internal LAN.

   ◦ In the Netmask field, enter the network mask of the internal LAN.

3. Check Enable Route if you want the branch server to route traffic from internal LAN to WAN.

   ◦ Check Enable NAT if you want the branch server to convert addresses from internal LAN to WAN.

   ◦ Select the bind DNS forwarder mode.

   ◦ Check DNS forwarder fallback if you want to rely on an external DNS if the branch DNS fails.

   ◦ Specify the working directory, and the directory owner and group.

Set up a Branch Server with a Shared Network

In this configuration, the branch server has only one network interface card, which is used to connect to the SUSE Multi-Linux Manager server as well as the terminals.

This configuration allows for the branch server to provide DNS, TFTP, PXE, and FTP services to terminals. These services can be configured with Salt formulas in the SUSE Multi-Linux Manager Web UI. Optionally, the branch server can also provide DHCP services in this configuration.

> If DHCP services are not provided by the branch server, ensure that your external DHCP

configuration is set correctly:

- The next-server option must point to the branch server for PXE boot to work.

- The filename option must correctly identify the network boot program (by default, this is /boot/pxelinux).

- The domain-name-servers option must point to the branch server for correct host name resolution.

Procedure: Setting Up a Branch Server with a Shared Network

1. In the SUSE Multi-Linux Manager Web UI, open the details page for the branch server, and navigate to the Formulas tab.

2. In the Branch Network section, set these parameters:

   ○ Keep Dedicated NIC unchecked.

   ○ Enable services on the branch server's firewall. Ensure you include DNS, TFTP, and FTP services.

   ○ Select the bind DNS forwarder mode.

   ○ Check DNS forwarder fallback if you want to rely on an external DNS if the branch DNS fails.

   ○ Specify the working directory, and the directory owner and group.

Set up Branch Server Terminal Naming

In this configuration it is required to fill at least Branch Identification. This identifies Branch Server in Retail subsystem and is also used to better organize terminals with their respective branch servers.

Procedure: Setting up a Branch Server Identification

1. In the SUSE Multi-Linux Manager Web UI, open the details page for the branch server, and navigate to the Formulas tab.

2. In the Terminal Naming section, enter the Branch Identification string.

3. Click **[Save]** to save your changes.

4. Apply the highstate.

It is also possible to set various options about terminal naming, for more information about terminal naming see **Retail › Retail-terminal-names**.

DHCPd Formula

The DHCPd formula is used to configure the DHCP service on the branch server.

Procedure: Configuring DHCP

1. In the SUSE Multi-Linux Manager Web UI, open the details page for the branch server, and navigate to the Formulas tab.

2. Check the Dhcpd formula, and click **[Save]**.

3. Navigate to the **Formulas › Dhcpd** tab, and set these parameters:

   ○ In the Domain Name field, enter the domain name for the branch server (for example: branch1.example.com).

   ○ In the Domain Name Server field, enter either the IP address or resolvable FQDN of the branch DNS server (for example: 192.168.1.5).

   ○ In the Listen Interfaces field, enter the name of the network interface used to connect to the local branch network (for example: eth1).

4. Navigate to the Network Configuration (subnet) section, and use these parameters for Network1:

   ○ In the Network IP field, enter the IP address of the branch server network (for example: 192.168.1.0).

   ○ In the Netmask field, enter the network mask of the branch server network (for example: 255.255.255.0).

   ○ In the Domain Name field, enter the domain name for the branch server network (for example: branch1.example.com).

5. In the Dynamic IP Range section, use these parameters to configure the IP range to be served by the DHCP service:

   ○ In the first input box, set the lower bound of the IP range (for example: 192.168.1.51).

   ○ In the second input box, set the upper bound of the IP range (for example: 192.168.1.151).

6. In the Broadcast Address field, enter the broadcast IP address for the branch network (for example: 192.168.1.255).

7. In the Routers field, enter the IP address to be used by routers in the branch server network (for example: 192.168.1.5).

8. In the Next Server field, enter the hostname or IP address of the branch server (for example: 192.168.1.5).

9. In the Filename field, if you are booting a client using PXE, type the path to the PXE bootloader. There is usually no need to change the default value of /boot/pxelinux.0.

10. In the Filename Efi field, if you are booting a UEFI client using PXE, type the path to the PXE bootloader. There is usually no need to change the default value of /boot/shim.efi.

11. In the Filename Http field, if you are booting a UEFI client using HTTP, type http://branchserver/saltboot/boot/shim.efi.

12. Click **[Save Formula]** to save your configuration.

13. Apply the highstate.

Image Synchronization Formula

The Image Synchronization formula is used to configure when OS images are synchronized to the branch server, and to specify which images to synchronize.

If this formula is not enabled, synchronization must be started manually, and all images will be synchronized.

Procedure: Configuring Image Synchronization

1. In the SUSE Multi-Linux Manager Web UI, open the details page for the branch server, and navigate to the Formulas tab.

2. Check the Image Synchronize formula, and click **[Save]**.

3. Navigate to the **Formulas › Image Synchronize** tab, and set these parameters:

   ◦ Check the Include Image Synchronization in Highstate field to have image synchronization occur every time highstate is applied. This ensures that you do not have to perform image synchronization manually, however it requires a high bandwidth environment.

   ◦ In the Synchronize only the listed images field, click **[Add item]** to add the images you want to have synchronized automatically. Alternatively, you can leave this list blank to have all images synchronized.

4. Click **[Save Formula]** to save your configuration.

5. Apply the highstate.

> ℹ️ The Image Synchronization state does not delete cached images. If you are running out of disk space, check the size of the Salt client cache directory, and delete it if required. By default, the directory is located at /var/cache/salt/minion.

Liberate Formula

The liberate formula migrates systems from EL clients such as CentOS 7 or Red Hat Enterprise Linux 9 to SUSE Liberty Linux. With this formula the conversion will take place during the client onboarding on SUSE Multi-Linux Manager.

> ℹ️ The Liberate Formula comes preinstalled within the server container.

Configure SUSE Multi-Linux Manager

To provide all the software channels for SUSE Liberty Linux on the SUSE Multi-Linux Manager Server, proceed as follows.

Procedure: Providing SUSE Customer Center credentials

1. Sign in to SUSE Customer Center at https://scc.suse.com.

2. Navigate to My Organization, and select your organization.

3. Navigate to **Users › Organization Credentials** and take note of your organization username and password.

4. In the SUSE Multi-Linux Manager Web UI, navigate to **Admin › Setup Wizard › Organization Credentials** to add the credentials to your SUSE Multi-Linux Manager Server.

5. Click **[Add new credential]**, and enter the SUSE Customer Center username and password noted in a previous step.

Procedure: Synchronizing the SLL/SLES-ES channels:

1. In the SUSE Multi-Linux Manager Web UI, navigate to **Admin › Setup Wizard › Products**

2. Select the SUSE Liberty Linux Channels that you will use:

    ◦ EL7 LTSS: SUSE Linux Enterprise Server with Expanded Support LTSS 7 x86_64

    ◦ EL7: SUSE Linux Enterprise Server with Expanded Support 7 x86_64

    ◦ EL8: RHEL or SLES ES or CentOS 8 Base

    ◦ EL9: RHEL and Liberty 9 Base

3. Click the top right button **[Add products]**.

Initial sychronization can take considerable time. You can check progress by accessing the server machine via SSH and monitoring the logs using:

```
tail -f /var/log/rhn/reposync/*
```

Procedure: Creating one Activation Key per SUSE Liberty Linux parent channel

1. Note: Activation Keys are the way to register systems and automatically assign them to the required software and configuration channels corresponding to them.

2. In the SUSE Multi-Linux Manager Web UI, navigate to **Systems › Activation Keys**, and click the top right button **[Create key]**.

3. In the Activation Key dialog, set the fields:

    Description

        Enter some text describing the activation key.

    Key

        Enter the identifier of the key. For example [literalsll9-default for EL 9 systems. Note: Keys will have a

numeric prefix depending on the organization, so that they are unique.

Usage

Leave blank.

Base Channel

Select one base channel:

- EL7 LTSS: RES-7-LTSS-Updates for x86_64

- EL7: RHEL x86_64 Server 7

- EL8: RHEL8-Pool for x86_64

- EL9: EL9-Pool for x86_64

Child Channel

Include all child channels.

Add-On system type

Leave all blank.

Contact Method

Default

Universal Default

Leave unchecked.

4. Click **[Create Activation Key]**.

Add Liberate formula and assign it to activation keys

When installed, the formula can be assigned to an Activation Key by creating a System Group:

Procedure: Assigning system group and assigning liberate formula

1. In the SUSE Multi-Linux Manager Web UI, navigate to **Systems › System Groups**, and click the **[Create Group]** button in top right corner.

2. In the dialog, fill in the following data:

Name

liberate

Description

Systems to be converted to SUSE Liberty Linux

3. From the liberate System Group page, navigate go to the Formulas tab.

4. Select the Liberate formula, and click [**Save**]. A new tab called Liberate will appear.

5. On the Liberate tab, you see the Reinstall all packages after conversion option. Keep it checked if you want to reinstall all the packages during the migration. This way you ensure all the packages will have SUSE signatures and no previous package will be kept. If you do not want to change the state of your system during the migration, uncheck this option and click the [**Save Formula**] button. In this case, you can re-install the packages later.

Now a system group exists that has assigned the Liberate formula. This formula will be applied only once to migrate the system to SUSE Liberty Linux, even if you run it multiple times. With the next procedure, assign the system group to the Activation Key.

Procedure: Assigning the system group to the Activation Key

1. In the SUSE Multi-Linux Manager Web UI, navigate to **Systems › Activation Keys**.

2. Select the Activation Key, for example sll9-default for the EL 9 systems.

3. From the Activation Key page navigate to the **Groups › Join** tab, select the liberate group, and click the [**Join Selected Groups**] button. The group will be assigned to the Activation Key

Procedure: Applying migrate directly during registration

1. From the Activation Key page, navigate to the Details tab.

2. Navigate to the Configuration File Deployment section, and checkb the Deploy configuration files to systems on registrationoption.

3. Click [**Update Activation Key**].

When you register a system with this key it will perform the migration automatically.

Register a new system and proceed to the migration

There are two ways to onboard (or register) a new client with the Activation Key:

Client-configuration › Registration-webui

This is intended for a one-off registration or for testing purposes.

Client-configuration › Registration-bootstrap

This is intended to be used for mass registration.

For already registered clients

Software channels, system group membership, and formulas can be assigned to any already registered client. This method makes use of the bootstrap script mentioned above.

Procedure: Creating an Reactivation key

1. In the SUSE Multi-Linux Manager Web UI, open the System Details page of any registered client you want to migrate to SUSE Liberty Linux.

2. Click the Reactivation tab. If there is already a key listed, you can use it. If not, click **[Generate New Key]**, and copy the entire key. The key will start with re-.

3. SSH into this client and set the environment variable to be the key that you copied:

```
export REACTIVATION_KEY=re-xxxxxxxxxxxxxx
```

4. Run the bootstrap script from **Client-configuration › Registration-bootstrap**, and the system will re-register using the same profile as before, but with the newly assigned SUSE Liberty Linux context.

Monitoring Formula

The monitoring services in SUSE Multi-Linux Manager are configured using formulas with forms. The package is installed by default, and contains these formulas:

- Grafana

- Prometheus

- Prometheus Exporters

For more information about using monitoring, see **Administration › Monitoring**.

Grafana

Procedure: Configuring the Grafana Formula

1. Navigate to the **Formulas › Grafana** tab, and set these parameters in the Grafana section:

   - Check the Enabled box to enable Grafana visualizations.

     > ℹ️ Initial admin password is used on the first run only, and Grafana UI prompts to change it. This field cannot be used to change the Grafana password. For more information on how to change the password, see **Administration › Monitoring**.

2. For each Prometheus data source you want to use, in the **Datasources › Prometheus** section, click **[+]**, and

set these parameters:

- In the Datasource name field, type a name to identify the data source.

- In the Prometheus URL field, type the used protocol, the location of the Prometheus server, and append port 9090. For example, http://example.com:9090. In case TLS encryption is enabled in Prometheus formula make sure to use https protocol and FQDN.

- In the fields Prometheus server username and Prometheus server password, enter basic authentication credentials for Prometheus server matching the ones in Prometheus formula.

3. In the Dashboards section, check the dashboards you want to use:

- Uyuni server dashboard

- Uyuni clients dashboard

- PostgreSQL dashboard

- Apache HTTPD dashboard

- Kubernetes cluster dashboard

- Kubernetes etcd dashboard

- Kubernetes namespaces dashboard

4. Click **[Save Formula]** to save your configuration.

Prometheus

Procedure: Configuring the Prometheus Formula

1. Navigate to the **Formulas › Prometheus** tab, and set these parameters in the Prometheus section:

- Check the Enabled box to enable Prometheus monitoring.

- In the Scrape interval field, type the frequency of data scraping, in seconds. For example, 15 will scrape data every fifteen seconds.

- In the Evaluation interval field, type the frequency of rules evaluation, in seconds. For example, 15 will evaluate alerting and aggregation rules every fifteen seconds.

2. In the TLS section, set these parameters:

- Check the Enabled box to enable the secure configuration on Prometheus server.

- In the Server Certificate field, type the path to the TLS server certificate.

- In the Server Key field, type the path to the TLS server key.

- In the User field, type the user name for Prometheus server.

- In the Password Hash field, type the password for Prometheus server hashed with bcrypt.

3. In the Uyuni Server section, set these parameters:

  ○ Check the Enabled box to enable monitoring on this server.

  ○ Check the Autodiscover clients box to enable Prometheus to automatically find and monitor new clients when they are added to the server.

  ○ In the Username field, type the user name of the Prometheus account on the server.

  ○ In the Password field, type the password of the Prometheus account on the server.

  ○ In the Targets TLS section, set these parameters:

    ■ Check the Enabled box to enable the secure configuration for auto-discovered targets.

    ■ In the CA Certificate field, type the path to the Certificate Authority certificate.

    ■ In the Client Certificate field, type the path to the TLS client certificate for authentication.

    ■ In the Client Key field, type the path to the TLS client key for authentication.

4. In the Alerting section, set these parameters:

  ○ Check the Enable local Alertmanager service box to enable the alert manager service.

  ○ Check the Use local Alertmanager box to use the local alert manager service.

5. For each alert manager you want to use, in the **Alerting › Alertmanagers** section, click **[+]**, and set these parameters:

  ○ In the IP Address:Port field, type the location of the alert manager target, including the port number.

6. To use a rule file, in the **Alerting › Rule Files** section, click **[+]**, and set these parameters:

  ○ In the Rule Files field, type the location of the rule file you want to use.

7. To add a custom scrape configuration, in the User defined scrape configurations section, click **[+]**, and set these parameters:

  ○ In the Job name field, type a unique job name for your configuration.

  ○ In the Files field, type the location pattern of file service discovery files you want to use. For more information, see the upstream documentation https://prometheus.io/docs/prometheus/latest/configuration/configuration/#file_sd_config.

8. Click **[Save Formula]** to save your configuration.

> **i** The formula does not generate and deploy the TLS certificates and keys. Ensure the files are present on the Salt client and readable for the user prometheus before applying the highstate. For more information about generating client and server certificates, see **Administration › Monitoring**.

Prometheus Exporters

Procedure: Configuring the Prometheus Exporters Formula

1. Navigate to the **Formulas › Prometheus Exporters** tab, and set these parameters in the Node Exporter section:

   ○ Check the Enabled box to enable the node exporter.

   ○ In the Arguments field, type any customized arguments for this exporter. For example, --web.listen-address=":9100".

2. In the Apache Exporter section:

   ○ Check the Enabled box to enable the Apache exporter.

   ○ In the Arguments field, type any customized arguments for this exporter. For example, --telemetry.address=":9117".

3. In the Postgres Exporter section:

   ○ Check the Enabled box to enable the PostreSQL exporter.

   ○ In the Data source Name field, type the name of the data source to use.

   ○ In the Arguments field, type any customized arguments for this exporter. For example, --web.listen-address=":9187".

4. In the TLS section:

   ○ Check the Enabled box to enable the secure configuration.

   ○ In the CA Certificate field, type the path to the Certificate Authority certificate.

   ○ In the Server Certificate field, type the path to the TLS server certificate.

   ○ In the Server Key field, type the path to the TLS server key.

5. Click **[Save Formula]** to save your configuration.

File-based service discovery

It is possible to define monitored targets using file-based service discovery provided in the Prometheus formula. This is a basic example demonstrating the usage:

```
[
  {
    "targets": [ "<client1>:9100", "<client2>:9100" ],
    "labels": {
      "role": "<MLM-client>",
      "job": "<MLM-refclient>"
    }
  },
  {
```

```
    "targets": [ "<server>:80" ],
    "labels": {
      "role": "<MLM-server>",
      "job": "<MLM-refhost>",
      "__metrics_path__": "/rhn/metrics"
    }
  }
]
```

For more information, see https://prometheus.io/docs/guides/file-sd/.

TLS certificates and keys

The formula does not generate and deploy the TLS certificates and keys. Ensure the files are present on the Salt client and readable for the user prometheus before applying the highstate. For more information about generating client and server certificates, see **Administration › Monitoring**.

Activate Forms

When you have completed and saved all the forms, apply the highstate.

For more information about using monitoring, see **Administration › Monitoring**.

PXE Formula

The PXE formula is used to configure PXE booting on the branch server.

> ! The formula is used only for connecting SUSE Multi-Linux Manager Proxy 4.3. with SUSE Multi-Linux Manager Server 5.0. Do not use this formula if you want to connect SUSE Multi-Linux Manager Proxy 5.0.

Procedure: Configuring PXE Booting

1. In the SUSE Multi-Linux Manager Web UI, open the details page for the branch server, and navigate to the Formulas tab.

2. Select the Pxe formula, and click Save.

3. Navigate to the **Formulas › Pxe** tab, and set these parameters:

   ○ In the Kernel Filename field, keep the default value.

   ○ In the Initrd Filename field, keep the default value.

   ○ If the terminals connecting to this branch server are running arm64 architecture, check the Enable ARM64 UEFI boot box. Leave unchecked for x86-64.

   ○ In the Kernel Filename for ARM64 field, keep the default value.

- In the Initrd Filename for ARM64 field, keep the default value.

- In the Kernel Command Line Parameters field, keep the default value. For more information about possible values, see Saltboot Kernel Command Line Parameters.

- In the PXE root directory field, enter the path to the Saltboot directory (for example, /srv/saltboot).

4. Click Save Formula to save your configuration.

5. Apply the highstate.

Saltboot Kernel Command Line Parameters

Saltboot supports common kernel parameters and Saltboot-specific kernel parameters. All the parameters can be entered in the Kernel Command Line Parameters field of the PXE formula.

kiwidebug=1

Starts a shell on tty2 during boot and enables debug logging in Salt.

> ⚠️ Do not use this parameter in a production environment as it creates a major security hole. This parameter should be used only in a development environment for debug purposes.

MASTER

Overrides auto-detection of the Salt master. For example:

```
MASTER=myproxy.domain.com
```

SALT_TIMEOUT

Overrides the local boot fallback timeout if the Salt master does not apply the Saltboot state within this timeout (default: 60 seconds). For example:

```
SALT_TIMEOUT=300
```

DISABLE_HOSTNAME_ID

If the terminal has a hostname assigned by DHCP, it is by default used as a minion ID. Setting this option to 1 disables this mechanism, and SMBios information will be used as a minion ID.

DISABLE_UNIQUE_SUFFIX

Setting this option to 1 disables adding random generated suffix to terminal minion ID.

If you set this parameter make sure your terminal has either a unique hostname provided by DHCP and DNS, or the terminal hardware comes with a unique serial number stored in its SMBios memory. Otherwise there is a risk of terminal minion ID duplicity, and bootstrapping the minion will fail.

The following parameters (`MINION_ID_PREFIX`, `salt_device`, `root`) are usually autoconfigured and should be used only in specific conditions such as debugging or development:

MINION_ID_PREFIX

Branch ID set in the Branch Network formula form.

salt_device

Device that contains the Salt configuration.

root

Device that contains the already deployed root file system. Used for falling back to local boot.

Saline Formula

Saline in SUSE Multi-Linux Manager monitoring is configured using formulas with forms. The package is installed by default, and contains these formulas:

- Saline Prometheus

- Saline Grafana

These formulas are extending the configuration of Grafana and Prometheus created with Monitoring Formulas.

Saline Prometheus

Procedure: Configuring the Saline Prometheus Formula

1. Navigate to the **Formulas › Saline Prometheus** tab, and set these parameters in the Saline Prometheus section:

   - Check the Enable Saline scrape configuration box to enable Saline Prometheus monitoring.

   - Check the Saline secure connection (HTTPS) to use secure connection to Saline (used by default).

2. Click **[Save Formula]** to save your configuration.

Saline Grafana

Procedure: Configuring the Saline Grafana Formula

1. Navigate to the **Formulas › Saline Grafana** tab, and set these parameters in the Saline Grafana section:

2. In the Dashboards section, check the dashboards you want to use:

   - SUSE Multi-Linux Manager server dashboard with Saline

○ SUSE Multi-Linux Manager Saline States Job dashboard

3. Click **[Save Formula]** to save your configuration.

Activate Forms

When you have completed and saved all the forms, apply the highstate.

- For more information about configuring Prometheus and Grafana with formulas, see Monitoring Formulas.

- For more information about using monitoring, see **Administration › Monitoring**.

Saltboot Formula

The Saltboot formula is used to configure disk images and partitioning for the selected hardware type.

> ⊘ The Saltboot formula is meant to be used as a group formula. Enable and configure Saltboot formula for hardware type groups.

> ⊘ To apply changes to a terminal, terminal needs to be restarted. Applying highstate does not have any effect on running terminals.

Procedure: Configuring the Hardware Type Group with Saltboot

1. Open the details page for your new hardware type group, and navigate to the Formulas tab.

2. Select the Saltboot formula and click **[Save]**.

3. Navigate to the **Formulas › Saltboot** tab.

4. In the Disk 1 section, set these parameters:

   ○ In the Disk symbolic ID field, enter a custom name for the disk (for example, disk1).

   ○ In the Device type field, select DISK.

   ○ In the Disk device field, select the device that corresponds to the device name on the target machine or asterisk *, see Disk Selection in Saltboot Formula.

   ○ In the RAID level field, leave it empty.

   ○ In the Disk Label field, select gpt.

5. In the Partition section, set these parameters for Partition 1:

   ○ In the Partition symbolic ID field, enter a custom name for the partition (for example, p1).

   ○ In the Partition size use value 500.

- In the Device mount point use /boot/efi.

- In the Filesystem format use vfat.

- In the OS Image to deploy field, leave it empty.

- In the Partition encryption password field, leave it empty.

- In the Partition flags use boot.

6. In the Partition section, set these parameters for Partition 2:

- In the Partition symbolic ID field, enter a custom name for the partition (for example, p2).

- In the Partition size field, specify a size for the partition in Mebibytes (MiB).

- In the Device mount point field, select a location to mount the partition (for example, /data).

- In the Filesystem format field, select your preferred format (for example, xfs).

- In the OS Image to deploy field, leave it empty.

- In the Partition encryption password field, enter a password if you want to encrypt the partition.

- In the Partition flags field, leave it empty.

7. In the Partition section, set these parameters for Partition 3:

- In the Partition symbolic ID field, enter a custom name for the partition (for example, p3).

- In the Partition size field, specify a size for the partition in Mebibytes (MiB).

- In the Device mount point field, leave it empty.

- In the Filesystem format field, select swap.

- In the OS Image to deploy field, leave it empty.

- In the Partition encryption password field, enter a password if you want to encrypt the partition.

- In the Partition flags field, select swap.

8. In the Partition section, set these parameters for Partition 4:

- In the Partition symbolic ID field, enter a custom name for the partition (for example, p4).

- In the Partition size field, leave it empty. This will ensure the partition uses up all remaining space.

- In the Device mount point field, select /.

- In the Filesystem format field, leave it empty.

- In the OS Image to deploy field, enter the name of the image to deploy.

