Red Hat Enterprise Linux 8

Automating system administration by using RHEL system roles

Consistent and repeatable configuration of RHEL deployments across multiple hosts with Red Hat Ansible Automation Platform playbooks

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Abstract

The Red Hat Enterprise Linux (RHEL) system roles are a collection of Ansible roles, modules, and playbooks that help automate the consistent and repeatable administration of RHEL systems. With RHEL system roles, you can efficiently manage large inventories of systems by running configuration playbooks from a single system.

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PROVIDING FEEDBACK ON RED HAT DOCUMENTATION

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CHAPTER 1. INTRODUCTION TO RHEL SYSTEM ROLES

By using RHEL system roles, you can remotely manage the system configurations of multiple RHEL systems across major versions of RHEL.

Important terms and concepts

The following describes important terms and concepts in an Ansible environment:

Control node

A control node is the system from which you run Ansible commands and playbooks. Your control node can be an Ansible Automation Platform, Red Hat Satellite, or a RHEL 9, 8, or 7 host. For more information, see Preparing a control node on RHEL 8 .

Managed node

Managed nodes are the servers and network devices that you manage with Ansible. Managed nodes are also sometimes called hosts. Ansible does not have to be installed on managed nodes. For more information, see Preparing a managed node .

Ansible playbook

In a playbook, you define the configuration you want to achieve on your managed nodes or a set of steps for the system on the managed node to perform. Playbooks are Ansible's configuration, deployment, and orchestration language.

Inventory

In an inventory file, you list the managed nodes and specify information such as IP address for each managed node. In the inventory, you can also organize the managed nodes by creating and nesting groups for easier scaling. An inventory file is also sometimes called a hostfile.

Available roles on a Red Hat Enterprise Linux 8 control node

On a Red Hat Enterprise Linux 8 control node, the **rhel-system-roles** package provides the following roles:

Role name	Role description	Chapter title
certificate	Certificate Issuance and Renewal	Requesting certificates by using RHEL system roles
cockpit	Web console	Installing and configuring web console with the cockpit RHEL system role
crypto_policies	System-wide cryptographic policies	Setting a custom cryptographic policy across systems
firewall	Firewalld	Configuring firewalld by using system roles
ha_cluster	HA Cluster	Configuring a high-availability cluster by using system roles
kdump	Kernel Dumps	Configuring kdump by using RHEL system roles

Role name	Role description	Chapter title
kernel_settings	Kernel Settings	Using Ansible roles to permanently configure kernel parameters
logging	Logging	Using the logging system role
metrics	Metrics (PCP)	Monitoring performance by using RHEL system roles
microsoft.sql.server	Microsoft SQL Server	Configuring Microsoft SQL Server by using the microsoft.sql.server Ansible role
network	Networking	Using the network RHEL system role to manage InfiniBand connections
nbde_client	Network Bound Disk Encryption client	Using the nbde_client and nbde_server system roles
nbde_server	Network Bound Disk Encryption server	Using the nbde_client and nbde_server system roles
postfix	Postfix	Variables of the postfix role in system roles
postgresql	PostgreSQL	Installing and configuring PostgreSQL by using the postgresql RHEL system role
selinux	SELinux	Configuring SELinux by using system roles
ssh	SSH client	Configuring secure communication with the ssh system roles
sshd	SSH server	Configuring secure communication with the ssh system roles
storage	Storage	Managing local storage by using RHEL system roles
tlog	Terminal Session Recording	Configuring a system for session recording by using the tlog RHEL system role
timesync	Time Synchronization	Configuring time synchronization by using RHEL system roles
vpn	VPN	Configuring VPN connections with IPsec by using the vpn RHEL system role

Additional resources

- Red Hat Enterprise Linux (RHEL) system roles

- **/usr/share/ansible/roles/rhel-system-roles.*<role_name>*/README.md** file
- **/usr/share/doc/rhel-system-roles/*<role_name>*/** directory

CHAPTER 2. PREPARING A CONTROL NODE AND MANAGED NODES TO USE RHEL SYSTEM ROLES

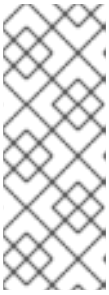
Before you can use individual RHEL system roles to manage services and settings, you must prepare the control node and managed nodes.

2.1. PREPARING A CONTROL NODE ON RHEL 8

Before using RHEL system roles, you must configure a control node. This system then configures the managed hosts from the inventory according to the playbooks.

Prerequisites

- RHEL 8.6 or later is installed. For more information about installing RHEL, see Performing a standard RHEL 8 installation.



NOTE

In RHEL 8.5 and earlier versions, Ansible packages were provided through Ansible Engine instead of Ansible Core, and with a different level of support. Do not use Ansible Engine because the packages might not be compatible with Ansible automation content in RHEL 8.6 and later. For more information, see Scope of support for the Ansible Core package included in the RHEL 9 and RHEL 8.6 and later AppStream repositories.

- The system is registered to the Customer Portal.
- A **Red Hat Enterprise Linux Server** subscription is attached to the system.
- Optional: An **Ansible Automation Platform** subscription is attached to the system.

Procedure

1. Create a user named **ansible** to manage and run playbooks:

```
[root@control-node]# useradd ansible
```

2. Switch to the newly created **ansible** user:

```
[root@control-node]# su - ansible
```

Perform the rest of the procedure as this user.

3. Create an SSH public and private key:

```
[ansible@control-node]$ ssh-keygen
Generating public/private rsa key pair.
Enter file in which to save the key (/home/ansible/.ssh/id_rsa):
Enter passphrase (empty for no passphrase): <password>
Enter same passphrase again: <password>
...
```

Use the suggested default location for the key file.

4. Optional: To prevent Ansible from prompting you for the SSH key password each time you establish a connection, configure an SSH agent.

5. Create the ~/**.ansible.cfg** file with the following content:

```
[defaults]
inventory = /home/ansible/inventory
remote_user = ansible

[privilege_escalation]
become = True
become_method = sudo
become_user = root
become_ask_pass = True
```

NOTE

Settings in the ~/**.ansible.cfg** file have a higher priority and override settings from the global **/etc/ansible/ansible.cfg** file.

With these settings, Ansible performs the following actions:

- Manages hosts in the specified inventory file.
- Uses the account set in the **remote_user** parameter when it establishes SSH connections to managed nodes.
- Uses the **sudo** utility to execute tasks on managed nodes as the **root** user.
- Prompts for the root password of the remote user every time you apply a playbook. This is recommended for security reasons.

6. Create an ~/**inventory** file in INI or YAML format that lists the hostnames of managed hosts. You can also define groups of hosts in the inventory file. For example, the following is an inventory file in the INI format with three hosts and one host group named **US**:

```
managed-node-01.example.com

[US]
managed-node-02.example.com ansible_host=192.0.2.100
managed-node-03.example.com
```

Note that the control node must be able to resolve the hostnames. If the DNS server cannot resolve certain hostnames, add the **ansible_host** parameter next to the host entry to specify its IP address.

7. Install RHEL system roles:

- On a RHEL host without Ansible Automation Platform, install the **rhel-system-roles** package:

```
[root@control-node]# yum install rhel-system-roles
```

This command installs the collections in the **/usr/share/ansible/collections/ansible_collections/redhat/rhel_system_roles/** directory, and the **ansible-core** package as a dependency.

- On Ansible Automation Platform, perform the following steps as the **ansible** user:

  i. Define Red Hat automation hub as the primary source for content in the **~/.ansible.cfg** file.

  ii. Install the **redhat.rhel_system_roles** collection from Red Hat automation hub:

  ```
  [ansible@control-node]$ ansible-galaxy collection install
  redhat.rhel_system_roles
  ```

  This command installs the collection in the **~/.ansible/collections/ansible_collections/redhat/rhel_system_roles/** directory.

Next steps

- Prepare the managed nodes. For more information, see Preparing a managed node .

Additional resources

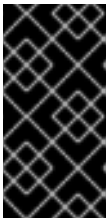
- Scope of support for the Ansible Core package included in the RHEL 9 and RHEL 8.6 and later AppStream repositories
- How to register and subscribe a system to the Red Hat Customer Portal using subscription-manager
- The **ssh-keygen(1)** manual page
- Connecting to remote machines with SSH keys using ssh-agent
- Ansible configuration settings
- How to build your inventory
- Updates to using Ansible in RHEL 8.6 and 9.0

2.2. PREPARING A MANAGED NODE

Managed nodes are the systems listed in the inventory and which will be configured by the control node according to the playbook. You do not have to install Ansible on managed hosts.

Prerequisites

- You prepared the control node. For more information, see Preparing a control node on RHEL 8 .
- You have SSH access from the control node.



IMPORTANT

Direct SSH access as the **root** user is a security risk. To reduce this risk, you will create a local user on this node and configure a **sudo** policy when preparing a managed node. Ansible on the control node can then use the local user account to log in to the managed node and run playbooks as different users, such as **root**.

Procedure

1. Create a user named **ansible**:

```
[root@managed-node-01]# useradd ansible
```

   The control node later uses this user to establish an SSH connection to this host.

2. Set a password for the **ansible** user:

```
[root@managed-node-01]# passwd ansible
Changing password for user ansible.
New password: <password>
Retype new password: <password>
passwd: all authentication tokens updated successfully.
```

   You must enter this password when Ansible uses **sudo** to perform tasks as the **root** user.

3. Install the **ansible** user's SSH public key on the managed node:

   a. Log in to the control node as the **ansible** user, and copy the SSH public key to the managed node:

```
[ansible@control-node]$ ssh-copy-id managed-node-01.example.com
/usr/bin/ssh-copy-id: INFO: Source of key(s) to be installed:
"/home/ansible/.ssh/id_rsa.pub"
The authenticity of host 'managed-node-01.example.com (192.0.2.100)' can't be
established.
ECDSA key fingerprint is
SHA256:9bZ33GJNODK3zbNhybokN/6Mq7hu3vpBXDrCxe7NAvo.
```

   b. When prompted, connect by entering **yes**:

```
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
/usr/bin/ssh-copy-id: INFO: attempting to log in with the new key(s), to filter out any that
are already installed
/usr/bin/ssh-copy-id: INFO: 1 key(s) remain to be installed -- if you are prompted now it is
to install the new keys
```

   c. When prompted, enter the password:

```
ansible@managed-node-01.example.com's password: <password>

Number of key(s) added: 1

Now try logging into the machine, with:   "ssh 'managed-node-01.example.com'"
and check to make sure that only the key(s) you wanted were added.
```

d. Verify the SSH connection by remotely executing a command on the control node:

```
[ansible@control-node]$ ssh managed-node-01.example.com whoami
ansible
```

4. Create a **sudo** configuration for the **ansible** user:

a. Create and edit the **/etc/sudoers.d/ansible** file by using the **visudo** command:

```
[root@managed-node-01]# visudo /etc/sudoers.d/ansible
```

The benefit of using **visudo** over a normal editor is that this utility provides basic checks, such as for parse errors, before installing the file.

b. Configure a **sudoers** policy in the **/etc/sudoers.d/ansible** file that meets your requirements, for example:

- To grant permissions to the **ansible** user to run all commands as any user and group on this host after entering the **ansible** user's password, use:

```
ansible   ALL=(ALL) ALL
```

- To grant permissions to the **ansible** user to run all commands as any user and group on this host without entering the **ansible** user's password, use:

```
ansible   ALL=(ALL) NOPASSWD: ALL
```

Alternatively, configure a more fine-granular policy that matches your security requirements. For further details on **sudoers** policies, see the **sudoers(5)** manual page.

Verification

1. Verify that you can execute commands from the control node on an all managed nodes:

```
[ansible@control-node]$ ansible all -m ping
BECOME password: <password>
managed-node-01.example.com | SUCCESS => {
    "ansible_facts": {
        "discovered_interpreter_python": "/usr/bin/python3"
    },
    "changed": false,
    "ping": "pong"
}
...
```

The hard-coded all group dynamically contains all hosts listed in the inventory file.

2. Verify that privilege escalation works correctly by running the **whoami** utility on a managed host by using the Ansible **command** module:

```
[ansible@control-node]$ ansible managed-node-01.example.com -m command -a
whoami
BECOME password: <password>
```

```
managed-node-01.example.com | CHANGED | rc=0 >>
root
```

If the command returns root, you configured **sudo** on the managed nodes correctly.

Additional resources

- Preparing a control node on RHEL 8
- **sudoers(5)** manual page

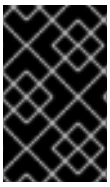
CHAPTER 3. ANSIBLE VAULT

Sometimes your playbook needs to use sensitive data such as passwords, API keys, and other secrets to configure managed hosts. Storing this information in plain text in variables or other Ansible-compatible files is a security risk because any user with access to those files can read the sensitive data.

With Ansible vault, you can encrypt, decrypt, view, and edit sensitive information. They could be included as:

- Inserted variable files in an Ansible Playbook
- Host and group variables
- Variable files passed as arguments when executing the playbook
- Variables defined in Ansible roles

You can use Ansible vault to securely manage individual variables, entire files, or even structured data like YAML files. This data can then be safely stored in a version control system or shared with team members without exposing sensitive information.



IMPORTANT

Files are protected with symmetric encryption of the Advanced Encryption Standard (AES256), where a single password or passphrase is used both to encrypt and decrypt the data. Note that the way this is done has not been formally audited by a third party.

To simplify management, it makes sense to set up your Ansible project so that sensitive variables and all other variables are kept in separate files, or directories. Then you can protect the files containing sensitive variables with the **ansible-vault** command.

Creating an encrypted file

The following command prompts you for a new vault password. Then it opens a file for storing sensitive variables using the default editor.

```
# ansible-vault create vault.yml
New Vault password: <vault_password>
Confirm New Vault password: <vault_password>
```

Viewing an encrypted file

The following command prompts you for your existing vault password. Then it displays the sensitive contents of an already encrypted file.

```
# ansible-vault view vault.yml
Vault password: <vault_password>
my_secret: "yJJvPqhsiusmmPPZdnjndkdnYNDjdj782meUZcw"
```

Editing an encrypted file

The following command prompts you for your existing vault password. Then it opens the already encrypted file for you to update the sensitive variables using the default editor.

```
# ansible-vault edit vault.yml
Vault password: <vault_password>
```

Encrypting an existing file

The following command prompts you for a new vault password. Then it encrypts an existing unencrypted file.

```
# ansible-vault encrypt vault.yml
New Vault password: <vault_password>
Confirm New Vault password: <vault_password>
Encryption successful
```

Decrypting an existing file

The following command prompts you for your existing vault password. Then it decrypts an existing encrypted file.

```
# ansible-vault decrypt vault.yml
Vault password: <vault_password>
Decryption successful
```

Changing the password of an encrypted file

The following command prompts you for your original vault password, then for the new vault password.

```
# ansible-vault rekey vault.yml
Vault password: <vault_password>
New Vault password: <vault_password>
Confirm New Vault password: <vault_password>
Rekey successful
```

Basic application of Ansible vault variables in a playbook

```
---
- name: Create user accounts for all servers
  hosts: managed-node-01.example.com
  vars_files:
    - vault.yml
  tasks:
    - name: Create user from vault.yml file
      user:
        name: "{{ username }}"
        password: "{{ pwhash }}"
```

You read-in the file with variables (**vault.yml**) in the **vars_files** section of your Ansible Playbook, and you use the curly brackets the same way you would do with your ordinary variables. Then you either run the playbook with the **ansible-playbook --ask-vault-pass** command and you enter the password manually. Or you save the password in a separate file and you run the playbook with the **ansible-playbook --vault-password-file /path/to/my/vault-password-file** command.

Additional resources

- **ansible-vault(1)**, **ansible-playbook(1)** man pages

- Ansible vault
- Ansible vault Best Practices

CHAPTER 4. ANSIBLE IPMI MODULES IN RHEL

4.1. THE RHEL_MGMT COLLECTION

The Intelligent Platform Management Interface (IPMI) is a specification for a set of standard protocols to communicate with baseboard management controller (BMC) devices. The **IPMI** modules allow you to enable and support hardware management automation. The **IPMI** modules are available in:

- The **rhel_mgmt** Collection. The package name is **ansible-collection-redhat-rhel_mgmt**.
- The RHEL 8 AppStream, as part of the new **ansible-collection-redhat-rhel_mgmt** package.

The following IPMI modules are available in the rhel_mgmt collection:

- **ipmi_boot**: Management of boot device order
- **ipmi_power**: Power management for machine

The mandatory parameters used for the IPMI Modules are:

- **ipmi_boot** parameters:

Module name	Description
name	Hostname or ip address of the BMC
password	Password to connect to the BMC
bootdev	Device to be used on next boot * network * floppy * hd * safe * optical * setup * default
User	Username to connect to the BMC

- **ipmi_power** parameters:

Module name	Description
name	BMC Hostname or IP address

Module name	Description
password	Password to connect to the BMC
user	Username to connect to the BMC
State	Check if the machine is on the desired status * on * off * shutdown * reset * boot

4.2. USING THE IPMI_BOOT MODULE

The following example shows how to use the **ipmi_boot** module in a playbook to set a boot device for the next boot. For simplicity, the examples use the same host as the Ansible control host and managed host, thus executing the modules on the same host where the playbook is executed.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- The **ansible-collection-redhat-rhel_mgmt** package is installed.
- The **python3-pyghmi** package is installed either on the control node or the managed nodes.
- The IPMI BMC that you want to control is accessible over network from the control node or the managed host (if not using **localhost** as the managed host). Note that the host whose BMC is being configured by the module is generally different from the managed host, as the module contacts the BMC over the network using the IPMI protocol.
- You have credentials to access BMC with an appropriate level of access.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Set boot device to be used on next boot
  hosts: managed-node-01.example.com
  tasks:
    - name: Ensure boot device is HD
      redhat.rhel_mgmt.ipmi_boot:
```

```
      user: <admin_user>
      password: <password>
      bootdev: hd
```

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

- When you run the playbook, Ansible returns **success**.

Additional resources

- **/usr/share/ansible/collections/ansible_collections/redhat/rhel_mgmt/README.md** file

4.3. USING THE IPMI_POWER MODULE

This example shows how to use the **ipmi_boot** module in a playbook to check if the system is turned on. For simplicity, the examples use the same host as the Ansible control host and managed host, thus executing the modules on the same host where the playbook is executed.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- The **ansible-collection-redhat-rhel_mgmt** package is installed.
- The **python3-pyghmi** package is installed either on the control node or the managed nodes.
- The IPMI BMC that you want to control is accessible over network from the control node or the managed host (if not using **localhost** as the managed host). Note that the host whose BMC is being configured by the module is generally different from the managed host, as the module contacts the BMC over the network using the IPMI protocol.
- You have credentials to access BMC with an appropriate level of access.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Power management
```

```
hosts: managed-node-01.example.com
tasks:
  - name: Ensure machine is powered on
    redhat.rhel_mgmt.ipmi_power:
      user: <admin_user>
      password: <password>
      state: on
```

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

- When you run the playbook, Ansible returns **true**.

Additional resources

- **/usr/share/ansible/collections/ansible_collections/redhat/rhel_mgmt/README.md** file

CHAPTER 5. THE REDFISH MODULES IN RHEL

The Redfish modules for remote management of devices are now part of the **redhat.rhel_mgmt** Ansible collection. With the Redfish modules, you can easily use management automation on bare-metal servers and platform hardware by getting information about the servers or control them through an Out-Of-Band (OOB) controller, using the standard HTTPS transport and JSON format.

5.1. THE REDFISH MODULES

The **redhat.rhel_mgmt** Ansible collection provides the Redfish modules to support hardware management in Ansible over Redfish. The **redhat.rhel_mgmt** collection is available in the **ansible-collection-redhat-rhel_mgmt** package. To install it, see Installing the redhat.rhel_mgmt Collection using the CLI.

The following Redfish modules are available in the **redhat.rhel_mgmt** collection:

1. **redfish_info**: The **redfish_info** module retrieves information about the remote Out-Of-Band (OOB) controller such as systems inventory.
2. **redfish_command**: The **redfish_command** module performs Out-Of-Band (OOB) controller operations like log management and user management, and power operations such as system restart, power on and off.
3. **redfish_config**: The **redfish_config** module performs OOB controller operations such as changing OOB configuration, or setting the BIOS configuration.

5.2. REDFISH MODULES PARAMETERS

The parameters used for the Redfish modules are:

redfish_info parameters:	Description
baseuri	(Mandatory) - Base URI of OOB controller.
category	(Mandatory) - List of categories to execute on OOB controller. The default value is ["Systems"].
command	(Mandatory) - List of commands to execute on OOB controller.
username	Username for authentication to OOB controller.
password	Password for authentication to OOB controller.

redfish_command parameters:	Description
baseuri	(Mandatory) - Base URI of OOB controller.
category	(Mandatory) - List of categories to execute on OOB controller. The default value is ["Systems"].

redfish_command parameters:	Description
command	(Mandatory) - List of commands to execute on OOB controller.
username	Username for authentication to OOB controller.
password	Password for authentication to OOB controller.

redfish_config parameters:	Description
baseuri	(Mandatory) - Base URI of OOB controller.
category	(Mandatory) - List of categories to execute on OOB controller. The default value is ["Systems"].
command	(Mandatory) - List of commands to execute on OOB controller.
username	Username for authentication to OOB controller.
password	Password for authentication to OOB controller.
bios_attributes	BIOS attributes to update.

5.3. USING THE REDFISH_INFO MODULE

The following example shows how to use the **redfish_info** module in a playbook to get information about the CPU inventory. For simplicity, the example uses the same host as the Ansible control host and managed host, thus executing the modules on the same host where the playbook is executed.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- The **ansible-collection-redhat-rhel_mgmt** package is installed.
- The **python3-pyghmi** package is installed either on the control node or the managed nodes.
- OOB controller access details.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Manage out-of-band controllers using Redfish APIs
  hosts: managed-node-01.example.com
  tasks:
    - name: Get CPU inventory
      redhat.rhel_mgmt.redfish_info:
        baseuri: "<URI>"
        username: "<username>"
        password: "<password>"
        category: Systems
        command: GetCpuInventory
      register: result
```

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

   Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

- When you run the playbook, Ansible returns the CPU inventory details.

Additional resources

- **/usr/share/ansible/collections/ansible_collections/redhat/rhel_mgmt/README.md** file

5.4. USING THE REDFISH_COMMAND MODULE

The following example shows how to use the **redfish_command** module in a playbook to turn on a system. For simplicity, the example uses the same host as the Ansible control host and managed host, thus executing the modules on the same host where the playbook is executed.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- The **ansible-collection-redhat-rhel_mgmt** package is installed.
- The **python3-pyghmi** package is installed either on the control node or the managed nodes.
- OOB controller access details.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Manage out-of-band controllers using Redfish APIs
  hosts: managed-node-01.example.com
  tasks:
    - name: Power on system
      redhat.rhel_mgmt.redfish_command:
        baseuri: "<URI>"
        username: "<username>"
        password: "<password>"
        category: Systems
        command: PowerOn
```

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

   Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

- The system powers on.