- In the Image version field, leave it empty. This will ensure you use the latest available version.

- In the Partition encryption password field, enter a password if you want to encrypt the partition.

- In the Partition flags field, leave it empty.

9. Click **[Save Formula]** to save your configuration.

Special Partition Types

The Saltboot formula helps you with setting up special partition types.

> ⊘ For terminal to be able to boot locally, either BIOS grub or EFI partition must be configured.

BIOS grub Partition

A BIOS grub partition is needed for local booting from a GPT disk on non-EFI machines. For more information, see https://en.wikipedia.org/wiki/BIOS_boot_partition.

In the formula, enter the following options:

```
Partition Symbolic ID: p1
Partition Size (MiB): 50
Partition Flags: bios_grub
```

Leave the other fields empty.

EFI Partition

An EFI partition is needed for local booting on EFI machines, Partition Table Type must be GPT. For more information, see https://en.wikipedia.org/wiki/EFI_system_partition.

In the formula, enter the following options:

```
Partition Symbolic ID: p1
Partition Size (MiB): 500
Device Mount Point: /boot/efi
Filesystem Format: vfat
Partition Flags: boot
```

Leave the other fields empty.

Disk Selection in Saltboot Formula

When there is only one disk present on target hardware (including USB drives), use an asterisk * to automatically select the disk device.

When there are multiple disks, use an asterisk * in the device path. In this example, SATA disks are differentiated from USB disks:

```
/dev/disk/by-path/*-ata-1
/dev/disk/by-path/*usb*
```

If the entered value does not contain /, the entered value is automatically prepended by /dev/disk/by-path/. For example, *usb* is the same as /dev/disk/by-path/*usb*.

If you prefer to select specific devices, you can this format in the disk device field:

- symbolic names (for example: /dev/sda)

- by-path (for example: /dev/disk/by-path/..)

- by-id (for example: /dev/disk/by-id/...)

To see a list of available devices from the command prompt, press $\boxed{\text{Esc}}$ while waiting for key approval.

Troubleshooting the Saltboot Formula

msdos Disklabel Limitations

On the msdos disk label, you can create a maximum of four primary partitions. Extended partitions are not supported. If you need more than four partitions, use the GPT disk label instead.

TFTPd Formula

The TFTPd formula is used to configure the TFTP service on the SUSE Multi-Linux Manager for Retail branch server.

> The formula is used only for connecting SUSE Multi-Linux Manager Proxy 4.3. with SUSE Multi-Linux Manager Server 5.0. Do not use this formula if you want to connect SUSE Multi-Linux Manager Proxy 5.0.

Procedure: Configuring TFTP

1. In the SUSE Multi-Linux Manager Web UI, open the details page for the branch server, and navigate to the Formulas tab.

2. Select the Tftpd formula, and click **[Save]**.

3. Navigate to the **Formulas › Tftpd** tab, and set these parameters:

   - In the Internal Network Address field, enter the IP address of the branch server (for example: 192.168.1.5).

   - In the TFTP Base Directory field, enter the path to the Saltboot directory (for example, /srv/saltboot).

   - In the Run TFTP Under User field, enter saltboot.

4. Click **[Save Formula]** to save your configuration.

5. Apply the highstate.

Virtualization Guest Formula

The Virtualization Guest formula is used to configure settings for virtual machine.

Open the Tuning pull-down checklist and select from the following virtual machine performance tuning settings:

- Disable IRQ balancing.

- Disable Kernel Samepage Merging (KSM). Reduces performance overhead by not sharing memory across virtual machines.

- Optimizations for KVM passed through host CPU. Requires the KVM hint-dedicated option to be set on the VM definition.

When configured, click **[Save Formula]** to save your configuration, and apply the highstate.

Virtualization Host Formula

The Virtualization Host formula is used to configure settings for a virtualization host.

Hypervisor

Select KVM or Xen as the hypervisor.

Create default storage pool

Create default virtual network

- Default pool: Open the pull-down list and enter the directory name of the default storage pool.

- Default net: Open the pull-down list and configure the default virtual network by setting the Mode (NAT or Bridge) and the Bridge name.

Tuning

Enable IOMMU support (x86_64).

When configured, click **[Save Formula]** to save your configuration, and apply the highstate.

Yomi Formula

The Yomi (yet one more installer) installer for SUSE and openSUSE operating systems is configured using formulas with forms.

The yomi-formula package provides these formulas:

- Yomi

- Yomi Storage

- Yomi Bootloader

- Yomi Software

- Yomi Services

- Yomi Users

Procedure: Install the Yomi Formulas with Forms

1. On the SUSE Multi-Linux Manager Server, at the command prompt, as root, install the yomi-formula package:

```
zypper in yomi-formula
```

2. Restart services:

```
systemctl restart salt-master.service
```

When the formula package is installed, you need to install the PXE Yomi image on the client, boot the client you want to provision, and enable the Yomi formulas on the client. For more information on preparing Yomi clients for provisioning, see **Specialized-guides › Salt**.

Procedure: Configuring the Yomi Formula

1. Navigate to the **Formulas › Yomi** tab, and set these parameters in the General Configuration section:

    ◦ Check the Events box to allow monitoring.

    ◦ In the Reboot field, select yes to instruct the client to reboot after installation.

    ◦ Check the Snapper box if you are using the btrfs file system on the client.

    ◦ In the Locale field, select the region and encoding for systemd to use on the client. For example: en_US.utf8 for US English and UTF-8.

    ◦ In the Keymap field, select the appropriate keyboard layout. For example: us for a US keyboard layout.

    ◦ In the Timezone field, select the timezone for the client to use. For example: America/New_York for EST.

    ◦ In the Hostname field, enter the hostname for the client to use. Leave this blank if you are using DHCP to provide the hostname.

- In the `Machine Id` field, enter a machine identification number for the client. Leave this blank to have systemd generate one automatically.

- In the `Target` field, enter a systemd target unit.

2. Click **[Save Formula]** to save your configuration.

Procedure: Configuring the Yomi Storage Formula

1. Navigate to the **Formulas › Yomi Storage** tab, and set these parameters in the **Partitions › Config** section:

   - In the `Labels` field, select the default partition table type to use.

   - In the `Initial Gap` field, select the default amount of space to leave before the first partition. For example: `1 MB`, or use `0` to leave no space between partitions.

2. For each device that you want to configure, in the **Partitions › Devices** section, click **[+]**, and set these parameters:

   - In the `Device` field, type the mount point for the device. For example, `/dev/sda`.

   - In the `Label` field, select the partition table type to use, if it is different from the default label you selected.

   - In the `Initial Gap` field, select the amount of space to leave before the first partition, if it is different from the default space you specified.

3. For each partition that you want to create, in the **Partitions › Devices › Partitions** section, click **[+]**, and set these parameters:

   - In the `Partition Number` field, enter a number for the partition. The number you enter here is appended to the device name to identify the partition. For example, partition number `1` on device `/dev/sda` can be identified as `/dev/sda1`.

   - In the `Partition Name` field, enter a name for the partition. Leave this blank if you have entered a partition number in the previous field.

   - In the `Partition Size` field, enter a size for the partition. For example: `500 MB`. Use `rest` to use all the remaining free space.

4. For each file system that you want to create, in the `Filesystems` section, click **[+]**, and set these parameters:

   - In the `Partition` field, select the partition to create the file system on. For example, `/dev/sda1`.

   - In the `Filesystem` field, select the file system type to create.

   - In the `Mountpoint` field, type the mount point for the file system. For example: `/` for root.

5. Click **[Save Formula]** to save your configuration.

   ⓘ   If you want to use LVM or RAID on your devices, click **[+]** in the appropriate sections, and

> complete the details for your environment.

Procedure: Configuring the Yomi Bootloader Formula

1. Navigate to the **Formulas › Yomi Bootloader** tab, and set these parameters in the Bootloader section:

   ○ In the Device field, type the path for the bootloader. For example, /dev/sda.

   ○ In the Timeout field, select the number of seconds grub will wait before booting the default menu entry.

   ○ In the Kernel field, type any additional kernel parameters you want to use. Any kernel parameters you add here will be appended to the GRUB_CMDLINE_LINUX_DEFAULT line during boot.

   ○ In the Terminal field, type the terminal to use for both terminal input and output.

   ○ In the Serial Command field, type parameters for using the serial port. Use this only if you are using the serial console as the default terminal.

   ○ In the Gfxmode field, type the resolution to use for the graphical terminal. Use this only if you are using the graphical console as the default terminal.

   ○ Check the Theme box to use GRUB2 default branding package.

   ○ Check the Disable OS Prober box to disable using the OS prober to discover other installed operating systems.

2. Click **[Save Formula]** to save your configuration.

Procedure: Configuring the Yomi Software Formula

1. Navigate to the **Formulas › Yomi Software** tab, and set these parameters in the **Software › Configuration** section:

   ○ Check the Minimal box to use a minimal installation, which only installs packages listed as Required.

2. For each repository that you want to add, in the **Software › Repositories** section, click **[+]**, and set these parameters:

   ○ In the Repository Name field, type a name for the repository.

   ○ In the Repository URL field, type the location of the repository.

3. To add packages from each repository, in the **Software › Packages** section, click **[+]**, and set these parameters:

   ○ In the **Software › Packages** field, type the names of the packages to install, or type a pattern to search for the appropriate packages. For example, pattern:enhanced_base glibc-locale, or kernel-default.

4. In the **Software › Image** section, set these parameters:

- In the Image URL field, type the location of the operating system ISO image to use.

- In the Md5 field, type the MD5 hash to use to verify the ISO.

5. In the **SUSEConect › Config** section, set these parameters:

- In the Registration Code field, type the registration code for the client you are installing. You can obtain this code from SUSE Customer Center.

- In the Email field, type the administrator email address to use.

- In the Url field, type the address of the registration server to use. For example, use https://scc.suse.com, to register with SUSE Customer Center.

- In the Version field, type the version of the product you are registering.

6. For each product that you want to register, in the **SUSEConnect › Products** section, click **[+]**, and set these parameters:

- In the Product field, type each product you want to register. For example, <product_name>/1.1/x86, for version 1.1 with x86 architecture.

- In the **SUSEConnect › Packages** field, type the names of the packages to install, or type a pattern to search for the appropriate packages. For example, pattern:enhanced_base glibc-locale, or kernel-default.

7. Click **[Save Formula]** to save your configuration.

Procedure: Configuring the Yomi Services Formula

1. Navigate to the **Formulas › Yomi Services** tab, and set these parameters:

- Check the Install salt-minion box to install and configure the client as a Salt client.

2. For each service you want to enable, in the **Services › Enabled** section, click **[+]**, and set these parameters:

- In the Service field, type the name of the service to enable. For example, salt-minion.

3. For each service you want to disable, in the **Services › Disabled** section, click **[+]**, and set these parameters:

- In the Service field, type the name of the service to disable.

4. Click **[Save Formula]** to save your configuration.

Procedure: Configuring the Yomi Users Formula

1. Navigate to the **Formulas › Yomi Users** tab.

2. For each user you want to create, in the Users section, click **[+]**, and set these parameters:

- In the Username field, type the name of the new user.

    ◦ In the **Password Hash** field, type the hashed version of the password to use.

3. To add a certificate for each user, in the **Users › Certificates** section, click **[+]**, and add the certificate to the Certificate field.

4. Click **[Save Formula]** to save your configuration.

When you have completed and saved all the forms, apply the highstate.

For more information about using Yomi, see **Specialized-guides › Salt**.

Custom Salt Formulas

This section contains information about writing custom formulas, including formulas with forms. You can write your own custom formulas, and make them available to client systems in the SUSE Multi-Linux Manager Web UI.

For information about the formulas provided by SUSE Multi-Linux Manager, see **Specialized-guides › Salt**.

File Structure Overview

RPM-based formulas must be placed in a specific directory structure to ensure that they work correctly. A formula contains two separate directories: states, and metadata. Folders in these directories need to have exactly matching names.

The formula states directory contains anything necessary for a Salt state to work independently. This includes .sls files, a map.jinja file and any other required files. This directory should only be modified by RPMs and should not be edited manually. For example, the locale-formula states directory is located in:

```
/usr/share/susemanager/formulas/states/locale/
```

To create formulas with forms, the metadata directory contains a form.yml file. The form.yml file defines the forms for SUSE Multi-Linux Manager. The metadata directory also contains an optional metadata.yml file with additional information about the formula. For example, the locale-formula metadata directory is located in:

```
/usr/share/susemanager/formulas/metadata/locale/
```

If you have a custom formula that is not in an RPM, it must be in a state directory configured as a Salt file root. Custom state formula data must be in:

```
/srv/salt/<custom-formula-name>/
```

Custom metadata information must be in:

```
/srv/formula_metadata/<custom-formula-name>/
```

All custom folders must contain a form.yml file. These files are detected as form recipes and are applied to groups and systems from the Web UI:

```
/srv/formula_metadata/<custom-formula-name>/form.yml
```

> **ℹ** The Salt formula directory changed in SUSE Multi-Linux Manager 4.0. The old directory location, /usr/share/susemanager/formulas, will continue to work for some time. You should ensure that you update to the new directory location, /usr/share/salt-formulas/ as soon as possible.

Define Formula with Forms Data

SUSE Multi-Linux Manager requires a file called form.yml, to describe how formula data should look within the Web UI. The form.yml file is used by SUSE Multi-Linux Manager to generate the desired formula with forms, with values editable by a user.

The file contains a list of editable attributes that start with a $ sign. These attributes are used to determine how to display the formula in the SUSE Multi-Linux Manager Web UI.

For example, the form.yml that is included with the locale-formula is in:

```
/usr/share/susemanager/formulas/metadata/locale/form.yml
```

Part of that file looks like this:

```
timezone:
  $type: group

  name:
    $type: select
    $values: ["CET",
              "Etc/Zulu"
             ]
    $default: CET

  hardware_clock_set_to_utc:
    $type: boolean
    $default: True
...
```

All values that start with a $ sign are annotations used to display the UI that users interact with. These annotations are not part of pillar data itself and are handled as metadata.

This section lists the available attributes:

$type

The most important attribute is the $type attribute. It defines the type of the pillar value and the form-field that is generated. The supported types are:

- text

- password

- number

- url

- email

- date

- time

- datetime

- boolean

- color

- select

- group

- edit-group

- namespace

- hidden-group (obsolete, renamed to namespace)

> ℹ️   The text attribute is the default and does not need to be specified explicitly.

Many of these values are self-explanatory:

- The text type generates a simple text field

- The password type generates a password field

- The color type generates a color picker

The group, edit-group, and namespace (formerly hidden-group) types do not generate an editable field and are used to structure form and pillar data. All these types support nesting.

The group and namespace types differ slightly. The group type generates a visible border with a heading. The namespace type shows nothing visually, and is only used to structure pillar data.

The edit-group type allows you to structure and restrict editable fields in a more flexible way. The edit-group type is a collection of items of the same kind. Collections can have these four shapes:

- List of primitive items

- List of dictionaries

- Dictionary of primitive items

- Dictionary of dictionaries

The size of each collection is variable. Users can add or remove elements.

For example, edit-group supports the $minItems and $maxItems attributes, which simplifies complex and repeatable input structures. These, and also itemName, are optional.

$default

Allows you to specify a default value to be displayed. This default value will be used if no other value is entered. In an edit-group it allows you to create initial members of the group and populate them with specified data.

$optional

This type is a Boolean attribute. If it is true and the field is empty in the form, then this field will not be generated in the formula data and the generated dictionary will not contain the field name key. If it is false and the field is empty, the formula data will contain a <field name>: null entry.

$ifEmpty

This type is used if the field is empty. This usually occurs because the user did not provide a value. The ifEmpty type can only be used when $optional is false or not defined. If $optional is true, then $ifEmpty is ignored. In this example, the DP2 string would be used if the user leaves the field empty:

```
displayName:
  $type: string
  $ifEmpty: DP2
```

$name

Allows you to specify the name of a value that is shown in the form. If this value is not set, the pillar name is used and capitalized without underscores and dashes. Reference it in the same section with ${name}.

$help and $placeholder

These attributes are used to give a user a better understanding of what the value should be. The $help type defines the message a user sees when hovering over a field The $placeholder type displays a gray placeholder text in the field

Use $placeholder only with text fields like text, password, email or date fields. Do not add a placeholder if you also use $default, as it will hide the placeholder.

$key

Applicable only if the edit-group has the shape of a dictionary. When the pillar data is a dictionary, the $key attribute determines the key of an entry in the dictionary.

For example:

```
user_passwords:
  $type: edit-group
  $minItems: 1
  $prototype:
    $key:
        $type: text
    $type: text
  $default:
    alice: secret-password
    bob: you-shall-not-pass
```

Pillar:

```
user_passwords:
  alice:
    secret-password
  bob:
    you-shall-not-pass
```

$minItems and $maxItems

In an edit-group, $minItems and $maxItems specifies the lowest and highest numbers for the group.

$itemName

In an edit-group, $itemName defines a template for the name to be used for the members of the group.

$prototype

In an edit-group, $prototype is mandatory and defines the default pre-filled values for newly added members in the group.

$scope

Specifies a hierarchy level at which a value may be edited. Possible values are system, group, and readonly.

The default value is $scope: system, allows values to be edited at group and system levels. A value can be entered for each system but if no value is entered the system will fall back to the group default.

The $scope: group option makes a value editable only for a group. On the system level you will be able to see the value, but not edit it.

The $scope: readonly option makes a field read-only. It can be used to show data to the user, but will not allow them to edit it. This option should be used in combination with the $default attribute.

$visibleIf

> **i** Deprecated in favor of $visible.

Allows you to show a field or group if a simple condition is met. An example condition is:

```
some_group#another_group#my_checkbox == true
```

The left part of the condition is the path to another value, and groups are separated by # signs. The middle section of the condition should be either == for a value to be equal or != for values that should be not equal. The last field in the statement can be any value which a field should have or not have.

The field with this attribute associated with it will be shown only when the condition is met. In this example the field will be shown only if my_checkbox is checked. The ability to use conditional statements is not limited to check boxes. It may also be used to check values of select-fields, text-fields, and similar.

A check box should be structured like this:

```
some_group:
  $type: group

  another_group:
    $type: group

      my_checkbox:
        $type: boolean
```

Relative paths can be specified using prefix dots. One dot indicates a sibling, two dots indicate a parent, and so on. This is mostly useful for edit-group.

```
some_group:
  $type: group

  another_group:
    $type: group

    my_checkbox:
      $type: boolean

    my_text:
      $visibleIf: .my_checkbox == true

  yet_another_group:
    $type: group

    my_text2:
      $visibleIf: ..another_group#my_checkbox == true
```

If you use multiple groups with the attribute, you can allow a users to select an option and show a completely different form, dependent upon the selected value.

Values from hidden fields can be merged into the pillar data and sent to the client. A formula must check the condition again and use the appropriate data. For example:

```
show_option:
  $type: checkbox
some_text:
  $visibleIf: .show_option == true
```

```
{% if pillar.show_option %}
do_something:
  with: {{ pillar.some_text }}
{% endif %}
```

$values

Can only be used together with $type Use to specify the different options in the select-field. $values must be a list of possible values to select. For example:

```
select_something:
  $type: select
  $values: ["option1", "option2"]
```

Or:

```
select_something:
  $type: select
  $values:
    - option1
    - option2
```

$visible

Allows you to show a field or group if a condition is met. You must use the jexl expression language to write the condition.

Example structure:

```
some_group:
  $type: group

  another_group:
    $type: group

      my_checkbox:
        $type: boolean
```

An example condition is:

```
formValues.some_group.another_group.my_checkbox == true
```

The field with this attribute will only show if the condition is met. In this example, the field will show only if my_checkbox is checked. You can also choose other elements for the conditional statement, such as select fields or text fields.

If you use multiple groups with the attribute, users can select an option that will show a completely different form, depending on the selected value.

Values from hidden fields can be merged into the pillar data and sent to the client. A formula must check the condition again and use the appropriate data. For example:

```
show_option:
  $type: checkbox
some_text:
  $visible: this.parent.value.show_option == true
```

```
{% if pillar.show_option %}
do_something:
  with: {{ pillar.some_text }}
{% endif %}
```

$disabled

Allows you to disable a field or group if a condition is met. You must use the jexl expression language to write the condition.

If specified at group level it will disable all fields in that group.

$required

Fields with this attribute are mandatory. Supports using the jexl expresion language.

$match

Allows using a regular expression to validate the content of a text field.

It supports the regular expression features existing in JavaScript.

Example:

```
    hardware:
      $type: text
      $name: Hardware Type and Address
      $placeholder: Enter hardware-type hardware-address (for example, "ethernet
AA:BB:CC:DD:EE:FF")
      $help: Hardware Identifier - prefix is mandatory
      $match: "\\w+ [A-Z]{2}:[A-Z]{2}:[A-Z]{2}:[A-Z]{2}:[A-Z]{2}:[A-Z]{2}"
```

Expression language

You must use the jexl expression language to write conditions.

Given a structure like this:

```
some_group:
  $type: group

  another_group:
    $type: group

      my_checkbox:
        $type: boolean
```

An example condition is:

```
formValues.some_group.another_group.my_checkbox == true
```

Absolute paths must begin with formValues.

Specify relative paths using this.parent.value to define the value of the parent.

You can also refer to the parent of the parent, with this.parent.parent.value. This is mostly useful for edit-group elements.

Example for relative paths:

```
some_group:
  $type: group

  another_group:
    $type: group

    my_checkbox:
      $type: boolean

    my_text:
      $visible: this.parent.value.my_checkbox

  yet_another_group:
    $type: group

    my_text2:
      $visible: this.parent.parent.value.another_group.my_checkbox
```

Listing 7. Example: Basic edit-group

```
partitions:
  $name: "Hard Disk Partitions"
  $type: "edit-group"
  $minItems: 1
```

```
$maxItems: 4
$itemName: "Partition ${name}"
$prototype:
  name:
    $default: "New partition"
  mountpoint:
    $default: "/var"
  size:
    $type: "number"
    $name: "Size in GB"
$default:
  - name: "Boot"
    mountpoint: "/boot"
  - name: "Root"
    mountpoint: "/"
    size: 5000
```

Click **[Add]** to fill the form with the default values.

The formula is called hd-partitions and will appear as Hd Partitions in the Web UI.

To remove the definition of a partition click the minus symbol in the title line of an inner group.

When you are finished, click **[Save Formula]**.

Listing 8. Example: Nested edit-group

```
users:
  $name: "Users"
  $type: edit-group
  $minItems: 2
  $maxItems: 5
  $prototype:
    name:
      $default: "username"
    password:
      $type: password
    groups:
      $type: edit-group
      $minItems: 1
      $prototype:
        group_name:
          $type: text
  $default:
    - name: "root"
      groups:
        - group_name: "users"
        - group_name: "admins"
    - name: "admin"
      groups:
        - group_name: "users"
```

Writing Salt Formulas

Salt formulas are pre-written Salt states. You can use Jinja to configure formulas with pillar data.

Basic Jinja syntax is:

```
pillar.some.value
```

When you are sure a pillar exists, use this syntax:

```
salt['pillar.get']('some:value', 'default value')
```

You can also replace the pillar value with grains. For example, grains.some.value.

Using data this way makes the formula configurable. In this example, a specified package is installed in the package_name pillar:

```
install_a_package:
  pkg.installed:
    - name: {{ pillar.package_name }}
```

You can also use more complex constructs such as if/else and for-loops to provide greater functionality:

```
{% if pillar.installSomething %}
something:
  pkg.installed
{% else %}
anotherPackage:
  pkg.installed
{% endif %}
```

Another example:

```
{% for service in pillar.services %}
start_{{ service }}:
  service.running:
    - name: {{ service }}
{% endfor %}
```

Jinja also provides other helpful functions. For example, you can iterate over a dictionary:

```
{% for key, value in some_dictionary.items() %}
do_something_with_{{ key }}: {{ value }}
{% endfor %}
```

You can have Salt manage your files (for example, configuration files for a program), and change them with pillar data.

In this example, Salt copies the file salt-file_roots/my_state/files/my_program.conf on the server to /etc/my_program/my_program.conf on the client and template it with Jinja:

```
/etc/my_program/my_program.conf:
  file.managed:
    - source: salt://my_state/files/my_program.conf
    - template: jinja
```

This example allows you to use Jinja in the file, like the previous example for states:

```
some_config_option = {{ pillar.config_option_a }}
```

Separate Data

Separating data from a state can increase flexibility and make it easier to re-use. You can do this by writing values into a separate file named map.jinja. This file must be within the same directory as the state files.

This example sets data to a dictionary with different values, depending on which system the state runs on. It will also merge data with the pillar using the some.pillar.data value so you can access some.pillar.data.value by using data.value.

You can choose to override defined values from pillars. For example, by overriding some.pillar.data.package in

this example:

```
{% set data = salt['grains.filter_by']({
    'Suse': {
        'package': 'packageA',
        'service': 'serviceA'
    },
    'RedHat': {
        'package': 'package_a',
        'service': 'service_a'
    }
}, merge=salt['pillar.get']('some:pillar:data')) %}
```

When you have created a map file, you can maintain compatibility with multiple system types while accessing deep pillar data in a simpler way.

Now you can import and use data in any file. For example:

```
{% from "some_folder/map.jinja" import data with context %}

install_package_a:
  pkg.installed:
    - name: {{ data.package }}
```

You can define multiple variables by copying the {% set …%} statement with different values and then merge it with other pillars. For example:

```
{% set server = salt['grains.filter_by']({
    'Suse': {
        'package': 'my-server-pkg'
    }
}, merge=salt['pillar.get']('myFormula:server')) %}
{% set client = salt['grains.filter_by']({
    'Suse': {
        'package': 'my-client-pkg'
    }
}, merge=salt['pillar.get']('myFormula:client')) %}
```

To import multiple variables, separate them with a comma. For example:

```
{% from "map.jinja" import server, client with context %}
```

For more information about conventions to use when writing formulas, see https://docs.saltproject.io/en/latest/topics/development/conventions/formulas.html.

Generated Pillar Data

Pillar data is generated by SUSE Multi-Linux Manager when events occur like generating the highstate. You can use an external pillar script to generate pillar data for packages and group IDs, and include all pillar data for a system:

```
/usr/share/susemanager/modules/pillar/MLM_minion.py
```

The process is executed like this:

1. The MLM_minion.py script starts and finds all formulas for a system by checking the group_formulas.json and server_formulas.json files.

2. The script loads the values for each formula (groups and from the system) and merges them with the highstate. By default, if no values are found, a group overrides a system if $scope: group.

3. The script also includes a list of formulas applied to the system in a pillar named formulas.

This structure makes it possible to include states. In this example, the top file is specifically generated by the mgr_master_tops.py script. The top file includes a state called formulas for each system. This includes the formulas.sls file located in /usr/share/susemanager/formulas/states or /usr/share/salt-formulas/states/. The content looks similar to this:

```
include: {{ pillar["formulas"] }}
```

This pillar includes all formulas that are specified in the pillar data generated from the external pillar script.

Formulas should be created directly after SUSE Multi-Linux Manager is installed. If you encounter any problems with formulas check these things first:

- The external pillar script (MLM_minion.py) must include formula data.

- Data is saved to /srv/susemanager/formula_data and the pillar and group_pillar sub-directories. These directories should be automatically generated by the server.

- Formulas must be included for every client listed in the top file. Currently this process is initiated by the mgr_master_tops.py script which includes the formulas.sls file located in /usr/share/susemanager/formulas/states/ or /usr/share/salt-formulas/states/. This directory must be a salt file root. File roots are configured on the salt-master (SUSE Multi-Linux Manager) located at /etc/salt/master.d/susemanager.conf.

Salt SSH

Salt SSH allows Salt commands and states to be issued directly over SSH. SSH connections are created on demand, when the server executes an action on a client.

For more information about Salt SSH, see https://docs.saltproject.io/en/latest/topics/ssh/.

SSH Connection Methods

In SUSE Multi-Linux Manager there are two SSH connection methods, ssh-push and ssh-push-tunnel. In both

methods the server initiates an SSH connection to the client to execute a Salt call.

In the ssh-push method, the package manager works as normal, and the HTTP or HTTPS connection is directly created.

In the ssh-push-tunnel method, the server creates an HTTP or HTTPS connection through an SSH tunnel. The HTTP connection initiated by the package manager is redirected through the tunnel using /etc/hosts aliasing. Use this method for in-place firewall environments that block HTTP or HTTPS connections between server and client.

Salt SSH Integration

As with all Salt calls, SUSE Multi-Linux Manager invokes salt-ssh via the salt-api.

Salt SSH relies on a roster to obtain details such as hostname, ports, and the SSH parameters of a client. SUSE Multi-Linux Manager keeps these details in the database and makes them available to Salt SSH by using the uyuni roster module, or by generating a temporary roster file on bootstrapping new clients with the Web UI. The location of the temporary roster file is supplied to Salt SSH using the roster-file option. For the registered clients roster set to uyuni is used instead to get the roster from the database with uyuni salt roster module.

> ! It is not recommended to run salt-ssh as root user. This can cause permission issues the next time SUSE Multi-Linux Manager tries to use Salt SSH. Use mgr-salt-ssh, which changes the effective user to salt and avoids file permission issues. If you want to use mgr-salt-ssh with a user other than root, the user should have the permission to change effective user to salt.

mgr-salt-ssh uses roster set to uyuni by default, if neither roster nor roster-file specified in the command line. It helps to call Salt commands to the registered Salt SSH clients with no roster file generation.

Authentication

Salt SSH supports both password and key authentication. SUSE Multi-Linux Manager uses both methods:

Password authentication is used only when bootstrapping. During the bootstrap step the key of the server is not authorized on the client and therefore a password must be used for a connection to be made. The password is used transiently in a temporary roster file used for bootstrapping and the roster file is removed on finishing processing the event. This password is not stored.

All other common Salt calls use key authentication. During the bootstrap step the SSH key of the server is authorized on the client and added to the client /.ssh/authorized_keys file. Subsequent calls no longer require a password.

User Account

The user for Salt SSH calls made by SUSE Multi-Linux Manager is taken from the ssh_push_sudo_user setting.
By default, the user is root.

> **i** If bootstrapping with default settings fail, check whether the client allows root login with ssh.

If the value of ssh_push_sudo_user is not root, then the --sudo options of salt-ssh are used. For this user you
must configure the NOPASSWD option in the sudoers file. At least, set the python binary with the version
number; for example:

```
<USER> ALL=(ALL) NOPASSWD:/usr/bin/python3.6
```

HTTP Redirection

The ssh-push-tunnel method requires traffic to be redirected through an SSH tunnel. This allows traffic to
bypass firewalls blocking a direct connection between the client and the server.

This is achieved by using port 1233 in the repository URL:

```
https://MLM-server:1233/repourl...
```

You can alias the MLM-server hostname to localhost in /etc/hosts:

```
127.0.0.1       localhost    MLM-server
```

The server creates a reverse SSH tunnel that connects localhost:1233 on the client to MLM-server:443:

```
ssh ... -R 1233:MLM-server:443
```

This means that the package manager will actually connect to localhost:1233, which is then forwarded to MLM-
server:443 by the SSH tunnel.

The package manager can contact the server only if the tunnel is open, which occurs only when the server
executes an action on the client.

Manual package manager operations that require server connectivity are not possible in this case.

Call Sequence

Salt SSH calls run in this sequence:

1. Set roster parameter to uyuni for registered clients or prepare the Salt roster on bootstrapping for the call

     a. Create remote port forwarding option if the contact method is ssh-push-tunnel

     b. Compute the ProxyCommand if the client is connected through a proxy

     c. Create Roster content

2. Create a temporary roster file (only in case of bootstrapping new client)

3. Execute a synchronous salt-ssh call using the API

4. Remove the temporary roster file (only in case of bootstrapping new client)

The roster content contains:

- hostname

- user

- port

- remote_port_forwards: The remote port forwarding SSH option

- ssh_options: Other ssh options:

     ○ ProxyCommand: If the client connects through a proxy

- timeout: defaults to 180 seconds

- minion_opts:

     ○ master: Set to the minion ID if the contact method is ssh-push-tunnel

- ssh_pre_flight: The path to the shell script executed on the client before running any Salt command

- ssh_pre_flight_args: The list of arguments to call the pre flight script on the client

Bootstrap Sequence

This section describes the sequence of events when clients are registered to a Salt master. While bootstrapping is a type of Salt SSH call, the sequence differs slightly from regular SSH calls.

Bootstrapping uses Salt SSH for communication between the master and the client. This happens for both regular and SSH clients.

1. For a regular Salt client, generate and pre-authorize the Salt key of the client.

2. For an SSH client, if a proxy was selected, retrieve the SSH public key of the proxy using the mgrutil.chain_ssh_cmd runner. The runner copies the public key of the proxy to the server using SSH. If needed, it can chain multiple SSH commands to reach the proxy across multiple hops.

3. Generate pillar data for bootstrap. The pillar data is compiled and stored on the Salt master, and retrieved

by the client.

4. Generate the roster for bootstrapping into a temporary file on the client. You can use the roster by passing it to the Salt API, with this command:

```
mgr-salt-ssh --roster-file=<temporary_bootstrap_roster> minion state.apply
certs,<bootstrap_state>`
```

For bootstrap_state, use bootstrap for regular clients or ssh_bootstrap for SSH clients.

The way the client retrieves the pillar data depends on the contact method you have chosen for your client:

- If you are using the ssh-push-tunnel contact method, ensure you have completed the remote port forwarding option.

- If the client connects through a proxy, ensure you have completed the ProxyCommand option. This depends on your proxy configuration, including how many proxies you need to connect through.

Pillar data contains:

- mgr_server: The hostname of the Salt master

- mgr_origin_server: The hostname of the SUSE Multi-Linux Manager Server

- minion_id: The hostname of the client to bootstrap

- contact_method: The connection type

- mgr_sudo_user: The user for salt-ssh

- activation_key: If selected

- minion_pub: The pre-authorized public client key

- minion_pem: The pre-authorized private client key

- proxy_pub_key: The public SSH key that was retrieved from the proxy if the target is an SSH client and a proxy was selected

The roster content contains:

- hostname

- user

- password

- port

- remote_port_forwards: the remote port forwarding SSH option

- ssh_options: other SSH options:

- ProxyCommand if the client connects through a proxy

- timeout: defaults to 180 seconds

- ssh_pre_flight: The path to the pre flight shell script (default: /usr/share/susemanager/salt-ssh/preflight.sh)

- ssh_pre_flight_args: The list of arguments to call the pre flight script on the client

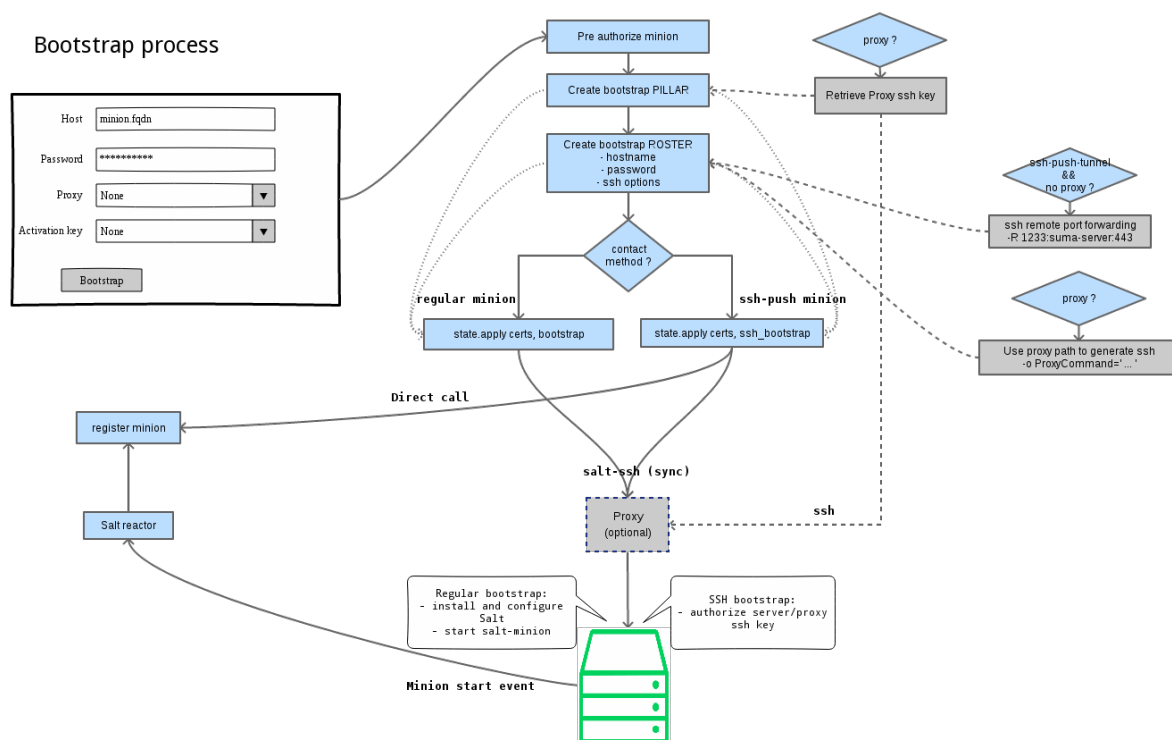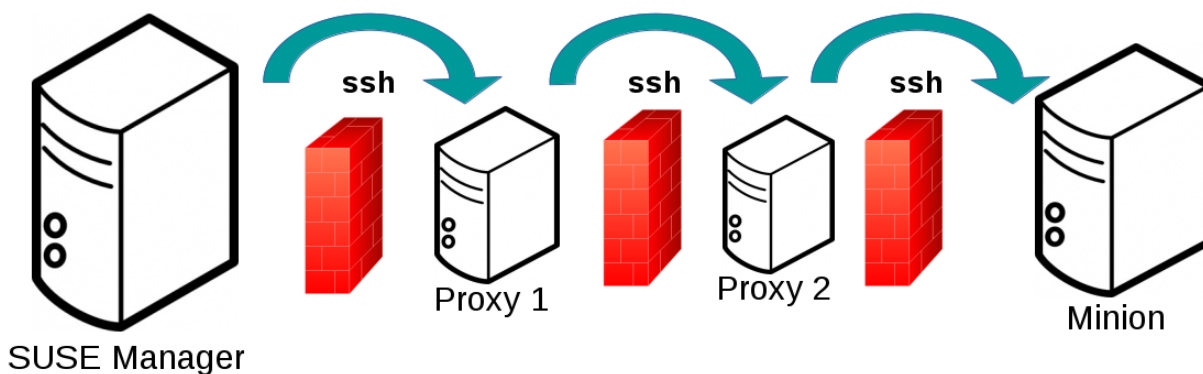This image provides an overview of the Salt SSH bootstrap process.

Figure 2. Salt SSH Bootstrap Process

Proxy Support

Salt SSH works with SUSE Multi-Linux Manager Proxy by chaining the SSH connection from one server or proxy to the next. This is also known as a multi-hop or multi-gateway SSH connection.
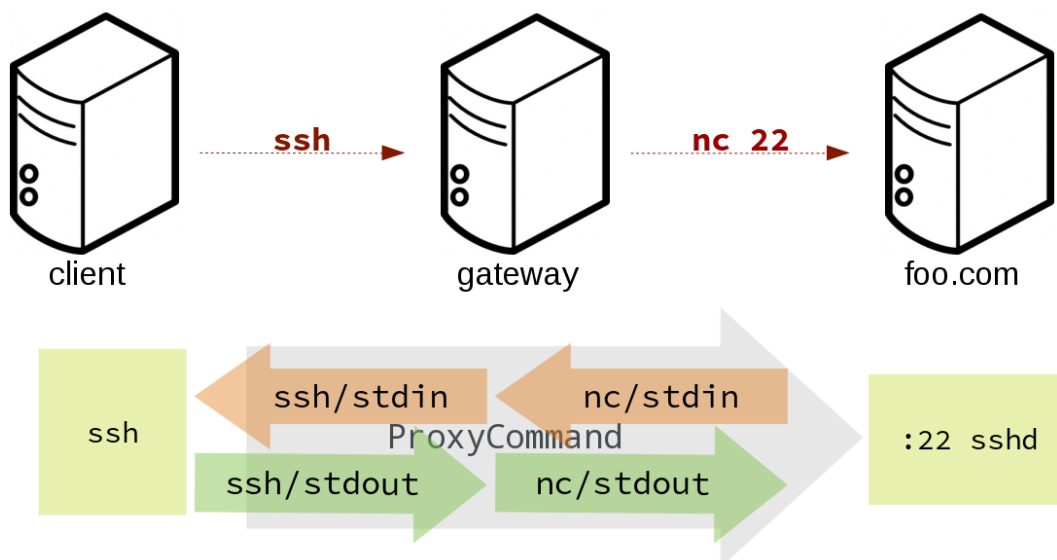
SUSE Multi-Linux Manager uses ProxyCommand to redirect SSH connections through proxies. This options invokes an arbitrary command that is expected to connect to the SSH port on the target host. The SSH process uses standard input and output of the command to communicate with the remote SSH daemon.

ProxyCommand replaces a TCP/IP connection. It does not perform any authorization or encryption. Its role is simply to create a byte stream to the remote SSH daemon port.

This image depicts a client connecting to a server that is behind a gateway. In this example netcat is used to pipe port 22 of the target host into the SSH standard input/output:

```
ssh -o ProxyCommand=<stdio/stdout to remote port> ...
ssh -o ProxyCommand='ssh gateway nc foo.com 22' root@foo.com
```


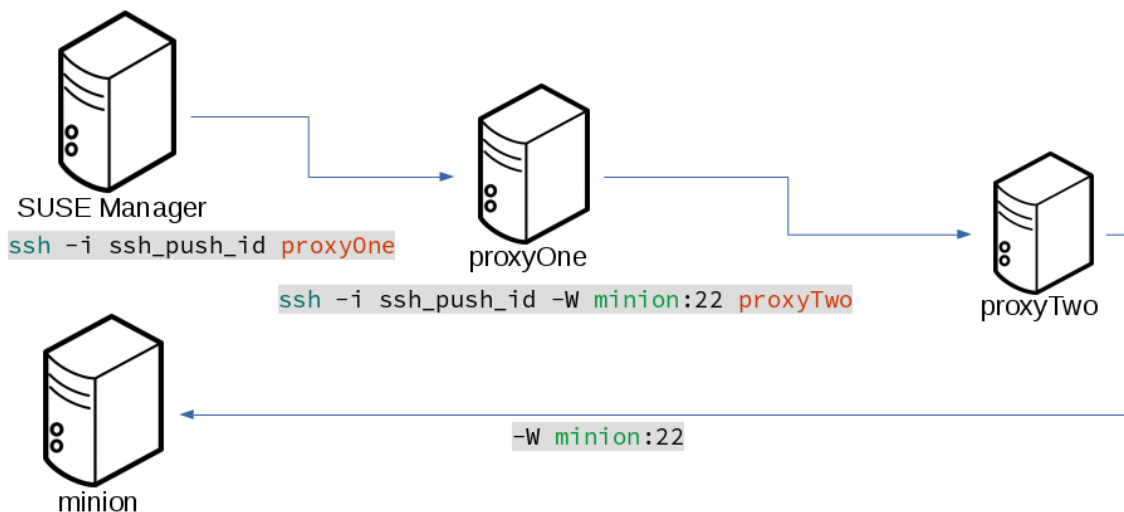The Salt SSH calls run in this sequence when a proxy is in use:

1. SUSE Multi-Linux Manager initiates the SSH connection.

2. ProxyCommand uses SSH to create a connection from the server to the client through the proxies.

This example uses ProxyCommand with two proxies and the ssh-push method:

```
# Connect the server to the first proxy:
/usr/bin/ssh -i /srv/susemanager/salt/salt_ssh/mgr_ssh_id -o StrictHostKeyChecking=no -o
User=mgrsshtunnel  proxy1

# Connect the first proxy to the second, and forward standard input/output on the client
to client:22 using the `-W` option:
/usr/bin/ssh -i /var/lib/spacewalk/mgrsshtunnel/.ssh/id_susemanager_ssh_push -o
StrictHostKeyChecking=no -o User=mgrsshtunnel -W client:22  proxy2
```
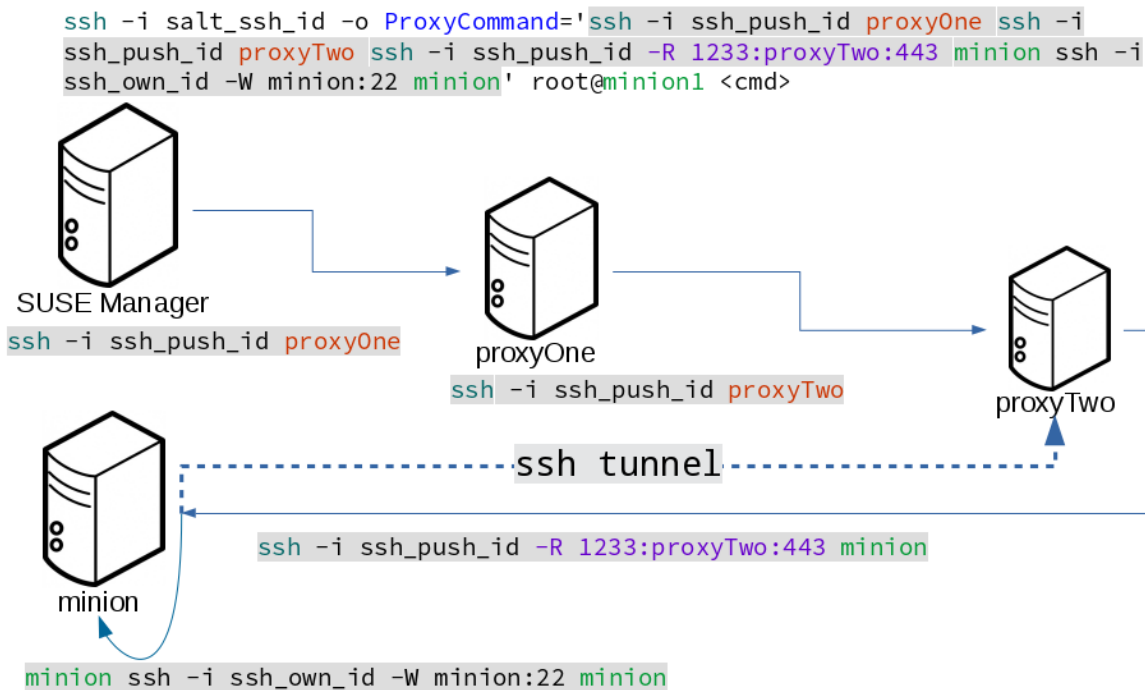

This example uses ProxyCommand with two proxies and the ssh-push-tunnel method:

```
# Connect the server to the first proxy:
/usr/bin/ssh -i /srv/susemanager/salt/salt_ssh/mgr_ssh_id -o User=mgrsshtunnel  proxy1

# Connect the first proxy to the second:
/usr/bin/ssh -i /home/mgrsshtunnel/.ssh/id_susemanager_ssh_push -o User=mgrsshtunnel
proxy2

# Connect the second proxy to the client and open an reverse tunnel (-R 1233:proxy2:443)
from the client to the HTTPS port on the second proxy:
/usr/bin/ssh -i /home/mgrsshtunnel/.ssh/id_susemanager_ssh_push -o User=root -R
1233:proxy2:443 client

# Connect the client to itself and forward the standard input/output of the server to the
SSH port of the client (-W client:22).
This is equivalent to `ssh ... proxy2 netcat client 22`` and is needed because SSH does
not allow both the reverse tunnel (-R 1233:proxy2:443) and the standard input/output
forward (-W client:22) in the same command.
/usr/bin/ssh -i /root/.ssh/mgr_own_id -W client:22 -o User=root client
```

```
ssh -i salt_ssh_id -o ProxyCommand='ssh -i ssh_push_id proxyOne ssh -i
ssh_push_id proxyTwo ssh -i ssh_push_id -R 1233:proxyTwo:443 minion ssh -i
ssh_own_id -W minion:22 minion' root@minion1 <cmd>
```

SUSE Manager
`ssh -i ssh_push_id proxyOne`

proxyOne
`ssh -i ssh_push_id proxyTwo`

proxyTwo

`ssh tunnel`

minion

`ssh -i ssh_push_id -R 1233:proxyTwo:443 minion`

`minion ssh -i ssh_own_id -W minion:22 minion`

Users and SSH Key Management

To connect to a proxy, the parent server or proxy uses a specific user called mgrsshtunnel. When mgrsshtunnel connects, the SSH configuration of the proxy will force the execution of /usr/sbin/mgr-proxy-ssh-force-cmd. This is a simple shell script that allows only the execution of scp, ssh, or cat commands.