Additional resources

- **/usr/share/ansible/collections/ansible_collections/redhat/rhel_mgmt/README.md** file

5.5. USING THE REDFISH_CONFIG MODULE

The following example shows how to use the **redfish_config** module in a playbook to configure a system to boot with UEFI. For simplicity, the example uses the same host as the Ansible control host and managed host, thus executing the modules on the same host where the playbook is executed.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- The **ansible-collection-redhat-rhel_mgmt** package is installed.
- The **python3-pyghmi** package is installed either on the control node or the managed nodes.
- OOB controller access details.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Manages out-of-band controllers using Redfish APIs
  hosts: managed-node-01.example.com
  tasks:
    - name: Set BootMode to UEFI
      redhat.rhel_mgmt.redfish_config:
        baseuri: "<URI>"
        username: "<username>"
        password: "<password>"
 category: Systems
        command: SetBiosAttributes
        bios_attributes:
          BootMode: Uefi
```

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

- The system boot mode is set to UEFI.

Additional resources

- **/usr/share/ansible/collections/ansible_collections/redhat/rhel_mgmt/README.md** file

CHAPTER 6. INTEGRATING RHEL SYSTEMS INTO AD DIRECTLY BY USING THE RHEL SYSTEM ROLE

With the **ad_integration** system role, you can automate a direct integration of a RHEL system with Active Directory (AD) by using Red Hat Ansible Automation Platform.

6.1. THE AD_INTEGRATION RHEL SYSTEM ROLE

Using the **ad_integration** system role, you can directly connect a RHEL system to Active Directory (AD).

The role uses the following components:

- SSSD to interact with the central identity and authentication source
- **realmd** to detect available AD domains and configure the underlying RHEL system services, in this case SSSD, to connect to the selected AD domain

NOTE

The **ad_integration** role is for deployments using direct AD integration without an Identity Management (IdM) environment. For IdM environments, use the **ansible-freeipa** roles.

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.ad_integration/README.md** file
- **/usr/share/doc/rhel-system-roles/ad_integration/** directory
- Connecting RHEL systems directly to AD using SSSD

6.2. CONNECTING A RHEL SYSTEM DIRECTLY TO AD BY USING THE AD_INTEGRATION RHEL SYSTEM ROLE

You can use the **ad_integration** system role to configure a direct integration between a RHEL system and an AD domain by running an Ansible playbook.

NOTE

Starting with RHEL8, RHEL no longer supports RC4 encryption by default. If it is not possible to enable AES in the AD domain, you must enable the **AD-SUPPORT** crypto policy and allow RC4 encryption in the playbook.

IMPORTANT

Time between the RHEL server and AD must be synchronized. You can ensure this by using the **timesync** system role in the playbook.

In this example, the RHEL system joins the **domain.example.com** AD domain, by using the AD **Administrator** user and the password for this user stored in the Ansible vault. The playbook also sets the **AD-SUPPORT** crypto policy and allows RC4 encryption. To ensure time synchronization between

the RHEL system and AD, the playbook sets the **adserver.domain.example.com** server as the **timesync** source.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- The following ports on the AD domain controllers are open and accessible from the RHEL server:

Table 6.1. Ports Required for Direct Integration of Linux Systems into AD Using the ad_integration system role

Source Port	Destination Port	Protocol	Service
1024:65535	53	UDP and TCP	DNS
1024:65535	389	UDP and TCP	LDAP
1024:65535	636	TCP	LDAPS
1024:65535	88	UDP and TCP	Kerberos
1024:65535	464	UDP and TCP	Kerberos change/set password (**kadmin**)
1024:65535	3268	TCP	LDAP Global Catalog
1024:65535	3269	TCP	LDAP Global Catalog SSL/TLS
1024:65535	123	UDP	NTP/Chrony (Optional)
1024:65535	323	UDP	NTP/Chrony (Optional)

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Configure a direct integration between a RHEL system and an AD domain
  hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.ad_integration
  vars:
    ad_integration_realm: "domain.example.com"
```

```
    ad_integration_password: !vault | vault encrypted password
    ad_integration_manage_crypto_policies: true
    ad_integration_allow_rc4_crypto: true
    ad_integration_timesync_source: "adserver.domain.example.com"
```

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

   Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

- Display an AD user details, such as the **administrator** user:

```
$ getent passwd administrator@ad.example.com
administrator@ad.example.com:*:1450400500:1450400513:Administrator:/home/administrator
@ad.example.com:/bin/bash
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.ad_integration/README.md** file
- **/usr/share/doc/rhel-system-roles/ad_integration/** directory

CHAPTER 7. REQUESTING CERTIFICATES BY USING THE RHEL SYSTEM ROLE

You can use the **certificate** system role to issue and manage certificates.

7.1. THE CERTIFICATE RHEL SYSTEM ROLE

Using the **certificate** system role, you can manage issuing and renewing TLS and SSL certificates using Ansible Core.

The role uses **certmonger** as the certificate provider, and currently supports issuing and renewing self-signed certificates and using the IdM integrated certificate authority (CA).

You can use the following variables in your Ansible playbook with the **certificate** system role:

certificate_wait

to specify if the task should wait for the certificate to be issued.

certificate_requests

to represent each certificate to be issued and its parameters.

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.certificate/README.md** file
- **/usr/share/doc/rhel-system-roles/certificate/** directory

7.2. REQUESTING A NEW SELF-SIGNED CERTIFICATE BY USING THE CERTIFICATE RHEL SYSTEM ROLE

With the **certificate** system role, you can use Ansible Core to issue self-signed certificates.

This process uses the **certmonger** provider and requests the certificate through the **getcert** command.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.certificate
  vars:
    certificate_requests:
```

```
    - name: mycert
      dns: "*.example.com"
      ca: self-sign
```

- Set the **name** parameter to the desired name of the certificate, such as **mycert**.
- Set the **dns** parameter to the domain to be included in the certificate, such as ***.example.com**.
- Set the **ca** parameter to **self-sign**.

By default, **certmonger** automatically tries to renew the certificate before it expires. You can disable this by setting the **auto_renew** parameter in the Ansible playbook to **no**.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.certificate/README.md** file
- **/usr/share/doc/rhel-system-roles/certificate/** directory

7.3. REQUESTING A NEW CERTIFICATE FROM IDM CA BY USING THE CERTIFICATE RHEL SYSTEM ROLE

With the **certificate** system role, you can use **anible-core** to issue certificates while using an IdM server with an integrated certificate authority (CA). Therefore, you can efficiently and consistently manage the certificate trust chain for multiple systems when using IdM as the CA.

This process uses the **certmonger** provider and requests the certificate through the **getcert** command.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- hosts: managed-node-01.example.com
```

```
roles:
  - rhel-system-roles.certificate
vars:
  certificate_requests:
    - name: mycert
      dns: www.example.com
      principal: HTTP/www.example.com@EXAMPLE.COM
      ca: ipa
```

- Set the **name** parameter to the desired name of the certificate, such as **mycert**.
- Set the **dns** parameter to the domain to be included in the certificate, such as **www.example.com**.
- Set the **principal** parameter to specify the Kerberos principal, such as **HTTP/www.example.com@EXAMPLE.COM**.
- Set the **ca** parameter to **ipa**.

By default, **certmonger** automatically tries to renew the certificate before it expires. You can disable this by setting the **auto_renew** parameter in the Ansible playbook to **no**.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.certificate/README.md** file
- **/usr/share/doc/rhel-system-roles/certificate/** directory

7.4. SPECIFYING COMMANDS TO RUN BEFORE OR AFTER CERTIFICATE ISSUANCE BY USING THE CERTIFICATE RHEL SYSTEM ROLE

With the **certificate** Role, you can use Ansible Core to execute a command before and after a certificate is issued or renewed.

In the following example, the administrator ensures stopping the **httpd** service before a self-signed certificate for **www.example.com** is issued or renewed, and restarting it afterwards.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.

- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.certificate
  vars:
    certificate_requests:
      - name: mycert
        dns: www.example.com
        ca: self-sign
        run_before: systemctl stop httpd.service
        run_after: systemctl start httpd.service
```

   - Set the **name** parameter to the desired name of the certificate, such as **mycert**.
   - Set the **dns** parameter to the domain to be included in the certificate, such as **www.example.com**.
   - Set the **ca** parameter to the CA you want to use to issue the certificate, such as **self-sign**.
   - Set the **run_before** parameter to the command you want to execute before this certificate is issued or renewed, such as **systemctl stop httpd.service**.
   - Set the **run_after** parameter to the command you want to execute after this certificate is issued or renewed, such as **systemctl start httpd.service**.

   By default, **certmonger** automatically tries to renew the certificate before it expires. You can disable this by setting the **auto_renew** parameter in the Ansible playbook to **no**.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

   Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.certificate/README.md** file
- **/usr/share/doc/rhel-system-roles/certificate/** directory

CHAPTER 8. INSTALLING AND CONFIGURING WEB CONSOLE BY USING THE RHEL SYSTEM ROLE

With the **cockpit** RHEL system role, you can install and configure the web console in your system.

8.1. THE COCKPIT RHEL SYSTEM ROLE

You can use the **cockpit** system role to automatically deploy and enable the web console and thus be able to manage your RHEL systems from a web browser.

8.2. INSTALLING THE WEB CONSOLE BY USING THECOCKPIT RHEL SYSTEM ROLE

You can use the **cockpit** system role to install and enable the RHEL web console.

By default, the RHEL web console uses a self-signed certificate. For security reasons, you can specify a certificate that was issued by a trusted certificate authority instead.

In this example, you use the **cockpit** system role to:

- Install the RHEL web console.
- Allow the web console to manage **firewalld**.
- Set the web console to use a certificate from the **ipa** trusted certificate authority instead of using a self-signed certificate.
- Set the web console to use a custom port 9050.

NOTE

You do not have to call the **firewall** or **certificate** system roles in the playbook to manage the Firewall or create the certificate. The **cockpit** system role calls them automatically as needed.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Manage the RHEL web console
  hosts: managed-node-01.example.com
  tasks:
    - name: Install RHEL web console
      ansible.builtin.include_role:
```

```
    name: rhel-system-roles.cockpit
  vars:
    cockpit_packages: default
    cockpit_port:9050
    cockpit_manage_selinux: true
    cockpit_manage_firewall: true
    cockpit_certificates:
      - name: /etc/cockpit/ws-certs.d/01-certificate
        dns: ['localhost', 'www.example.com']
        ca: ipa
        group: cockpit-ws
```

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.cockpit/README.md** file
- **/usr/share/doc/rhel-system-roles/cockpit** directory
- Requesting certificates using RHEL system roles .

CHAPTER 9. SETTING A CUSTOM CRYPTOGRAPHIC POLICY BY USING THE RHEL SYSTEM ROLE

As an administrator, you can use the **crypto_policies** RHEL system role to quickly and consistently configure custom cryptographic policies across many different systems using the Ansible Core package.

9.1. SETTING A CUSTOM CRYPTOGRAPHIC POLICY BY USING THE CRYPTO_POLICIES RHEL SYSTEM ROLE

You can use the **crypto_policies** system role to configure a large number of managed nodes consistently from a single control node.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Configure crypto policies
  hosts: managed-node-01.example.com
  tasks:
    - name: Configure crypto policies
      ansible.builtin.include_role:
        name: rhel-system-roles.crypto_policies
      vars:
        - crypto_policies_policy: FUTURE
        - crypto_policies_reboot_ok: true
```

   You can replace the *FUTURE* value with your preferred crypto policy, for example: **DEFAULT**, **LEGACY**, and **FIPS:OSPP**.

   The **crypto_policies_reboot_ok: true** setting causes the system to reboot after the system role changes the cryptographic policy.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

   Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

WARNING

Because the **FIPS:OSPP** system-wide subpolicy contains further restrictions for cryptographic algorithms required by the Common Criteria (CC) certification, the system is less interoperable after you set it. For example, you cannot use RSA and DH keys shorter than 3072 bits, additional SSH algorithms, and several TLS groups. Setting **FIPS:OSPP** also prevents connecting to Red Hat Content Delivery Network (CDN) structure. Furthermore, you cannot integrate Active Directory (AD) into the IdM deployments that use **FIPS:OSPP**, communication between RHEL hosts using **FIPS:OSPP** and AD domains might not work, or some AD accounts might not be able to authenticate.

Note that your **system is not CC-compliant** after you set the **FIPS:OSPP** cryptographic subpolicy. The only correct way to make your RHEL system compliant with the CC standard is through the installation of the **cc-config** package. See the Common Criteria section in the Compliance Activities and Government Standards Knowledgebase article for a list of certified RHEL versions, validation reports, and links to CC guides hosted at the National Information Assurance Partnership (NIAP) website.

Verification

1. On the control node, create another playbook named, for example, **verify_playbook.yml**:

```
---
- name: Verification
  hosts: managed-node-01.example.com
  tasks:
    - name: Verify active crypto policy
      ansible.builtin.include_role:
        name: rhel-system-roles.crypto_policies
    - debug:
        var: crypto_policies_active
```

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/verify_playbook.yml
```

3. Run the playbook:

```
$ ansible-playbook ~/verify_playbook.yml
TASK [debug] ***************************
ok: [host] => {
    "crypto_policies_active": "FUTURE"
}
```

The **crypto_policies_active** variable shows the policy active on the managed node.

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.crypto_policies/README.md** file
- **/usr/share/doc/rhel-system-roles/crypto_policies/** directory

CHAPTER 10. CONFIGURING FIREWALLD BY USING THE RHEL SYSTEM ROLE

You can use the **firewall** RHEL system role to configure settings of the **firewalld** service on multiple clients at once. This solution:

- Provides an interface with efficient input settings.
- Keeps all intended **firewalld** parameters in one place.

After you run the **firewall** role on the control node, the RHEL system role applies the **firewalld** parameters to the managed node immediately and makes them persistent across reboots.

10.1. INTRODUCTION TO THE FIREWALL RHEL SYSTEM ROLE

RHEL system roles is a set of contents for the Ansible automation utility. This content together with the Ansible automation utility provides a consistent configuration interface to remotely manage multiple systems.

The **rhel-system-roles.firewall** role from the RHEL system roles was introduced for automated configurations of the **firewalld** service. The **rhel-system-roles** package contains this RHEL system role, and also the reference documentation.

To apply the **firewalld** parameters on one or more systems in an automated fashion, use the **firewall** RHEL system role variable in a playbook. A playbook is a list of one or more plays that is written in the text-based YAML format.

You can use an inventory file to define a set of systems that you want Ansible to configure.

With the **firewall** role you can configure many different **firewalld** parameters, for example:

- Zones.
- The services for which packets should be allowed.
- Granting, rejection, or dropping of traffic access to ports.
- Forwarding of ports or port ranges for a zone.

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.firewall/README.md** file
- **/usr/share/doc/rhel-system-roles/firewall/** directory
- Working with playbooks
- How to build your inventory

10.2. RESETTING THE FIREWALLD SETTINGS BY USING THE FIREWALL RHEL SYSTEM ROLE

With the **firewall** RHEL system role, you can reset the **firewalld** settings to their default state. If you add the **previous:replaced** parameter to the variable list, the RHEL system role removes all existing user-

defined settings and resets **firewalld** to the defaults. If you combine the **previous:replaced** parameter with other settings, the **firewall** role removes all existing settings before applying new ones.

Perform this procedure on the Ansible control node.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Reset firewalld example
  hosts: managed-node-01.example.com
  tasks:
    - name: Reset firewalld
      ansible.builtin.include_role:
        name: rhel-system-roles.firewall
      vars:
        firewall:
          - previous: replaced
```

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

   Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

- Run this command as **root** on the managed node to check all the zones:

```
# firewall-cmd --list-all-zones
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.firewall/README.md** file
- **/usr/share/doc/rhel-system-roles/firewall/** directory

10.3. FORWARDING INCOMING TRAFFIC IN FIREWALLD FROM ONE LOCAL PORT TO A DIFFERENT LOCAL PORT BY USING THE FIREWALL

RHEL SYSTEM ROLE

With the **firewall** role you can remotely configure **firewalld** parameters with persisting effect on multiple managed hosts.

Perform this procedure on the Ansible control node.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Configure firewalld
  hosts: managed-node-01.example.com
  tasks:
    - name: Forward incoming traffic on port 8080 to 443
      ansible.builtin.include_role:
        name: rhel-system-roles.firewall
      vars:
        firewall:
          - { forward_port: 8080/tcp;443;, state: enabled, runtime: true, permanent: true }
```

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

- On the managed host, display the **firewalld** settings:

```
# firewall-cmd --list-forward-ports
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.firewall/README.md** file
- **/usr/share/doc/rhel-system-roles/firewall/** directory

10.4. MANAGING PORTS IN FIREWALLD BY USING THE FIREWALL RHEL SYSTEM ROLE

You can use the **firewall** RHEL system role to open or close ports in the local firewall for incoming traffic and make the new configuration persist across reboots. For example you can configure the default zone to permit incoming traffic for the HTTPS service.

Perform this procedure on the Ansible control node.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Configure firewalld
  hosts: managed-node-01.example.com
  tasks:
    - name: Allow incoming HTTPS traffic to the local host
      ansible.builtin.include_role:
        name: rhel-system-roles.firewall
      vars:
        firewall:
          - port: 443/tcp
            service: http
            state: enabled
            runtime: true
            permanent: true
```

   The **permanent: true** option makes the new settings persistent across reboots.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

   Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

- On the managed node, verify that the **443/tcp** port associated with the **HTTPS** service is open:

```
# firewall-cmd --list-ports
443/tcp
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.firewall/README.md** file
- **/usr/share/doc/rhel-system-roles/firewall/** directory

10.5. CONFIGURING A FIREWALLD DMZ ZONE BY USING THE FIREWALL RHEL SYSTEM ROLE

As a system administrator, you can use the **firewall** RHEL system role to configure a **dmz** zone on the **enp1s0** interface to permit **HTTPS** traffic to the zone. In this way, you enable external users to access your web servers.

Perform this procedure on the Ansible control node.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Configure firewalld
  hosts: managed-node-01.example.com
  tasks:
    - name: Creating a DMZ with access to HTTPS port and masquerading for hosts in DMZ
      ansible.builtin.include_role:
        name: rhel-system-roles.firewall
      vars:
        firewall:
          - zone: dmz
            interface: enp1s0
            service: https
            state: enabled
            runtime: true
            permanent: true
```

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

- On the managed node, view detailed information about the **dmz** zone:

```
# firewall-cmd --zone=dmz --list-all
dmz (active)
  target: default
  icmp-block-inversion: no
  interfaces: enp1s0
  sources:
  services: https ssh
  ports:
  protocols:
  forward: no
  masquerade: no
  forward-ports:
  source-ports:
  icmp-blocks:
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.firewall/README.md** file
- **/usr/share/doc/rhel-system-roles/firewall/** directory

CHAPTER 11. CONFIGURING A HIGH-AVAILABILITY CLUSTER BY USING THE RHEL SYSTEM ROLE

With the **ha_cluster** system role, you can configure and manage a high-availability cluster that uses the Pacemaker high availability cluster resource manager.

11.1. VARIABLES OF THE HA_CLUSTER RHEL SYSTEM ROLE

In an **ha_cluster** system role playbook, you define the variables for a high availability cluster according to the requirements of your cluster deployment.

The variables you can set for an **ha_cluster** system role are as follows:

ha_cluster_enable_repos

A boolean flag that enables the repositories containing the packages that are needed by the **ha_cluster** system role. When this variable is set to **true**, the default value, you must have active subscription coverage for RHEL and the RHEL High Availability Add-On on the systems that you will use as your cluster members or the system role will fail.

ha_cluster_enable_repos_resilient_storage

(RHEL 8.10 and later) A boolean flag that enables the repositories containing resilient storage packages, such as **dlm** or **gfs2**. For this option to take effect, **ha_cluster_enable_repos** must be set to **true**. The default value of this variable is **false**.

ha_cluster_manage_firewall

(RHEL 8.8 and later) A boolean flag that determines whether the **ha_cluster** system role manages the firewall. When **ha_cluster_manage_firewall** is set to **true**, the firewall high availability service and the **fence-virt** port are enabled. When **ha_cluster_manage_firewall** is set to **false**, the **ha_cluster** system role does not manage the firewall. If your system is running the **firewalld** service, you must set the parameter to **true** in your playbook.
You can use the **ha_cluster_manage_firewall** parameter to add ports, but you cannot use the parameter to remove ports. To remove ports, use the **firewall** system role directly.

As of RHEL 8.8, the firewall is no longer configured by default, because it is configured only when **ha_cluster_manage_firewall** is set to **true**.

ha_cluster_manage_selinux

(RHEL 8.8 and later) A boolean flag that determines whether the **ha_cluster** system role manages the ports belonging to the firewall high availability service using the **selinux** system role. When **ha_cluster_manage_selinux** is set to **true**, the ports belonging to the firewall high availability service are associated with the SELinux port type **cluster_port_t**. When **ha_cluster_manage_selinux** is set to **false**, the **ha_cluster** system role does not manage SELinux. If your system is running the **selinux** service, you must set this parameter to **true** in your playbook. Firewall configuration is a prerequisite for managing SELinux. If the firewall is not installed, the managing SELinux policy is skipped.

You can use the **ha_cluster_manage_selinux** parameter to add policy, but you cannot use the parameter to remove policy. To remove policy, use the **selinux** system role directly.

ha_cluster_cluster_present

A boolean flag which, if set to **true**, determines that HA cluster will be configured on the hosts according to the variables passed to the role. Any cluster configuration not specified in the playbook and not supported by the role will be lost.

If **ha_cluster_cluster_present** is set to **false**, all HA cluster configuration will be removed from the target hosts.

The default value of this variable is **true**.

The following example playbook removes all cluster configuration on **node1** and **node2**