The connection to the proxy or client is authorized using SSH keys in this sequence:

1. The server connects to the client and to the first proxy using the key in `/srv/susemanager/salt/salt_ssh/mgr_ssh_id.

2. Each proxy has its own key pair in `/home/mgrsshtunnel/.ssh/id_susemanager_ssh_push.

3. Each proxy authorizes the key of the parent proxy or server.

4. The client authorizes its own key.
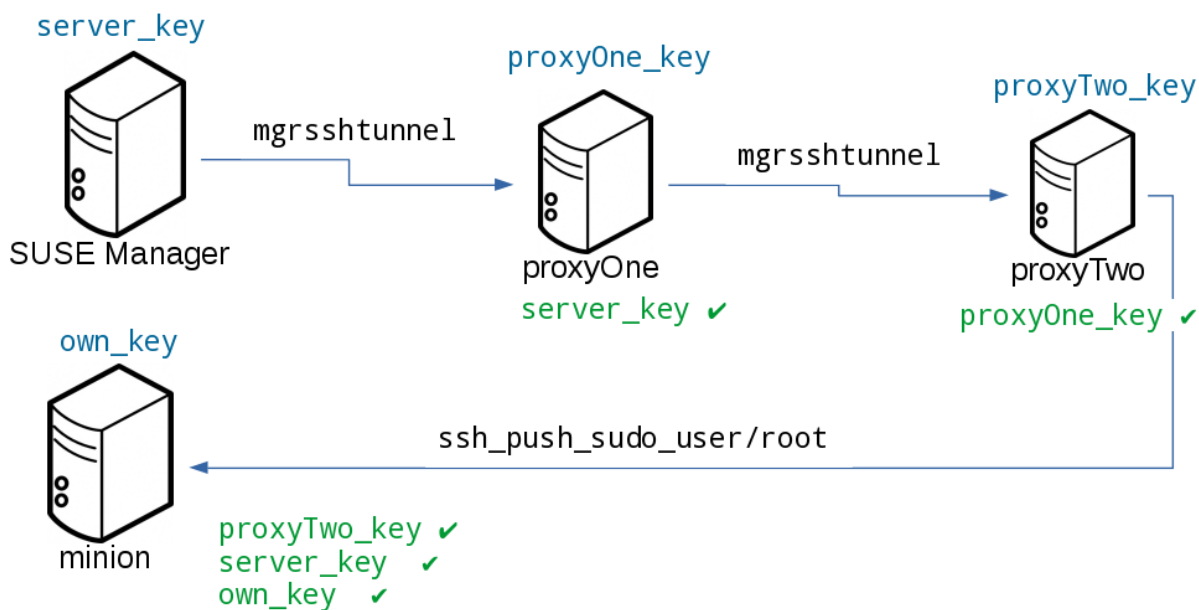
Repository Access with a Proxy

When SUSE Multi-Linux Manager connects to a repository using a proxy, it can use either ssh-push or ssh-push-tunnel.

In both methods the client connects to the proxy to retrieve package and repository information.

In the ssh-push method, the package manager connects directly to the proxy using HTTP or HTTPS. This works in cases where there is no firewall between the client and the proxy that blocks HTTP connections initiated by the client.
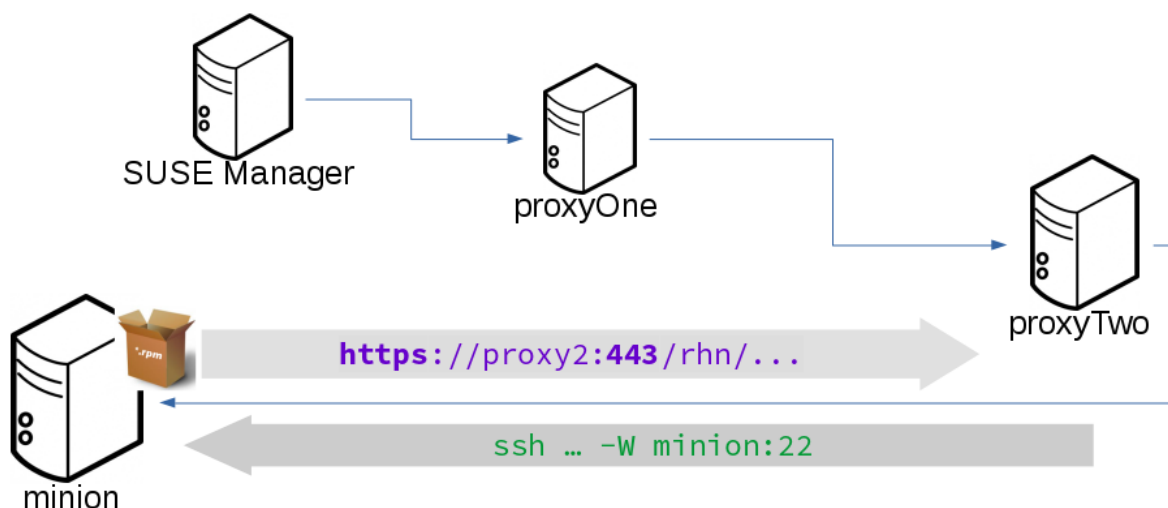
In the ssh-push-tunnel method, the HTTP connection to the proxy is redirected through a reverse SSH tunnel.
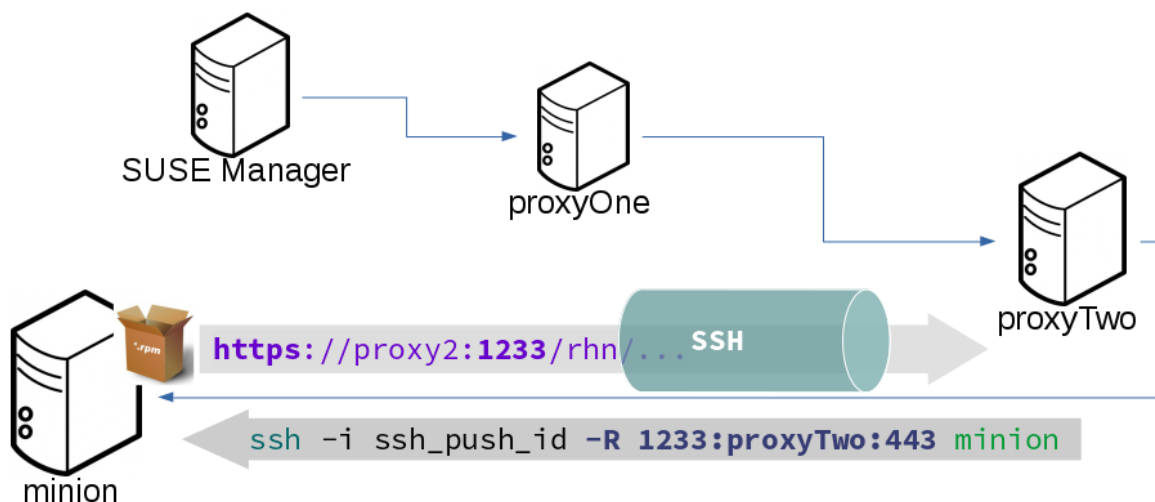
Proxy Setup

When the spacewalk-proxy package is installed on the proxy, the mgrsshtunnel user is created.

The initial configuration with configure-proxy.sh occurs using this sequence:

1. An SSH key pair is generated, or an existing keypair is imported.

2. The SSH key of the parent server or proxy is retrieved to authorize it on the proxy.

3. The ssh daemon on the proxy is configured to restrict the mgrsshtunnel user. This is done by the mgr-proxy-ssh-push-init script, which is called from configure-proxy.sh. It does not have to be manually invoked.

The parent key is retrieved by calling an HTTPS endpoint on the parent server or proxy. The first endpoint tried is https://$PARENT/pub/id_susemanager_ssh_push.pub. If the parent is a proxy then this will return the public SSH key of the proxy.

If a 404 error is received from that endpoint, then the parent is assumed to be a server not a proxy, and https://$PARENT/rhn/manager/download/saltssh/pubkey is tried instead.

If an SSH key exists at /srv/susemanager/salt/salt_ssh/mgr_ssh_id.pub on the server it is returned.

If the public key does not exist because salt-ssh has not been invoked yet, a key will be generates by calling the mgrutil.ssh_keygen runner.

> **ⓘ** Salt SSH generates a keypair the first time it is invoked with /srv/susemanager/salt/salt_ssh/mgr_ssh_id. The sequence in this section is needed if a proxy is configured before Salt SSH was invoked for the first time.

Rotate SSH keys

The SSH key is used on salt-ssh managed systems. Additionally, it is used on SUSE Multi-Linux Manager Proxies for the user mgrsshtunnel. Normal systems managed with the Salt default method are not affected and do not have this key configured.

Procedure: Rotating SSH keys

1. On the SUSE Multi-Linux Manager Server, as user root, change to user salt:

   ```
   su -s /bin/bash - salt
   ```

2. Create a new SSH key:

   ```
   ssh-keygen -N "" -t rsa -q -f /var/lib/salt/.ssh/new_mgr_ssh_id
   ```

3. Copy the public key into the Salt filesystem to make it usable in a Salt state:

   ```
   cp /var/lib/salt/.ssh/new_mgr_ssh_id.pub /srv/susemanager/salt/salt_ssh/
   ```

4. Change back to user root again:

   ```
   exit
   ```

5. Rollout the new key to all systems that need it. Applying the util.mgr_rotate_saltssh_key state will limit the changes to salt-ssh managed systems and proxies:

   ```
   salt '*' state.apply util.mgr_rotate_saltssh_key
   mgr-salt-ssh '*' state.apply util.mgr_rotate_saltssh_key
   ```

6. Move the old key away and make the new key the standard key. Rename mgr_ssh_id key to disabled_mgr_ssh_id and new_mgr_ssh_id key to mgr_ssh_id in the SSH keystore of the user salt as well as in the Salt filesystem for the public keys:

   ```
   su -s /bin/bash - salt
   cd .ssh
   mv mgr_ssh_id disabled_mgr_ssh_id
   mv mgr_ssh_id.pub disabled_mgr_ssh_id.pub
   mv new_mgr_ssh_id mgr_ssh_id
   mv new_mgr_ssh_id.pub mgr_ssh_id.pub
   cd /srv/susemanager/salt/salt_ssh/
   mv mgr_ssh_id.pub disabled_mgr_ssh_id.pub
   mv new_mgr_ssh_id.pub mgr_ssh_id.pub
   ```

7. OPTIONAL: When containerized proxies exist, re-create the configuration to get the new SSH key into the proxy configuration. Restart the containers with the new configuration. It is also possible to change the

existing configuration on the podman host (ssh.yaml). Change the value of server_ssh_key_pub with the content of the current mgr_ssh_id.pub.

8. To remove the disabled keys from the authorized_keys` files of the [literal]salt-ssh`` managed systems and the proxies, apply the state a second time:

```
salt '*' state.apply util.mgr_rotate_saltssh_key
mgr-salt-ssh '*' state.apply util.mgr_rotate_saltssh_key
```

Salt Rate Limiting

Salt is able to run commands in parallel on a large number of clients. This can potentially create large amounts of load on your infrastructure. You can use these rate-limiting parameters to control the load in your environment.

These parameters are all configured in the /etc/rhn/rhn.conf configuration file.

ℹ️ Salt commands that are executed from the command line are not subject to these parameters.

Batching

There are two parameters that control how actions are sent to clients, one for the batch size, and one for the delay.

When the SUSE Multi-Linux Manager Server sends a batch of actions to the target clients, it will send it to the number of clients determined in the batch size parameter. After the specified delay period, commands will be sent to the next batch of clients. The number of clients in each subsequent batch is equal to the number of clients that have completed in the previous batch.

Choosing a lower batch size will reduce system load and parallelism, but might reduce overall performance for processing actions.

The batch size parameter sets the maximum number of clients that can execute a single action at the same time. Adjust the java.salt_batch_size parameter. Defaults to 200.

Increasing the delay increases the chance that multiple clients will have completed before the next action is issued (more clients are grouped together in subsequent batches), resulting in fewer overall commands, and reducing load.

The batch delay parameter sets the amount of time, in seconds, to wait after a command from the previous batch is processed before beginning to process the command on the next client. Adjust the java.salt_batch_delay parameter. Defaults to 1.0 seconds.

Disabling the Salt Mine

In older versions, SUSE Multi-Linux Manager used a tool called Salt mine to check client availability. The Salt mine would cause clients to contact the server every hour, which created significant load. With the introduction of a more efficient mechanism in SUSE Multi-Linux Manager 3.2, the Salt mine is no longer required. Instead, the SUSE Multi-Linux Manager Server uses Taskomatic to ping only the clients that appear to have been offline for twelve hours or more, with all clients being contacted at least once in every twenty four hour period by default. You can adjust this by changing the web.system_checkin_threshold parameter in rhn.conf. The value is expressed in days, and the default value is 1.

Newly registered Salt clients will have the Salt mine disabled by default. If the Salt mine is running on your system, you can reduce load by disabling it. This is especially effective if you have a large number of clients.

Disable the Salt mine by running this command on the server:

```
salt '*' state.sls util.mgr_mine_config_clean_up
```

This will restart the clients and generate some Salt events to be processed by the server. If you have a large number of clients, handling these events could create excessive load. To avoid this, you can execute the command in batch mode with this command:

```
salt --batch-size 50 '*' state.sls util.mgr_mine_config_clean_up
```

You will need to wait for this command to finish executing. Do not end the process with `Ctrl` + `C`.

Scaling Minions (Large Scale Deployments)

SUSE Multi-Linux Manager is designed by default to work on small and medium scale installations. For installations with more than 1000 clients per SUSE Multi-Linux Manager Server, adequate hardware sizing and parameter tuning must be performed.

For more information on managing large scale deployments, see **Specialized-guides › Large-deployments**.

Salt Connectivity

Depending on the size and spreadness of the environment where SUSE Multi-Linux Manager is used some connectivity issues are possible. There are no common recommendations for all the possible use cases as the environments could be very different expecially if public clouds instances are involved.

Minions Connectivity

In case clients are losing the connection to the SUSE Multi-Linux Manager Server (or SUSE Multi-Linux Manager

Proxy if involved), they are unreachable from the SUSE Multi-Linux Manager Server Web UI or with command line tools. To understand such a connection issue check if the client is not reachable from the SUSE Multi-Linux Manager Server with salt MINION_ID test.ping, while venv-salt-call test.ping (or salt-call test.ping if non-bundle Salt is used on the client) is working fine on the client side. If this is the case, it is recommended to set tcp_keepalive parameters.

The parameters with the values from the example below can be used as a starting point to look for settings, which could prevent cases of connection loss without restoring for some environments. It is recommended to put the parameters in the separate drop-in configuration file like /etc/venv-salt-minion/minion.d/tuning-keepalives.conf or /etc/salt/minion.d/tuning-keepalives.conf, depending on the minion type used on the client side.

Listing 9. Example: Keepalive Parameters Example Values

```
######      Keepalive settings      ######
##########################################
# ZeroMQ now includes support for configuring SO_KEEPALIVE if supported by
# the OS. If connections between the minion and the master pass through
# a state tracking device such as a firewall or VPN gateway, there is
# the risk that it could tear down the connection the master and minion
# without informing either party that their connection has been taken away.
# Enabling TCP Keepalives prevents this from happening.

# Overall state of TCP Keepalives, enable (1 or True), disable (0 or False)
# or leave to the OS defaults (-1), on Linux, typically disabled. Default True, enabled.
tcp_keepalive: True

# How long before the first keepalive should be sent in seconds. Default 300
# to send the first keepalive after 5 minutes, OS default (-1) is typically 7200 seconds
# on Linux see /proc/sys/net/ipv4/tcp_keepalive_time.
tcp_keepalive_idle: 10

# How many lost probes are needed to consider the connection lost. Default -1
# to use OS defaults, typically 9 on Linux, see /proc/sys/net/ipv4/tcp_keepalive_probes.
tcp_keepalive_cnt: 3

# How often, in seconds, to send keepalives after the first one. Default -1 to
# use OS defaults, typically 75 seconds on Linux, see
# /proc/sys/net/ipv4/tcp_keepalive_intvl.
tcp_keepalive_intvl: 10
```

Proxies Connectivity

salt-broker service is used on SUSE Multi-Linux Manager Proxies to forward Salt traffic between the SUSE Multi-Linux Manager Server and salt-minion service used on the client side. It is possible that salt-broker and all the clients behind it could be affected with the same issue as the clients directly connected to the SUSE Multi-Linux Manager Server. The issue could be fixed with the same parameters as recommended for the minions, but specified in /etc/salt/broker on each SUSE Multi-Linux Manager Proxy.

SUSE Multi-Linux Manager Proxy connectivity can also suffer when the connectivity to the SUSE Multi-Linux Manager Server is lost for a quite long interval. In such a case Proxy connected clients started to retry the

authentication to the salt-master service on the SUSE Multi-Linux Manager Server. This situation could be potentially dangerous because it could lead to collecting large amount of ZeroMQ messages with authentication attemps in the interal buffer of ZeroMQ sockets used inside the salt-broker service. Then, on restoring the connection to the salt-master all of the pending messages will be pushed to it. It could lead to the issues on SUSE Multi-Linux Manager Server side with salt-master service, because it could be impossible to serve all the cached requests in appropriate time or even to the complete denial of the service.

To avoid such situation a set of tuning parameters is available. As the most important one, wait_for_backend should be set to True. This prevents opening the sockets for the clients behind the proxy while the connectivity to the salt-master service is not established. In this case the messages from the clients are not collected in the internal buffers. drop_after_retries is setting the number of retries before closing the sockets to drop the cached messages. The other parameters could help to fine tune the behavior for the environment.

> Setting timeouts, intervals and drop_after_retries to lower values are making salt-broker service more aggressive on detecting the connection loss to the salt-master, so that it puts the clients behind the proxy to the conditions closer as they are connected directly to the SUSE Multi-Linux Manager Server. Increasing the values could provide some benefits in case if the network channel between the SUSE Multi-Linux Manager Proxy and SUSE Multi-Linux Manager Server is not stable enough, the message buffering can provide some flexibility while re-establishing the connection.

Listing 10. Example: Values for Keepalive Parameters

```
######   ZeroMQ connection options    ######
############################################
# For more details about the following parameters check ZeroMQ documentation:
# http://api.zeromq.org/4-2:zmq-setsockopt
# All of these parameters will be set to the backend sockets
# (from the salt-broker to the salt-master)

# connect_timeout (sets ZMQ_CONNECT_TIMEOUT)
# default: 0
# value unit: milliseconds
# Sets how long to wait before timing-out a connect to the remote socket.
# 0 could take much time, so it could be better to set to more strict value
# for particular environment depending on the network conditions.
# The value equal to 10000 is setting 10 seconds connect timeout.
connect_timeout: 3000

# reconnect_ivl (sets ZMQ_RECONNECT_IVL)
# default: 100
# value unit: milliseconds
# Sets the interval of time before reconnection attempt on connection drop.
reconnect_ivl: 1000

# heartbeat_ivl (sets ZMQ_HEARTBEAT_IVL)
# default: 0
# value unit: milliseconds
# This parameter is important for detection of loosing the connection.
# In case of value equal to 0 it is not sending heartbits.
# It's better to set to more relevant value for the particular environment,
# depending on possible network issues.
# The value equal to 20000 (20 seconds) works good for most cases.
```

```
heartbeat_ivl: 5000

# heartbeat_timeout (sets ZMQ_HEARTBEAT_TIMEOUT)
# default: 0
# value unit: milliseconds
# Sets the interval of time to consider that the connection is timed out
# after sending the heartbeat and not getting the response on it.
# The value equal to 60000 (1 minute) is considering the connection is down
# after 1 minute of no response to the heartbeat.
heartbeat_timeout: 10000


######   Other connection options    ######
# The following parameters are not related to ZeroMQ,
# but the internal parameters of the salt-broker.
# drop_after_retries
# default: -1
# value unit: number of retries
# Drop the frontend sockets of the salt-broker in case if it reaches
# the number of retries to reconnect to the backend socket.
# -1 means not drop the frontend sockets
# It's better to choose more relevant value for the particular environment.
# 10 can be a good choise for most of the cases.
drop_after_retries: 5

# wait_for_backend
# default: False
# The main aim of this parameter is to prevent  collecting the messages
# with the open frontend socket and prevent pushing them on connecting
# the backend socket to prevent large number of messages to be pushed
# at once to salt-master.
# It's better to set it to True if there is significant numer of minions
# behind the salt-broker.
wait_for_backend: True
```

Monitoring Salt Events

In some cases the Salt event bus could publish significant amount of events with a high rate, what could make it hard to analyze. Getting the statistics based on the events published in the Salt event bus can help to identify possible weak points and perform Salt internals profiling.

Saline

Saline is a powerful tool designed to function as a Prometheus exporter, enabling the collection of metrics based on events from the Salt event bus. These metrics are derived from event data available on the Salt master, similar to what is accessible through the command:

```
mgrctl exec -ti -- salt-run state.event
```

Saline is distributed as a separate container image, server-saline, for use with SUSE Multi-Linux Manager Server. All related commands and operations should be executed on the SUSE Multi-Linux Manager Server container host system.

In addition to its role as a Prometheus exporter, Saline also provides the saline-formula, which simplifies configuration of Prometheus and Grafana dashboards, enhancing monitoring and visualization capabilities.

Saline deployment

To deploy Saline on the SUSE Multi-Linux Manager Server use mgradm upgrade podman with --saline-replicas 1. Saline can be deployed during the installation of the SUSE Multi-Linux Manager Server using mgradm install podman with --saline-replicas 1. The only possible values for --saline-replicas are 1 or 0. After finishing the deployment SUSE Multi-Linux Manager-saline.service should be configured on the SUSE Multi-Linux Manager Server host system.

Salt master configuration recommendations

It is recommended to add master_stats: True and adjust the value of master_stats_event_iter: 60 if needed. Then restart salt-master to get the detailed statistics of internal Salt calls. This can be help with tuning large scale deployment installations.

Saline formula

To configure Prometheus and Grafana dashboards, see **Specialized-guides › Salt**.