```
- hosts: node1 node2
  vars:
    ha_cluster_cluster_present: false

  roles:
    - rhel-system-roles.ha_cluster
```

ha_cluster_start_on_boot

A boolean flag that determines whether cluster services will be configured to start on boot. The default value of this variable is **true**.

ha_cluster_fence_agent_packages

List of fence agent packages to install. The default value of this variable is **fence-agents-all**, **fence-virt**.

ha_cluster_extra_packages

List of additional packages to be installed. The default value of this variable is no packages.
This variable can be used to install additional packages not installed automatically by the role, for example custom resource agents.

It is possible to specify fence agents as members of this list. However, **ha_cluster_fence_agent_packages** is the recommended role variable to use for specifying fence agents, so that its default value is overridden.

ha_cluster_hacluster_password

A string value that specifies the password of the **hacluster** user. The **hacluster** user has full access to a cluster. To protect sensitive data, vault encrypt the password, as described in Encrypting content with Ansible Vault. There is no default password value, and this variable must be specified.

ha_cluster_hacluster_qdevice_password

(RHEL 8.9 and later) A string value that specifies the password of the **hacluster** user for a quorum device. This parameter is needed only if the **ha_cluster_quorum** parameter is configured to use a quorum device of type **net** and the password of the **hacluster** user on the quorum device is different from the password of the **hacluster** user specified with the **ha_cluster_hacluster_password** parameter. The **hacluster** user has full access to a cluster. To protect sensitive data, vault encrypt the password, as described in Encrypting content with Ansible Vault . There is no default value for this password.

ha_cluster_corosync_key_src

The path to Corosync **authkey** file, which is the authentication and encryption key for Corosync communication. It is highly recommended that you have a unique **authkey** value for each cluster. The key should be 256 bytes of random data.
If you specify a key for this variable, it is recommended that you vault encrypt the key, as described in Encrypting content with Ansible Vault .

If no key is specified, a key already present on the nodes will be used. If nodes do not have the same key, a key from one node will be distributed to other nodes so that all nodes have the same key. If no node has a key, a new key will be generated and distributed to the nodes.

If this variable is set, **ha_cluster_regenerate_keys** is ignored for this key.

The default value of this variable is null.

ha_cluster_pacemaker_key_src

The path to the Pacemaker **authkey** file, which is the authentication and encryption key for Pacemaker communication. It is highly recommended that you have a unique **authkey** value for each cluster. The key should be 256 bytes of random data.
If you specify a key for this variable, it is recommended that you vault encrypt the key, as described in Encrypting content with Ansible Vault .

If no key is specified, a key already present on the nodes will be used. If nodes do not have the same key, a key from one node will be distributed to other nodes so that all nodes have the same key. If no node has a key, a new key will be generated and distributed to the nodes.

If this variable is set, **ha_cluster_regenerate_keys** is ignored for this key.

The default value of this variable is null.

ha_cluster_fence_virt_key_src

The path to the **fence-virt** or **fence-xvm** pre-shared key file, which is the location of the authentication key for the **fence-virt** or **fence-xvm** fence agent.
If you specify a key for this variable, it is recommended that you vault encrypt the key, as described in Encrypting content with Ansible Vault .

If no key is specified, a key already present on the nodes will be used. If nodes do not have the same key, a key from one node will be distributed to other nodes so that all nodes have the same key. If no node has a key, a new key will be generated and distributed to the nodes. If the **ha_cluster** system role generates a new key in this fashion, you should copy the key to your nodes' hypervisor to ensure that fencing works.

If this variable is set, **ha_cluster_regenerate_keys** is ignored for this key.

The default value of this variable is null.

ha_cluster_pcsd_public_key_srcr, ha_cluster_pcsd_private_key_src

The path to the **pcsd** TLS certificate and private key. If this is not specified, a certificate-key pair already present on the nodes will be used. If a certificate-key pair is not present, a random new one will be generated.
If you specify a private key value for this variable, it is recommended that you vault encrypt the key, as described in Encrypting content with Ansible Vault .

If these variables are set, **ha_cluster_regenerate_keys** is ignored for this certificate-key pair.

The default value of these variables is null.

ha_cluster_pcsd_certificates

(RHEL 8.8 and later) Creates a **pcsd** private key and certificate using the **certificate** system role.
If your system is not configured with a **pcsd** private key and certificate, you can create them in one of two ways:

- Set the **ha_cluster_pcsd_certificates** variable. When you set the **ha_cluster_pcsd_certificates** variable, the **certificate** system role is used internally and it creates the private key and certificate for **pcsd** as defined.

- Do not set the **ha_cluster_pcsd_public_key_src**, **ha_cluster_pcsd_private_key_src**, or the **ha_cluster_pcsd_certificates** variables. If you do not set any of these variables, the **ha_cluster** system role will create **pcsd** certificates by means of **pcsd** itself. The value of **ha_cluster_pcsd_certificates** is set to the value of the variable **certificate_requests** as specified in the **certificate** system role. For more information about the **certificate** system role, see Requesting certificates using RHEL system roles .

The following operational considerations apply to the use of the **ha_cluster_pcsd_certificate** variable:

- Unless you are using IPA and joining the systems to an IPA domain, the **certificate** system role creates self-signed certificates. In this case, you must explicitly configure trust settings outside of the context of RHEL system roles. System roles do not support configuring trust settings.
- When you set the **ha_cluster_pcsd_certificates** variable, do not set the **ha_cluster_pcsd_public_key_src** and **ha_cluster_pcsd_private_key_src** variables.
- When you set the **ha_cluster_pcsd_certificates** variable, **ha_cluster_regenerate_keys** is ignored for this certificate - key pair.

The default value of this variable is **[]**.
For an example **ha_cluster** system role playbook that creates TLS certificates and key files in a high availability cluster, see Creating pcsd TLS certificates and key files for a high availability cluster .

ha_cluster_regenerate_keys

A boolean flag which, when set to **true**, determines that pre-shared keys and TLS certificates will be regenerated. For more information about when keys and certificates will be regenerated, see the descriptions of the **ha_cluster_corosync_key_src**, **ha_cluster_pacemaker_key_src**, **ha_cluster_fence_virt_key_src**, **ha_cluster_pcsd_public_key_src**, and **ha_cluster_pcsd_private_key_src** variables.

The default value of this variable is **false**.

ha_cluster_pcs_permission_list

Configures permissions to manage a cluster using **pcsd**. The items you configure with this variable are as follows:

- **type** - **user** or **group**
- **name** - user or group name
- **allow_list** - Allowed actions for the specified user or group:
  - **read** - View cluster status and settings
  - **write** - Modify cluster settings except permissions and ACLs
  - **grant** - Modify cluster permissions and ACLs
  - **full** - Unrestricted access to a cluster including adding and removing nodes and access to keys and certificates

The structure of the **ha_cluster_pcs_permission_list** variable and its default values are as follows:

```
ha_cluster_pcs_permission_list:
```

```
- type: group
  name: hacluster
  allow_list:
    - grant
    - read
    - write
```

ha_cluster_cluster_name

The name of the cluster. This is a string value with a default of **my-cluster**.

ha_cluster_transport

(RHEL 8.7 and later) Sets the cluster transport method. The items you configure with this variable are as follows:

- **type** (optional) - Transport type: **knet**, **udp**, or **udpu**. The **udp** and **udpu** transport types support only one link. Encryption is always disabled for **udp** and **udpu**. Defaults to **knet** if not specified.
- **options** (optional) - List of name-value dictionaries with transport options.
- **links** (optional) - List of list of name-value dictionaries. Each list of name-value dictionaries holds options for one Corosync link. It is recommended that you set the **linknumber** value for each link. Otherwise, the first list of dictionaries is assigned by default to the first link, the second one to the second link, and so on.
- **compression** (optional) - List of name-value dictionaries configuring transport compression. Supported only with the **knet** transport type.
- **crypto** (optional) - List of name-value dictionaries configuring transport encryption. By default, encryption is enabled. Supported only with the **knet** transport type.

For a list of allowed options, see the **pcs -h cluster setup** help page or the **setup** description in the **cluster** section of the **pcs**(8) man page. For more detailed descriptions, see the **corosync.conf**(5) man page.
The structure of the **ha_cluster_transport** variable is as follows:

```
ha_cluster_transport:
  type: knet
  options:
    - name: option1_name
      value: option1_value
    - name: option2_name
      value: option2_value
  links:
    -
      - name: option1_name
        value: option1_value
      - name: option2_name
        value: option2_value
    -
      - name: option1_name
        value: option1_value
      - name: option2_name
        value: option2_value
  compression:
```

```
    - name: option1_name
      value: option1_value
    - name: option2_name
      value: option2_value
  crypto:
    - name: option1_name
      value: option1_value
    - name: option2_name
      value: option2_value
```

For an example **ha_cluster** system role playbook that configures a transport method, see Configuring Corosync values in a high availability cluster .

ha_cluster_totem

(RHEL 8.7 and later) Configures Corosync totem. For a list of allowed options, see the **pcs -h cluster setup** help page or the **setup** description in the **cluster** section of the **pcs**(8) man page. For a more detailed description, see the **corosync.conf**(5) man page.
The structure of the **ha_cluster_totem** variable is as follows:

```
ha_cluster_totem:
  options:
    - name: option1_name
      value: option1_value
    - name: option2_name
      value: option2_value
```

For an example **ha_cluster** system role playbook that configures a Corosync totem, see Configuring Corosync values in a high availability cluster.

ha_cluster_quorum

(RHEL 8.7 and later) Configures cluster quorum. You can configure the following items for cluster quorum:

- **options** (optional) - List of name-value dictionaries configuring quorum. Allowed options are: **auto_tie_breaker**, **last_man_standing**, **last_man_standing_window**, and **wait_for_all**. For information about quorum options, see the **votequorum**(5) man page.
- **device** (optional) - (RHEL 8.8 and later) Configures the cluster to use a quorum device. By default, no quorum device is used.
  - **model** (mandatory) - Specifies a quorum device model. Only **net** is supported
  - **model_options** (optional) - List of name-value dictionaries configuring the specified quorum device model. For model **net**, you must specify **host** and **algorithm** options. Use the **pcs-address** option to set a custom **pcsd** address and port to connect to the **qnetd** host. If you do not specify this option, the role connects to the default **pcsd** port on the **host**.
  - **generic_options** (optional) - List of name-value dictionaries setting quorum device options that are not model specific.
  - **heuristics_options** (optional) - List of name-value dictionaries configuring quorum device heuristics.
    For information about quorum device options, see the **corosync-qdevice**(8) man page. The generic options are **sync_timeout** and **timeout**. For model **net** options see the

quorum.device.net section. For heuristics options, see the **quorum.device.heuristics** section.

To regenerate a quorum device TLS certificate, set the **ha_cluster_regenerate_keys** variable to **true**.

The structure of the **ha_cluster_quorum** variable is as follows:

```
ha_cluster_quorum:
  options:
    - name: option1_name
      value: option1_value
    - name: option2_name
      value: option2_value
  device:
    model: string
    model_options:
      - name: option1_name
        value: option1_value
      - name: option2_name
        value: option2_value
    generic_options:
      - name: option1_name
        value: option1_value
      - name: option2_name
        value: option2_value
    heuristics_options:
      - name: option1_name
        value: option1_value
      - name: option2_name
        value: option2_value
```

For an example **ha_cluster** system role playbook that configures cluster quorum, see Configuring Corosync values in a high availability cluster. For an example **ha_cluster** system role playbook that configures a cluster using a quorum device, see Configuring a high availability cluster using a quorum device.

ha_cluster_sbd_enabled

(RHEL 8.7 and later) A boolean flag which determines whether the cluster can use the SBD node fencing mechanism. The default value of this variable is **false**.
For an example **ha_cluster** system role playbook that enables SBD, see Configuring a high availability cluster with SBD node fencing.

ha_cluster_sbd_options

(RHEL 8.7 and later) List of name-value dictionaries specifying SBD options. Supported options are:

- **delay-start** - defaults to **no**
- **startmode** - defaults to **always**
- **timeout-action** - defaults to **flush,reboot**
- **watchdog-timeout** - defaults to **5**

For information about these options, see the **Configuration via environment** section of the **sbd**(8) man page.

For an example **ha_cluster** system role playbook that configures SBD options, see Configuring a high availability cluster with SBD node fencing.
When using SBD, you can optionally configure watchdog and SBD devices for each node in an inventory. For information about configuring watchdog and SBD devices in an inventory file, see Specifying an inventory for the ha_cluster system role .

ha_cluster_cluster_properties

List of sets of cluster properties for Pacemaker cluster-wide configuration. Only one set of cluster properties is supported.
The structure of a set of cluster properties is as follows:

```
ha_cluster_cluster_properties:
  - attrs:
      - name: property1_name
        value: property1_value
      - name: property2_name
        value: property2_value
```

By default, no properties are set.

The following example playbook configures a cluster consisting of **node1** and **node2** and sets the **stonith-enabled** and **no-quorum-policy** cluster properties.

```
- hosts: node1 node2
  vars:
    ha_cluster_cluster_name: my-new-cluster
    ha_cluster_hacluster_password: password
    ha_cluster_cluster_properties:
      - attrs:
          - name: stonith-enabled
            value: 'true'
          - name: no-quorum-policy
            value: stop

  roles:
    - rhel-system-roles.ha_cluster
```

ha_cluster_node_options

(RHEL 8. 10 and later) This variable defines various settings which vary from one cluster node to another. It sets the options for the specified nodes, but does not specify which nodes form the cluster. You specify which nodes form the cluster with the **hosts** parameter in an inventory or a playbook.
The items you configure with this variable are as follows:

- **node_name** (mandatory) - Name of the node for which to define Pacemaker node attributes.
- **attributes** (optional) - List of sets of Pacemaker node attributes for the node. Currently no more than one set for each node is supported.

The structure of the **ha_cluster_node_options** variable is as follows:

```
ha_cluster_node_options:
  - node_name: node1
    attributes:
      - attrs:
          - name: attribute1
            value: value1_node1
          - name: attribute2
            value: value2_node1
  - node_name: node2
    attributes:
      - attrs:
          - name: attribute1
            value: value1_node2
          - name: attribute2
            value: value2_node2
```

By default, no node options are defined.

For an example **ha_cluster** system role playbook that includes node options configuration, see Configuring a high availability cluster with node attributes .

ha_cluster_resource_primitives

This variable defines pacemaker resources configured by the system role, including fencing resources. You can configure the following items for each resource:

- **id** (mandatory) - ID of a resource.
- **agent** (mandatory) - Name of a resource or fencing agent, for example **ocf:pacemaker:Dummy** or **stonith:fence_xvm**. It is mandatory to specify **stonith:** for STONITH agents. For resource agents, it is possible to use a short name, such as **Dummy**, instead of **ocf:pacemaker:Dummy**. However, if several agents with the same short name are installed, the role will fail as it will be unable to decide which agent should be used. Therefore, it is recommended that you use full names when specifying a resource agent.
- **instance_attrs** (optional) - List of sets of the resource's instance attributes. Currently, only one set is supported. The exact names and values of attributes, as well as whether they are mandatory or not, depend on the resource or fencing agent.
- **meta_attrs** (optional) - List of sets of the resource's meta attributes. Currently, only one set is supported.
- **copy_operations_from_agent** (optional) - (RHEL 8.9 and later) Resource agents usually define default settings for resource operations, such as **interval** and **timeout**, optimized for the specific agent. If this variable is set to **true**, then those settings are copied to the resource configuration. Otherwise, clusterwide defaults apply to the resource. If you also define resource operation defaults for the resource with the **ha_cluster_resource_operation_defaults** role variable, you can set this to **false**. The default value of this variable is **true**.
- **operations** (optional) - List of the resource's operations.
  - **action** (mandatory) - Operation action as defined by pacemaker and the resource or fencing agent.
  - **attrs** (mandatory) - Operation options, at least one option must be specified.

The structure of the resource definition that you configure with the **ha_cluster** system role is as follows:

```
- id: resource-id
  agent: resource-agent
  instance_attrs:
    - attrs:
        - name: attribute1_name
          value: attribute1_value
        - name: attribute2_name
          value: attribute2_value
  meta_attrs:
    - attrs:
        - name: meta_attribute1_name
          value: meta_attribute1_value
        - name: meta_attribute2_name
          value: meta_attribute2_value
  copy_operations_from_agent: bool
  operations:
    - action: operation1-action
      attrs:
        - name: operation1_attribute1_name
          value: operation1_attribute1_value
        - name: operation1_attribute2_name
          value: operation1_attribute2_value
    - action: operation2-action
      attrs:
        - name: operation2_attribute1_name
          value: operation2_attribute1_value
        - name: operation2_attribute2_name
          value: operation2_attribute2_value
```

By default, no resources are defined.

For an example **ha_cluster** system role playbook that includes resource configuration, see Configuring a high availability cluster with fencing and resources .

ha_cluster_resource_groups

This variable defines pacemaker resource groups configured by the system role. You can configure the following items for each resource group:

- **id** (mandatory) - ID of a group.
- **resources** (mandatory) - List of the group's resources. Each resource is referenced by its ID and the resources must be defined in the **ha_cluster_resource_primitives** variable. At least one resource must be listed.
- **meta_attrs** (optional) - List of sets of the group's meta attributes. Currently, only one set is supported.

The structure of the resource group definition that you configure with the **ha_cluster** system role is as follows:

```
ha_cluster_resource_groups:
  - id: group-id
```

```
    resource_ids:
      - resource1-id
      - resource2-id
    meta_attrs:
      - attrs:
          - name: group_meta_attribute1_name
            value: group_meta_attribute1_value
          - name: group_meta_attribute2_name
            value: group_meta_attribute2_value
```

By default, no resource groups are defined.

For an example **ha_cluster** system role playbook that includes resource group configuration, see Configuring a high availability cluster with fencing and resources .

ha_cluster_resource_clones

This variable defines pacemaker resource clones configured by the system role. You can configure the following items for a resource clone:

- **resource_id** (mandatory) - Resource to be cloned. The resource must be defined in the **ha_cluster_resource_primitives** variable or the **ha_cluster_resource_groups** variable.
- **promotable** (optional) - Indicates whether the resource clone to be created is a promotable clone, indicated as **true** or **false**.
- **id** (optional) - Custom ID of the clone. If no ID is specified, it will be generated. A warning will be displayed if this option is not supported by the cluster.
- **meta_attrs** (optional) - List of sets of the clone's meta attributes. Currently, only one set is supported.

The structure of the resource clone definition that you configure with the **ha_cluster** system role is as follows:

```
ha_cluster_resource_clones:
  - resource_id: resource-to-be-cloned
    promotable: true
    id: custom-clone-id
    meta_attrs:
      - attrs:
          - name: clone_meta_attribute1_name
            value: clone_meta_attribute1_value
          - name: clone_meta_attribute2_name
            value: clone_meta_attribute2_value
```

By default, no resource clones are defined.

For an example **ha_cluster** system role playbook that includes resource clone configuration, see Configuring a high availability cluster with fencing and resources .

ha_cluster_resource_defaults

(RHEL 8.9 and later) This variable defines sets of resource defaults. You can define multiple sets of defaults and apply them to resources of specific agents using rules. The defaults you specify with the **ha_cluster_resource_defaults** variable do not apply to resources which override them with their own defined values.

Only meta attributes can be specified as defaults.

You can configure the following items for each defaults set:

- **id** (optional) - ID of the defaults set. If not specified, it is autogenerated.
- **rule** (optional) - Rule written using **pcs** syntax defining when and for which resources the set applies. For information on specifying a rule, see the **resource defaults set create** section of the **pcs**(8) man page.
- **score** (optional) - Weight of the defaults set.
- **attrs** (optional) - Meta attributes applied to resources as defaults.

The structure of the **ha_cluster_resource_defaults** variable is as follows:

```
ha_cluster_resource_defaults:
  meta_attrs:
    - id: defaults-set-1-id
      rule: rule-string
      score: score-value
      attrs:
        - name: meta_attribute1_name
          value: meta_attribute1_value
        - name: meta_attribute2_name
          value: meta_attribute2_value
    - id: defaults-set-2-id
      rule: rule-string
      score: score-value
      attrs:
        - name: meta_attribute3_name
          value: meta_attribute3_value
        - name: meta_attribute4_name
          value: meta_attribute4_value
```

For an example **ha_cluster** system role playbook that configures resource defaults, see Configuring a high availability cluster with resource and resource operation defaults.

ha_cluster_resource_operation_defaults

(RHEL 8.9 and later) This variable defines sets of resource operation defaults. You can define multiple sets of defaults and apply them to resources of specific agents and specific resource operations using rules. The defaults you specify with the **ha_cluster_resource_operation_defaults** variable do not apply to resource operations which override them with their own defined values. By default, the **ha_cluster** system role configures resources to define their own values for resource operations. For information about overriding these defaults with the **ha_cluster_resource_operations_defaults** variable, see the description of the **copy_operations_from_agent** item in **ha_cluster_resource_primitives**.
Only meta attributes can be specified as defaults.

The structure of the **ha_cluster_resource_operations_defaults** variable is the same as the structure for the **ha_cluster_resource_defaults** variable, with the exception of how you specify a rule. For information about specifying a rule to describe the resource operation to which a set applies, see the **resource op defaults set create** section of the **pcs**(8) man page.

ha_cluster_stonith_levels

(RHEL 8.10 and later) This variable defines STONITH levels, also known as fencing topology. Fencing levels configure a cluster to use multiple devices to fence nodes. You can define alternative devices in case one device fails and you can require multiple devices to all be executed successfully to consider a node successfully fenced. For more information on fencing levels, see Configuring fencing levels in Configuring and managing high availability clusters.
You can configure the following items when defining fencing levels:

- **level** (mandatory) - Order in which to attempt the fencing level. Pacemaker attempts levels in ascending order until one succeeds.
- **target** (optional) - Name of a node this level applies to.
- You must specify one of the following three selections:
  - **target_pattern** - POSIX extended regular expression matching the names of the nodes this level applies to.
  - **target_attribute** - Name of a node attribute that is set for the node this level applies to.
  - **target_attribute** and **target_value** - Name and value of a node attribute that is set for the node this level applies to.
- **resouce_ids** (mandatory) - List of fencing resources that must all be tried for this level.
  By default, no fencing levels are defined.

The structure of the fencing levels definition that you configure with the **ha_cluster** system role is as follows:

```
ha_cluster_stonith_levels:
  - level: 1..9
    target: node_name
    target_pattern: node_name_regular_expression
    target_attribute: node_attribute_name
    target_value: node_attribute_value
    resource_ids:
      - fence_device_1
      - fence_device_2
  - level: 1..9
    target: node_name
    target_pattern: node_name_regular_expression
    target_attribute: node_attribute_name
    target_value: node_attribute_value
    resource_ids:
      - fence_device_1
      - fence_device_2
```

For an example **ha_cluster** system role playbook that configures fencing defaults, see Configuring a high availability cluster with fencing levels.

ha_cluster_constraints_location

This variable defines resource location constraints. Resource location constraints indicate which nodes a resource can run on. You can specify a resources specified by a resource ID or by a pattern, which can match more than one resource. You can specify a node by a node name or by a rule.
You can configure the following items for a resource location constraint:

- **resource** (mandatory) - Specification of a resource the constraint applies to.
- **node** (mandatory) - Name of a node the resource should prefer or avoid.
- **id** (optional) - ID of the constraint. If not specified, it will be autogenerated.
- **options** (optional) - List of name-value dictionaries.
  - **score** - Sets the weight of the constraint.
    - A positive **score** value means the resource prefers running on the node.
    - A negative **score** value means the resource should avoid running on the node.
    - A **score** value of **-INFINITY** means the resource must avoid running on the node.
    - If **score** is not specified, the score value defaults to **INFINITY**.

By default no resource location constraints are defined.
The structure of a resource location constraint specifying a resource ID and node name is as follows:

```
ha_cluster_constraints_location:
  - resource:
      id: resource-id
    node: node-name
    id: constraint-id
    options:
      - name: score
        value: score-value
      - name: option-name
        value: option-value
```

The items that you configure for a resource location constraint that specifies a resource pattern are the same items that you configure for a resource location constraint that specifies a resource ID, with the exception of the resource specification itself. The item that you specify for the resource specification is as follows:

- **pattern** (mandatory) - POSIX extended regular expression resource IDs are matched against.

The structure of a resource location constraint specifying a resource pattern and node name is as follows:

```
ha_cluster_constraints_location:
  - resource:
      pattern: resource-pattern
    node: node-name
    id: constraint-id
    options:
      - name: score
        value: score-value
      - name: resource-discovery
        value: resource-discovery-value
```

You can configure the following items for a resource location constraint that specifies a resource ID and a rule:

- **resource** (mandatory) - Specification of a resource the constraint applies to.
  - **id** (mandatory) - Resource ID.
  - **role** (optional) - The resource role to which the constraint is limited: **Started**, **Unpromoted**, **Promoted**.
- **rule** (mandatory) - Constraint rule written using **pcs** syntax. For further information, see the **constraint location** section of the **pcs**(8) man page.
- Other items to specify have the same meaning as for a resource constraint that does not specify a rule.

The structure of a resource location constraint that specifies a resource ID and a rule is as follows:

```
ha_cluster_constraints_location:
  - resource:
      id: resource-id
      role: resource-role
    rule: rule-string
    id: constraint-id
    options:
      - name: score
        value: score-value
      - name: resource-discovery
        value: resource-discovery-value
```

The items that you configure for a resource location constraint that specifies a resource pattern and a rule are the same items that you configure for a resource location constraint that specifies a resource ID and a rule, with the exception of the resource specification itself. The item that you specify for the resource specification is as follows:

- **pattern** (mandatory) - POSIX extended regular expression resource IDs are matched against.

The structure of a resource location constraint that specifies a resource pattern and a rule is as follows:

```
ha_cluster_constraints_location:
  - resource:
      pattern: resource-pattern
      role: resource-role
    rule: rule-string
    id: constraint-id
    options:
      - name: score
        value: score-value
      - name: resource-discovery
        value: resource-discovery-value
```

For an example **ha_cluster** system role playbook that creates a cluster with resource constraints, see Configuring a high availability cluster with resource constraints .

ha_cluster_constraints_colocation

This variable defines resource colocation constraints. Resource colocation constraints indicate that

the location of one resource depends on the location of another one. There are two types of colocation constraints: a simple colocation constraint for two resources, and a set colocation constraint for multiple resources.
You can configure the following items for a simple resource colocation constraint:

- **resource_follower** (mandatory) - A resource that should be located relative to **resource_leader**.
  - **id** (mandatory) - Resource ID.
  - **role** (optional) - The resource role to which the constraint is limited: **Started**, **Unpromoted**, **Promoted**.
- **resource_leader** (mandatory) - The cluster will decide where to put this resource first and then decide where to put **resource_follower**.
  - **id** (mandatory) - Resource ID.
  - **role** (optional) - The resource role to which the constraint is limited: **Started**, **Unpromoted**, **Promoted**.
- **id** (optional) - ID of the constraint. If not specified, it will be autogenerated.
- **options** (optional) - List of name-value dictionaries.
  - **score** - Sets the weight of the constraint.
    - Positive **score** values indicate the resources should run on the same node.
    - Negative **score** values indicate the resources should run on different nodes.
    - A **score** value of **+INFINITY** indicates the resources must run on the same node.
    - A **score** value of **-INFINITY** indicates the resources must run on different nodes.
    - If **score** is not specified, the score value defaults to **INFINITY**.

By default no resource colocation constraints are defined.
The structure of a simple resource colocation constraint is as follows:

```
ha_cluster_constraints_colocation:
  - resource_follower:
      id: resource-id1
      role: resource-role1
    resource_leader:
      id: resource-id2
      role: resource-role2
    id: constraint-id
    options:
      - name: score
        value: score-value
      - name: option-name
        value: option-value
```

You can configure the following items for a resource set colocation constraint:

- **resource_sets** (mandatory) - List of resource sets.

    - **resource_ids** (mandatory) - List of resources in a set.
    - **options** (optional) - List of name-value dictionaries fine-tuning how resources in the sets are treated by the constraint.
- **id** (optional) - Same values as for a simple colocation constraint.
- **options** (optional) - Same values as for a simple colocation constraint.

The structure of a resource set colocation constraint is as follows:

```
ha_cluster_constraints_colocation:
  - resource_sets:
      - resource_ids:
          - resource-id1
          - resource-id2
        options:
          - name: option-name
            value: option-value
    id: constraint-id
    options:
      - name: score
        value: score-value
      - name: option-name
        value: option-value
```

For an example **ha_cluster** system role playbook that creates a cluster with resource constraints, see Configuring a high availability cluster with resource constraints .

ha_cluster_constraints_order

This variable defines resource order constraints. Resource order constraints indicate the order in which certain resource actions should occur. There are two types of resource order constraints: a simple order constraint for two resources, and a set order constraint for multiple resources.
You can configure the following items for a simple resource order constraint:

- **resource_first** (mandatory) - Resource that the **resource_then** resource depends on.
    - **id** (mandatory) - Resource ID.
    - **action** (optional) - The action that must complete before an action can be initiated for the **resource_then** resource. Allowed values: **start**, **stop**, **promote**, **demote**.
- **resource_then** (mandatory) - The dependent resource.
    - **id** (mandatory) - Resource ID.
    - **action** (optional) - The action that the resource can execute only after the action on the **resource_first** resource has completed. Allowed values: **start**, **stop**, **promote**, **demote**.
- **id** (optional) - ID of the constraint. If not specified, it will be autogenerated.
- **options** (optional) - List of name-value dictionaries.

By default no resource order constraints are defined.
The structure of a simple resource order constraint is as follows:

```
ha_cluster_constraints_order:
  - resource_first:
      id: resource-id1
      action: resource-action1
    resource_then:
      id: resource-id2
      action: resource-action2
    id: constraint-id
    options:
      - name: score
        value: score-value
      - name: option-name
        value: option-value
```

You can configure the following items for a resource set order constraint:

- **resource_sets** (mandatory) - List of resource sets.
  - **resource_ids** (mandatory) - List of resources in a set.
  - **options** (optional) - List of name-value dictionaries fine-tuning how resources in the sets are treated by the constraint.
- **id** (optional) - Same values as for a simple order constraint.
- **options** (optional) - Same values as for a simple order constraint.

The structure of a resource set order constraint is as follows:

```
ha_cluster_constraints_order:
  - resource_sets:
      - resource_ids:
          - resource-id1
          - resource-id2
        options:
          - name: option-name
            value: option-value
    id: constraint-id
    options:
      - name: score
        value: score-value
      - name: option-name
        value: option-value
```

For an example **ha_cluster** system role playbook that creates a cluster with resource constraints, see Configuring a high availability cluster with resource constraints .

ha_cluster_constraints_ticket

This variable defines resource ticket constraints. Resource ticket constraints indicate the resources that depend on a certain ticket. There are two types of resource ticket constraints: a simple ticket constraint for one resource, and a ticket order constraint for multiple resources.
You can configure the following items for a simple resource ticket constraint:

- **resource** (mandatory) - Specification of a resource the constraint applies to.

    - **id** (mandatory) - Resource ID.
    - **role** (optional) - The resource role to which the constraint is limited: **Started**, **Unpromoted**, **Promoted**.
- **ticket** (mandatory) - Name of a ticket the resource depends on.
- **id** (optional) - ID of the constraint. If not specified, it will be autogenerated.
- **options** (optional) - List of name-value dictionaries.
    - **loss-policy** (optional) - Action to perform on the resource if the ticket is revoked.

By default no resource ticket constraints are defined.
The structure of a simple resource ticket constraint is as follows:

```
ha_cluster_constraints_ticket:
  - resource:
      id: resource-id
      role: resource-role
    ticket: ticket-name
    id: constraint-id
    options:
      - name: loss-policy
        value: loss-policy-value
      - name: option-name
        value: option-value
```

You can configure the following items for a resource set ticket constraint:

- **resource_sets** (mandatory) - List of resource sets.
    - **resource_ids** (mandatory) - List of resources in a set.
    - **options** (optional) - List of name-value dictionaries fine-tuning how resources in the sets are treated by the constraint.
- **ticket** (mandatory) - Same value as for a simple ticket constraint.
- **id** (optional) - Same value as for a simple ticket constraint.
- **options** (optional) - Same values as for a simple ticket constraint.

The structure of a resource set ticket constraint is as follows:

```
ha_cluster_constraints_ticket:
  - resource_sets:
      - resource_ids:
          - resource-id1
          - resource-id2
        options:
          - name: option-name
            value: option-value
    ticket: ticket-name
    id: constraint-id
```

```
options:
  - name: option-name
    value: option-value
```

For an example **ha_cluster** system role playbook that creates a cluster with resource constraints, see Configuring a high availability cluster with resource constraints .

ha_cluster_qnetd

(RHEL 8.8 and later) This variable configures a **qnetd** host which can then serve as an external quorum device for clusters.
You can configure the following items for a **qnetd** host:

- **present** (optional) - If **true**, configure a **qnetd** instance on the host. If **false**, remove **qnetd** configuration from the host. The default value is **false**. If you set this **true**, you must set **ha_cluster_cluster_present** to **false**.
- **start_on_boot** (optional) - Configures whether the **qnetd** instance should start automatically on boot. The default value is **true**.
- **regenerate_keys** (optional) - Set this variable to **true** to regenerate the **qnetd** TLS certificate. If you regenerate the certificate, you must either re-run the role for each cluster to connect it to the **qnetd** host again or run **pcs** manually.

You cannot run **qnetd** on a cluster node because fencing would disrupt **qnetd** operation.
For an example **ha_cluster** system role playbook that configures a cluster using a quorum device, see Configuring a cluster using a quorum device .

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.ha_cluster/README.md** file
- **/usr/share/doc/rhel-system-roles/ha_cluster/** directory

11.2. SPECIFYING AN INVENTORY FOR THE HA_CLUSTER RHEL SYSTEM ROLE

When configuring an HA cluster using the **ha_cluster** system role playbook, you configure the names and addresses of the nodes for the cluster in an inventory.

11.2.1. Configuring node names and addresses in an inventory

For each node in an inventory, you can optionally specify the following items:

- **node_name** - the name of a node in a cluster.
- **pcs_address** - an address used by **pcs** to communicate with the node. It can be a name, FQDN or an IP address and it can include a port number.
- **corosync_addresses** - list of addresses used by Corosync. All nodes which form a particular cluster must have the same number of addresses and the order of the addresses matters.

The following example shows an inventory with targets **node1** and **node2**. **node1** and **node2** must be either fully qualified domain names or must otherwise be able to connect to the nodes as when, for example, the names are resolvable through the **/etc/hosts** file.

```
all:
  hosts:
    node1:
      ha_cluster:
        node_name: node-A
        pcs_address: node1-address
        corosync_addresses:
          - 192.168.1.11
          - 192.168.2.11
    node2:
      ha_cluster:
        node_name: node-B
        pcs_address: node2-address:2224
        corosync_addresses:
          - 192.168.1.12
          - 192.168.2.12
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.ha_cluster/README.md** file
- **/usr/share/doc/rhel-system-roles/ha_cluster/** directory

11.2.2. Configuring watchdog and SBD devices in an inventory

(RHEL 8.7 and later) When using SBD, you can optionally configure watchdog and SBD devices for each node in an inventory. Even though all SBD devices must be shared to and accessible from all nodes, each node can use different names for the devices. Watchdog devices can be different for each node as well. For information about the SBD variables you can set in a system role playbook, see the entries for **ha_cluster_sbd_enabled** and **ha_cluster_sbd_options** in Variables of the **ha_cluster** system role.

For each node in an inventory, you can optionally specify the following items:

- **sbd_watchdog_modules** (optional) - (RHEL 8.9 and later) Watchdog kernel modules to be loaded, which create **/dev/watchdog*** devices. Defaults to empty list if not set.
- **sbd_watchdog_modules_blocklist** (optional) - (RHEL 8.9 and later) Watchdog kernel modules to be unloaded and blocked. Defaults to empty list if not set.
- **sbd_watchdog** - Watchdog device to be used by SBD. Defaults to **/dev/watchdog** if not set.
- **sbd_devices** - Devices to use for exchanging SBD messages and for monitoring. Defaults to empty list if not set.

The following example shows an inventory that configures watchdog and SBD devices for targets **node1** and **node2**.

```
all:
  hosts:
    node1:
      ha_cluster:
```

```
      sbd_watchdog_modules:
        - module1
        - module2
      sbd_watchdog: /dev/watchdog2
      sbd_devices:
        - /dev/vdx
        - /dev/vdy
  node2:
    ha_cluster:
      sbd_watchdog_modules:
        - module1
      sbd_watchdog_modules_blocklist:
        - module2
      sbd_watchdog: /dev/watchdog1
      sbd_devices:
        - /dev/vdw
        - /dev/vdz
```

For information about creating a high availability cluster that uses SBD fencing, see Configuring a high availability cluster with SBD node fencing.

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.ha_cluster/README.md** file
- **/usr/share/doc/rhel-system-roles/ha_cluster/** directory

11.3. CREATING PCSD TLS CERTIFICATES AND KEY FILES FOR A HIGH AVAILABILITY CLUSTER

(RHEL 8.8 and later)

You can use the **ha_cluster** system role to create TLS certificates and key files in a high availability cluster. When you run this playbook, the **ha_cluster** system role uses the **certificate** system role internally to manage TLS certificates.

WARNING

The **ha_cluster** system role replaces any existing cluster configuration on the specified nodes. Any settings not specified in the playbook will be lost.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

- The systems that you will use as your cluster members have active subscription coverage for RHEL and the RHEL High Availability Add-On.
- The inventory file specifies the cluster nodes as described in Specifying an inventory for the ha_cluster system role.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Create TLS certificates and key files in a high availability cluster
  hosts: node1 node2
  roles:
    - rhel-system-roles.ha_cluster
  vars:
    ha_cluster_cluster_name: my-new-cluster
    ha_cluster_hacluster_password: <password>
    ha_cluster_manage_firewall: true
    ha_cluster_manage_selinux: true
    ha_cluster_pcsd_certificates:
      - name: FILENAME
        common_name: "{{ ansible_hostname }}"
        ca: self-sign
```

   This playbook configures a cluster running the **firewalld** and **selinux** services and creates a self-signed **pcsd** certificate and private key files in **/var/lib/pcsd**. The **pcsd** certificate has the file name **FILENAME.crt** and the key file is named **FILENAME.key**.

   When creating your playbook file for production, vault encrypt the password, as described in Encrypting content with Ansible Vault .

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

   Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.ha_cluster/README.md** file
- **/usr/share/doc/rhel-system-roles/ha_cluster/** directory Requesting certificates using RHEL system roles

11.4. CONFIGURING A HIGH AVAILABILITY CLUSTER RUNNING NO RESOURCES

The following procedure uses the **ha_cluster** system role, to create a high availability cluster with no fencing configured and which runs no resources.

WARNING

The **ha_cluster** system role replaces any existing cluster configuration on the specified nodes. Any settings not specified in the playbook will be lost.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- The systems that you will use as your cluster members have active subscription coverage for RHEL and the RHEL High Availability Add-On.
- The inventory file specifies the cluster nodes as described in Specifying an inventory for the ha_cluster system role.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Create a high availability cluster with no fencing and which runs no resources
  hosts: node1 node2
  roles:
    - rhel-system-roles.ha_cluster
  vars:
    ha_cluster_cluster_name: my-new-cluster
    ha_cluster_hacluster_password: <password>
    ha_cluster_manage_firewall: true
    ha_cluster_manage_selinux: true
```

   This example playbook file configures a cluster running the **firewalld** and **selinux** services with no fencing configured and which runs no resources.

   When creating your playbook file for production, vault encrypt the password, as described in Encrypting content with Ansible Vault .

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

   Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.ha_cluster/README.md** file
- **/usr/share/doc/rhel-system-roles/ha_cluster/** directory

11.5. CONFIGURING A HIGH AVAILABILITY CLUSTER WITH FENCING AND RESOURCES

The following procedure uses the **ha_cluster** system role to create a high availability cluster that includes a fencing device, cluster resources, resource groups, and a cloned resource.

WARNING

The **ha_cluster** system role replaces any existing cluster configuration on the specified nodes. Any settings not specified in the playbook will be lost.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- The systems that you will use as your cluster members have active subscription coverage for RHEL and the RHEL High Availability Add-On.
- The inventory file specifies the cluster nodes as described in Specifying an inventory for the ha_cluster system role.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Create a high availability cluster that includes a fencing device and resources
  hosts: node1 node2
  roles:
    - rhel-system-roles.ha_cluster
  vars:
    ha_cluster_cluster_name: my-new-cluster
    ha_cluster_hacluster_password: <password>
    ha_cluster_manage_firewall: true
    ha_cluster_manage_selinux: true
    ha_cluster_resource_primitives:
      - id: xvm-fencing
```

```
    agent: 'stonith:fence_xvm'
    instance_attrs:
      - attrs:
          - name: pcmk_host_list
            value: node1 node2
  - id: simple-resource
    agent: 'ocf:pacemaker:Dummy'
  - id: resource-with-options
    agent: 'ocf:pacemaker:Dummy'
    instance_attrs:
      - attrs:
          - name: fake
            value: fake-value
          - name: passwd
            value: passwd-value
    meta_attrs:
      - attrs:
          - name: target-role
            value: Started
          - name: is-managed
            value: 'true'
    operations:
      - action: start
        attrs:
          - name: timeout
            value: '30s'
      - action: monitor
        attrs:
          - name: timeout
            value: '5'
          - name: interval
            value: '1min'
  - id: dummy-1
    agent: 'ocf:pacemaker:Dummy'
  - id: dummy-2
    agent: 'ocf:pacemaker:Dummy'
  - id: dummy-3
    agent: 'ocf:pacemaker:Dummy'
  - id: simple-clone
    agent: 'ocf:pacemaker:Dummy'
  - id: clone-with-options
    agent: 'ocf:pacemaker:Dummy'
ha_cluster_resource_groups:
  - id: simple-group
    resource_ids:
      - dummy-1
      - dummy-2
    meta_attrs:
      - attrs:
          - name: target-role
            value: Started
          - name: is-managed
            value: 'true'
  - id: cloned-group
    resource_ids:
      - dummy-3
```

```
ha_cluster_resource_clones:
  - resource_id: simple-clone
  - resource_id: clone-with-options
    promotable: yes
    id: custom-clone-id
    meta_attrs:
      - attrs:
          - name: clone-max
            value: '2'
          - name: clone-node-max
            value: '1'
  - resource_id: cloned-group
    promotable: yes
```

This example playbook file configures a cluster running the **firewalld** and **selinux** services. The cluster includes fencing, several resources, and a resource group. It also includes a resource clone for the resource group.

When creating your playbook file for production, vault encrypt the password, as described in Encrypting content with Ansible Vault .

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.ha_cluster/README.md** file
- **/usr/share/doc/rhel-system-roles/ha_cluster/** directory

11.6. CONFIGURING A HIGH AVAILABILITY CLUSTER WITH RESOURCE AND RESOURCE OPERATION DEFAULTS

(RHEL 8.9 and later) The following procedure uses the **ha_cluster** system role to create a high availability cluster that defines resource and resource operation defaults.

WARNING

The **ha_cluster** system role replaces any existing cluster configuration on the specified nodes. Any settings not specified in the playbook will be lost.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- The systems that you will use as your cluster members have active subscription coverage for RHEL and the RHEL High Availability Add-On.
- The inventory file specifies the cluster nodes as described in Specifying an inventory for the ha_cluster system role.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Create a high availability cluster that defines resource and resource operation
defaults
  hosts: node1 node2
  roles:
    - rhel-system-roles.ha_cluster
  vars:
    ha_cluster_cluster_name: my-new-cluster
    ha_cluster_hacluster_password: <password>
    ha_cluster_manage_firewall: true
    ha_cluster_manage_selinux: true
    # Set a different resource-stickiness value during
    # and outside work hours. This allows resources to
    # automatically move back to their most
    # preferred hosts, but at a time that
    # does not interfere with business activities.
    ha_cluster_resource_defaults:
      meta_attrs:
        - id: core-hours
          rule: date-spec hours=9-16 weekdays=1-5
          score: 2
          attrs:
            - name: resource-stickiness
              value: INFINITY
        - id: after-hours
          score: 1
          attrs:
            - name: resource-stickiness
              value: 0
    # Default the timeout on all 10-second-interval
    # monitor actions on IPaddr2 resources to 8 seconds.
    ha_cluster_resource_operation_defaults:
      meta_attrs:
        - rule: resource ::IPaddr2 and op monitor interval=10s
          score: INFINITY
          attrs:
            - name: timeout
              value: 8s
```

This example playbook file configures a cluster running the **firewalld** and **selinux** services. The cluster includes resource and resource operation defaults.

When creating your playbook file for production, vault encrypt the password, as described in Encrypting content with Ansible Vault .

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.ha_cluster/README.md** file
- **/usr/share/doc/rhel-system-roles/ha_cluster/** directory

11.7. CONFIGURING A HIGH AVAILABILITY CLUSTER WITH FENCING LEVELS

(RHEL 8.10 and later) The following procedure uses the **ha_cluster** system role to create a high availability cluster that defines fencing levels.

WARNING

The **ha_cluster** system role replaces any existing cluster configuration on the specified nodes. Any settings not specified in the playbook will be lost.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- The systems that you will use as your cluster members have active subscription coverage for RHEL and the RHEL High Availability Add-On.
- The inventory file specifies the cluster nodes as described in Specifying an inventory for the ha_cluster system role. For general information about creating an inventory file, see Preparing a control node on RHEL 8.

Procedure

1. Store your sensitive variables in an encrypted file:

   a. Create the vault:

   ```
   $ ansible-vault create vault.yml
   New Vault password: <vault_password>
   Confirm New Vault password: <vault_password>
   ```

   b. After the **ansible-vault create** command opens an editor, enter the sensitive data in the ***<key>: <value>*** format:

   ```
   cluster_password: <cluster_password>
   fence1_password: <fence1_password>
   fence2_password: <fence2_password>
   ```

   c. Save the changes, and close the editor. Ansible encrypts the data in the vault.