Removing Saline

To remove Saline from the SUSE Multi-Linux Manager Server use mgradm upgrade podman with --saline-replicas 0.
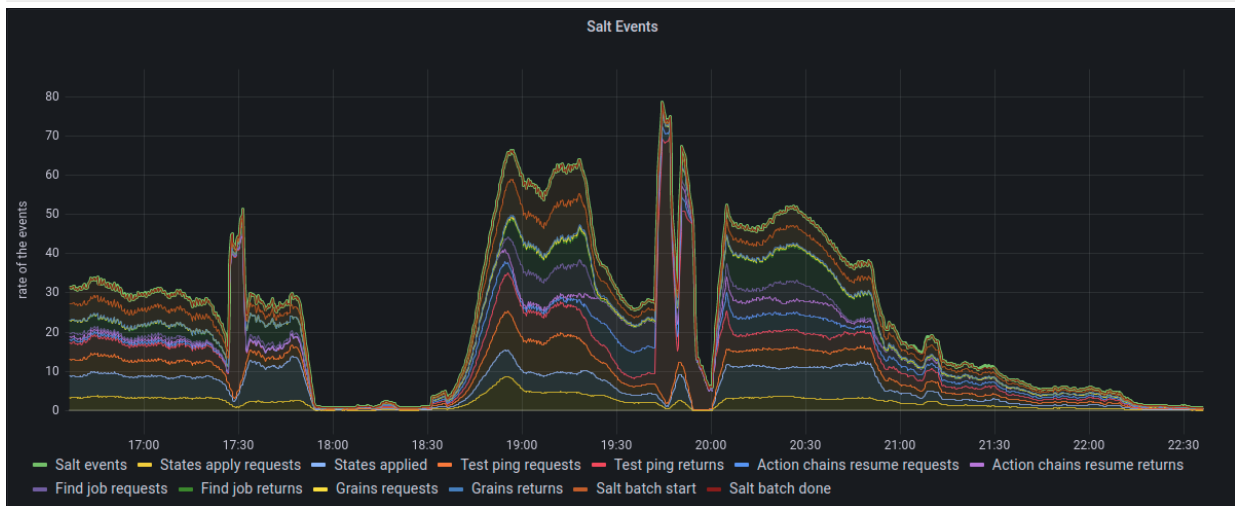
Examples of resulting Grafana dashboards

SUSE Multi-Linux Manager Server (with Saline) dashboard

The dashboard represents Salt events with the different views presented on the panels.

Salt Events

The panel represents all the Salt events grouped by categories. Salt events represents the total number of all categories of the events.

Minions Activity

The panel provides the minions activity status for the specified interval of times. It shows the amount of minions which were active in last minute, 5 minutes, 15 minutes, 1 hour or considered offline on this moment of time or even ever seen (could be targeted or either responded or not) or active.
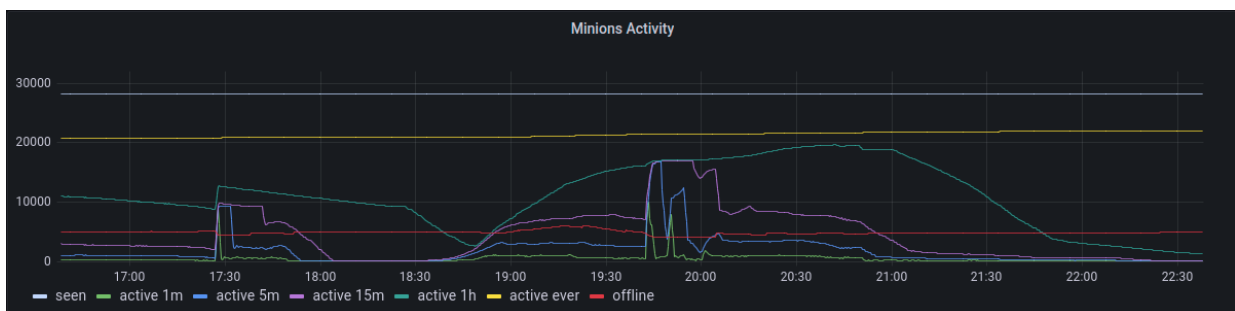
Salt Events by Tags and Functions

The panel provides the detailed representation of Salt Events with the event spread by direction The events which are send to the minions are presented on the positive side of the axis, while the events received from the minions are presented on the negative side.
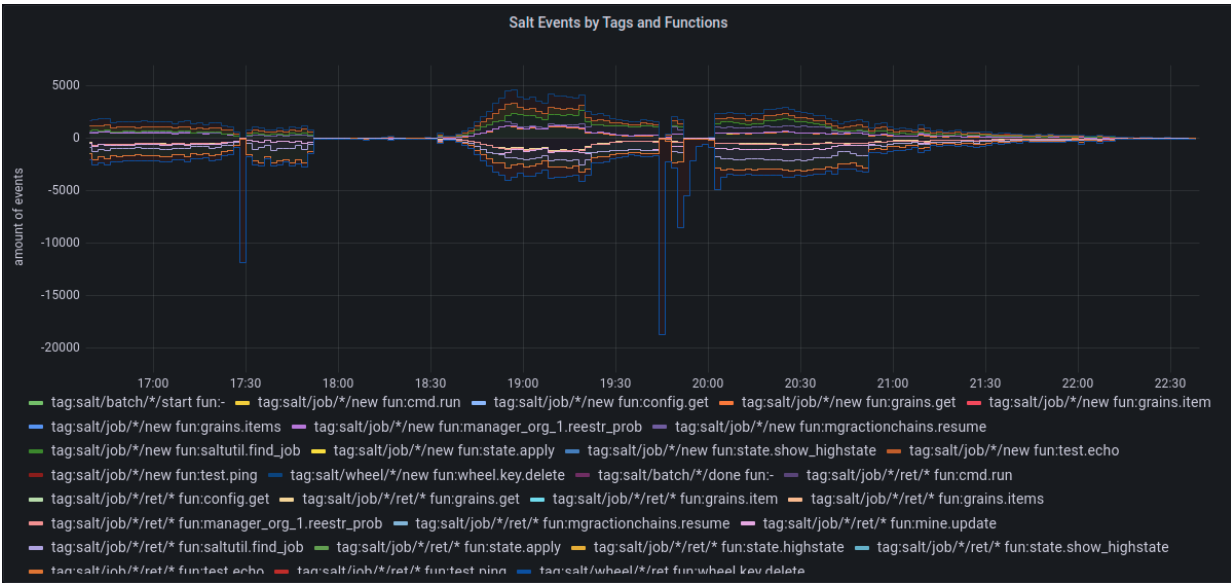
Salt States

The panel represents states apply process events grouped by the status: succeeded, failed, causing errors or applied in the test mode.
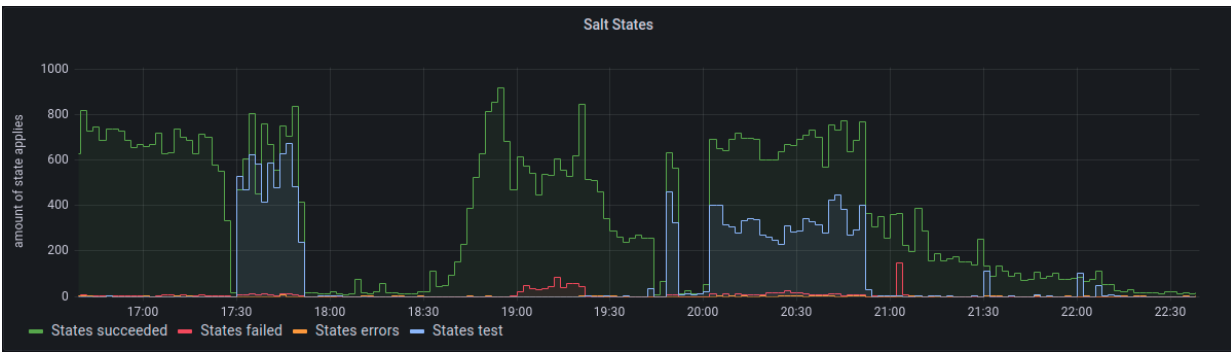
Salt Master Stats (runs)

The panel represents the number of internal calls grouped by function, which are exposed with Salt stats.
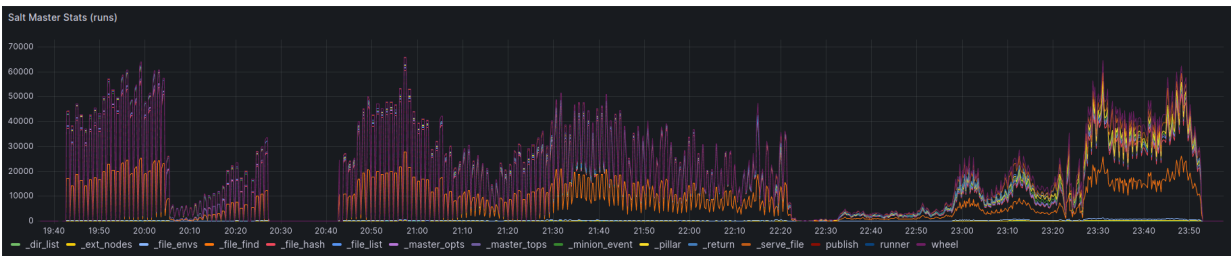
Salt Master Stats (avg. duration)

The panel represents the average duration of internal calls grouped by function, which are exposed with Salt stats.

Saline State Jobs dashboard

The dashboard represents Salt state apply process, it can be used for detailed monitoring of the internals of state apply process initiated for a number of targets.

Salt State Jobs (instant)

The panel represents an instant view of the state functions calls represented in the table view.

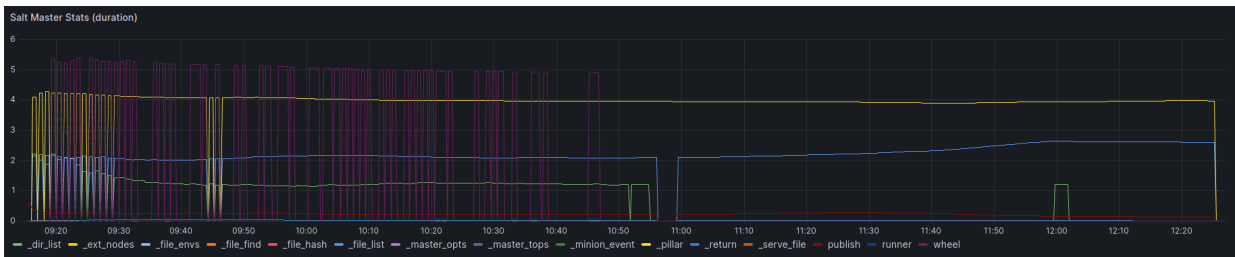| Function	MODS	Test	Targeted	Progress		Succeeded		Failed ↓		Timed out	
state.apply	manager_org_1.UpdateA…	-	1		100%		0%		100%		0%
state.highstate	HIGHSTATE	-	17		100%		24%		76%		0%
state.apply	util.systeminfo	-	21181		100%		96%		3%		2%
state.apply	util.synccustomall, hard…	-	48		100%		96%		2%		2%
state.apply	HIGHSTATE	-	77		100%		95%		1%		4%
state.apply	manager_org_1.test_exa…	-	20596		100%		83%		0%		17%
state.apply	packages.profileupdate	-	10756		100%		99%		0%		1%
state.apply	minion.install-ptf	-	29		100%		100%		0%		0%

Salt States Profiling

The panel provides the table of state functions calls with the detailed profiling data that can be used for state optimization.

SLS	State ID	Function	Succeeded	Avg. duration (succ.) ·	Failed	Avg. duration (fail.)
manager_org_1.test	test_chromium-gost-s…	pkg.latest	8162	2.85 min	435	1.82 min
manager_org_1.test	test_chromium-gost-s…	pkg.installed	12	1.84 min	0	-
minion.install-ptf	salt-minion-upgrade	pkg.installed	7	1.33 min	0	-
util.syncmodules	sync_modules	module.run	41667	36.3 s	545	4.02 min
util.syncgrains	sync_grains	module.run	42106	26.8 s	107	4.10 min
util.syncbeacons	sync_beacons	module.run	27787	26.0 s	19	3.82 min
packages.profileupdate	products	module.run	14408	6.42 s	0	-
manager_org_1.test	/etc/skel/Desktop/re…	file.managed	8173	6.00 s	436	576 ms
channels	mgrchannels_repo	file.managed	323	3.81 s	0	-

Salt timeouts

General Salt timeouts

Salt features two timeout parameters called timeout and gather_job_timeout that are relevant during the execution of Salt commands and jobs—it does not matter whether they are triggered using the command line interface or API. These two parameters are explained in the following article.

This is a normal workflow when all clients are well reachable:

- A Salt command or job is executed:

```
salt '*' test.ping
```

- Salt master publishes the job with the targeted clients into the Salt PUB channel.

- Clients take that job and start working on it.

- Salt master is looking at the Salt RET channel to gather responses from the clients.

- If Salt master gets all responses from targeted clients, then everything is completed and Salt master will return a response containing all the client responses.

If some of the clients are down during this process, the workflow continues as follows:

1. If timeout is reached before getting all expected responses from the clients, then Salt master would trigger an aditional job (a Salt find_job job) targeting only pending clients to check whether the job is already running on the client.

2. Now gather_job_timeout is evaluated. A new counter is now triggered.

3. If this new find_job job responds that the original job is actually running on the client, then Salt master will wait for that client's response for another gather_job_timeout interval before issuing the next find_job job.

4. In case of reaching gather_job_timeout without having any response from the client (neither for the initial test.ping nor for the find_job job), Salt master will return with only the gathered responses from the responding clients.

By default, SUSE Multi-Linux Manager globally sets timeout and gather_job_timeout to 120 seconds. So, in the worst case, a Salt call targeting unreachable clients will end up with 240 seconds of waiting until getting a response.

You can configure these values differently by creating a /etc/salt/master.d/custom.conf configuration file according to syntax in /etc/salt/master.conf.

Presence Ping Timeouts

Before Actions are executed on Salt clients, whether they scheduled via the Web UI or the API, SUSE Multi-Linux Manager performs a "presence ping" command to ensure the respective salt-minion processes are active and able to respond. Then, a ping gather job runs on the Salt master to handle the incoming pings from the clients. Actual commands will begin only after all clients have either responded to the ping, or timed out.

The presence ping is an ordinary Salt command, but is not subject to the same timeout parameters as all other Salt commands (timeout/gather_job_timeout, described above). Rather, it has its own parameters (java.salt_presence_ping_timeout/java.salt_presence_ping_gather_job_timeout) that can be set in /etc/rhn/rhn.conf.

To allow for quicker detection of unresponsive clients, the timeout values for presence pings are by default significantly shorter than the general defaults. You can configure the presence ping parameters in /etc/rhn/rhn.conf, however the default values should be sufficient in most cases.

A lower total presence ping timeout value will increase the chance of false negatives. In some cases, a client might be marked as non-responding, when it is responding but did not respond quickly enough. Additionally, setting this total presence ping timeout value too low could result in a client hanging at the boot screen. A higher total presence ping timeout will increase the accuracy of the test, as even slow clients will respond to the presence ping before timing out. Additionally, a higher presence ping timeout could limit throughput if you are targeting a large number of clients, when some of them are slow.

If a client does not reply to a ping within the allocated time, it is marked as not available, and is excluded from the command. The Web UI shows a minion is down or could not be contacted message in this case.

The presence ping timeout parameter changes the timeout setting for the presence ping, in seconds. Adjust the java.salt_presence_ping_timeout parameter. Defaults to 4 seconds.

The presence ping gather job parameter changes the timeout setting for gathering the presence ping, in seconds. Adjust the java.salt_presence_ping_gather_job_timeout parameter. Defaults to 1 second.

Salt SSH Clients (SSH Push)

Salt SSH clients are slightly different than regular clients (zeromq). Salt SSH clients do not use Salt PUB/RET channels but a wrapper Salt command inside of an SSH call. Salt timeout and gather_job_timeout are not playing a role here.

SUSE Multi-Linux Manager defines a timeout for SSH connections in /etc/rhn/rhn.conf:

```
# salt_ssh_connect_timeout = 180
```

Large Deployments Guide Overview

SUSE Multi-Linux Manager is designed by default to work on small and medium scale installations. For installations with more than 1000 clients per SUSE Multi-Linux Manager Server, adequate hardware sizing and parameter tuning must be performed.

There is no hard maximum number of supported systems. Many factors can affect how many clients can reliably be used in a particular installation. Factors can include which features are used, and how the hardware and systems are configured.

There are two main ways to manage large scale deployments. You can manage them with a single SUSE Multi-Linux Manager Server, or you can use multiple servers in a hub. Both methods are described in this book.

With large scale environments one should also consider the usage of SUSE Multi-Linux Manager Proxies. Sizing and location of the Proxies will dependent on the deployment topology. For more information, see **Installation-and-upgrade › Install-proxy**.

Additionally, if you are operating within a Retail environment, you can use SUSE Multi-Linux Manager for Retail to manage large deployments of point-of-service terminals. There is an introduction to SUSE Multi-Linux Manager for Retail in this book.

Tuning and monitoring large scale deployments can differ from smaller installations. This book contains guidance for both tuning and monitoring within larger installations.

Hardware Requirements

Not all problems can be solved with better hardware, but choosing the right hardware is an absolute necessity for large scale deployments.

The minimum requirements for the SUSE Multi-Linux Manager Server are:

- Eight or more recent x86-64 CPU cores.

- 32 GiB RAM. For installations with thousands of clients, use 64 GB or more.

- Fast I/O storage devices, such as locally attached SSDs. For PostgreSQL data directories, we recommend locally attached RAID-0 SSDs.

If the SUSE Multi-Linux Manager Server is virtualized, enable the `elevator=none` kernel command line option, for the best input/output performance. You can check the current status with `cat /sys/block/<DEVICE>/queue/scheduler`. This command will display a list of available schedulers with the currently active one in brackets. To change the scheduler before a reboot, use `echo none > /sys/block/<DEVICE>/queue/scheduler`.

The minimum requirements for the SUSE Multi-Linux Manager Proxy are:

- One SUSE Multi-Linux Manager Proxy per 500-1000 clients, depending on available network bandwidth.

- Two or more recent x86-64 CPU cores.

- 16 GB RAM, and sufficient storage for caching.

Clients should never be directly attached to the SUSE Multi-Linux Manager Server in production systems.

In large scale installations, the SUSE Multi-Linux Manager Proxy is used primarily as a local cache for content between the server and clients. Using proxies in this way can substantially reduce download time for clients, and decrease Server egress bandwidth use.

The number of clients per proxy will affect the download time. Always take network structure and available bandwidth into account.

We recommend you estimate the download time of typical usage to determine how many clients to connnect to each proxy. To do this, you will need to estimate the number of package upgrades required in every patch cycle. You can use this formula to calculate the download time:

```
Size of updates * Number of clients / Theoretical download speed / 60
```

For example, the total time needed to transfer 400 MB of upgrades through a physical link speed of 1 GB/s to 3000 clients:

```
400 MB  * 3000 / 119 MB/s / 60 = 169 min
```

Using a Single Server to Manage Large Scale Deployments

This section discusses how to set up a single SUSE Multi-Linux Manager Server to manage a large number of clients. It contains some recommendations for hardware and networking, and an overview of the tuning parameters that you need to consider in a large scale deployment.

Operation Recommendations

This section contains a range of recommendations for large scale deployments.

> **ℹ** Always start small and scale up gradually. Monitor the server as you scale to identify problems early.

Client Onboarding Rate

The rate at which SUSE Multi-Linux Manager can onboard clients is limited and depends on hardware resources. Onboarding clients at a faster rate than SUSE Multi-Linux Manager is configured for will build up a backlog of unprocessed keys. This slows down the process and can potentially exhaust resources. We

recommend that you limit the acceptance key rate programmatically. A safe starting point would be to onboard a client every 15 seconds. You can do that with this command:

```
for k in $(salt-key -l un|grep -v Unaccepted); do salt-key -y -a $k; sleep 15; done
```

Clients and the RNG

All communication to and from clients is encrypted. During client onboarding, Salt uses asymmetric cryptography, which requires available entropy from the Random Number Generator (RNG) facility in the kernel. If sufficient entropy is not available from the RNG, it will significantly slow down communications. This is especially true in virtualized environments. Ensure enough entropy is present, or change the virtualization host options.

You can check the amount of available entropy with the cat /proc/sys/kernel/random/entropy_avail. It should never be below 100-200.

Clients Running with Unaccepted Salt Keys

Idle clients which have not been onboarded, that is clients running with unaccepted Salt keys, consume more resources than idle clients that have been onboarded. Generally, this consumes about an extra 2.5 Kb/s of inbound network bandwidth per client. For example, 1000 idle clients will consume about 2.5 Mb/s extra. This consumption will reduce almost to zero when onboarding has been completed for all clients. Limit the number of non-onboarded clients for optimal performance.

Disabling the Salt Mine

In older versions, SUSE Multi-Linux Manager used a tool called Salt Mine to check client availability. The Salt Mine would cause clients to contact the server every hour, which created significant load. Since the introduction of a more efficient mechanism in SUSE Multi-Linux Manager 3.2, the Salt Mine is no longer required. Instead, the SUSE Multi-Linux Manager Server uses Taskomatic to ping only the clients that appear to have been offline for twelve hours or more, with all clients being contacted at least once in every twenty four hour period by default. You can adjust this by changing the web.system_checkin_threshold parameter in rhn.conf. The value is expressed in days, and the default value is 1.

Newly registered clients will have the Salt Mine disabled by default. If the Salt Mine is running on your system, you can reduce load by disabling it. This is especially effective if you have a large number of clients.

Disable the Salt Mine by running this command on the server:

```
salt '*' state.sls util.mgr_mine_config_clean_up
```

This will restart the clients and generate some Salt events to be processed by the server. If you have a large

number of clients, handling these events could create excessive load. To avoid this, you can execute the command in batch mode with this command:

```
salt --batch-size 50 '*' state.sls util.mgr_mine_config_clean_up
```

You will need to wait for this command to finish executing. Do not end the process with `Ctrl` + `C`.

Disable Unnecessary Taskomatic Jobs

To minimize wasted resources, you can disable non-essential or unused Taskomatic jobs.

You can see the list of Taskomatic jobs in the SUSE Multi-Linux Manager Web UI, at **Admin › Task Schedules**.

To disable a job, click the name of the job you want to disable, select Disable Schedule, and click **[Update Schedule]**.

To delete a job, click the name of the job you want to delete, and click **[Delete Schedule]**.

We recommend disabling these jobs:

- Daily comparison of configuration files: compare-configs-default

- Hourly synchronization of Cobbler files: cobbler-sync-default

- Daily gatherer and subscription matcher: gatherer-matcher-default

Do not attempt to disable any other jobs, as it could prevent SUSE Multi-Linux Manager from functioning correctly.

Swap and Monitoring

It is especially important in large scale deployments that you keep your SUSE Multi-Linux Manager Server constantly monitored and backed up.

Swap space use can have significant impacts on performance. If significant non-transient swap usage is detected, you can increase the available hardware RAM.

You can also consider tuning the Server to consume less memory. For more information on tuning, see **Specialized-guides › Salt**.

AES Key Rotation

Communications from the Salt Master to clients is encrypted with a single AES key. The key is rotated when:

- The salt-master process is restarted, or

- Any minion key is deleted (for example, when a client is deleted from SUSE Multi-Linux Manager)

After the AES key has been rotated, all clients must re-authenticate to the master. By default, this happens next time a client receives a message. If you have a large number of clients (several thousands), this can cause a high CPU load on the SUSE Multi-Linux Manager Server. If the CPU load is excessive, we recommend that you delete keys in batches, and in off-peak hours if possible, to avoid overloading the server.

For more information, see:

- https://docs.saltproject.io/en/latest/topics/tutorials/intro_scale.html#too-many-minions-re-authing

- https://docs.saltproject.io/en/getstarted/system/communication.html

Multiple Servers with Hub to Manage Large Scale Deployments

If you need to manage a large number of clients, in most cases you can do so with a single SUSE Multi-Linux Manager Server, tuned appropriately.

However, if you need to manage tens of thousands of clients, you might find it easier to use one of the following mechanisms:

- Inter-Server Sunchronization (ISS)

- SUSE Multi-Linux Manager Hub

ISS is based on exporting data from one server (source) and importing it on another (target) server. For more information, see **Specialized-guides › Large-deployments**.

SUSE Multi-Linux Manager Hub helps you manage very large deployments. The typical Hub topology looks like this:
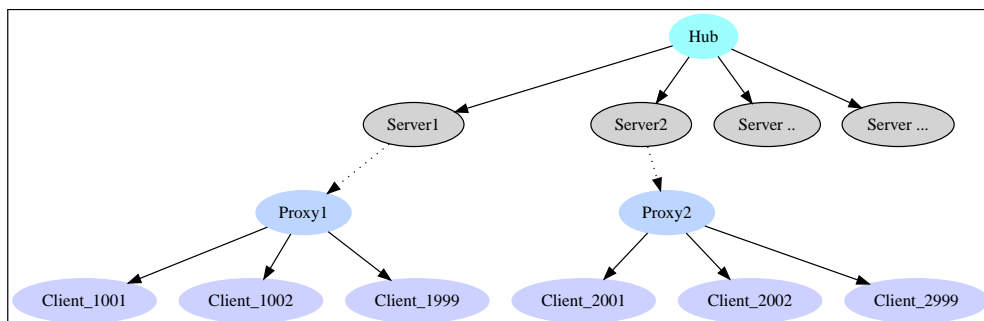
This chapter gives more details about Hub deployment.

Hub Requirements

To set up a Hub installation, you require:

- One central SUSE Multi-Linux Manager Server, which acts as the Hub Server.

- One or more additional SUSE Multi-Linux Manager Servers, registered to the Hub. This document refers to these additional servers as peripheral servers.

- Any number of clients registered to the peripheral servers.

- Ensure the Hub Server and all peripheral servers are running SUSE Multi-Linux Manager 5.0 or higher.

Hub Server

Deploy the central SUSE Multi-Linux Manager Server, which acts as the Hub Server, with the `mgradm` command. Add `--hubxmlrpc-replicas 1` to the `mgradm` install command line. For example:

```
mgradm install podman MLM.example.com --hubxmlrpc-replicas 1
```

For more information about hub server deployment, see **Specialized-guides › Large-deployments**.

> **i** The Hub Server must not have clients registered to it. Clients should only be registered to the Peripheral Servers.

SSL Certificates

The Hub Server's and the Peripheral Servers' SSL certificates must be signed by the same CA. There are two ways to fulfill this requirement:

- Use third party certificates.

- Deploy the Hub Server first and use it to generate the certificates for the Peripheral Servers. For more information, see specialized-guides:large-deployments/hub-reqs.pdf.

Generate the Certificates for Peripheral Servers

> **i** If you will use third party provided Certificates, you can skip this procedure.

Procedure: Generating the Certificates for Peripheral Servers

1. From the container host, enter the shell in the Hub Server container with:

```
mgrctl term
```

2. On the command line, run rhn-ssl-tool for each Peripheral Server (replace placeholders such as COUNTRY, STATE, example.com, etc. with values from your environment):

```
rhn-ssl-tool --gen-server --dir="/root/ssl-build" --set-country="COUNTRY" \
    --set-state="STATE" --set-city="CITY" --set-org="ORGANIZATION" \
    --set-org-unit="ORGANIZATION UNIT" --set-email="name@example.com" \
    --set-hostname="HOSTNAME" --set-cname="example.com"
```

3. Copy these files to the Peripheral Server host:

   ○ /root/ssl-build/RHN-ORG-TRUSTED-SSL-CERT

   ○ /root/ssl-build/HOSTNAME/server.crt

   ○ /root/ssl-build/HOSTNAME/server.key

Peripheral Servers

Deploy the peripheral servers with `mgradm`. For more information about deploying with `mgradm`, see **Installation-and-upgrade › Container-deployment**.

Procedure:Deploying and Registering Peripheral Servers

1. Prepare Peripheral Server hosts.

2. On each Peripheral Server host:

   ○ Copy RHN-ORG-TRUSTED-SSL-CERT to /etc/pki/trust/anchors/ and run update-ca-certificates.

   ○ Deploy the Peripheral Server with:

   ```
   mgradm install podman --ssl-ca-root RHN-ORG-TRUSTED-SSL-CERT \
       --ssl-server-cert server.crt --ssl-server-key server.key
   ```

3. On each Peripheral Server host register Peripheral Server to the Hub Server:

```
mgradm hub register --api-server <HUB_FQDN> --api-user <HUB_ADMIN> \
    --api-password <HUB_ADMIN_PASSWORD>
```

Peripheral Servers must be registered to the Hub Server as foreign clients. Standard registration methods cannot be used.

ℹ️ ⋮ Peripheral Servers must be registered to the Hub Server directly, do not use a proxy.

Optionally, it is possible to register the podman container host as a standard client (Salt minion) and manage it from SUSE Multi-Linux Manager Server.

Now the XMLRPC API is available and reportdb synchronization will take place.

Hub Deployment with XMLRPC

You can deploy a hub environment either with third party certificates or with self-generated certificates.

For more information about SSL certificates, see specialized-guides:large-deployments/hub-reqs.pdf.

With Third Party Certificates

Prepare third party certificates for both the Hub Server and the Peripheral servers first.

Hub Server Installation

Procedure: Installing the Hub Server

1. Install a container host with SL Micro. For more information about SL Micro as a container host, see installation-and-upgrade:container-deployment/mlm/server-deployment-mlm.pdf.

2. On the container host, deploy SUSE Multi-Linux Manager as the hub server using the third party certificate. Add --hubxmlrpc-replicas 1 to the mgradm install command line. For example:

```
mgradm install podman --ssl-ca-root CA-Certificate.crt --ssl-server-cert hub.crt
--ssl-server-key hub.key --hubxmlrpc-replicas 1
```

For more information about deploying with mgradm, see installation-and-upgrade:container-deployment/mlm/server-deployment-mlm.pdf.

Peripheral Servers

Procedure: Installing peripheral servers using third party certificates

1. Preliminary Requirement: A certificate for every peripheral server (for example, server.crt) and a key (for example, server.key).

2. Preliminary Requirement: CA Certificate.

3. Preliminary Requirement: Hub server installation. For more information, see specialized-guides:large-deployments/hub-install.pdf.

   ○ On every peripheral server host, copy the same CA to /etc/pki/trust/anchors/ and run update-ca-certificates.

   ○ On every peripheral server host, install SUSE Multi-Linux Manager using the following command (replace appropriately the names of the certificates):

   ```
   mgradm install podman --ssl-ca-root CA-Certificate.crt --ssl-server-cert
   server.crt --ssl-server-key server.key
   ```

With Self-Generated Certificates

Hub Server Installation

Procedure: Installing the hub server

1. Install a container host with SL Micro. For more information about SL Micro as a container host, see installation-and-upgrade:container-deployment/mlm/server-deployment-mlm.pdf.

2. On the container host, deploy SUSE Multi-Linux Manager as the hub server. Add --hubxmlrpc-replicas 1 to the mgradm install command line. For example:

```
mgradm install podman MLM.example.com --hubxmlrpc-replicas 1
```

For more information about deploying with mgradm, see installation-and-upgrade:container-deployment/mlm/server-deployment-mlm.pdf.

Peripheral Servers

Procedure: Peripheral Servers with Self-Generated Certificates

1. Preliminary Requirement: Hub server installation. For more information, see specialized-guides:large-deployments/hub-install.pdf.

2. On the container host of the hub server, enter the server container with:

```
mgrctl term
```

3. Inside the container, run rhn-ssl-tool for every pheripheral server:

```
rhn-ssl-tool --gen-server --dir="/root/ssl-build" --set-country="COUNTRY" \
  --set-state="STATE" --set-city="CITY" --set-org="ORGANIZATION" \
  --set-org-unit="ORGANIZATION UNIT" --set-email="name@example.com" \
  --set-hostname=PERIPHAL --set-cname="example.com"
```

4. For every peripheral server:

   ○ From the hub server container, copy /root/ssl-build/RHN-ORG-TRUSTED-SSL-CERT, /root/ssl-build/<hostname>/server.crt and /root/ssl-build/<hostname>/server.key to the peripheral server host.

   ○ On every peripheral server host, copy RHN-ORG-TRUSTED-SSL-CERT to /etc/pki/trust/anchors/, and run update-ca-certificates.

   ○ On every peripheral server host, deploy SUSE Multi-Linux Manager with:

```
mgradm install podman --ssl-ca-root RHN-ORG-TRUSTED-SSL-CERT --ssl-server-cert
server.crt --ssl-server-key server.key
```

     ◦ Finally, on every peripheral server host, register the peripheral server to the hub server:

```
mgradm hub register --api-password <hub password> --api-server <hub fqdn> --api
-user <hub admin>
```

Background Information

    ⓘ   Checking the following hub configuration settings is optional.

On the container host, find environment variables in /etc/systemd/system/uyuni-hub-xmlrpc.service generated by mgradm. If needed, you can customize these variables with Environment=settings in a user created /etc/systemd/system/uyuni-hub-xmlrpc.service.d/local.conf systemd configuration file on the container host.

It will override settings in /etc/hub/hub.conf inside the server container. It is the same file for all containers.

- HUB_API_URL: URL to the Hub Server XMLRPC API endpoint. Use the default value if you are installing hub-xmlrpc-api on the Hub Server. It is set automatically in the systemd unit file during the installation.

- HUB_CONNECT_TIMEOUT: the maximum number of seconds to wait for a response when connecting to a Server. Use the default value in most cases.

- HUB_REQUEST_TIMEOUT: the maximum number of seconds to wait for a response when calling a Server method. Use the default value in most cases.

- HUB_CONNECT_USING_SSL: use HTTPS instead of HTTP for communicating with peripheral Servers. Recommended for a secure environment. It is always enabled.

Using the Hub XMLRPC API

When XMLRPC API is running, connect to the service at port 2830 using any XMLRPC-compliant client libraries. For examples, see **Specialized-guides › Large-deployments**.

Logs are saved in /var/log/hub/hub-xmlrpc-api.log. Logs are rotated weekly, or when the log file size reaches the specified limit. By default, the log file size limit is 10 MB.

Hub XMLRPC API Namespaces

The Hub XMLRPC API operates in a similar way to the SUSE Multi-Linux Manager API. For SUSE Multi-Linux Manager API documentation, see https://documentation.suse.com/MLM.

The Hub XMLRPC API exposes the same methods that are available from the server's XMLRPC API, with a few differences in parameter and return types. Additionally, the Hub XMLRPC API supports some Hub-specific end points which are not available in the SUSE Multi-Linux Manager API.

The Hub XMLRPC API supports three different namespaces:

- The hub namespace is used to target the Hub XMLRPC API Server. It supports Hub-specific XMLRPC endpoints which are primarily related to authentication.

- The unicast namespace is used to target a single server registered in the hub. It redirects any call transparently to one specific server and returns any value as if the server's XMLRPC API endpoint was used directly.

- The multicast namespace is used to target multiple peripheral servers registered in the hub. It redirects any call transparently to all the specified servers and returns the results in the form of a map.

- If you do not specify a namespace, all calls are transparently redirected to the underlying SUSE Multi-Linux Manager Server XMLRPC API of the Hub Server. This allows you to call all available methods on the SUSE Multi-Linux Manager Server XMLRPC API.

Methods called without specifying any of the above namespaces will be forwarded to the normal XMLRPC API of the hub. This is the API exposed on ports 80 and 443.

Some important considerations for hub namespaces:

- Individual server IDs can be obtained using client.hub.listServerIds(hubSessionKey).

- The unicast namespace assumes all methods receive hubSessionKey and serverID as their first two parameters, then any other parameter as specified by the regular Server API.

  ```
  client.unicast.[namespace].[methodName](hubSessionKey, serverId, param1, param2)
  ```

- The hubSessionKey can be obtained using different authentication methods. For more information, see **Specialized-guides › Large-deployments**.

- The multicast namespace assumes all methods receive hubSessionKey, a list of ServerID values, then lists of per-server parameters as specified by the regular server XMLRPC API. The return value is a map, with Successful and Failed entries for each server involved in the call.

  ```
  client.multicast.[namespace].[methodname](hubSessionKey, [serverId1, serverId2],
  [param1_s1, param1_s2], [param2_s1, param2_s2])
  ```

Hub XMLRPC API Authentication Modes

The Hub XMLRPC API supports three different authentication modes:

- Manual mode (default): API credentials must be explicitly provided for each server.

- Relay mode: the credentials used to authenticate with the Hub are also used to authenticate to each server. You must provide a list of servers to connect to.

- Auto-connect mode: credentials are reused for each server, and any peripheral server you have access to is automatically connected.

Authentication Examples

This section provides examples of each authentication method.

Example: Manual Authentication

In manual mode, credentials have to be explicitly provided for each peripheral server before you can connect to it.

A typical workflow for manual authentication is:

1. Credentials for the Hub are passed to the login method, and a session key for the Hub is returned (hubSessionKey).

2. Using the session key from the previous step, SUSE Multi-Linux Manager Server IDs are obtained for all the peripheral servers attached to the Hub via the hub.listServerIds method.

3. Credentials for each peripheral server are provided to the attachToServers method. This performs authentication against each server's XMLRPC API endpoint.

4. A multicast call is performed on a set of servers. This is defined by serverIds, which contains the IDs of the servers to target. In the background, system.list_system is called on each server's XMLRPC API

5. Hub aggregates the results and returns the response in the form of a map. The map has two entries:

   ○ Successful: list of responses for those peripheral servers where the call succeeded.

   ○ Failed: list of responses for those peripheral servers where the call failed.

   > If you want to call a method on just one SUSE Multi-Linux Manager Server, then Hub API also provides a unicast namespace. In this case, the response will be a single value and not a map, in the same way as if you called that SUSE Multi-Linux Manager server's API directly.

Listing 11. Example Python Script for Manual Authentication:

```
#!/usr/bin/python3
import xmlrpc.client

HUB_XMLRPC_API_URL = "<HUB_XMLRPC_API_URL>"
HUB_USERNAME = "<USERNAME>"
HUB_PASSWORD = "<PASSWORD>"
```

```
client = xmlrpc.client.ServerProxy(HUB_XMLRPC_API_URL, verbose=0)

hubSessionKey = client.hub.login(HUB_USERNAME, HUB_PASSWORD)

# Get the server IDs
serverIds = client.hub.listServerIds(hubSessionKey)

# For simplicity, this example assumes you are using the same username and password here,
as on the hub server.
# However, in most cases, every server has its own individual credentials.
usernames = [HUB_USERNAME for s in serverIds]
passwords = [HUB_PASSWORD for s in serverIds]

# Each server uses the credentials set above, client.hub.attachToServers needs
# them passed as lists with as many elements as there are servers.
client.hub.attachToServers(hubSessionKey, serverIds, usernames, passwords)

# Perform the operation
systemsPerServer = client.multicast.system.list_systems(hubSessionKey, serverIds)
successfulResponses = systemsPerServer["Successful"]["Responses"]
failedResponses = systemsPerServer["Failed"]["Responses"]

for system in successfulResponses:
  print(system)

# Log out
client.hub.logout(hubSessionKey)
```

Example: Relay Authentication

In relay authentication mode, the credentials used to sign in to the Hub API are also used to sign in into the APIs of the peripheral servers the user wants to work with. In this authentication mode, it is assumed that the same credentials are valid for every server, and that they correspond to a user with appropriate permissions.

After signing in, you must call the attachToServers method. This method defines the servers to target in all subsequent calls.

A typical workflow for relay authentication is:

1. Credentials for the Hub are passed to the loginWithAuthRelayMode method, and a session key for the Hub is returned (hubSessionKey).

2. Using the session key from the previous step, SUSE Multi-Linux Manager Server IDs are obtained for all the peripheral servers attached to the Hub via the hub.listServerIds method

3. A call to attachToServers is made, and the same credentials used to sign in to the Hub are passed to each server. This performs authentication against each server's XMLRPC API endpoint.

4. A multicast call is performed on a set of servers. This is defined by serverIds, which contains the IDs of the servers to target. In the background, system.list_system is called on each server's XMLRPC API.

5. Hub aggregates the results and returns the response in the form of a map. The map has two entries:

   ◦ Successful: list of responses for those peripheral servers where the call succeeded.

○ Failed: list of responses for those peripheral servers the call failed.

Listing 12. Example Python Script for Relay Authentication:

```python
#!/usr/bin/python3
import xmlrpc.client

HUB_XMLRPC_API_URL = "<HUB_XMLRPC_API_URL>"
HUB_USERNAME = "<USERNAME>"
HUB_PASSWORD = "<PASSWORD>"

client = xmlrpc.client.ServerProxy(HUB_XMLRPC_API_URL, verbose=0)

hubSessionKey = client.hub.loginWithAuthRelayMode(HUB_USERNAME, HUB_PASSWORD)

# Get the server IDs
serverIds = client.hub.listServerIds(hubSessionKey)

# Authenticate those servers(same credentials will be used as of hub to authenticate)
client.hub.attachToServers(hubSessionKey, serverIds)

# Perform the needed operation
systemsPerServer = client.multicast.system.list_systems(hubSessionKey, serverIds)
successfulResponses = systemsPerServer["Successful"]["Responses"]
failedResponses = systemsPerServer["Failed"]["Responses"]

for system in successfulResponses:
  print(system)

# Log out
client.hub.logout(hubSessionKey)
```

Example: Auto-Connect Authentication

Auto-connect mode is similar to relay mode, it uses the Hub credentials to sign in in to all peripheral servers. However, there is no need to use the attachToServers method, as auto-connect mode connects to all available peripheral servers. This occurs at the same time as you sign in to the Hub.

A typical workflow for auto-connect authentication is:

1. Credentials for the Hub are passed to the loginWithAutoconnectMode method, and a session key for the Hub is returned (hubSessionKey).

2. A multicast call is performed on a set of servers. This is defined by serverIds, which contains the IDs of the servers to target. In the background, system.list_system is called on each server's XMLRPC API.

3. Hub aggregates the results and returns the response in the form of a map. The map has two entries:

   ○ Successful: list of responses for those peripheral servers where the call succeeded.

   ○ Failed: list of responses for those peripheral servers where the call failed.

Listing 13. Example Python Script for Auto-Connect Authentication:

```python
#!/usr/bin/python3
```

```
import xmlrpc.client

HUB_XMLRPC_API_URL = "<HUB_XMLRPC_API_URL>"
HUB_USERNAME = "<USERNAME>"
HUB_PASSWORD = "<PASSWORD>"

client = xmlrpc.client.ServerProxy(HUB_XMLRPC_API_URL, verbose=0)

loginResponse = client.hub.loginWithAutoconnectMode(HUB_USERNAME, HUB_PASSWORD)
hubSessionKey = loginResponse["SessionKey"]

# Get the server IDs
serverIds = client.hub.listServerIds(hubSessionKey)

# Perform the needed operation
systemsPerServer = client.multicast.system.list_systems(hubSessionKey, serverIds)
successfulResponses = systemsPerServer["Successful"]["Responses"]
failedResponses = systemsPerServer["Failed"]["Responses"]

for system in successfulResponses:
  print(system)

# Log out
client.hub.logout(hubSessionKey)
```

Hub Reporting

The Hub prepares and provides content for multiple peripheral SUSE Multi-Linux Manager Servers. The goal of the reporting feature is to get data from these Servers back and have combined reporting data available on the Hub. The data is made available for external Reporting Tools.

Architecture

The main database is a PostgreSQL database in the SUSE Multi-Linux Manager Hub system. It stores all the information collected from all the servers, and aggregates them. Every peripheral Server has its own reporting database where the information is collected for that system. In summary:

- the DB in SUSE Multi-Linux Manager Hub stores, collects and aggregates data coming from all the DBs of the peripheral Servers,

- the DB in SUSE Multi-Linux Manager Hub stores also its own data from the systems directly connected and managed by the Hub,

- the DB in peripheral SUSE Multi-Linux Manager Server stores its own data,

- the reporting tool can be connected either to the Hub or to any SUSE Multi-Linux Manager Server.

Setup

The reporting database and schema are set up by default using the local PostgreSQL server. The reporting database is a separate database accessible via the network.

> ⚠️ As a requirement we expect all server certificates are signed by the same Root Certificate Authority (CA). The whole SUSE Multi-Linux Manager Hub environment should be using only one Root CA.
>
> For more information about certificates, see specialized-guides:large-deployments/hub-reqs.pdf.

Create a DB user for the reporting

Before connecting an external Reporting Tools to the Database, a user with read-only permission should be created. For doing that, it is possible to use uyuni-setup-reportdb-user.

```
usage: uyuni-setup-reportdb-user [options]

options:
  --help
          show this help message and exit
  --non-interactive
          Switches to non-interactive mode
  --dbuser=DBUSER
          Report DB User
  --dbpassword=DBPASSWORD
          Report DB Password
  --add
          Add the new user
  --delete
          Delete the user
  --modify
          Set a new password
```

Database Schema

The schema exports the most important tables from the main SUSE Multi-Linux Manager Database as a de-normalized variant containing only data which are relevant for a report.

Ready-to-use reports are provided as views, aggregating data over multiple tables.

Every table gets an extra id column (mgm_id) specifying the SUSE Multi-Linux Manager server which provided the data. On a single SUSE Multi-Linux Manager Server this column has the standard value 1 which represent localhost. On the SUSE Multi-Linux Manager Hub it is replaced with the real server id the managed server has in the hub database.

Another common additional field is synced_date, which represents the time when the data were exported from the main SUSE Multi-Linux Manager Server database.

Navigate to **Help › Report Database Schema** to find the schema documentation.

Data Generation and Update

SUSE Multi-Linux Manager uses taskomatic jobs to generate the data for the reporting database and to get the data from the peripheral servers to the hub.

To generate and update the data on a peripheral server, the responsible schedule is called update-reporting-default. It is executed by default daily at midnight.

On the SUSE Multi-Linux Manager Hub there is a second schedule which is important. To fetch the reporting data from all registered peripheral servers, the task with the name update-reporting-hub-default is executed daily at 1:30 AM.

All times are in the local timezone of the server. If the peripheral servers are in different timezones, it is recommended to align all the schedules. Make sure that all reporting data are gathered at a specific point in time, and update-reporting-hub-default is running when all peripheral servers have actually finished their local jobs.

Tuning Reporting Jobs

report_db_batch_size

Description	The maximum number of rows fetched and written from one database to the other in one shot.
Tune when	Out of memory errors or on processing speed problems.
Value default	2000
Value recommendation	500 - 5000
Location	/etc/rhn/rhn.conf
Example	report_db_batch_size = 4000
After changing	Check memory usage. Monitor memory usage closely before and after the change.

report_db_hub_workers

Description	The maximum number of workers requesting data from peripheral servers on a hub at the same point in time.

Tune when	The number of peripheral servers increases significantly (more than 100), or a faster synchronization is required.
Value default	2
Value recommendation	2 - 10
Location	/etc/rhn/rhn.conf
Example	report_db_hub_workers = 5
After changing	Check memory usage. Monitor memory and cpu usage of the hub closely before and after the change. Also monitor the load, cpu and memory usage of the reporting database of the hub.
Notes	All the data collected from the peripheral server must be written into the hub reporting database. Tuning that database could increase the performance as well.

Hub Online Synchronization

Introduction

Hub online synchronization reuses the existing repository synchronization and synchronizes channels in the peripheral servers from the repositories on the hub server.

When the connection between hub and peripheral server is established, the hub server becomes the main source of data for the peripheral server. In case of vendor channels, hub server is effectively replacing SUSE Customer Center. In case of custom channels, when they are synchronized, the peripheral server will fetch the packages from the hub and not from the original location of the custom channel defined on the hub.

The main characteristics of this feature are:

- There can only be one hub server per connection, with one or more peripheral servers.

- Each peripheral server can only have one hub server.

- Content can be synchronized on regular basis, or on demand.

Registration of the hub and peripheral servers

Hub online synchronization is configured from menu **Admin › Hub Configuration**.

Configuration process uses token which uniquely identifies peripheral server's connection to the hub.

There are two ways to register a peripheral server to the hub server:

1. by using a combination of token creation on the peripheral, and subsequent registration on the hub server. This method uses Procedure: Generating token on the peripheral server and Procedure: Registering to the hub server with the token.

2. by direct registration from the hub, without any user interactions with the peripheral server. This method is described in Procedure: Direct registering from the hub server.

> **!** In any case, if the peripheral host should be managed by the hub, you must first bootstrap the host as a minion to the hub before proceeding with the registration of the peripheral server. If the bootstrapping happens later, two systems are shown in the systems list.

Registration from peripheral server by token generation

Before being registered to the hub server, a token needs to be generated on the peripheral server and passed to the administrator of the hub server.