2. Create a playbook file, for example ~/**playbook.yml**. This example playbook file configures a cluster running the **firewalld** and **selinux** services.

```
---
- name: Create a high availability cluster
  hosts: node1 node2
  vars_files:
    - vault.yml
  tasks:
    - name: Configure a cluster that defines fencing levels
      ansible.builtin.include_role:
        name: rhel-system-roles.ha_cluster
      vars:
        ha_cluster_cluster_name: my-new-cluster
        ha_cluster_hacluster_password: "{{ cluster_password }}"
        ha_cluster_manage_firewall: true
        ha_cluster_manage_selinux: true
        ha_cluster_resource_primitives:
          - id: apc1
            agent: 'stonith:fence_apc_snmp'
            instance_attrs:
              - attrs:
                  - name: ip
                    value: apc1.example.com
                  - name: username
                    value: user
                  - name: password
                    value: "{{ fence1_password }}"
                  - name: pcmk_host_map
                    value: node1:1;node2:2
          - id: apc2
            agent: 'stonith:fence_apc_snmp'
            instance_attrs:
              - attrs:
                  - name: ip
                    value: apc2.example.com
                  - name: username
```

```
            value: user
          - name: password
            value: "{{ fence2_password }}"
          - name: pcmk_host_map
            value: node1:1;node2:2
    # Nodes have redundant power supplies, apc1 and apc2. Cluster must
    # ensure that when attempting to reboot a node, both power
    # supplies # are turned off before either power supply is turned
    # back on.
    ha_cluster_stonith_levels:
      - level: 1
        target: node1
        resource_ids:
          - apc1
          - apc2
      - level: 1
        target: node2
        resource_ids:
          - apc1
          - apc2
```

3. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check --ask-vault-pass ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

4. Run the playbook:

```
$ ansible-playbook --ask-vault-pass ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.ha_cluster/README.md** file
- **/usr/share/doc/rhel-system-roles/ha_cluster/** directory
- Ansible vault

11.8. CONFIGURING A HIGH AVAILABILITY CLUSTER WITH RESOURCE CONSTRAINTS

The following procedure uses the **ha_cluster** system role to create a high availability cluster that includes resource location constraints, resource colocation constraints, resource order constraints, and resource ticket constraints.

WARNING

The **ha_cluster** system role replaces any existing cluster configuration on the specified nodes. Any settings not specified in the playbook will be lost.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- The systems that you will use as your cluster members have active subscription coverage for RHEL and the RHEL High Availability Add-On.
- The inventory file specifies the cluster nodes as described in Specifying an inventory for the ha_cluster system role.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Create a high availability cluster with resource constraints
  hosts: node1 node2
  roles:
    - rhel-system-roles.ha_cluster
  vars:
    ha_cluster_cluster_name: my-new-cluster
    ha_cluster_hacluster_password: <password>
    ha_cluster_manage_firewall: true
    ha_cluster_manage_selinux: true
    # In order to use constraints, we need resources the constraints will apply
    # to.
    ha_cluster_resource_primitives:
      - id: xvm-fencing
        agent: 'stonith:fence_xvm'
        instance_attrs:
          - attrs:
              - name: pcmk_host_list
                value: node1 node2
      - id: dummy-1
        agent: 'ocf:pacemaker:Dummy'
      - id: dummy-2
        agent: 'ocf:pacemaker:Dummy'
      - id: dummy-3
        agent: 'ocf:pacemaker:Dummy'
      - id: dummy-4
        agent: 'ocf:pacemaker:Dummy'
      - id: dummy-5
```

```
    agent: 'ocf:pacemaker:Dummy'
  - id: dummy-6
    agent: 'ocf:pacemaker:Dummy'
# location constraints
ha_cluster_constraints_location:
  # resource ID and node name
  - resource:
      id: dummy-1
    node: node1
    options:
      - name: score
        value: 20
  # resource pattern and node name
  - resource:
      pattern: dummy-\d+
    node: node1
    options:
      - name: score
        value: 10
  # resource ID and rule
  - resource:
      id: dummy-2
    rule: '#uname eq node2 and date in_range 2022-01-01 to 2022-02-28'
  # resource pattern and rule
  - resource:
      pattern: dummy-\d+
    rule: node-type eq weekend and date-spec weekdays=6-7
# colocation constraints
ha_cluster_constraints_colocation:
  # simple constraint
  - resource_leader:
      id: dummy-3
    resource_follower:
      id: dummy-4
    options:
      - name: score
        value: -5
  # set constraint
  - resource_sets:
      - resource_ids:
          - dummy-1
          - dummy-2
      - resource_ids:
          - dummy-5
          - dummy-6
        options:
          - name: sequential
            value: "false"
    options:
      - name: score
        value: 20
# order constraints
ha_cluster_constraints_order:
  # simple constraint
  - resource_first:
      id: dummy-1
```

```
      resource_then:
        id: dummy-6
      options:
        - name: symmetrical
          value: "false"
    # set constraint
    - resource_sets:
        - resource_ids:
            - dummy-1
            - dummy-2
          options:
            - name: require-all
              value: "false"
            - name: sequential
              value: "false"
        - resource_ids:
            - dummy-3
        - resource_ids:
            - dummy-4
            - dummy-5
          options:
            - name: sequential
              value: "false"
  # ticket constraints
  ha_cluster_constraints_ticket:
    # simple constraint
    - resource:
        id: dummy-1
      ticket: ticket1
      options:
        - name: loss-policy
          value: stop
    # set constraint
    - resource_sets:
        - resource_ids:
            - dummy-3
            - dummy-4
            - dummy-5
      ticket: ticket2
      options:
        - name: loss-policy
          value: fence
```

This example playbook file configures a cluster running the **firewalld** and **selinux** services. The cluster includes resource location constraints, resource colocation constraints, resource order constraints, and resource ticket constraints.

When creating your playbook file for production, vault encrypt the password, as described in Encrypting content with Ansible Vault .

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.ha_cluster/README.md** file
- **/usr/share/doc/rhel-system-roles/ha_cluster/** directory

11.9. CONFIGURING COROSYNC VALUES IN A HIGH AVAILABILITY CLUSTER

(RHEL 8.7 and later) The following procedure uses the **ha_cluster** system role to create a high availability cluster that configures Corosync values.

WARNING

The **ha_cluster** system role replaces any existing cluster configuration on the specified nodes. Any settings not specified in the playbook will be lost.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- The systems that you will use as your cluster members have active subscription coverage for RHEL and the RHEL High Availability Add-On.
- The inventory file specifies the cluster nodes as described in Specifying an inventory for the ha_cluster system role.

Procedure

1. Create a playbook file, for example **~/playbook.yml**, with the following content:

```
---
- name: Create a high availability cluster that configures Corosync values
  hosts: node1 node2
  roles:
    - rhel-system-roles.ha_cluster
  vars:
    ha_cluster_cluster_name: my-new-cluster
    ha_cluster_hacluster_password: <password>
    ha_cluster_manage_firewall: true
    ha_cluster_manage_selinux: true
```

```
    ha_cluster_transport:
      type: knet
      options:
        - name: ip_version
          value: ipv4-6
        - name: link_mode
          value: active
      links:
        -
          - name: linknumber
            value: 1
          - name: link_priority
            value: 5
        -
          - name: linknumber
            value: 0
          - name: link_priority
            value: 10
      compression:
        - name: level
          value: 5
        - name: model
          value: zlib
      crypto:
        - name: cipher
          value: none
        - name: hash
          value: none
    ha_cluster_totem:
      options:
        - name: block_unlisted_ips
          value: 'yes'
        - name: send_join
          value: 0
    ha_cluster_quorum:
      options:
        - name: auto_tie_breaker
          value: 1
        - name: wait_for_all
          value: 1
```

This example playbook file configures a cluster running the **firewalld** and **selinux** services that configures Corosync properties.

When creating your playbook file for production, Vault encrypt the password, as described in Encrypting content with Ansible Vault .

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.ha_cluster/README.md** file
- **/usr/share/doc/rhel-system-roles/ha_cluster/** directory

11.10. CONFIGURING A HIGH AVAILABILITY CLUSTER WITH SBD NODE FENCING

(RHEL 8.7 and later) The following procedure uses the **ha_cluster** system role to create a high availability cluster that uses SBD node fencing.

WARNING

The **ha_cluster** system role replaces any existing cluster configuration on the specified nodes. Any settings not specified in the playbook will be lost.

This playbook uses an inventory file that loads a watchdog module (supported in RHEL 8.9 and later) as described in Configuring watchdog and SBD devices in an inventory .

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- The systems that you will use as your cluster members have active subscription coverage for RHEL and the RHEL High Availability Add-On.
- The inventory file specifies the cluster nodes as described in Specifying an inventory for the ha_cluster system role.

Procedure

1. Create a playbook file, for example **~/playbook.yml**, with the following content:

```
---
- name: Create a high availability cluster that uses SBD node fencing
  hosts: node1 node2
  roles:
    - rhel-system-roles.ha_cluster
  vars:
    ha_cluster_cluster_name: my-new-cluster
    ha_cluster_hacluster_password: <password>
    ha_cluster_manage_firewall: true
```

```
    ha_cluster_manage_selinux: true
    ha_cluster_sbd_enabled: yes
    ha_cluster_sbd_options:
      - name: delay-start
        value: 'no'
      - name: startmode
        value: always
      - name: timeout-action
        value: 'flush,reboot'
      - name: watchdog-timeout
        value: 30
    # Suggested optimal values for SBD timeouts:
    # watchdog-timeout * 2 = msgwait-timeout (set automatically)
    # msgwait-timeout * 1.2 = stonith-timeout
    ha_cluster_cluster_properties:
      - attrs:
          - name: stonith-timeout
            value: 72
    ha_cluster_resource_primitives:
      - id: fence_sbd
        agent: 'stonith:fence_sbd'
        instance_attrs:
          - attrs:
              # taken from host_vars
              - name: devices
                value: "{{ ha_cluster.sbd_devices | join(',') }}"
              - name: pcmk_delay_base
                value: 30
```

This example playbook file configures a cluster running the **firewalld** and **selinux** services that uses SBD fencing and creates the SBD Stonith resource.

When creating your playbook file for production, vault encrypt the password, as described in Encrypting content with Ansible Vault .

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.ha_cluster/README.md** file
- **/usr/share/doc/rhel-system-roles/ha_cluster/** directory

11.11. CONFIGURING A HIGH AVAILABILITY CLUSTER USING A QUORUM DEVICE

(RHEL 8.8 and later) To configure a high availability cluster with a separate quorum device by using the **ha_cluster** system role, first set up the quorum device. After setting up the quorum device, you can use the device in any number of clusters.

11.11.1. Configuring a quorum device

To configure a quorum device using the **ha_cluster** system role, follow these steps. Note that you cannot run a quorum device on a cluster node.

WARNING

The **ha_cluster** system role replaces any existing cluster configuration on the specified nodes. Any settings not specified in the playbook will be lost.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- The system that you will use to run the quorum device has active subscription coverage for RHEL and the RHEL High Availability Add-On.
- The inventory file specifies the quorum devices as described in Specifying an inventory for the ha_cluster system role.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Configure a quorum device
  hosts: nodeQ
  roles:
    - rhel-system-roles.ha_cluster
  vars:
    ha_cluster_cluster_present: false
    ha_cluster_hacluster_password: <password>
    ha_cluster_manage_firewall: true
    ha_cluster_manage_selinux: true
    ha_cluster_qnetd:
      present: true
```

This example playbook file configures a quorum device on a system running the **firewalld** and **selinux** services.

When creating your playbook file for production, vault encrypt the password, as described in Encrypting content with Ansible Vault .

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.ha_cluster/README.md** file
- **/usr/share/doc/rhel-system-roles/ha_cluster/** directory

11.11.2. Configuring a cluster to use a quorum device

To configure a cluster to use a quorum device, follow these steps.

WARNING

The **ha_cluster** system role replaces any existing cluster configuration on the specified nodes. Any settings not specified in the playbook will be lost.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- The systems that you will use as your cluster members have active subscription coverage for RHEL and the RHEL High Availability Add-On.
- The inventory file specifies the cluster nodes as described in Specifying an inventory for the ha_cluster system role.
- You have configured a quorum device.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Configure a cluster to use a quorum device
  hosts: node1 node2
  roles:
```

```
    - rhel-system-roles.ha_cluster
  vars:
    ha_cluster_cluster_name: my-new-cluster
    ha_cluster_hacluster_password: <password>
    ha_cluster_manage_firewall: true
    ha_cluster_manage_selinux: true
    ha_cluster_quorum:
      device:
        model: net
        model_options:
          - name: host
            value: nodeQ
          - name: algorithm
            value: lms
```

This example playbook file configures a cluster running the **firewalld** and **selinux** services that uses a quorum device.

When creating your playbook file for production, vault encrypt the password, as described in Encrypting content with Ansible Vault .

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

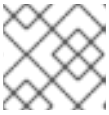
- **/usr/share/ansible/roles/rhel-system-roles.ha_cluster/README.md** file
- **/usr/share/doc/rhel-system-roles/ha_cluster/** directory

11.12. CONFIGURING A HIGH AVAILABILITY CLUSTER WITH NODE ATTRIBUTES

(RHEL 8.10 and later) The following procedure uses the **ha_cluster** system role to create a high availability cluster that configures node attributes.

Prerequisites

- You have **ansible-core** installed on the node from which you want to run the playbook.



NOTE

You do not need to have **ansible-core** installed on the cluster member nodes.

- You have the **rhel-system-roles** package installed on the system from which you want to run the playbook.
- The systems that you will use as your cluster members have active subscription coverage for RHEL and the RHEL High Availability Add-On.

WARNING

The **ha_cluster** system role replaces any existing cluster configuration on the specified nodes. Any settings not specified in the playbook will be lost.

Procedure

1. Create an inventory file specifying the nodes in the cluster, as described in Specifying an inventory for the ha_cluster system role.
2. Create a playbook file, for example **new-cluster.yml**.

NOTE

When creating your playbook file for production, vault encrypt the password, as described in Encrypting content with Ansible Vault .

The following example playbook file configures a cluster running the **firewalld** and **selinux** services with node attributes configured for the nodes in the cluster.

```
- hosts: node1 node2
  vars:
    ha_cluster_cluster_name: my-new-cluster
    ha_cluster_hacluster_password: password
    ha_cluster_manage_firewall: true
    ha_cluster_manage_selinux: true
    ha_cluster_node_options:
      - node_name: node1
        attributes:
          - attrs:
              - name: attribute1
                value: value1A
              - name: attribute2
                value: value2A
      - node_name: node2
        attributes:
          - attrs:
              - name: attribute1
                value: value1B
              - name: attribute2
                value: value2B

  roles:
    - linux-system-roles.ha_cluster
```

3. Save the file.
4. Run the playbook, specifying the path to the inventory file *inventory* you created in Step 1.

```
# ansible-playbook -i inventory new-cluster.yml
```

11.13. CONFIGURING AN APACHE HTTP SERVER IN A HIGH AVAILABILITY CLUSTER WITH THE HA_CLUSTER RHEL SYSTEM ROLE

This procedure configures an active/passive Apache HTTP server in a two-node Red Hat Enterprise Linux High Availability Add-On cluster using the **ha_cluster** system role.

WARNING

The **ha_cluster** system role replaces any existing cluster configuration on the specified nodes. Any settings not specified in the playbook will be lost.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- The systems that you will use as your cluster members have active subscription coverage for RHEL and the RHEL High Availability Add-On.
- The inventory file specifies the cluster nodes as described in Specifying an inventory for the ha_cluster system role.
- You have configured an LVM logical volume with an XFS file system, as described in Configuring an LVM volume with an XFS file system in a Pacemaker cluster.
- You have configured an Apache HTTP server, as described in Configuring an Apache HTTP Server.
- Your system includes an APC power switch that will be used to fence the cluster nodes.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Configure active/passive Apache server in a high availability cluster
  hosts: z1.example.com z2.example.com
  roles:
    - rhel-system-roles.ha_cluster
  vars:
    ha_cluster_hacluster_password: <password>
```

```
ha_cluster_cluster_name: my_cluster
ha_cluster_manage_firewall: true
ha_cluster_manage_selinux: true
ha_cluster_fence_agent_packages:
  - fence-agents-apc-snmp
ha_cluster_resource_primitives:
  - id: myapc
    agent: stonith:fence_apc_snmp
    instance_attrs:
      - attrs:
          - name: ipaddr
            value: zapc.example.com
          - name: pcmk_host_map
            value: z1.example.com:1;z2.example.com:2
          - name: login
            value: apc
          - name: passwd
            value: apc
  - id: my_lvm
    agent: ocf:heartbeat:LVM-activate
    instance_attrs:
      - attrs:
          - name: vgname
            value: my_vg
          - name: vg_access_mode
            value: system_id
  - id: my_fs
    agent: Filesystem
    instance_attrs:
      - attrs:
          - name: device
            value: /dev/my_vg/my_lv
          - name: directory
            value: /var/www
          - name: fstype
            value: xfs
  - id: VirtualIP
    agent: IPaddr2
    instance_attrs:
      - attrs:
          - name: ip
            value: 198.51.100.3
          - name: cidr_netmask
            value: 24
  - id: Website
    agent: apache
    instance_attrs:
      - attrs:
          - name: configfile
            value: /etc/httpd/conf/httpd.conf
          - name: statusurl
            value: http://127.0.0.1/server-status
ha_cluster_resource_groups:
  - id: apachegroup
    resource_ids:
      - my_lvm
```

```
    - my_fs
    - VirtualIP
    - Website
```

This example playbook file configures a previously-created Apache HTTP server in an active/passive two-node HA cluster running the **firewalld** and **selinux** services.

This example uses an APC power switch with a host name of **zapc.example.com**. If the cluster does not use any other fence agents, you can optionally list only the fence agents your cluster requires when defining the **ha_cluster_fence_agent_packages** variable, as in this example.

When creating your playbook file for production, vault encrypt the password, as described in Encrypting content with Ansible Vault .

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

4. When you use the **apache** resource agent to manage Apache, it does not use **systemd**. Because of this, you must edit the **logrotate** script supplied with Apache so that it does not use **systemctl** to reload Apache.
Remove the following line in the **/etc/logrotate.d/httpd** file on each node in the cluster.

```
# /bin/systemctl reload httpd.service > /dev/null 2>/dev/null || true
```

- For RHEL 8.6 and later, replace the line you removed with the following three lines, specifying **/var/run/httpd-*website*.pid** as the PID file path where *website* is the name of the Apache resource. In this example, the Apache resource name is **Website**.

```
/usr/bin/test -f /var/run/httpd-Website.pid >/dev/null 2>/dev/null &&
/usr/bin/ps -q $(/usr/bin/cat /var/run/httpd-Website.pid) >/dev/null 2>/dev/null &&
/usr/sbin/httpd -f /etc/httpd/conf/httpd.conf -c "PidFile /var/run/httpd-Website.pid" -k
graceful > /dev/null 2>/dev/null || true
```

- For RHEL 8.5 and earlier, replace the line you removed with the following three lines.

```
/usr/bin/test -f /run/httpd.pid >/dev/null 2>/dev/null &&
/usr/bin/ps -q $(/usr/bin/cat /run/httpd.pid) >/dev/null 2>/dev/null &&
/usr/sbin/httpd -f /etc/httpd/conf/httpd.conf -c "PidFile /run/httpd.pid" -k graceful > /dev/null
2>/dev/null || true
```

Verification

1. From one of the nodes in the cluster, check the status of the cluster. Note that all four resources are running on the same node, **z1.example.com**.
If you find that the resources you configured are not running, you can run the **pcs resource debug-start *resource*** command to test the resource configuration.

```
[root@z1 ~]# pcs status
Cluster name: my_cluster
Last updated: Wed Jul 31 16:38:51 2013
Last change: Wed Jul 31 16:42:14 2013 via crm_attribute on z1.example.com
Stack: corosync
Current DC: z2.example.com (2) - partition with quorum
Version: 1.1.10-5.el7-9abe687
2 Nodes configured
6 Resources configured

Online: [ z1.example.com z2.example.com ]

Full list of resources:
 myapc  (stonith:fence_apc_snmp):       Started z1.example.com
 Resource Group: apachegroup
     my_lvm     (ocf::heartbeat:LVM-activate):   Started z1.example.com
     my_fs      (ocf::heartbeat:Filesystem):    Started z1.example.com
     VirtualIP  (ocf::heartbeat:IPaddr2):       Started z1.example.com
     Website    (ocf::heartbeat:apache):        Started z1.example.com
```

2. Once the cluster is up and running, you can point a browser to the IP address you defined as the **IPaddr2** resource to view the sample display, consisting of the simple word "Hello".

```
Hello
```

3. To test whether the resource group running on **z1.example.com** fails over to node **z2.example.com**, put node **z1.example.com** in **standby** mode, after which the node will no longer be able to host resources.

```
[root@z1 ~]# pcs node standby z1.example.com
```

4. After putting node **z1** in **standby** mode, check the cluster status from one of the nodes in the cluster. Note that the resources should now all be running on **z2**.

```
[root@z1 ~]# pcs status
Cluster name: my_cluster
Last updated: Wed Jul 31 17:16:17 2013
Last change: Wed Jul 31 17:18:34 2013 via crm_attribute on z1.example.com
Stack: corosync
Current DC: z2.example.com (2) - partition with quorum
Version: 1.1.10-5.el7-9abe687
2 Nodes configured
6 Resources configured

Node z1.example.com (1): standby
Online: [ z2.example.com ]

Full list of resources:

 myapc  (stonith:fence_apc_snmp):       Started z1.example.com
 Resource Group: apachegroup
     my_lvm     (ocf::heartbeat:LVM-activate):   Started z2.example.com
     my_fs      (ocf::heartbeat:Filesystem):    Started z2.example.com
     VirtualIP  (ocf::heartbeat:IPaddr2):       Started z2.example.com
     Website    (ocf::heartbeat:apache):        Started z2.example.com
```

The web site at the defined IP address should still display, without interruption.

5. To remove **z1** from **standby** mode, enter the following command.

```
[root@z1 ~]# pcs node unstandby z1.example.com
```

NOTE

Removing a node from **standby** mode does not in itself cause the resources to fail back over to that node. This will depend on the **resource-stickiness** value for the resources. For information about the **resource-stickiness** meta attribute, see Configuring a resource to prefer its current node .

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.ha_cluster/README.md** file
- **/usr/share/doc/rhel-system-roles/ha_cluster/** directory

CHAPTER 12. CONFIGURING THE SYSTEMD JOURNAL BY USING THE RHEL SYSTEM ROLE

With the **journald** RHEL system role you can automate the **systemd** journal, and configure persistent logging by using the Red Hat Ansible Automation Platform.

12.1. CONFIGURING PERSISTENT LOGGING BY USING THE JOURNALD RHEL SYSTEM ROLE

As a system administrator, you can configure persistent logging by using the **journald** RHEL system role. The following example shows how to set up the **journald** RHEL system role variables in a playbook to achieve the following goals:

- Configuring persistent logging
- Specifying the maximum size of disk space for journal files
- Configuring **journald** to keep log data separate for each user
- Defining the synchronization interval

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Configure persistent logging
  hosts: managed-node-01.example.com
  vars:
    journald_persistent: true
    journald_max_disk_size: 2048
    journald_per_user: true
    journald_sync_interval: 1
  roles:
    - rhel-system-roles.journald
```

   As a result, the **journald** service stores your logs persistently on a disk to the maximum size of 2048 MB, and keeps log data separate for each user. The synchronization happens every minute.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.journald/README.md** file
- **/usr/share/doc/rhel-system-roles/journald/** directory

CHAPTER 13. CONFIGURING AUTOMATIC CRASH DUMPS BY USING THE RHEL SYSTEM ROLE

To manage kdump using Ansible, you can use the **kdump** role, which is one of the RHEL system roles available in RHEL 8.

Using the **kdump** role enables you to specify where to save the contents of the system's memory for later analysis.

13.1. CONFIGURING THE KERNEL CRASH DUMPING MECHANISM BY USING THE KDUMP RHEL SYSTEM ROLE

You can set basic kernel dump parameters on multiple systems by using the **kdump** system role by running an Ansible playbook.