Procedure: Generating token on the peripheral server

1. On the peripheral server, go to **Admin › Hub Configuration › Access Tokens**.

2. Click button **[Add token]** and select option Issue new token.

3. In the field Server FQDN on the form that opens type the FQDN of the hub server that will be using this token.

4. Click **[Issue]**.

5. A new form with the successfully generated token appears and button **[Copy]**.

> **!** The only time token is displayed is at the time of its creation. Save it in a safe place until it is later needed.

6. Once generated, the token appears on the screen Access Tokens.

The generated token needs to be transferred to the hub server before it can be used.

Procedure: Registering to the hub server with the token

1. On the hub server, go to **Hub Configuration › Peripherals Configuration**.

2. Click button **[Add peripheral]**. A new form Register a new peripheral server opens.

3. In the field Peripheral Server FQDN enter the name of the peripheral server.

4. In the field Registration mode select option Existing token.

5. In the field Token paste the token that was created on the peripheral server.

6. In the field Root CA certificate specify the certificate using one of the options:

    ◦ Use option Not needed if both hub and peripheral servers have the same certificate authority.

    ◦ Use option Upload a file if the servers have different certificate authorities to upload a certificate file.

    ◦ Use option Paste a PEM certificate to paste a certificate.

7. Click button **[Register]**. A newly registered peripheral server will appear on screen Peripherals Configuration.

Registration from the hub server directly

It is possible to initiate the registration of a peripheral server from hub server, without any interaction with the peripheral server.

Procedure: Direct registering from the hub server

1. On the hub server, go to **Hub Configuration › Peripherals Configuration**.

2. Click button **[Add peripheral]**. A new form Register a new peripheral server opens.

3. In the field Peripheral Server FQDN enter the name of the peripheral server.

4. In the field Registration mode select option Administrator User/Password.

5. In the fields Username and Password enter the credentials for the peripheral server.

> ⚠️ The credentials must be those of SUSE Manager Administrator of the peripheral server.

6. In the field Root CA certificate specify the certificate using one of the options:

    ◦ Use option Not needed if both hub and peripheral servers have the same certificate authority.

    ◦ Use option Upload a file if the servers have different certificate authorities to upload a certificate file.

    ◦ Use option Paste a PEM certificate in cases when PEM certificate is used.

7. Click button **[Register]**.

8. The newly registered peripheral server will be shown in the **Systems › System List** with the value Foreign in the column System Type.

9. To access its details, click on the peripheral server's name and select tab **Details › Peripheral Server**.

Peripheral server uses hub to access the vendor channels and does not connect to the SUSE Customer Center

directly. Therefore, if you open configured peripheral server's page **Admin › Setup Wizard › Organization Credentials**, **Admin › Setup Wizard › Products** or **Admin › Setup Wizard › PAYG Connections**, you will see a notification that this is peripheral server and its connections are managed via hub.

Access tokens

All existing tokens are shown in **Hub Configuration › Access Tokens**.

A token can viewed as Consumed and Issued, both from the perspective of the peripheral and the hub server.

- From the perspective of the peripheral server:

  Consumed

  > The Consumedtoken is generated on the peripheral server and received by the hub server to be used.

  Issued

  > The Issued token is issued by the hub server to be used by the peripheral server.

- From the perspective of the hub server:

  Consumed

  > The Consumedtoken is generated on the hub server and received by the peripheral server to be used.

  Issued

  > The Issued token is issued by the peripheral server to be used by the hub server.

Token operations

A token can be invalidated, or deleted.

Be careful when using option **[Invalidate]** as it no longer grants access to the other server. This operation ensures that no communication will happen until a new token is generated if the existing one is compromised, or until the current token is reactivated. Invalidated token can be made valid again at any time.

It is possible to delete a token. Deleting is only possible when the server associated with the token is not registered as hub or peripheral. This operation cannot be undone.

Access hub server details from the peripheral server

Every peripheral server stores the information about its hub server.

> ! ⋮ A peripheral server can only have one hub server configured.

Procedure: Accessing hub server details

1. On the peripheral server, go to **Hub Configuration › Hub Details**.

2. On the screen Hub Details find the information about the hub server.

   a. Field Server FQDN shows the hub server's FQDN.

   b. Field Registration date shows the time when the peripheral server was registered to the hub server.

   c. Field Last modified shows the time of the last saved configuration change.

   d. Field Root Certificate Authority shows certificate details. To download, edit or delete the root certificate, clicking **[Download]**, **[Edit]** or **[Delete]** respectively. Deleting the certificate will break the connection between servers.

   e. Field GPG Public Key shows whether the GPG key has been configured for the hub server. For more information about GPG keys between hub and peripheral servers, see GPG key usage with hub online synhronization.

   f. Field Mirror credentials is the username the peripheral server uses when connecting to the hub server to synchronize vendor channels. This username is generated automatically on the hub server, and then transmitted to the peripheral server during the registration phase.

GPG key usage with hub online synhronization

When the metadata on the hub server are signed with a GPG key, the public key is automatically transmitted from hub to peripheral server.

By default, SUSE Multi-Linux Manager is not signing metadata. Therefore, when the peripheral server is downloading data from the hub server there is no way of checking if the downloaded metadata have a valid signature, unless the customer has created their own GPG key.

To enable checking of the data integrity, the GPG key needs to be created on the hub. When the peripheral server is configured to communicate with the hub, the public GPG key will then automatically be transferred to it.

When the GPG key is created on the hub, field GPG Public Key will be set to show that this server is using the GPG key. For more information about setting up own GPG key, see **Administration › Repo-metadata**.

Deregister peripheral server

Deregistration can happen from both sides, from the hub or from the peripheral server.

Procedure: Deregistering from the peripheral server

1. Go to **Hub Configuration › Hub Details**.

2. Click **[Deregister]**.

3. Confirm the operation by clicking **[Deregister]** on the pop-up window.

4. Page **Hub Configuration › Hub Details** is now empty.

Procedure: Deregistering from the hub server

1. Go to **Hub Configuration › Peripheral Configuration**.

2. Find the perpheral server on the list.

3. Click **[Deregister]** next to the peripheral server's name.

4. The peripheral server is no longer shown on the list.

Synchronize channels from hub to peripheral server

Synchronizing vendor channels for the configured hub and server is done via dedicated user interface.

Procedure: Synchronizing channels from hub to peripheral server

1. Go to **Admin › Hub Configuration › Peripherals Configuration**.

2. In the field Synchronized channels click on **[Edit channels]**.

3. Page Sync Channels from Hub to Peripheral opens.

4. Select the channels you want to synchronize.

5. For custom channels also select the target organization on the peripheral from the dropdown.

> ❗ The drop-down list exists only for custom channels which do not yet exist on the peripheral server. If the channel exists, the organization stays unchanged.

6. Click **[Apply Changes]** to view the summary of your changes.

7. A pop-up window with the summary of your selections will open.

8. Click **[Confirm]** to confirm the selection.

Following the confirmation, the channels will be created on the peripheral server and everything will be set up to mirror the channels during the next regular repository synchronization task.

The repository synchronization can be initated from the peripheral server.

Procedure: Initiating repository synchronization from the peripheral server

1. Go to **Admin › Hub Configuration › Hub Details**.

2. Click **[Sync Channels]**.

3. Confirm the operation by clicking **[Schedule]** on the pop-up window.

The full channel synchronization will start in the background.

Inter-Server Synchronization version 2

If you have more than one SUSE Multi-Linux Manager installation, you will need to copy contents between servers. Inter-Server Synchronization (ISS) allows you to export data from one server (hub) and import it on another server (peripheral). This is useful for hub deployment scenarios or disconnected setups.

Install Inter-Server Synchronization packages

To use ISS you need to install the inter-server-sync package on hub and peripheral servers.

Content synchronization

> ❗ Use mgrctl term before running steps inside the server container.

Procedure: Export data on hub server

1. On the hub server, on the command line execute the ISS export command. The -h option provides detailed help:

```
inter-server-sync export -h
```

The export procedure creates an output directory with all the needed data for the import procedure.

Procedure: Copy export directory to peripheral server

1. Contents from the hub server needs to be synchronized to the peripheral server. On the command line, as root, execute:

```
rsync -r <PATH_EXPORTED_DIR> root@<TARGET_SERVER>:~/
```

When all contents is copied, start importing it.

Procedure: Import data on peripheral server

1. On the peripheral server, on the command line execute the ISS import command. The -h option provides detailed help:

```
inter-server-sync import -h
```

Database connection configuration

Database connection configuration is loaded by default from **/etc/rhn/rhn.conf**. Properties file location can be overridden with parameter **--serverConfig**.

Known limitations

- Hub and peripheral servers need to be on the same version.

- Export and import organization should have exactly the same name. The organization name is case sensitive.

Managing Large Scale Deployments in a Retail Environment

SUSE Multi-Linux Manager for Retail 5.1 is an open source infrastructure management solution, optimized and tailored specifically for the retail industry. It uses the same technology as SUSE Multi-Linux Manager, but is customized to address the needs of retail organizations.

SUSE Multi-Linux Manager for Retail is designed for use in retail situations where customers can use point-of-service terminals to purchase or exchange goods, take part in promotions, or collect loyalty points. In addition to retail installations, it can also be used for novel purposes, such as maintaining student computers in an educational environment, or self-service kiosks in banks or hospitals.

SUSE Multi-Linux Manager for Retail is intended for use in installations that include servers, workstations, point-of-service terminals, and other devices. It allows administrators to install, configure, and update the software on their servers, and manage the deployment and provisioning of point-of-service machines.

Point-of-Service (POS) terminals can come in many different formats, such as point-of-sale terminals, kiosks, digital scales, self-service systems, and reverse-vending systems. Every terminal, however, is provided by a vendor, who set basic information about the device in the firmware. SUSE Multi-Linux Manager for Retail accesses this vendor information to determine how best to work with the terminal in use.

In most cases, different terminals will require a different operating system (OS) image to ensure they work correctly. For example, an information kiosk has a high-resolution touchscreen, where a cashier terminal might only have a very basic display. While both of these terminals require similar processing and network functionality, they will require different OS images. The OS images ensure that the different display mechanisms work correctly.

For more information about setting up and using SUSE Multi-Linux Manager for Retail, see **Retail › Retail-overview**.

Tuning Large Scale Deployments

SUSE Multi-Linux Manager is designed by default to work on small and medium scale installations. For installations with more than 1000 clients per SUSE Multi-Linux Manager Server, adequate hardware sizing and parameter tuning must be performed.

⚠️ The instructions in this section can have severe and catastrophic performance impacts when improperly used. In some cases, they can cause SUSE Multi-Linux Manager to completely cease functioning. Always test changes before implementing them in a production environment. During implementation, take care when changing parameters. Monitor performance before and after each change, and revert any steps that do not produce the expected result.

⚠️ We strongly recommend that you contact SUSE Consulting for assistance with tuning.

SUSE will not provide support for catastrophic failure when these advanced parameters are modified without consultation.

⚠️ Tuning is not required on installations of fewer than 1000 clients. Do not perform these instructions on small or medium scale installations.

The Tuning Process

Any SUSE Multi-Linux Manager installation is subject to a number of design and infrastructure constraints that, for the purposes of tuning, we call environmental variables. Environmental variables can include the total number of clients, the number of different operating systems under management, and the number of software channels.

Environmental variables influence, either directly or indirectly, the value of most configuration parameters. During the tuning process, the configuration parameters are manipulated to improve system performance.

Before you begin tuning, you will need to estimate the best setting for each environment variable, and adjust the configuration parameters to suit.

To help you with the estimation process, we have provided you with a dependency graph. Locate the environmental variables on the dependency graph to determine how they will influence other variables and parameters.

Environmental variables are represented by graph nodes in a rectangle at the top of the dependency graph. Each node is connected to the relevant parameters that might need tuning. Consult the relevant sections in this document for more information about recommended values.

Tuning one parameter might require tuning other parameters, or changing hardware, or the infrastructure. When you change a parameter, follow the arrows from that node on the graph to determine what other

parameters might need adjustment. Continue through each parameter until you have visited all nodes on the graph.
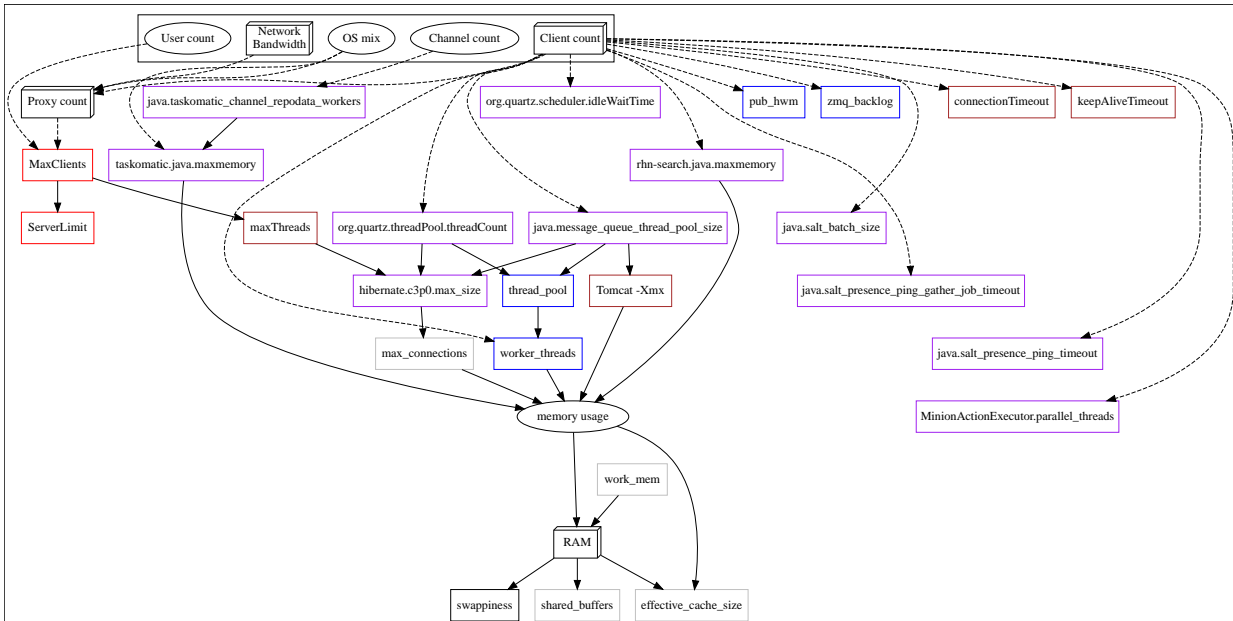
Key to the Dependency Graph

- 3D boxes are hardware design variables or constraints

- Oval-shaped boxes are software or system design variables or constraints

- Rectangle-shaped boxes are configurable parameters, color-coded by configuration file:

  - Red: Apache httpd configuration files

  - Blue: Salt configuration files

  - Brown: Tomcat configuration files

  - Grey: PostgreSQL configuration files

  - Purple: /etc/rhn/rhn.conf

- Dashed connecting lines indicate a variable or constraint that might require a change to another parameter

- Solid connecting lines indicate that changing a configuration parameter requires checking another one to prevent issues

After the initial tuning has been completed, you will need to consider tuning again in these cases:

- If your tuning inputs change significantly

- If special conditions arise that require a certain parameter to be changed. For example, if specific warnings appear in a log file.

- If performance is not satisfactory

To re-tune your installation, you will need to use the dependency graph again. Start from the node where significant change has happened.

Environmental Variables

This section contains information about environmental variables (inputs to the tuning process).

Network Bandwidth

A measure of the typically available egress bandwith from the SUSE Multi-Linux Manager Server host to the clients or SUSE Multi-Linux Manager Proxy hosts. This should take into account network hardware and topology as well as possible capacity limits on switches, routers, and other network equipment between the server and clients.

Channel count

The number of expected channels to manage. Includes any vendor-provided, third-party, and cloned or staged channels.

Client count

The total number of actual or expected clients. It is important to tune any parameters in advance of a client count increase, whenever possible.

OS mix

The number of distinct operating system versions that managed clients have installed. This is ordered by family (SUSE Linux Enterprise, openSUSE, Red Hat Enterprise Linux, or Ubuntu based). Storage and computing requirements are different in each case.

User count

The expected maximum amount of concurrent users interacting with the Web UI plus the number of programs simultaneously using the XMLRPC API. Includes spacecmd, spacewalk-clone-by-date, and similar.

Parameters

This section contains information about the available parameters.

MaxClients

Description	The maximum number of HTTP requests served simultaneously by Apache httpd. Proxies, Web UI, and XMLRPC API clients each consume one. Requests exceeding the parameter will be queued and might result in timeouts.
Tune when	User count and proxy count increase significantly and this line appears in /var/log/apache2/error_log: [...] [mpm_prefork:error] [pid ...] AH00161: server reached MaxRequestWorkers setting, consider raising the MaxRequestWorkers setting.
Value default	150
Value recommendation	150-500
Location	/etc/apache2/server-tuning.conf, in the prefork.c section
Example	MaxClients = 200
After changing	Immediately change ServerLimit and check maxThreads for possible adjustment.
Notes	This parameter was renamed to MaxRequestWorkers, both names are valid.
More information	https://httpd.apache.org/docs/2.4/en/mod/mpm_common.html#maxrequestworkers

ServerLimit

Description	The number of Apache httpd processes serving HTTP requests simultaneously. The number must equal MaxClients.
Tune when	MaxClients changes
Value default	150
Value recommendation	The same value as MaxClients
Location	/etc/apache2/server-tuning.conf, in the prefork.c section
Example	ServerLimit = 200

More information	https://httpd.apache.org/docs/2.4/en/mod/mpm_common.html#serverlimit

maxThreads

Description	The number of Tomcat threads dedicated to serving HTTP requests
Tune when	MaxClients changes. maxThreads must always be equal or greater than MaxClients
Value default	150
Value recommendation	The same value as MaxClients
Location	/etc/tomcat/server.xml
Example	<Connector port="8009" protocol="AJP/1.3" redirectPort="8443" URIEncoding="UTF-8" address="127.0.0.1" maxThreads="200" connectionTimeout="20000"/>
More information	https://tomcat.apache.org/tomcat-9.0-doc/config/http.html

connectionTimeout

Description	The number of milliseconds before a non-responding AJP connection is forcibly closed.
Tune when	Client count increases significantly and AH00992, AH00877, and AH01030 errors appear in Apache error logs during a load peak.
Value default	900000
Value recommendation	20000-3600000
Location	/etc/tomcat/server.xml
Example	<Connector port="8009" protocol="AJP/1.3" redirectPort="8443" URIEncoding="UTF-8" address="127.0.0.1" maxThreads="200" connectionTimeout="1000000" keepAliveTimeout="300000"/>

More information	https://tomcat.apache.org/tomcat-9.0-doc/config/http.html

keepAliveTimeout

Description	The number of milliseconds without data exchange from the JVM before a non-responding AJP connection is forcibly closed.
Tune when	Client count increases significantly and AH00992, AH00877, and AH01030 errors appear in Apache error logs during a load peak.
Value default	300000
Value recommendation	20000-600000
Location	/etc/tomcat/server.xml
Example	<Connector port="8009" protocol="AJP/1.3" redirectPort="8443" URIEncoding="UTF-8" address="127.0.0.1" maxThreads="200" connectionTimeout="1000000" keepAliveTimeout="400000"/>
More information	https://tomcat.apache.org/tomcat-9.0-doc/config/http.html

Tomcat's -Xmx

Description	The maximum amount of memory Tomcat can use
Tune when	java.message_queue_thread_pool_size is increased or OutOfMemoryException errors appear in /var/log/rhn/rhn_web_ui.log
Value default	1 GiB
Value recommendation	4-8 GiB
Location	/etc/tomcat/conf.d/tomcat_java_opts.conf
Example	JAVA_OPTS="… -Xmx8G …"
After changing	Check memory usage

More information	https://docs.oracle.com/javase/8/docs/technotes/tools/windows/java.html

java.disable_list_update_status

Description	Disable displaying the update status for clients of a system group
Tune when	displaying the update status causes timeouts
Value default	false
Value recommendation	
Location	/etc/rhn/rhn.conf
Example	java.disable_list_update_status = true
After changing	?
Notes	
More information	man rhn.conf

java.message_queue_thread_pool_size

Description	The maximum number of threads in Tomcat dedicated to asynchronous operations
Tune when	Client count increases significantly
Value default	5
Value recommendation	50 - 150
Location	/etc/rhn/rhn.conf
Example	java.message_queue_thread_pool_size = 50

After changing	Check hibernate.c3p0.max_size, as each thread consumes a PostgreSQL connection, starvation might happen if the allocated connection pool is insufficient. Check thread_pool, as each thread might perform Salt API calls, starvation might happen if the allocated Salt thread pool is insufficient. Check Tomcat's -Xmx, as each thread consumes memory, OutOfMemoryException might be raised if insufficient.
Notes	Incoming Salt events are handled in separate thread pool, see java.salt_event_thread_pool_size
More information	man rhn.conf

java.salt_batch_size

Description	The maximum number of minions concurrently executing a scheduled action.
Tune when	Client count reaches several thousands and actions are not executed quickly enough.
Value default	200
Value recommendation	200-500
Location	/etc/rhn/rhn.conf
Example	java.salt_batch_size = 300
After changing	Check memory usage. Monitor memory usage closely before and after the change.
More information	**Specialized-guides › Salt**

java.salt_event_thread_pool_size

Description	The maximum number of threads in Tomcat dedicated to handling of incoming Salt events.

Tune when	The number of queued Salt events grows. Typically, this can happen during onboarding of large number of minions with higher value of java.salt_presence_ping_timeout. The number of events can be queried by echo "select count(*) from susesaltevent;" | spacewalk-sql --select-mode-direct -
Value default	8
Value recommendation	20-100
Location	/etc/rhn/rhn.conf
Example	java.salt_event_thread_pool_size = 50
After changing	Check the length of Salt event queue. Check hibernate.c3p0.max_size, as each thread consumes a PostgreSQL connection, starvation might happen if the allocated connection pool is insufficient. Check thread_pool, as each thread might perform Salt API calls, starvation might happen if the allocated Salt thread pool is insufficient. Check Tomcat's -Xmx, as each thread consumes memory, OutOfMemoryException might be raised if insufficient.
More information	man rhn.conf

java.salt_presence_ping_timeout

Description	Before any action is executed on a client, a presence ping is executed to make sure the client is reachable. This parameter sets the amount of time before a second command (in most cases state.apply or any other Salt function) is sent to the client to verify its presence. Having many clients typically means some will respond faster than others, so this timeout could be raised to accommodate for the slower ones.