WARNING

The **kdump** Systeme Role replaces the **kdump** configuration of the managed hosts entirely by replacing the **/etc/kdump.conf** file. Additionally, if the **kdump** role is applied, all previous **kdump** settings are also replaced, even if they are not specified by the role variables, by replacing the **/etc/sysconfig/kdump** file.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example **~/playbook.yml**, with the following content:

```
---
- hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.kdump
  vars:
    kdump_path: /var/crash
```

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

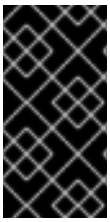
- **/usr/share/ansible/roles/rhel-system-roles.kdump/README.md** file
- **/usr/share/doc/rhel-system-roles/kdump/** directory

CHAPTER 14. CONFIGURING KERNEL PARAMETERS PERMANENTLY BY USING THE RHEL SYSTEM ROLE

You can use the **kernel_settings** RHEL system role to configure kernel parameters on multiple clients at once. This solution:

- Provides a friendly interface with efficient input setting.
- Keeps all intended kernel parameters in one place.

After you run the **kernel_settings** role from the control machine, the kernel parameters are applied to the managed systems immediately and persist across reboots.



IMPORTANT

Note that RHEL system role delivered over RHEL channels are available to RHEL customers as an RPM package in the default AppStream repository. RHEL system role are also available as a collection to customers with Ansible subscriptions over Ansible Automation Hub.

14.1. INTRODUCTION TO THE KERNEL_SETTINGS RHEL SYSTEM ROLE

RHEL system roles is a set of roles that provide a consistent configuration interface to remotely manage multiple systems.

RHEL system roles were introduced for automated configurations of the kernel using the **kernel_settings** RHEL system role. The **rhel-system-roles** package contains this system role, and also the reference documentation.

To apply the kernel parameters on one or more systems in an automated fashion, use the **kernel_settings** role with one or more of its role variables of your choice in a playbook. A playbook is a list of one or more plays that are human-readable, and are written in the YAML format.

You can use an inventory file to define a set of systems that you want Ansible to configure according to the playbook.

With the **kernel_settings** role you can configure:

- The kernel parameters using the **kernel_settings_sysctl** role variable
- Various kernel subsystems, hardware devices, and device drivers using the **kernel_settings_sysfs** role variable
- The CPU affinity for the **systemd** service manager and processes it forks using the **kernel_settings_systemd_cpu_affinity** role variable
- The kernel memory subsystem transparent hugepages using the **kernel_settings_transparent_hugepages** and **kernel_settings_transparent_hugepages_defrag** role variables

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.kernel_settings/README.md** file
- **/usr/share/doc/rhel-system-roles/kernel_settings/** directory

- Working with playbooks
- How to build your inventory

14.2. APPLYING SELECTED KERNEL PARAMETERS BY USING THE KERNEL_SETTINGS RHEL SYSTEM ROLE

Follow these steps to prepare and apply an Ansible playbook to remotely configure kernel parameters with persisting effect on multiple managed operating systems.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Configure kernel settings
  hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.kernel_settings
  vars:
    kernel_settings_sysctl:
      - name: fs.file-max
        value: 400000
      - name: kernel.threads-max
        value: 65536
    kernel_settings_sysfs:
      - name: /sys/class/net/lo/mtu
        value: 65000
    kernel_settings_transparent_hugepages: madvise
```

- **name**: optional key which associates an arbitrary string with the play as a label and identifies what the play is for.
- **hosts**: key in the play which specifies the hosts against which the play is run. The value or values for this key can be provided as individual names of managed hosts or as groups of hosts as defined in the **inventory** file.
- **vars**: section of the playbook which represents a list of variables containing selected kernel parameter names and values to which they have to be set.
- **role**: key which specifies what RHEL system role is going to configure the parameters and values mentioned in the **vars** section.

NOTE

You can modify the kernel parameters and their values in the playbook to fit your needs.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

4. Restart your managed hosts and check the affected kernel parameters to verify that the changes have been applied and persist across reboots.

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.kernel_settings/README.md** file
- **/usr/share/doc/rhel-system-roles/kernel_settings/** directory
- Working With Playbooks
- Using Variables
- Roles

CHAPTER 15. CONFIGURING LOGGING BY USING THE RHEL SYSTEM ROLE

As a system administrator, you can use the **logging** RHEL system role to configure a Red Hat Enterprise Linux host as a logging server to collect logs from many client systems.

15.1. THE LOGGING RHEL SYSTEM ROLE

With the **logging** RHEL system role, you can deploy logging configurations on local and remote hosts.

Logging solutions provide multiple ways of reading logs and multiple logging outputs.

For example, a logging system can receive the following inputs:

- Local files
- **systemd/journal**
- Another logging system over the network

In addition, a logging system can have the following outputs:

- Logs stored in the local files in the **/var/log** directory
- Logs sent to Elasticsearch
- Logs forwarded to another logging system

With the **logging** RHEL system role, you can combine the inputs and outputs to fit your scenario. For example, you can configure a logging solution that stores inputs from **journal** in a local file, whereas inputs read from files are both forwarded to another logging system and stored in the local log files.

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.logging/README.md** file
- **/usr/share/doc/rhel-system-roles/logging/** directory
- RHEL system roles

15.2. APPLYING A LOCAL LOGGING RHEL SYSTEM ROLE

Prepare and apply an Ansible playbook to configure a logging solution on a set of separate machines. Each machine records logs locally.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

NOTE

You do not have to have the **rsyslog** package installed, because the RHEL system role installs **rsyslog** when deployed.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Deploying basics input and implicit files output
  hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.logging
  vars:
    logging_inputs:
      - name: system_input
        type: basics
    logging_outputs:
      - name: files_output
        type: files
    logging_flows:
      - name: flow1
        inputs: [system_input]
        outputs: [files_output]
```

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

1. Test the syntax of the /**etc**/**rsyslog.conf** file:

```
# rsyslogd -N 1
rsyslogd: version 8.1911.0-6.el8, config validation run...
rsyslogd: End of config validation run. Bye.
```

2. Verify that the system sends messages to the log:

   a. Send a test message:

```
# logger test
```

   b. View the /**var**/**log**/**messages** log, for example:

```
# cat /var/log/messages
Aug  5 13:48:31 <hostname> root[6778]: test
```

Where ***<hostname>*** is the host name of the client system. Note that the log contains the user name of the user that entered the logger command, in this case **root**.

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.logging/README.md** file
- **/usr/share/doc/rhel-system-roles/logging/** directory

15.3. FILTERING LOGS IN A LOCAL LOGGING RHEL SYSTEM ROLE

You can deploy a logging solution which filters the logs based on the **rsyslog** property-based filter.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

NOTE

You do not have to have the **rsyslog** package installed, because the RHEL system role installs **rsyslog** when deployed.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Deploying files input and configured files output
  hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.logging
  vars:
    logging_inputs:
      - name: files_input
        type: basics
    logging_outputs:
      - name: files_output0
        type: files
        property: msg
        property_op: contains
        property_value: error
        path: /var/log/errors.log
      - name: files_output1
        type: files
        property: msg
        property_op: "!contains"
        property_value: error
```

```
      path: /var/log/others.log
  logging_flows:
    - name: flow0
      inputs: [files_input]
      outputs: [files_output0, files_output1]
```

Using this configuration, all messages that contain the **error** string are logged in **/var/log/errors.log**, and all other messages are logged in **/var/log/others.log**.

You can replace the **error** property value with the string by which you want to filter.

You can modify the variables according to your preferences.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

1. Test the syntax of the **/etc/rsyslog.conf** file:

```
# rsyslogd -N 1
rsyslogd: version 8.1911.0-6.el8, config validation run...
rsyslogd: End of config validation run. Bye.
```

2. Verify that the system sends messages that contain the **error** string to the log:

   a. Send a test message:

   ```
   # logger error
   ```

   b. View the **/var/log/errors.log** log, for example:

   ```
   # cat /var/log/errors.log
   Aug  5 13:48:31 hostname root[6778]: error
   ```

   Where ***hostname*** is the host name of the client system. Note that the log contains the user name of the user that entered the logger command, in this case **root**.

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.logging/README.md** file
- **/usr/share/doc/rhel-system-roles/logging/** directory

15.4. APPLYING A REMOTE LOGGING SOLUTION BY USING THE LOGGING RHEL SYSTEM ROLE

Follow these steps to prepare and apply a Red Hat Ansible Core playbook to configure a remote logging solution. In this playbook, one or more clients take logs from **systemd-journal** and forward them to a remote server. The server receives remote input from **remote_rsyslog** and **remote_files** and outputs the logs to local files in directories named by remote host names.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

NOTE

You do not have to have the **rsyslog** package installed, because the RHEL system role installs **rsyslog** when deployed.

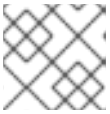
Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Deploying remote input and remote_files output
  hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.logging
  vars:
    logging_inputs:
      - name: remote_udp_input
        type: remote
        udp_ports: [ 601 ]
      - name: remote_tcp_input
        type: remote
        tcp_ports: [ 601 ]
    logging_outputs:
      - name: remote_files_output
        type: remote_files
    logging_flows:
      - name: flow_0
        inputs: [remote_udp_input, remote_tcp_input]
        outputs: [remote_files_output]

- name: Deploying basics input and forwards output
  hosts: managed-node-02.example.com
  roles:
    - rhel-system-roles.logging
  vars:
    logging_inputs:
      - name: basic_input
        type: basics
    logging_outputs:
```

```
      - name: forward_output0
        type: forwards
        severity: info
        target: <host1.example.com>
        udp_port: 601
      - name: forward_output1
        type: forwards
        facility: mail
        target: <host1.example.com>
        tcp_port: 601
    logging_flows:
      - name: flows0
        inputs: [basic_input]
        outputs: [forward_output0, forward_output1]

[basic_input]
[forward_output0, forward_output1]
```

Where ***<host1.example.com>*** is the logging server.



NOTE

You can modify the parameters in the playbook to fit your needs.

WARNING

The logging solution works only with the ports defined in the SELinux policy of the server or client system and open in the firewall. The default SELinux policy includes ports 601, 514, 6514, 10514, and 20514. To use a different port, modify the SELinux policy on the client and server systems .

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

1. On both the client and the server system, test the syntax of the **/etc/rsyslog.conf** file:

```
# rsyslogd -N 1
rsyslogd: version 8.1911.0-6.el8, config validation run (level 1), master config
/etc/rsyslog.conf
```

```
rsyslogd: End of config validation run. Bye.
```

2. Verify that the client system sends messages to the server:

   a. On the client system, send a test message:

   ```
   # logger test
   ```

   b. On the server system, view the **/var/log/*<host2.example.com>*/messages** log, for example:

   ```
   # cat /var/log/<host2.example.com>/messages
   Aug  5 13:48:31 <host2.example.com> root[6778]: test
   ```

   Where ***<host2.example.com>*** is the host name of the client system. Note that the log contains the user name of the user that entered the logger command, in this case **root**.

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.logging/README.md** file
- **/usr/share/doc/rhel-system-roles/logging/** directory

15.5. USING THE LOGGING RHEL SYSTEM ROLE WITH TLS

Transport Layer Security (TLS) is a cryptographic protocol designed to allow secure communication over the computer network.

As an administrator, you can use the **logging** RHEL system role to configure a secure transfer of logs using Red Hat Ansible Automation Platform.

15.5.1. Configuring client logging with TLS

You can use an Ansible playbook with the **logging** RHEL system role to configure logging on RHEL clients and transfer logs to a remote logging system using TLS encryption.

This procedure creates a private key and certificate, and configures TLS on all hosts in the clients group in the Ansible inventory. The TLS protocol encrypts the message transmission for secure transfer of logs over the network.

NOTE

You do not have to call the **certificate** RHEL system role in the playbook to create the certificate. The **logging** RHEL system role calls it automatically.

In order for the CA to be able to sign the created certificate, the managed nodes must be enrolled in an IdM domain.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

- The managed nodes are enrolled in an IdM domain.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Deploying files input and forwards output with certs
  hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.logging
  vars:
    logging_certificates:
      - name: logging_cert
        dns: ['localhost', 'www.example.com']
        ca: ipa
    logging_pki_files:
      - ca_cert: /local/path/to/ca_cert.pem
        cert: /local/path/to/logging_cert.pem
        private_key: /local/path/to/logging_cert.pem
    logging_inputs:
      - name: input_name
        type: files
        input_log_path: /var/log/containers/*.log
    logging_outputs:
      - name: output_name
        type: forwards
        target: your_target_host
        tcp_port: 514
        tls: true
        pki_authmode: x509/name
        permitted_server: 'server.example.com'
    logging_flows:
      - name: flow_name
        inputs: [input_name]
        outputs: [output_name]
```

The playbook uses the following parameters:

logging_certificates

The value of this parameter is passed on to **certificate_requests** in the **certificate** RHEL system role and used to create a private key and certificate.

logging_pki_files

Using this parameter, you can configure the paths and other settings that logging uses to find the CA, certificate, and key files used for TLS, specified with one or more of the following sub-parameters: **ca_cert**, **ca_cert_src**, **cert**, **cert_src**, **private_key**, **private_key_src**, and **tls**.

NOTE

If you are using **logging_certificates** to create the files on the target node, do not use **ca_cert_src**, **cert_src**, and **private_key_src**, which are used to copy files not created by **logging_certificates**.

ca_cert

Represents the path to the CA certificate file on the target node. Default path is **/etc/pki/tls/certs/ca.pem** and the file name is set by the user.

cert

Represents the path to the certificate file on the target node. Default path is **/etc/pki/tls/certs/server-cert.pem** and the file name is set by the user.

private_key

Represents the path to the private key file on the target node. Default path is **/etc/pki/tls/private/server-key.pem** and the file name is set by the user.

ca_cert_src

Represents the path to the CA certificate file on the control node which is copied to the target host to the location specified by **ca_cert**. Do not use this if using **logging_certificates**.

cert_src

Represents the path to a certificate file on the control node which is copied to the target host to the location specified by **cert**. Do not use this if using **logging_certificates**.

private_key_src

Represents the path to a private key file on the control node which is copied to the target host to the location specified by **private_key**. Do not use this if using **logging_certificates**.

tls

Setting this parameter to **true** ensures secure transfer of logs over the network. If you do not want a secure wrapper, you can set **tls: false**.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

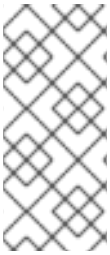
Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.logging/README.md** file
- **/usr/share/doc/rhel-system-roles/logging/** directory
- Requesting certificates using RHEL system roles .

15.5.2. Configuring server logging with TLS

You can use an Ansible playbook with the **logging** RHEL system role to configure logging on RHEL servers and set them to receive logs from a remote logging system using TLS encryption.

This procedure creates a private key and certificate, and configures TLS on all hosts in the server group in the Ansible inventory.



NOTE

You do not have to call the **certificate** RHEL system role in the playbook to create the certificate. The **logging** RHEL system role calls it automatically.

In order for the CA to be able to sign the created certificate, the managed nodes must be enrolled in an IdM domain.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- The managed nodes are enrolled in an IdM domain.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Deploying remote input and remote_files output with certs
  hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.logging
  vars:
    logging_certificates:
      - name: logging_cert
        dns: ['localhost', 'www.example.com']
        ca: ipa
    logging_pki_files:
      - ca_cert: /local/path/to/ca_cert.pem
        cert: /local/path/to/logging_cert.pem
        private_key: /local/path/to/logging_cert.pem
    logging_inputs:
      - name: input_name
        type: remote
        tcp_ports: 514
        tls: true
        permitted_clients: ['clients.example.com']
    logging_outputs:
      - name: output_name
        type: remote_files
        remote_log_path: /var/log/remote/%FROMHOST%/%PROGRAMNAME:::secpath-
replace%.log
        async_writing: true
        client_count: 20
        io_buffer_size: 8192
    logging_flows:
      - name: flow_name
        inputs: [input_name]
        outputs: [output_name]
```

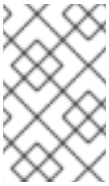
The playbook uses the following parameters:

logging_certificates

The value of this parameter is passed on to **certificate_requests** in the **certificate** RHEL system role and used to create a private key and certificate.

logging_pki_files

Using this parameter, you can configure the paths and other settings that logging uses to find the CA, certificate, and key files used for TLS, specified with one or more of the following sub-parameters: **ca_cert**, **ca_cert_src**, **cert**, **cert_src**, **private_key**, **private_key_src**, and **tls**.



NOTE

If you are using **logging_certificates** to create the files on the target node, do not use **ca_cert_src**, **cert_src**, and **private_key_src**, which are used to copy files not created by **logging_certificates**.

ca_cert

Represents the path to the CA certificate file on the target node. Default path is **/etc/pki/tls/certs/ca.pem** and the file name is set by the user.

cert

Represents the path to the certificate file on the target node. Default path is **/etc/pki/tls/certs/server-cert.pem** and the file name is set by the user.

private_key

Represents the path to the private key file on the target node. Default path is **/etc/pki/tls/private/server-key.pem** and the file name is set by the user.

ca_cert_src

Represents the path to the CA certificate file on the control node which is copied to the target host to the location specified by **ca_cert**. Do not use this if using **logging_certificates**.

cert_src

Represents the path to a certificate file on the control node which is copied to the target host to the location specified by **cert**. Do not use this if using **logging_certificates**.

private_key_src

Represents the path to a private key file on the control node which is copied to the target host to the location specified by **private_key**. Do not use this if using **logging_certificates**.

tls

Setting this parameter to **true** ensures secure transfer of logs over the network. If you do not want a secure wrapper, you can set **tls: false**.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.logging/README.md** file
- **/usr/share/doc/rhel-system-roles/logging/** directory
- Requesting certificates using RHEL system roles .

15.6. USING THE LOGGING RHEL SYSTEM ROLES WITH RELP

Reliable Event Logging Protocol (RELP) is a networking protocol for data and message logging over the TCP network. It ensures reliable delivery of event messages and you can use it in environments that do not tolerate any message loss.

The RELP sender transfers log entries in form of commands and the receiver acknowledges them once they are processed. To ensure consistency, RELP stores the transaction number to each transferred command for any kind of message recovery.

You can consider a remote logging system in between the RELP Client and RELP Server. The RELP Client transfers the logs to the remote logging system and the RELP Server receives all the logs sent by the remote logging system.

Administrators can use the **logging** RHEL system role to configure the logging system to reliably send and receive log entries.

15.6.1. Configuring client logging with RELP

You can use the **logging** RHEL system role to configure logging in RHEL systems that are logged on a local machine and can transfer logs to the remote logging system with RELP by running an Ansible playbook.

This procedure configures RELP on all hosts in the **clients** group in the Ansible inventory. The RELP configuration uses Transport Layer Security (TLS) to encrypt the message transmission for secure transfer of logs over the network.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Deploying basic input and relp output
  hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.logging
  vars:
    logging_inputs:
      - name: basic_input
```

```
      type: basics
  logging_outputs:
    - name: relp_client
      type: relp
      target: logging.server.com
      port: 20514
      tls: true
      ca_cert: /etc/pki/tls/certs/ca.pem
      cert: /etc/pki/tls/certs/client-cert.pem
      private_key: /etc/pki/tls/private/client-key.pem
      pki_authmode: name
      permitted_servers:
        - '*.server.example.com'
  logging_flows:
    - name: example_flow
      inputs: [basic_input]
      outputs: [relp_client]
```

The playbook uses following settings:

target

This is a required parameter that specifies the host name where the remote logging system is running.

port

Port number the remote logging system is listening.

tls

Ensures secure transfer of logs over the network. If you do not want a secure wrapper you can set the **tls** variable to **false**. By default **tls** parameter is set to true while working with RELP and requires key/certificates and triplets {**ca_cert**, **cert**, **private_key**} and/or {**ca_cert_src**, **cert_src**, **private_key_src**}.

- If the {**ca_cert_src**, **cert_src**, **private_key_src**} triplet is set, the default locations **/etc/pki/tls/certs** and **/etc/pki/tls/private** are used as the destination on the managed node to transfer files from control node. In this case, the file names are identical to the original ones in the triplet

- If the {**ca_cert**, **cert**, **private_key**} triplet is set, files are expected to be on the default path before the logging configuration.

- If both triplets are set, files are transferred from local path from control node to specific path of the managed node.

ca_cert

Represents the path to CA certificate. Default path is **/etc/pki/tls/certs/ca.pem** and the file name is set by the user.

cert

Represents the path to certificate. Default path is **/etc/pki/tls/certs/server-cert.pem** and the file name is set by the user.

private_key

Represents the path to private key. Default path is **/etc/pki/tls/private/server-key.pem** and the file name is set by the user.

ca_cert_src

Represents local CA certificate file path which is copied to the target host. If **ca_cert** is specified, it is copied to the location.

cert_src

Represents the local certificate file path which is copied to the target host. If **cert** is specified, it is copied to the location.

private_key_src

Represents the local key file path which is copied to the target host. If **private_key** is specified, it is copied to the location.

pki_authmode

Accepts the authentication mode as **name** or **fingerprint**.

permitted_servers

List of servers that will be allowed by the logging client to connect and send logs over TLS.

inputs

List of logging input dictionary.

outputs

List of logging output dictionary.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.logging/README.md** file
- **/usr/share/doc/rhel-system-roles/logging/** directory

15.6.2. Configuring server logging with RELP

You can use the **logging** RHEL system role to configure logging in RHEL systems as a server and can receive logs from the remote logging system with RELP by running an Ansible playbook.

This procedure configures RELP on all hosts in the **server** group in the Ansible inventory. The RELP configuration uses TLS to encrypt the message transmission for secure transfer of logs over the network.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Deploying remote input and remote_files output
  hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.logging
  vars:
    logging_inputs:
      - name: relp_server
        type: relp
        port: 20514
        tls: true
        ca_cert: /etc/pki/tls/certs/ca.pem
        cert: /etc/pki/tls/certs/server-cert.pem
        private_key: /etc/pki/tls/private/server-key.pem
        pki_authmode: name
        permitted_clients:
          - '*example.client.com'
    logging_outputs:
      - name: remote_files_output
        type: remote_files
    logging_flows:
      - name: example_flow
        inputs: relp_server
        outputs: remote_files_output
```

The playbooks uses the following settings:

port

Port number the remote logging system is listening.

tls

Ensures secure transfer of logs over the network. If you do not want a secure wrapper you can set the **tls** variable to **false**. By default **tls** parameter is set to true while working with RELP and requires key/certificates and triplets {**ca_cert**, **cert**, **private_key**} and/or {**ca_cert_src**, **cert_src**, **private_key_src**}.