Tune when	Client count increases significantly, or some clients are responding correctly but too slowly, and SUSE Multi-Linux Manager excludes them from calls. This line appears in /var/log/rhn/rhn_web_ui.log: "Got no result for <COMMAND> on minion <MINION_ID> (minion did not respond in time)"
Value default	4 seconds
Value recommendation	4-20 seconds
Location	/etc/rhn/rhn.conf
Example	java.salt_presence_ping_timeout = 10
After changing	Large java.salt_presence_ping_timeout value can reduce overall throughput. This can be compensated by increasing java.salt_event_thread_pool_size
More information	**Specialized-guides › Salt**

java.salt_presence_ping_gather_job_timeout

Description	Before any action is executed on a client, a presence ping is executed to make sure the client is reachable. After java.salt_presence_ping_timeout seconds have elapsed without a response, a second command (in most cases state.apply or any other Salt function) is sent to the client and if there is no response from the client for the amount of seconds specified with this parameter one more call (saltutil.find_job) is sent for a final check. This parameter sets the number of seconds after the second command after which the client is definitely considered timeout. Having many clients typically means some will respond faster than others, so this timeout could be raised to accommodate for the slower ones.
Tune when	Client count increases significantly, or some clients are responding correctly but too slowly, and SUSE Multi-Linux Manager excludes them from calls. This line appears in /var/log/rhn/rhn_web_ui.log: "Got no result for <COMMAND> on minion <MINION_ID> (minion did not respond in time)"

Value default	1 second
Value recommendation	1-50 seconds
Location	/etc/rhn/rhn.conf
Example	java.salt_presence_ping_gather_job_timeout = 20
More information	**Specialized-guides › Salt**

java.taskomatic_channel_repodata_workers

Description	Whenever content is changed in a software channel, its metadata needs to be recomputed before clients can use it. Channel-altering operations include the addition of a patch, the removal of a package or a repository synchronization run. This parameter specifies the maximum number of Taskomatic threads that SUSE Multi-Linux Manager will use to recompute the channel metadata. Channel metadata computation is both CPU-bound and memory-heavy, so raising this parameter and operating on many channels simultaneously could cause Taskomatic to consume significant resources, but channels will be available to clients sooner.
Tune when	Channel count becomes larger than 50, or more concurrent operations on channels are expected.
Value default	2
Value recommendation	2-10
Location	/etc/rhn/rhn.conf
Example	java.taskomatic_channel_repodata_workers = 4
After changing	Check taskomatic.java.maxmemory for adjustment, as every new thread will consume memory
More information	man rhn.conf

taskomatic.java.maxmemory

Description	The maximum amount of memory Taskomatic can use. Generation of metadata, especially for some OSs, can be memory-intensive, so this parameter might need raising depending on the managed OS mix.
Tune when	java.taskomatic_channel_repodata_workers increases, OSs are added to SUSE Multi-Linux Manager (particularly Red Hat Enterprise Linux or Ubuntu), or OutOfMemoryException errors appear in /var/log/rhn/rhn_taskomatic_daemon.log.
Value default	4096 MiB
Value recommendation	4096-16384 MiB
Location	/etc/rhn/rhn.conf
Example	taskomatic.java.maxmemory = 8192
After changing	Check memory usage.
More information	man rhn.conf

org.quartz.threadPool.threadCount

Description	The number of Taskomatic worker threads. Increasing this value allows Taskomatic to serve more clients in parallel.
Tune when	Client count increases significantly
Value default	20
Value recommendation	20-200
Location	/etc/rhn/rhn.conf
Example	org.quartz.threadPool.threadCount = 100
After changing	Check hibernate.c3p0.max_size and thread_pool for adjustment
More information	http://www.quartz-scheduler.org/documentation/2.4.0-SNAPSHOT/configuration.html

org.quartz.scheduler.idleWaitTime

Description	Cycle time for Taskomatic. Decreasing this value lowers the latency of Taskomatic.
Tune when	Client count is in the thousands.
Value default	5000 ms
Value recommendation	1000-5000 ms
Location	/etc/rhn/rhn.conf
Example	org.quartz.scheduler.idleWaitTime = 1000
More information	http://www.quartz-scheduler.org/documentation/2.4.0-SNAPSHOT/configuration.html

MinionActionExecutor.parallel_threads

Description	Number of Taskomatic threads dedicated to sending commands to Salt clients as a result of actions being executed.
Tune when	Client count is in the thousands.
Value default	1
Value recommendation	1-10
Location	/etc/rhn/rhn.conf
Example	taskomatic.minion_action_executor.parallel_threads = 10

SSHMinionActionExecutor.parallel_threads

Description	Number of Taskomatic threads dedicated to sending commands to Salt SSH clients as a result of actions being executed.
Tune when	Client count is in the hundreds.
Value default	20

Value recommendation	20-100
Location	/etc/rhn/rhn.conf
Example	taskomatic.sshminion_action_executor.parallel_threads = 40

hibernate.c3p0.max_size

Description	Maximum number of PostgreSQL connections simultaneously available to both Tomcat and Taskomatic. If any of those components requires more concurrent connections, their requests will be queued.
Tune when	java.message_queue_thread_pool_size or maxThreads increase significantly, or when org.quartz.threadPool.threadCount has changed significantly. Each thread consumes one connection in Taskomatic and Tomcat, having more threads than connections might result in starving.
Value default	20
Value recommendation	100 to 200, higher than the maximum of java.message_queue_thread_pool_size + maxThreads and org.quartz.threadPool.threadCount
Location	/etc/rhn/rhn.conf
Example	hibernate.c3p0.max_size = 100
After changing	Check max_connections for adjustment.
More information	https://www.mchange.com/projects/c3p0/#maxPoolSize

rhn-search.java.maxmemory

Description	The maximum amount of memory that the rhn-search service can use.

Tune when	Client count increases significantly, and OutOfMemoryException errors appear in journalctl -u rhn-search.
Value default	512 MiB
Value recommendation	512-4096 MiB
Location	/etc/rhn/rhn.conf
Example	rhn-search.java.maxmemory = 4096
After changing	Check memory usage.

shared_buffers

Description	The amount of memory reserved for PostgreSQL shared buffers, which contain caches of database tables and index data.
Tune when	RAM changes
Value default	25% of total RAM
Value recommendation	25-40% of total RAM
Location	/var/lib/containers/storage/volumes/var-pgsql/_data/postgresql.conf
Example	shared_buffers = 8192MB
After changing	Check memory usage.
More information	https://www.postgresql.org/docs/15/runtime-config-resource.html#GUC-SHARED-BUFFERS

max_connections

Description	Maximum number of PostgreSQL connections available to applications. More connections allow for more concurrent threads/workers in various components (in particular Tomcat and Taskomatic), which generally improves performance. However, each connection consumes resources, in particular work_mem megabytes per sort operation per connection.
Tune when	hibernate.c3p0.max_size changes significantly, as that parameter determines the maximum number of connections available to Tomcat and Taskomatic
Value default	400
Value recommendation	Depends on other settings, use /usr/lib/susemanager/bin/susemanager-connection-check to obtain a recommendation.
Location	/var/lib/containers/storage/volumes/var-pgsql/_data/postgresql.conf
Example	max_connections = 250
After changing	Check memory usage. Monitor memory usage closely before and after the change.
More information	https://www.postgresql.org/docs/15/runtime-config-connection.html#GUC-MAX-CONNECTIONS

work_mem

Description	The amount of memory allocated by PostgreSQL every time a connection needs to do a sort or hash operation. Every connection (as specified by max_connections) might make use of an amount of memory equal to a multiple of work_mem.

Tune when	Database operations are slow because of excessive temporary file disk I/O. To test if that is happening, add log_temp_files = 5120 to /var/lib/containers/storage/volumes/var-pgsql/_data/postgresql.conf, restart PostgreSQL, and monitor the PostgreSQL log files. If you see lines containing LOG: temporary file: try raising this parameter's value to help reduce disk I/O and speed up database operations.
Value recommendation	2-20 MB
Location	/var/lib/containers/storage/volumes/var-pgsql/_data/postgresql.conf
Example	work_mem = 10MB
After changing	check if the SUSE Multi-Linux Manager Server might need additional RAM.
More information	https://www.postgresql.org/docs/15/runtime-config-resource.html#GUC-WORK-MEM

effective_cache_size

Description	Estimation of the total memory available to PostgreSQL for caching. It is the explicitly reserved memory (shared_buffers) plus any memory used by the kernel as cache/buffer.
Tune when	Hardware RAM or memory usage increase significantly
Value recommendation	Start with 75% of total RAM. For finer settings, use shared_buffers + free memory + buffer/cache memory. Free and buffer/cache can be determined via the free -m command (free and buff/cache in the output respectively)
Location	/var/lib/containers/storage/volumes/var-pgsql/_data/postgresql.conf
Example	effective_cache_size = 24GB
After changing	Check memory usage

Notes	This is an estimation for the query planner, not an allocation.
More information	https://www.postgresql.org/docs/15/runtime-config-query.html#GUC-EFFECTIVE-CACHE-SIZE

thread_pool

Description	The number of worker threads serving Salt API HTTP requests. A higher number can improve parallelism of SUSE Multi-Linux Manager Server-initiated Salt operations, but will consume more memory.
Tune when	java.message_queue_thread_pool_size or org.quartz.threadPool.threadCount are changed. Starvation can occur when there are more Tomcat or Taskomatic threads making simultaneous Salt API calls than there are Salt API worker threads.
Value default	100
Value recommendation	100-500, but should be higher than the sum of java.message_queue_thread_pool_size and org.quartz.threadPool.threadCount
Location	/etc/salt/master.d/susemanager.conf, in the rest_cherrypy section.
Example	thread_pool: 100
After changing	Check worker_threads for adjustment.
More information	https://docs.saltproject.io/en/latest/ref/netapi/all/salt.netapi.rest_cherrypy.html#performance-tuning

worker_threads

Description	The number of salt-master worker threads that process commands and replies from minions and the Salt API. Increasing this value, assuming sufficient resources are available, allows Salt to process more data in parallel from minions without timing out, but will consume significantly more RAM (typically about 70 MiB per thread). Setting this value to very high values could cause opposite effect as the workers will compete to each other for the CPU resources and the performance could be dropped significantly.
Tune when	Client count increases significantly, thread_pool increases significantly, or SaltReqTimeoutError or Message timed out errors appear in /var/log/salt/master could be a sign of too low or too high value of this parameter.
Value default	8
Value recommendation	8-32, depending on the number of the CPU cores available for the server, it is recommended to keep the value slightly less than the number of CPU cores.
Location	/etc/salt/master.d/tuning.conf
Example	worker_threads: 16
After changing	Check memory usage. Monitor memory usage closely before and after the change. It makes sense to monitor the salt-master stats event by enabling master_stats and adjusting master_stats_event_iter to fine tune the value of this parameter.
More information	https://docs.saltproject.io/en/latest/ref/configuration/master.html#worker-threads

auth_events

Description	Determines whether the master will fire authentication events. Authentication events are fired when a minion performs an authentication check with the master. It helps to reduce the number of events published with the Salt Master Event Publisher and reduce the workload on Event Publisher subscribers.

Tune when	Large amount of salt/auth events published in the Salt event bus, which in most cases are useless for the subscribers.
Value default	True
Value recommendation	False
Location	/etc/salt/master.d/tuning.conf
Example	auth_events: False
More information	https://docs.saltproject.io/en/latest/ref/configuration/master.html#auth-events

minion_data_cache_events

Description	Determines whether the master will fire minion data cache events (minion/refresh/*). Minion data cache events are fired when a minion requests a minion data cache refresh. It helps to reduce the number of events published with the Salt Master Event Publisher and reduce the workload on Event Publisher subscribers.
Tune when	Large amount of minion/refresh/* events published in the Salt event bus, which in most cases are useless for the subscribers.
Value default	True
Value recommendation	False
Location	/etc/salt/master.d/tuning.conf
Example	minion_data_cache_events: False
More information	https://docs.saltproject.io/en/latest/ref/configuration/master.html#minion-data-cache-events

pub_hwm

Description	The maximum number of outstanding messages sent by salt-master. If more than this number of messages need to be sent concurrently, communication with clients slows down, potentially resulting in timeout errors during load peaks.
Tune when	Client count increases significantly and Salt request timed out. The master is not responding. errors appear when pinging minions during a load peak.
Value default	1000
Value recommendation	10000-100000
Location	/etc/salt/master.d/tuning.conf
Example	pub_hwm: 10000
More information	https://docs.saltproject.io/en/latest/ref/configuration/master.html#pub-hwm, https://zeromq.org/socket-api/#high-water-mark

zmq_backlog

Description	The maximum number of allowed client connections that have started but not concluded the opening process. If more than this number of clients connects in a very short time frame, connections are dropped and clients experience a delay re-connecting.
Tune when	Client count increases significantly and very many clients reconnect in a short time frame, TCP connections to the salt-master process get dropped by the kernel.
Value default	1000
Value recommendation	1000-5000
Location	/etc/salt/master.d/tuning.conf
Example	zmq_backlog: 2000

More information	https://docs.saltproject.io/en/latest/ref/ configuration/master.html#zmq-backlog, http://api.zeromq.org/3-0:zmq-getsockopt (ZMQ_BACKLOG)

swappiness

Description	How aggressively the kernel moves unused data from memory to the swap partition. Setting a lower parameter typically reduces swap usage and results in better performance, especially when RAM memory is abundant.
Tune when	RAM increases, or swap is used when RAM memory is sufficient.
Value default	60
Value recommendation	1-60. For 128 GB of RAM, 10 is expected to give good results.
Location	/etc/sysctl.conf
Example	vm.swappiness = 20
More information	https://documentation.suse.com/sles/15-SP6/ html/SLES-all/cha-tuning-memory.html#cha-tuning-memory-vm

wait_for_backend

Description	Determines whether the salt-broker service should wait for backend sockets to be connected before opening the sockets for listening for connections from salt-minions. When enabled, it helps to prevent collecting ZeroMQ messages with the internal buffers of the sockets and pushing them to the salt-master once connection is restored.
Tune when	Unstable connectivity between the SUSE Multi-Linux Manager Proxy and the SUSE Multi-Linux Manager Server.

Value default	False
Value recommendation	True
Location	/etc/salt/broker
Example	wait_for_backend: True
More information	Proxies Connectivity

tcp_keepalive

Description	The tcp keepalive interval to set on TCP ports. This setting can be used to tune Salt connectivity issues in messy network environments with misbehaving firewalls.
Tune when	Unstable connectivity between managed clients and the SUSE Multi-Linux Manager Proxy or the SUSE Multi-Linux Manager Server.
Value default	True
Value recommendation	True
Location	/etc/venv-salt-minon/minion.d/tuning.conf or /etc/salt/minion.d/tuning.conf, depending on the minion type.
Example	tcp_keepalive: True
After changing	Check Minions Connectivity for more details to fine tune extra keepalive parameters.
More information	https://docs.saltproject.io/en/latest/ref/ configuration/minion.html#tcp-keepalive, Minions Connectivity

Memory Usage

Adjusting some of the parameters listed in this section can result in a higher amount of RAM being used by various components. It is important that the amount of hardware RAM is adequate after any significant change.

To determine how RAM is being used, you will need to check each process that consumes it.

Operating system

Stop all SUSE Multi-Linux Manager services and inspect the output of free -h.

Java-based components

This includes Taskomatic, Tomcat, and rhn-search. These services support a configurable memory cap.

The SUSE Multi-Linux Manager Server

Depends on many factors and can only be estimated. Measure PostgreSQL reserved memory by checking shared_buffers, permanently. You can also multiply work_mem and max_connections, and multiply by three for a worst case estimate of per-query RAM. You will also need to check the operating system buffers and caches, which are used by PostgreSQL to host copies of database data. These often automatically occupy any available RAM.

It is important that the SUSE Multi-Linux Manager Server has sufficient RAM to accommodate all of these processes, especially OS buffers and caches, to have reasonable PostgreSQL performance. We recommend you keep several gigabytes available at all times, and add more as the database size on disk increases.

Whenever the expected amount of memory available for OS buffers and caches changes, update the effective_cache_size parameter to have PostgreSQL use it correctly. You can calculate the total available by finding the total RAM available, less the expected memory usage.

To get a live breakdown of the memory used by services on the SUSE Multi-Linux Manager Server, use this command:

```
pidstat -p ALL -r --human 1 60 | tee pidstat-memory.log
```

This command will save a copy of displayed data in the pidstat-memory.log file for later analysis.

Monitoring Large Scale Deployments

You can monitor your SUSE Multi-Linux Manager environment using Prometheus and Grafana. SUSE Multi-Linux Manager Server and Proxy are able to provide self-health metrics. You can also install and manage a number of Prometheus exporters on clients.

Prometheus and Grafana packages are included in the SUSE Multi-Linux Manager Client Tools for SUSE Linux Enterprise 12, SUSE Linux Enterprise 15, Red Hat Enterprise Linux 7, Red Hat Enterprise Linux 8 and openSUSE 15.x.

You need to install Prometheus and Grafana on a machine separate from the SUSE Multi-Linux Manager Server. We recommend you use a managed client as your monitoring server.

It is recommended to monitor the Salt event bus in the large scale deployments with Saline to identify possible bottlenecks.

For more information on monitoring, see **Administration › Monitoring**.

Quick Start: SAP Overview

This guide shows you how to use SUSE Multi-Linux Manager to install and configure an SAP cluster. It guides you through setting up a single SUSE Multi-Linux Manager Server, preparing your client systems, and configuring the cluster using formulas.

- For more information about SAP, see the SAP documentation at https://documentation.suse.com/sles-sap.

- For more information about SUSE Multi-Linux Manager, see the SUSE Multi-Linux Manager documentation at https://documentation.suse.com/MLM.

Prepare Server

Before you start you need to deploy the SUSE Multi-Linux Manager Server. The method for deploying the SUSE Multi-Linux Manager Server varies depending on your hardware and environment.

SUSE Multi-Linux Manager is deployed using the `mgradm` command. During the deployment process, when you are prompted for which product to install, select SUSE Multi-Linux Manager Server. For more information about deploying the SUSE Multi-Linux Manager Server, see **Installation-and-upgrade › Container-deployment**.

You need to do some configuration to set up the SUSE Multi-Linux Manager Web UI. In your browser, navigate to the URL of the server, and configure your administration access to the Web UI.

Now you can use the Web UI to prepare software channels and activation keys for your clients.

On the SUSE Multi-Linux Manager Server, add the appropriate SAP channels: From the Web UI, add `SUSE Linux Enterprise Server 15 for SAP`.

Synchronize the SUSE Multi-Linux Manager Server with the SUSE Customer Center. You can do this using the Web UI. Add the new channel to your activation key.

To check if a channel has finished synchronizing navigate to **Admin › Setup Wizard** and select the Products tab. This dialog displays a completion bar for each product when they are being synchronized.

> ℹ Software channels can be very large. The initial channel synchronization can sometimes take up to several hours.
>
> When the initial synchronization is complete, we recommended you clone the channel before you work with it. This gives you a backup of the original synchronization data.

Preparing Clients

Your SAP cluster requires several client systems. Prepare your clients on physical or virtual hardware, and ensure you have SUSE Linux Enterprise Server 15 for SAP installation media ready. You cannot create an SAP cluster without the SUSE Linux Enterprise Server SAP extension, as it provides tooling specific to SAP.

One of the key features of SAP is high availability of the cluster. Every component within an SAP cluster has redundancy and failover protection. When you are preparing your clients, ensure you have enough hardware and infrastructure to allow for this. For more information about hardware requirements, see https://documentation.suse.com/sles-sap/15-SP4/html/SLES-SAP-installation/cha-plan.html# sec-hardware

For more information about the clients you need to set up for an SAP cluster, see https://documentation.suse.com/sbp/all.

Register Clients to the SUSE Customer Center

Each client within your SAP cluster must be registered with the SUSE Customer Center. To obtain your registration code, navigate to https://scc.suse.com/login in your web browser. Log in to your SCC account, or follow the prompts to create a new account. Click the **[Subscriptions]** tab to see the registration code. When you install SUSE Linux Enterprise Server 15 for SAP the Unified Installer prompts you for the code.

For more information about registering SUSE Multi-Linux Manager with SUSE Customer Center, see **Installation-and-upgrade › General-requirements**.

Configure the Clients for Clustering

Every client system must have all the other client systems listed in their /etc/hosts file. Open the /etc/hosts file on each client, and add the hostname for each of the other clients.

Create a Shared Storage Device

Each of the clients needs to be able to access a shared disk. The shared disk can be physical hardware connected by ethernet, or you can set up a virtual disk and access it with iSCSI.

If you use a virtual disk, consider hosting it on a separate system. Do not use a client machine to host the shared storage disk.

Download the SAP Installation Software

Download the SAP installation media and save a copy on each client. The software that you require differs depending on your environment. For example, if you are using HANA, you need the SAP HANA platform. If you

are using Netweaver, you need different packages. These software packages are provided by SAP, not by SUSE.

Ensure you have saved the installation software in the same file system location on each client. Alternatively, save it to a shared NFS drive.

Configure Clients to Use Latest module.run

Each client needs to be configured to use the latest version of module.run. On each of the client machines, open the /etc/salt/minion configuration file and add or edit this line:

```
use_superseded:
  - module.run
```

Restart the salt-minion process to enable the changes:

```
systemctl restart salt-minion
```

Install Additional Disks for HANA

For the clients that are going to run the HANA database, you require an additional storage device. This device is used to store files required by HANA, which are located in the /hana/ directory.

We recommend that this storage device be at least 20 GB. For some installations, you might require more, and it is possible to use multiple disks to provide this storage. For comprehensive hardware requirements, see https://documentation.suse.com/sbp/all.

Register Clients to the Server

First of all, make sure you have an activation key that is associated with the SLE-Product-SLES_SAP15 base channel. For more information about activation keys, see **Client-configuration › Activation-keys**.

In the SUSE Multi-Linux Manager Web UI, navigate to **Systems › Bootstrapping**. Fill in the appropriate details, and make sure you check the Manage System Completely via SSH checkbox. In the Activation Key field, select the SLES for SAP activation key.

For more information about registering, see **Client-configuration › Registration-webui**.

Configure Clients

SUSE Multi-Linux Manager uses formulas with forms to configure your SAP clients. There are two formulas that you need to use:

- Hana to configure the HANA database

- Cluster to configure the clients into a cluster

The formulas are provided by packages that you can download with your package manager. You need to install the formulas on the SUSE Multi-Linux Manager Server. When you have installed the package, you can use the SUSE Multi-Linux Manager Web UI to enable and configure the formulas. As you go through the formula configuration process, provide details of the clients that contain your SAP cluster, to set them up appropriately.

To install the formulas on the SUSE Multi-Linux Manager Server, use your package manager to install these packages:

- saphanabootstrap-formula

- sapnwbootstrap-formula

- drbd-formula

- habootstrap-formula

- salt-shaptools

> ❗ The order that you enable and configure the formulas is important. You must enable, configure, and apply the HANA formula first. Then you can enable, configure, and apply the cluster formula. If you perform these steps in the wrong order, your SAP installation fails.

Enable and Configure the HANA Formula

In the SUSE Multi-Linux Manager Web UI, navigate to **Systems › System List** and click the client to use as the primary client in the cluster.

Navigate to the Formulas tab, locate the Sap Hana Deployment heading, and check the Saphanabootstrap formula in the list. Click **[Save]** and apply the highstate to activate the formula.

When the formula is activated, navigate to the **Formulas › Hana** tab, and complete the details in the form.

Make sure you check Install required packages to install everything you need on the client. In the Nodes sections, type the short hostname of the client to install the HANA database or the hostname you can retrieve on the command line with:

```
salt '<client-name>' grains.item host
```

Provide further details for the installation.

Complete the remaining details according to your environment, click **[Save]**, and apply the highstate. When

the highstate is complete, you can go on to apply the cluster formula.

Enable and Configure the Cluster Formula

In the SUSE Multi-Linux Manager Web UI, navigate to **Systems › System List** and click the client to use as the primary client in the cluster.

Navigate to the Formulas tab, locate the Cluster heading, and check the Habootstrap formula in the list. Click **[Save]** and apply the highstate to activate the formula.

When the formula is activated, navigate to the **Formulas › Cluster** tab, and complete the details in the form.

Make sure you check Install required packages to install everything you need on the client. Give your cluster a name, and specify the hostname of the primary client in the cluster.

Complete the remaining details according to your environment, click **[Save]**, and apply the highstate.

test-client ?

Details   Software   Configuration   Provisioning   Groups   Audit   States   Formulas   Events

Configuration   Habootstrap Formula   Saphanabootstrap Formula

On this page you can configure Salt Formulas to automatically install and configure software.

← Prev   Next →   Save Formula   Clear values

Saphanabootstrap Formula

SAP HANA deployment formula

⌃ HANA

HANA

Install required packages: ☑   ?

⌃ Nodes   +

Nodes

⌃   −

Hostname to install HANA: [   ] ▣   ?

HANA system identifier (SID):   [   ]   ?

HANA instance number: [   ]   ?

SAP user password: [   ]   🔍   👁   ?

HANA scenario type: [performance-optimized   ▾]   ?

Install HANA: ☑   ?

⌃ Install new HANA instance

Install new HANA instance

Downloaded HANA software path: [   ]   ?

Machine root user: [   ]   ?

Machine root password: [   ]   🔍   👁   ?

Use configuration file: ☐   ?

SAP admin password (<sid>adm):   [   ]   🔍   👁

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