- If the {**ca_cert_src**, **cert_src**, **private_key_src**} triplet is set, the default locations **/etc/pki/tls/certs** and **/etc/pki/tls/private** are used as the destination on the managed node to transfer files from control node. In this case, the file names are identical to the original ones in the triplet
- If the {**ca_cert**, **cert**, **private_key**} triplet is set, files are expected to be on the default path before the logging configuration.
- If both triplets are set, files are transferred from local path from control node to specific path of the managed node.

ca_cert

Represents the path to CA certificate. Default path is **/etc/pki/tls/certs/ca.pem** and the file name is set by the user.

cert

Represents the path to the certificate. Default path is **/etc/pki/tls/certs/server-cert.pem** and the file name is set by the user.

private_key

Represents the path to private key. Default path is **/etc/pki/tls/private/server-key.pem** and the file name is set by the user.

ca_cert_src

Represents local CA certificate file path which is copied to the target host. If **ca_cert** is specified, it is copied to the location.

cert_src

Represents the local certificate file path which is copied to the target host. If **cert** is specified, it is copied to the location.

private_key_src

Represents the local key file path which is copied to the target host. If **private_key** is specified, it is copied to the location.

pki_authmode

Accepts the authentication mode as **name** or **fingerprint**.

permitted_clients

List of clients that will be allowed by the logging server to connect and send logs over TLS.

inputs

List of logging input dictionary.

outputs

List of logging output dictionary.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.logging/README.md** file
- **/usr/share/doc/rhel-system-roles/logging/** directory

CHAPTER 16. MONITORING PERFORMANCE BY USING THE RHEL SYSTEM ROLE

As a system administrator, you can use the **metrics** RHEL system role with any Ansible Automation Platform control node to monitor the performance of a system.

16.1. INTRODUCTION TO THE METRICS RHEL SYSTEM ROLE

RHEL system roles is a collection of Ansible roles and modules that provide a consistent configuration interface to remotely manage multiple RHEL systems. The **metrics** system role configures performance analysis services for the local system and, optionally, includes a list of remote systems to be monitored by the local system. The **metrics** system role enables you to use **pcp** to monitor your systems performance without having to configure **pcp** separately, as the set-up and deployment of **pcp** is handled by the playbook.

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.metrics/README.md** file
- **/usr/share/doc/rhel-system-roles/metrics/** directory

16.2. USING THE METRICS RHEL SYSTEM ROLE TO MONITOR YOUR LOCAL SYSTEM WITH VISUALIZATION

This procedure describes how to use the **metrics** RHEL system role to monitor your local system while simultaneously provisioning data visualization via **Grafana**.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- **localhost** is configured in the inventory file on the control node:

```
localhost ansible_connection=local
```

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Manage metrics
  hosts: localhost
  roles:
    - rhel-system-roles.metrics
  vars:
    metrics_graph_service: yes
    metrics_manage_firewall: true
    metrics_manage_selinux: true
```

Because the **metrics_graph_service** boolean is set to **value="yes"**, **Grafana** is automatically installed and provisioned with **pcp** added as a data source. Because **metrics_manage_firewall** and **metrics_manage_selinux** are both set to **true**, the metrics role uses the **firewall** and **selinux** system roles to manage the ports used by the metrics role.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

- To view visualization of the metrics being collected on your machine, access the **grafana** web interface as described in Accessing the Grafana web UI.

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.metrics/README.md** file
- **/usr/share/doc/rhel-system-roles/metrics/** directory

16.3. USING THE METRICS RHEL SYSTEM ROLE TO SET UP A FLEET OF INDIVIDUAL SYSTEMS TO MONITOR THEMSELVES

This procedure describes how to use the **metrics** system role to set up a fleet of machines to monitor themselves.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example **~/playbook.yml**, with the following content:

```
---
- name: Configure a fleet of machines to monitor themselves
  hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.metrics
  vars:
    metrics_retention_days: 0
    metrics_manage_firewall: true
    metrics_manage_selinux: true
```

Because **metrics_manage_firewall** and **metrics_manage_selinux** are both set to **true**, the metrics role uses the **firewall** and **selinux** roles to manage the ports used by the **metrics** role.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.metrics/README.md** file
- **/usr/share/doc/rhel-system-roles/metrics/** directory

16.4. USING THE METRICS RHEL SYSTEM ROLE TO MONITOR A FLEET OF MACHINES CENTRALLY USING YOUR LOCAL MACHINE

This procedure describes how to use the **metrics** system role to set up your local machine to centrally monitor a fleet of machines while also provisioning visualization of the data via **grafana** and querying of the data via **redis**.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- **localhost** is configured in the inventory file on the control node:

```
localhost ansible_connection=local
```

Procedure

1. Create a playbook file, for example **~/playbook.yml**, with the following content:

```
- name: Set up your local machine to centrally monitor a fleet of machines
  hosts: localhost
  roles:
    - rhel-system-roles.metrics
  vars:
    metrics_graph_service: yes
    metrics_query_service: yes
    metrics_retention_days: 10
```

```
metrics_monitored_hosts: ["database.example.com", "webserver.example.com"]
metrics_manage_firewall: yes
metrics_manage_selinux: yes
```

Because the **metrics_graph_service** and **metrics_query_service** booleans are set to **value="yes"**, **grafana** is automatically installed and provisioned with **pcp** added as a data source with the **pcp** data recording indexed into **redis**, allowing the **pcp** querying language to be used for complex querying of the data. Because **metrics_manage_firewall** and **metrics_manage_selinux** are both set to **true**, the **metrics** role uses the **firewall** and **selinux** roles to manage the ports used by the **metrics** role.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

- To view a graphical representation of the metrics being collected centrally by your machine and to query the data, access the **grafana** web interface as described in Accessing the Grafana web UI.

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.metrics/README.md** file
- **/usr/share/doc/rhel-system-roles/metrics/** directory

16.5. SETTING UP AUTHENTICATION WHILE MONITORING A SYSTEM BY USING THE METRICS RHEL SYSTEM ROLE

PCP supports the **scram-sha-256** authentication mechanism through the Simple Authentication Security Layer (SASL) framework. The **metrics** RHEL system role automates the steps to setup authentication by using the **scram-sha-256** authentication mechanism. This procedure describes how to setup authentication by using the **metrics** RHEL system role.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Edit an existing playbook file, for example **~/playbook.yml**, and add the authentication-related variables:

```
---
- name: Set up authentication by using the scram-sha-256 authentication mechanism
  hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.metrics
  vars:
    metrics_retention_days: 0
    metrics_manage_firewall: true
    metrics_manage_selinux: true
    metrics_username: <username>
    metrics_password: <password>
```

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

- Verify the **sasl** configuration:

```
# pminfo -f -h "pcp://managed-node-01.example.com?username=<username>"
disk.dev.read
Password: <password>
disk.dev.read
inst [0 or "sda"] value 19540
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.metrics/README.md** file
- **/usr/share/doc/rhel-system-roles/metrics/** directory

16.6. USING THE METRICS RHEL SYSTEM ROLE TO CONFIGURE AND ENABLE METRICS COLLECTION FOR SQL SERVER

This procedure describes how to use the **metrics** RHEL system role to automate the configuration and enabling of metrics collection for Microsoft SQL Server via **pcp** on your local system.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

- You have installed Microsoft SQL Server for Red Hat Enterprise Linux and established a trusted connection to an SQL server.
- You have installed the Microsoft ODBC driver for SQL Server for Red Hat Enterprise Linux .
- **localhost** is configured in the inventory file on the control node:

```
localhost ansible_connection=local
```

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Configure and enable metrics collection for Microsoft SQL Server
  hosts: localhost
  roles:
    - rhel-system-roles.metrics
  vars:
    metrics_from_mssql: true
    metrics_manage_firewall: true
    metrics_manage_selinux: true
```

   Because **metrics_manage_firewall** and **metrics_manage_selinux** are both set to **true**, the **metrics** role uses the **firewall** and **selinux** roles to manage the ports used by the **metrics** role.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

   Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

- Use the **pcp** command to verify that SQL Server PMDA agent (mssql) is loaded and running:

```
# pcp
platform: Linux sqlserver.example.com 4.18.0-167.el8.x86_64 #1 SMP Sun Dec 15 01:24:23
UTC 2019 x86_64
 hardware: 2 cpus, 1 disk, 1 node, 2770MB RAM
 timezone: PDT+7
 services: pmcd pmproxy
     pmcd: Version 5.0.2-1, 12 agents, 4 clients
     pmda: root pmcd proc pmproxy xfs linux nfsclient mmv kvm mssql
           jbd2 dm
 pmlogger: primary logger: /var/log/pcp/pmlogger/sqlserver.example.com/20200326.16.31
     pmie: primary engine: /var/log/pcp/pmie/sqlserver.example.com/pmie.log
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.metrics/README.md** file
- **/usr/share/doc/rhel-system-roles/metrics/** directory
- Performance Co-Pilot for Microsoft SQL Server with RHEL 8.2 blog post

CHAPTER 17. CONFIGURING MICROSOFT SQL SERVER BY USING THE RHEL SYSTEM ROLE

As an administrator, you can use the **microsoft.sql.server** Ansible role to install, configure, and start Microsoft SQL Server (SQL Server). The **microsoft.sql.server** Ansible role optimizes your operating system to improve performance and throughput for the SQL Server. The role simplifies and automates the configuration of your Red Hat Enterprise Linux host with recommended settings to run the SQL Server workloads.

17.1. INSTALLING AND CONFIGURING SQL SERVER BY USING THE MICROSOFT.SQL.SERVER SYSTEM ROLE WITH EXISTING CERTIFICATE FILES

You can use the **microsoft.sql.server** Ansible role to install and configure SQL Server version 2019. The playbook in this example also configures the server to use an existing **sql_cert** certificate and private key files for TLS encryption.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- Minimum 2 GB RAM
- The **ansible-collection-microsoft-sql** package is installed on the managed node.
- The managed node uses one of the following versions: RHEL 7.9, RHEL 8, RHEL 9.4 or later.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Install and configure SQL Server
  hosts: managed-node-01.example.com
  roles:
    - microsoft.sql.server
  vars:
    mssql_accept_microsoft_odbc_driver_17_for_sql_server_eula: true
    mssql_accept_microsoft_cli_utilities_for_sql_server_eula: true
    mssql_accept_microsoft_sql_server_standard_eula: true
    mssql_version: 2019
    mssql_manage_firewall: true
    mssql_tls_enable: true
    mssql_tls_cert: sql_crt.pem
    mssql_tls_private_key: sql_cert.key
    mssql_tls_version: 1.2
    mssql_tls_force: false
    mssql_password: <password>
    mssql_edition: Developer
    mssql_tcp_port: 1433
```

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/microsoft.sql-server/README.md** file

17.2. INSTALLING AND CONFIGURING SQL SERVER BY USING THE MICROSOFT.SQL.SERVER SYSTEM ROLE WITH THE CERTIFICATE RHEL SYSTEM ROLE

You can use the **microsoft.sql.server** Ansible role to install and configure SQL Server version 2019. The playbook in this example also configures the server to use TLS encryption and creates a self-signed **sql_cert** certificate file and private key by using the **certificate** system role.

You do not have to call the **certificate** system role in the playbook to create the certificate. The **microsoft.sql.server** Ansible role calls it automatically.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- Minimum 2 GB RAM
- The **ansible-collection-microsoft-sql** package is installed on the managed node.
- The managed nodes are enrolled in a Red Hat Identity Management (IdM) domain.
- The managed node uses one of the following versions: RHEL 7.9, RHEL 8, RHEL 9.4 or later.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Install and configure SQL Server
  hosts: managed-node-01.example.com
  roles:
    - microsoft.sql.server
  vars:
    mssql_accept_microsoft_odbc_driver_17_for_sql_server_eula: true
```

```
mssql_accept_microsoft_cli_utilities_for_sql_server_eula: true
mssql_accept_microsoft_sql_server_standard_eula: true
mssql_version: 2019
mssql_manage_firewall: true
mssql_tls_enable: true
mssql_tls_certificates:
  - name: sql_cert
    dns: *.example.com
    ca: self-sign
mssql_password: <password>
mssql_edition: Developer
mssql_tcp_port: 1433
```

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/microsoft.sql-server/README.md** file
- Requesting certificates by using RHEL system roles

17.3. SETTING UP CUSTOM STORAGE PATHS FOR DATA AND LOGS

To store your data or logs in a different directory than the default one, specify the custom storage path using the **mssql_datadir**, **mssql_datadir_mode**, **mssql_logdir**, and **mssql_logdir_mode** variables in an existing playbook. When you define a custom path, the role creates the provided directory and ensures correct permissions and ownership for it.

IMPORTANT

If you later decide to remove the variables, the storage paths will not change back to the default ones but will store the data or logs in the latest defined paths.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- Minimum 2 GB RAM
- The **ansible-collection-microsoft-sql** package is installed on the managed node.

- The managed node uses one of the following versions: RHEL 7.9, RHEL 8, RHEL 9.4 or later.

Procedure

1. Edit an existing playbook file, for example ~/**playbook.yml**, and add the storage and log-related variables:

```
---
- name: Install and configure SQL Server
  hosts: managed-node-01.example.com
  roles:
    - microsoft.sql.server
  vars:
    mssql_accept_microsoft_odbc_driver_17_for_sql_server_eula: true
    mssql_accept_microsoft_cli_utilities_for_sql_server_eula: true
    mssql_accept_microsoft_sql_server_standard_eula: true
    mssql_version: 2019
    mssql_manage_firewall: true
    mssql_tls_enable: true
    mssql_tls_cert: sql_crt.pem
    mssql_tls_private_key: sql_cert.key
    mssql_tls_version: 1.2
    mssql_tls_force: false
    mssql_password: <password>
    mssql_edition: Developer
    mssql_tcp_port: 1433
    mssql_datadir: /var/lib/mssql/
    mssql_datadir_mode: '0700'
    mssql_logdir: /var/log/mssql/
    mssql_logdir_mode: '0700'
```

   Enter the permission modes in single quotation marks so that Ansible parses it as a string and not as an octal number.

   If you do not specify the mode and the destination directory does not exist, the role uses the default umask on the system when setting the mode. If you do not specify the mode and the destination directory does exist, the role uses the mode of the existing directory.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

   Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/microsoft.sql-server/README.md** file

17.4. PREPARING AND RUNNING A PLAYBOOK TO ENABLE SQL SERVER AUTHENTICATION WITH ACTIVE DIRECTORY

To be able to automatically authenticate your Microsoft SQL server with Active Directory, you need to set up an **microsoft.sql.server** Ansible playbook with variables according to your use case.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- Minimum 2 GB RAM
- The **ansible-collection-microsoft-sql** package is installed on the managed node.
- The managed node uses one of the following versions: RHEL 7.9, RHEL 8, RHEL 9.4 or later.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Configure with AD server authentication
  hosts: managed-node-01.example.com
  roles:
    - microsoft.sql.server
  vars:
    # General variables
    mssql_accept_microsoft_odbc_driver_17_for_sql_server_eula: true
    mssql_accept_microsoft_cli_utilities_for_sql_server_eula: true
    mssql_accept_microsoft_sql_server_standard_eula: true
    mssql_version: 2022
    mssql_password: "<password>"
    mssql_edition: Evaluation
    mssql_manage_firewall: true
    # AD Integration required variables
    mssql_ad_configure: true
    mssql_ad_sql_user_name: sqluser
    mssql_ad_sql_password: "<password>"
    ad_integration_realm: domain.com
    ad_integration_user: Administrator
    ad_integration_password: <password>
```

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

   Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/microsoft.sql-server/README.md** file

17.5. CONFIGURING SQL SERVER TO AUTHENTICATE WITH ACTIVE DIRECTORY (AD) SERVER

The following procedure shows how to configure SQL Server to authenticate with Active Directory (AD) Server.

Prerequisites

- An Active Directory domain controller is configured on your network.
- An applicable RDNS (Reverse DNS) zone exists for both the domain controller and the IP address of the Linux machine that will be running SQL Server.
- A PTR record that points to your domain controllers exists.
- The SQL Server host resolves relative domain name, fully qualified domain name, and the IP of the domain controller to the fully qualified domain name of the domain controller.

Procedure

1. Log in to your AD server through the web UI.
2. Navigate to **Tools** > **Active Directory Users and Computers** > **domain.com** > **Users** > **sqluser** > **Account**.
3. In the **Account options** list, select **This account supports Kerberos AES 128 bit encryption** and **This account supports Kerberos AES 256 bit encryption**
4. Click **Apply**

Verification

1. Use **ssh** to log in to the *client.domain.com* machine:

```
# ssh -l <sqluser>@<domain.com> <client.domain.com>
```

2. Obtain the Kerberos ticket for the Administrator user:

```
# kinit Administrator@<domain.com>
```

3. Use the **sqlcmd** utility to log in to the SQL Server and, for example, run the following query to view the current user:

```
# /opt/mssql-tools/bin/sqlcmd -S. -Q 'SELECT SYSTEM_USER'
```

CHAPTER 18. CONFIGURING NBDE BY USING RHEL SYSTEM ROLES

18.1. INTRODUCTION TO THE NBDE_CLIENT AND NBDE_SERVER RHEL SYSTEM ROLES (CLEVIS AND TANG)

RHEL system roles is a collection of Ansible roles and modules that provide a consistent configuration interface to remotely manage multiple RHEL systems.

RHEL 8.3 introduced Ansible roles for automated deployments of Policy-Based Decryption (PBD) solutions using Clevis and Tang. The **rhel-system-roles** package contains these system roles, related examples, and also the reference documentation.

The **nbde_client** system role enables you to deploy multiple Clevis clients in an automated way. Note that the **nbde_client** role supports only Tang bindings, and you cannot use it for TPM2 bindings at the moment.

The **nbde_client** role requires volumes that are already encrypted using LUKS. This role supports to bind a LUKS-encrypted volume to one or more Network-Bound (NBDE) servers - Tang servers. You can either preserve the existing volume encryption with a passphrase or remove it. After removing the passphrase, you can unlock the volume only using NBDE. This is useful when a volume is initially encrypted using a temporary key or password that you should remove after you provision the system.

If you provide both a passphrase and a key file, the role uses what you have provided first. If it does not find any of these valid, it attempts to retrieve a passphrase from an existing binding.

PBD defines a binding as a mapping of a device to a slot. This means that you can have multiple bindings for the same device. The default slot is slot 1.

The **nbde_client** role provides also the **state** variable. Use the **present** value for either creating a new binding or updating an existing one. Contrary to a **clevis luks bind** command, you can use **state: present** also for overwriting an existing binding in its device slot. The **absent** value removes a specified binding.

Using the **nbde_client** system role, you can deploy and manage a Tang server as part of an automated disk encryption solution. This role supports the following features:

- Rotating Tang keys
- Deploying and backing up Tang keys

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.nbde_server/README.md** file
- **/usr/share/ansible/roles/rhel-system-roles.nbde_client/README.md** file
- **/usr/share/doc/rhel-system-roles/nbde_server/** directory
- **/usr/share/doc/rhel-system-roles/nbde_client/** directory

18.2. USING THE NBDE_SERVER RHEL SYSTEM ROLE FOR SETTING UP MULTIPLE TANG SERVERS

Follow the steps to prepare and apply an Ansible playbook containing your Tang server settings.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.nbde_server
  vars:
    nbde_server_rotate_keys: yes
    nbde_server_manage_firewall: true
    nbde_server_manage_selinux: true
```

   This example playbook ensures deploying of your Tang server and a key rotation.

   When **nbde_server_manage_firewall** and **nbde_server_manage_selinux** are both set to **true**, the **nbde_server** role uses the **firewall** and **selinux** roles to manage the ports used by the **nbde_server** role.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

   Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

- To ensure that networking for a Tang pin is available during early boot by using the **grubby** tool on the systems where Clevis is installed, enter:

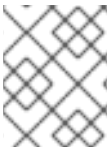
```
# grubby --update-kernel=ALL --args="rd.neednet=1"
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.nbde_server/README.md** file
- **/usr/share/doc/rhel-system-roles/nbde_server/** directory

18.3. SETTING UP MULTIPLE CLEVIS CLIENTS BY USING THE NBDE_CLIENT RHEL SYSTEM ROLE

With the **nbde_client** RHEL system role, you can prepare and apply an Ansible playbook that contains your Clevis client settings on multiple systems.



NOTE

The **nbde_client** system role supports only Tang bindings. Therefore, you cannot use it for TPM2 bindings.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
- hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.nbde_client
  vars:
    nbde_client_bindings:
      - device: /dev/rhel/root
        encryption_key_src: /etc/luks/keyfile
        servers:
          - http://server1.example.com
          - http://server2.example.com
      - device: /dev/rhel/swap
        encryption_key_src: /etc/luks/keyfile
        servers:
          - http://server1.example.com
          - http://server2.example.com
```

This example playbook configures Clevis clients for automated unlocking of two LUKS-encrypted volumes when at least one of two Tang servers is available

The **nbde_client** system role supports only scenarios with Dynamic Host Configuration Protocol (DHCP). To use NBDE for clients with static IP configuration use the following playbook:

```
- hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.nbde_client
  vars:
    nbde_client_bindings:
      - device: /dev/rhel/root
        encryption_key_src: /etc/luks/keyfile
        servers:
```

```
        - http://server1.example.com
        - http://server2.example.com
      - device: /dev/rhel/swap
        encryption_key_src: /etc/luks/keyfile
        servers:
        - http://server1.example.com
        - http://server2.example.com
  tasks:
    - name: Configure a client with a static IP address during early boot
      ansible.builtin.command:
        cmd: grubby --update-kernel=ALL --args='GRUB_CMDLINE_LINUX_DEFAULT="ip={{
<ansible_default_ipv4.address> }}::{{ <ansible_default_ipv4.gateway> }}:{{
<ansible_default_ipv4.netmask> }}::{{ <ansible_default_ipv4.alias> }}:none"'
```

In this playbook, replace the ***<ansible_default_ipv4.*>*** strings with IP addresses of your network, for example: **ip={{ 192.0.2.10 }}::{{ 192.0.2.1 }}:{{ 255.255.255.0 }}::{{ ens3 }}:none**.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.nbde_client/README.md** file
- **/usr/share/doc/rhel-system-roles/nbde_client/** directory
- Looking forward to Linux network configuration in the initial ramdisk (initrd) article

CHAPTER 19. CONFIGURING NETWORK SETTINGS BY USING THE RHEL SYSTEM ROLE

Administrators can automate network-related configuration and management tasks by using the **network** RHEL system role.

19.1. CONFIGURING AN ETHERNET CONNECTION WITH A STATIC IP ADDRESS BY USING THE NETWORK RHEL SYSTEM ROLE WITH AN INTERFACE NAME

You can remotely configure an Ethernet connection by using the **network** RHEL system role.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- A physical or virtual Ethernet device exists in the server's configuration.
- The managed nodes use NetworkManager to configure the network.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Configure the network
  hosts: managed-node-01.example.com
  tasks:
    - name: Configure an Ethernet connection with static IP
      ansible.builtin.include_role:
        name: rhel-system-roles.network
      vars:
        network_connections:
          - name: enp1s0
            interface_name: enp1s0
            type: ethernet
            autoconnect: yes
            ip:
              address:
                - 192.0.2.1/24
                - 2001:db8:1::1/64
              gateway4: 192.0.2.254
              gateway6: 2001:db8:1::fffe
              dns:
                - 192.0.2.200
                - 2001:db8:1::ffbb
              dns_search:
                - example.com
            state: up
```

These settings define an Ethernet connection profile for the **enp1s0** device with the following settings:

- A static IPv4 address - **192.0.2.1** with a **/24** subnet mask
- A static IPv6 address - **2001:db8:1::1** with a **/64** subnet mask
- An IPv4 default gateway - **192.0.2.254**
- An IPv6 default gateway - **2001:db8:1::fffe**
- An IPv4 DNS server - **192.0.2.200**
- An IPv6 DNS server - **2001:db8:1::ffbb**
- A DNS search domain - **example.com**

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.network/README.md** file
- **/usr/share/doc/rhel-system-roles/network/** directory

19.2. CONFIGURING AN ETHERNET CONNECTION WITH A STATIC IP ADDRESS BY USING THE NETWORK RHEL SYSTEM ROLE WITH A DEVICE PATH

You can remotely configure an Ethernet connection using the **network** RHEL system role.

You can identify the device path with the following command:

```
# udevadm info /sys/class/net/<device_name> | grep ID_PATH=
```

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- A physical or virtual Ethernet device exists in the server's configuration.

- The managed nodes use NetworkManager to configure the network.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Configure the network
  hosts: managed-node-01.example.com
  tasks:
    - name: Configure an Ethernet connection with static IP
      ansible.builtin.include_role:
        name: rhel-system-roles.network
      vars:
        network_connections:
          - name: example
            match:
              path:
                - pci-0000:00:0[1-3].0
                - &!pci-0000:00:02.0
            type: ethernet
            autoconnect: yes
            ip:
              address:
                - 192.0.2.1/24
                - 2001:db8:1::1/64
              gateway4: 192.0.2.254
              gateway6: 2001:db8:1::fffe
              dns:
                - 192.0.2.200
                - 2001:db8:1::ffbb
              dns_search:
                - example.com
            state: up
```

These settings define an Ethernet connection profile with the following settings:

- A static IPv4 address - **192.0.2.1** with a **/24** subnet mask
- A static IPv6 address - **2001:db8:1::1** with a **/64** subnet mask
- An IPv4 default gateway - **192.0.2.254**
- An IPv6 default gateway - **2001:db8:1::fffe**
- An IPv4 DNS server - **192.0.2.200**
- An IPv6 DNS server - **2001:db8:1::ffbb**
- A DNS search domain - **example.com**
  The **match** parameter in this example defines that Ansible applies the play to devices that match PCI ID **0000:00:0[1-3].0**, but not **0000:00:02.0**. For further details about special modifiers and wild cards you can use, see the **match** parameter description in the **/usr/share/ansible/roles/rhel-system-roles.network/README.md** file.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.network/README.md** file
- **/usr/share/doc/rhel-system-roles/network/** directory

19.3. CONFIGURING AN ETHERNET CONNECTION WITH A DYNAMIC IP ADDRESS BY USING THE NETWORK RHEL SYSTEM ROLE WITH AN INTERFACE NAME

You can remotely configure an Ethernet connection using the **network** RHEL system role. For connections with dynamic IP address settings, NetworkManager requests the IP settings for the connection from a DHCP server.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- A physical or virtual Ethernet device exists in the server's configuration.
- A DHCP server is available in the network
- The managed nodes use NetworkManager to configure the network.

Procedure

1. Create a playbook file, for example **~/playbook.yml**, with the following content:

```
---
- name: Configure the network
  hosts: managed-node-01.example.com
  tasks:
    - name: Configure an Ethernet connection with dynamic IP
      ansible.builtin.include_role:
        name: rhel-system-roles.network
      vars:
        network_connections:
          - name: enp1s0
            interface_name: enp1s0
            type: ethernet
```

```
    autoconnect: yes
    ip:
      dhcp4: yes
      auto6: yes
    state: up
```

These settings define an Ethernet connection profile for the **enp1s0** device. The connection retrieves IPv4 addresses, IPv6 addresses, default gateway, routes, DNS servers, and search domains from a DHCP server and IPv6 stateless address autoconfiguration (SLAAC).

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.network/README.md** file
- **/usr/share/doc/rhel-system-roles/network/** directory

19.4. CONFIGURING AN ETHERNET CONNECTION WITH A DYNAMIC IP ADDRESS BY USING THE NETWORK RHEL SYSTEM ROLE WITH A DEVICE PATH

You can remotely configure an Ethernet connection using the **network** RHEL system role. For connections with dynamic IP address settings, NetworkManager requests the IP settings for the connection from a DHCP server.

You can identify the device path with the following command:

```
# udevadm info /sys/class/net/<device_name> | grep ID_PATH=
```

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- A physical or virtual Ethernet device exists in the server's configuration.
- A DHCP server is available in the network.
- The managed hosts use NetworkManager to configure the network.

Procedure

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Configure the network
  hosts: managed-node-01.example.com
  tasks:
    - name: Configure an Ethernet connection with dynamic IP
      ansible.builtin.include_role:
        name: rhel-system-roles.network
      vars:
        network_connections:
          - name: example
            match:
              path:
                - pci-0000:00:0[1-3].0
                - &!pci-0000:00:02.0
            type: ethernet
            autoconnect: yes
            ip:
              dhcp4: yes
              auto6: yes
            state: up
```

   These settings define an Ethernet connection profile. The connection retrieves IPv4 addresses, IPv6 addresses, default gateway, routes, DNS servers, and search domains from a DHCP server and IPv6 stateless address autoconfiguration (SLAAC).

   The **match** parameter defines that Ansible applies the play to devices that match PCI ID **0000:00:0[1-3].0**, but not **0000:00:02.0**.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

   Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.network/README.md** file
- **/usr/share/doc/rhel-system-roles/network/** directory

19.5. CONFIGURING VLAN TAGGING BY USING THE NETWORK RHEL SYSTEM ROLE

You can use the **network** RHEL system role to configure VLAN tagging. This example adds an Ethernet connection and a VLAN with ID **10** on top of this Ethernet connection. As the child device, the VLAN connection contains the IP, default gateway, and DNS configurations.

Depending on your environment, adjust the play accordingly. For example:

- To use the VLAN as a port in other connections, such as a bond, omit the **ip** attribute, and set the IP configuration in the child configuration.
- To use team, bridge, or bond devices in the VLAN, adapt the **interface_name** and **type** attributes of the ports you use in the VLAN.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Configure the network
  hosts: managed-node-01.example.com
  tasks:
    - name: Configure a VLAN that uses an Ethernet connection
      ansible.builtin.include_role:
        name: rhel-system-roles.network
      vars:
        network_connections:
          # Add an Ethernet profile for the underlying device of the VLAN
          - name: enp1s0
            type: ethernet
            interface_name: enp1s0
            autoconnect: yes
            state: up
            ip:
              dhcp4: no
              auto6: no

          # Define the VLAN profile
          - name: enp1s0.10
            type: vlan
            ip:
              address:
                - "192.0.2.1/24"
                - "2001:db8:1::1/64"
              gateway4: 192.0.2.254
              gateway6: 2001:db8:1::fffe
              dns:
                - 192.0.2.200
                - 2001:db8:1::ffbb
              dns_search:
                - example.com
            vlan_id: 10
            parent: enp1s0
            state: up
```

These settings define a VLAN to operate on top of the **enp1s0** device. The VLAN interface has the following settings:

- A static IPv4 address - **192.0.2.1** with a **/24** subnet mask
- A static IPv6 address - **2001:db8:1::1** with a **/64** subnet mask
- An IPv4 default gateway - **192.0.2.254**
- An IPv6 default gateway - **2001:db8:1::fffe**
- An IPv4 DNS server - **192.0.2.200**
- An IPv6 DNS server - **2001:db8:1::ffbb**
- A DNS search domain - **example.com**
- VLAN ID - **10**
  The **parent** attribute in the VLAN profile configures the VLAN to operate on top of the **enp1s0** device. As the child device, the VLAN connection contains the IP, default gateway, and DNS configurations.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.network/README.md** file
- **/usr/share/doc/rhel-system-roles/network/** directory

19.6. CONFIGURING A NETWORK BRIDGE BY USING THE NETWORK RHEL SYSTEM ROLE

You can remotely configure a network bridge by using the **network** RHEL system role.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- Two or more physical or virtual network devices are installed on the server.

Procedure

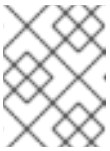
1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Configure the network
  hosts: managed-node-01.example.com
  tasks:
    - name: Configure a network bridge that uses two Ethernet ports
      ansible.builtin.include_role:
        name: rhel-system-roles.network
      vars:
        network_connections:
          # Define the bridge profile
          - name: bridge0
            type: bridge
            interface_name: bridge0
            ip:
              address:
                - "192.0.2.1/24"
                - "2001:db8:1::1/64"
              gateway4: 192.0.2.254
              gateway6: 2001:db8:1::fffe
              dns:
                - 192.0.2.200
                - 2001:db8:1::ffbb
              dns_search:
                - example.com
            state: up

          # Add an Ethernet profile to the bridge
          - name: bridge0-port1
            interface_name: enp7s0
            type: ethernet
            controller: bridge0
            port_type: bridge
            state: up

          # Add a second Ethernet profile to the bridge
          - name: bridge0-port2
            interface_name: enp8s0
            type: ethernet
            controller: bridge0
            port_type: bridge
            state: up
```

These settings define a network bridge with the following settings:

- A static IPv4 address - **192.0.2.1** with a **/24** subnet mask
- A static IPv6 address - **2001:db8:1::1** with a **/64** subnet mask
- An IPv4 default gateway - **192.0.2.254**
- An IPv6 default gateway - **2001:db8:1::fffe**

- An IPv4 DNS server - **192.0.2.200**
- An IPv6 DNS server - **2001:db8:1::ffbb**
- A DNS search domain - **example.com**
- Ports of the bridge - **enp7s0** and **enp8s0**



NOTE

Set the IP configuration on the bridge and not on the ports of the Linux bridge.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.network/README.md** file
- **/usr/share/doc/rhel-system-roles/network/** directory

19.7. CONFIGURING A NETWORK BOND BY USING THE NETWORK RHEL SYSTEM ROLE

You can remotely configure a network bond by using the **network** RHEL system role.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- Two or more physical or virtual network devices are installed on the server.

Procedure

1. Create a playbook file, for example **~/playbook.yml**, with the following content:

```
---
- name: Configure the network
  hosts: managed-node-01.example.com
  tasks:
```

```
- name: Configure a network bond that uses two Ethernet ports
  ansible.builtin.include_role:
    name: rhel-system-roles.network
  vars:
    network_connections:
      # Define the bond profile
      - name: bond0
        type: bond
        interface_name: bond0
        ip:
          address:
            - "192.0.2.1/24"
            - "2001:db8:1::1/64"
          gateway4: 192.0.2.254
          gateway6: 2001:db8:1::fffe
          dns:
            - 192.0.2.200
            - 2001:db8:1::ffbb
          dns_search:
            - example.com
        bond:
          mode: active-backup
        state: up

      # Add an Ethernet profile to the bond
      - name: bond0-port1
        interface_name: enp7s0
        type: ethernet
        controller: bond0
        state: up

      # Add a second Ethernet profile to the bond
      - name: bond0-port2
        interface_name: enp8s0
        type: ethernet
        controller: bond0
        state: up
```

These settings define a network bond with the following settings:

- A static IPv4 address - **192.0.2.1** with a **/24** subnet mask
- A static IPv6 address - **2001:db8:1::1** with a **/64** subnet mask
- An IPv4 default gateway - **192.0.2.254**
- An IPv6 default gateway - **2001:db8:1::fffe**
- An IPv4 DNS server - **192.0.2.200**
- An IPv6 DNS server - **2001:db8:1::ffbb**
- A DNS search domain - **example.com**
- Ports of the bond - **enp7s0** and **enp8s0**
- Bond mode - **active-backup**

NOTE

Set the IP configuration on the bond and not on the ports of the Linux bond.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.network/README.md** file
- **/usr/share/doc/rhel-system-roles/network/** directory

19.8. CONFIGURING AN IPOIB CONNECTION BY USING THE NETWORK RHEL SYSTEM ROLE

You can use the **network** RHEL system role to remotely create NetworkManager connection profiles for IP over InfiniBand (IPoIB) devices. For example, remotely add an InfiniBand connection for the **mlx4_ib0** interface with the following settings by running an Ansible playbook:

- An IPoIB device - **mlx4_ib0.8002**
- A partition key **p_key** - **0x8002**
- A static **IPv4** address - **192.0.2.1** with a **/24** subnet mask
- A static **IPv6** address - **2001:db8:1::1** with a **/64** subnet mask

Perform this procedure on the Ansible control node.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- An InfiniBand device named **mlx4_ib0** is installed in the managed nodes.
- The managed nodes use NetworkManager to configure the network.

Procedure

1. Create a playbook file, for example **~/playbook.yml**, with the following content:

```
---
- name: Configure the network
  hosts: managed-node-01.example.com
  tasks:
    - name: Configure IPoIB
      ansible.builtin.include_role:
        name: rhel-system-roles.network
      vars:
        network_connections:
          # InfiniBand connection mlx4_ib0
          - name: mlx4_ib0
            interface_name: mlx4_ib0
            type: infiniband

          # IPoIB device mlx4_ib0.8002 on top of mlx4_ib0
          - name: mlx4_ib0.8002
            type: infiniband
            autoconnect: yes
            infiniband:
              p_key: 0x8002
              transport_mode: datagram
            parent: mlx4_ib0
            ip:
              address:
                - 192.0.2.1/24
                - 2001:db8:1::1/64
            state: up
```

If you set a **p_key** parameter as in this example, do not set an **interface_name** parameter on the IPoIB device.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

1. On the **managed-node-01.example.com** host, display the IP settings of the **mlx4_ib0.8002** device:

```
# ip address show mlx4_ib0.8002
...
inet 192.0.2.1/24 brd 192.0.2.255 scope global noprefixroute ib0.8002
   valid_lft forever preferred_lft forever
inet6 2001:db8:1::1/64 scope link tentative noprefixroute
   valid_lft forever preferred_lft forever
```

2. Display the partition key (P_Key) of the **mlx4_ib0.8002** device:

```
# cat /sys/class/net/mlx4_ib0.8002/pkey
0x8002
```

3. Display the mode of the **mlx4_ib0.8002** device:

```
# cat /sys/class/net/mlx4_ib0.8002/mode
datagram
```

Additional resources

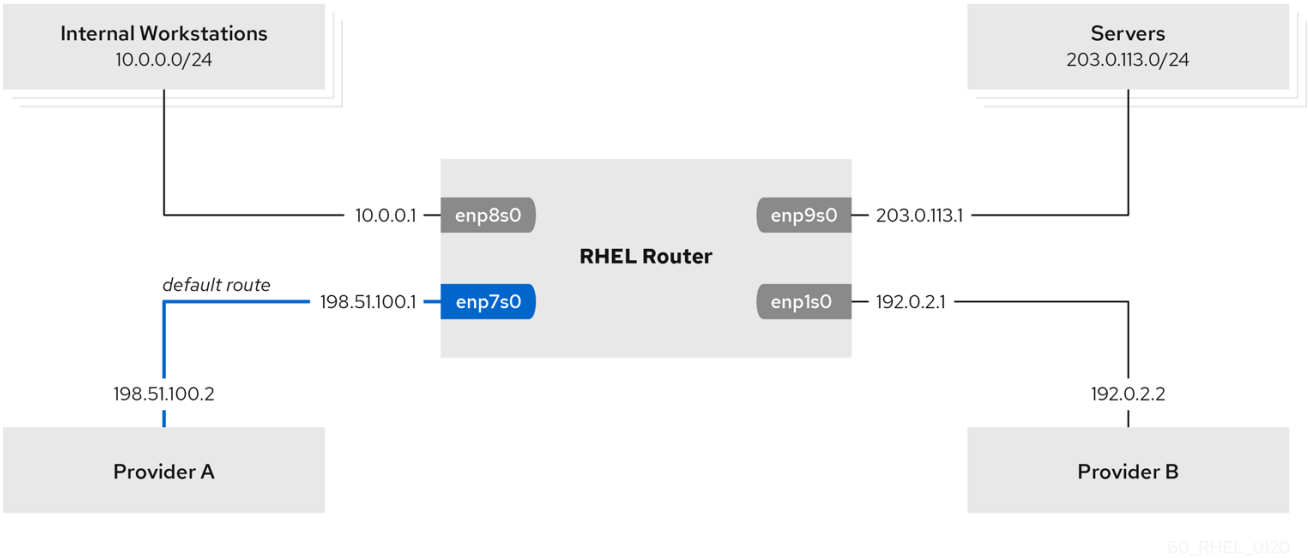
- **/usr/share/ansible/roles/rhel-system-roles.network/README.md** file
- **/usr/share/doc/rhel-system-roles/network/** directory

19.9. ROUTING TRAFFIC FROM A SPECIFIC SUBNET TO A DIFFERENT DEFAULT GATEWAY BY USING THE NETWORK RHEL SYSTEM ROLE

You can use policy-based routing to configure a different default gateway for traffic from certain subnets. For example, you can configure RHEL as a router that, by default, routes all traffic to internet provider A using the default route. However, traffic received from the internal workstations subnet is routed to provider B.

To configure policy-based routing remotely and on multiple nodes, you can use the **network** RHEL system role.

This procedure assumes the following network topology:



Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

- The managed nodes uses the **NetworkManager** and **firewalld** services.
- The managed nodes you want to configure has four network interfaces:
  - The **enp7s0** interface is connected to the network of provider A. The gateway IP in the provider's network is **198.51.100.2**, and the network uses a **/30** network mask.
  - The **enp1s0** interface is connected to the network of provider B. The gateway IP in the provider's network is **192.0.2.2**, and the network uses a **/30** network mask.
  - The **enp8s0** interface is connected to the **10.0.0.0/24** subnet with internal workstations.
  - The **enp9s0** interface is connected to the **203.0.113.0/24** subnet with the company's servers.
- Hosts in the internal workstations subnet use **10.0.0.1** as the default gateway. In the procedure, you assign this IP address to the **enp8s0** network interface of the router.
- Hosts in the server subnet use **203.0.113.1** as the default gateway. In the procedure, you assign this IP address to the **enp9s0** network interface of the router.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Configuring policy-based routing
  hosts: managed-node-01.example.com
  tasks:
    - name: Routing traffic from a specific subnet to a different default gateway
      ansible.builtin.include_role:
        name: rhel-system-roles.network
      vars:
        network_connections:
          - name: Provider-A
            interface_name: enp7s0
            type: ethernet
            autoconnect: True
            ip:
              address:
                - 198.51.100.1/30
              gateway4: 198.51.100.2
              dns:
                - 198.51.100.200
            state: up
            zone: external

          - name: Provider-B
            interface_name: enp1s0
            type: ethernet
            autoconnect: True
            ip:
              address:
                - 192.0.2.1/30
              route:
                - network: 0.0.0.0
```

```
        prefix: 0
        gateway: 192.0.2.2
        table: 5000
    state: up
    zone: external

  - name: Internal-Workstations
    interface_name: enp8s0
    type: ethernet
    autoconnect: True
    ip:
      address:
        - 10.0.0.1/24
      route:
        - network: 10.0.0.0
          prefix: 24
          table: 5000
      routing_rule:
        - priority: 5
          from: 10.0.0.0/24
          table: 5000
    state: up
    zone: trusted

  - name: Servers
    interface_name: enp9s0
    type: ethernet
    autoconnect: True
    ip:
      address:
        - 203.0.113.1/24
    state: up
    zone: trusted
```

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

1. On a RHEL host in the internal workstation subnet:
   a. Install the **traceroute** package:

```
# yum install traceroute
```

   b. Use the **traceroute** utility to display the route to a host on the internet:

```
# traceroute redhat.com
traceroute to redhat.com (209.132.183.105), 30 hops max, 60 byte packets
 1  10.0.0.1 (10.0.0.1)     0.337 ms  0.260 ms  0.223 ms
 2  192.0.2.1 (192.0.2.1)   0.884 ms  1.066 ms  1.248 ms
 ...
```

The output of the command displays that the router sends packets over **192.0.2.1**, which is the network of provider B.

2. On a RHEL host in the server subnet:

   a. Install the **traceroute** package:

   ```
   # yum install traceroute
   ```

   b. Use the **traceroute** utility to display the route to a host on the internet:

   ```
   # traceroute redhat.com
   traceroute to redhat.com (209.132.183.105), 30 hops max, 60 byte packets
    1  203.0.113.1 (203.0.113.1)    2.179 ms  2.073 ms  1.944 ms
    2  198.51.100.2 (198.51.100.2)  1.868 ms  1.798 ms  1.549 ms
    ...
   ```

   The output of the command displays that the router sends packets over **198.51.100.2**, which is the network of provider A.

3. On the RHEL router that you configured using the RHEL system role:

   a. Display the rule list:

   ```
   # ip rule list
   0:      from all lookup local
   5:    from 10.0.0.0/24 lookup 5000
   32766:  from all lookup main
   32767:  from all lookup default
   ```

   By default, RHEL contains rules for the tables **local**, **main**, and **default**.

   b. Display the routes in table **5000**:

   ```
   # ip route list table 5000
   0.0.0.0/0 via 192.0.2.2 dev enp1s0 proto static metric 100
   10.0.0.0/24 dev enp8s0 proto static scope link src 192.0.2.1 metric 102
   ```

   c. Display the interfaces and firewall zones:

   ```
   # firewall-cmd --get-active-zones
   external
     interfaces: enp1s0 enp7s0
   trusted
     interfaces: enp8s0 enp9s0
   ```

   d. Verify that the **external** zone has masquerading enabled:

```
# firewall-cmd --info-zone=external
external (active)
  target: default
  icmp-block-inversion: no
  interfaces: enp1s0 enp7s0
  sources:
  services: ssh
  ports:
  protocols:
  masquerade: yes
  ...
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.network/README.md** file
- **/usr/share/doc/rhel-system-roles/network/** directory

19.10. CONFIGURING A STATIC ETHERNET CONNECTION WITH 802.1X NETWORK AUTHENTICATION BY USING THE NETWORK RHEL SYSTEM ROLE

You can remotely configure an Ethernet connection with 802.1X network authentication by using the **network** RHEL system role.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- The network supports 802.1X network authentication.
- The managed nodes uses NetworkManager.
- The following files required for TLS authentication exist on the control node:
  - The client key is stored in the **/srv/data/client.key** file.
  - The client certificate is stored in the **/srv/data/client.crt** file.
  - The Certificate Authority (CA) certificate is stored in the **/srv/data/ca.crt** file.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Configure an Ethernet connection with 802.1X authentication
  hosts: managed-node-01.example.com
  tasks:
    - name: Copy client key for 802.1X authentication
```

```
    ansible.builtin.copy:
      src: "/srv/data/client.key"
      dest: "/etc/pki/tls/private/client.key"
      mode: 0600

  - name: Copy client certificate for 802.1X authentication
    ansible.builtin.copy:
      src: "/srv/data/client.crt"
      dest: "/etc/pki/tls/certs/client.crt"

  - name: Copy CA certificate for 802.1X authentication
    ansible.builtin.copy:
      src: "/srv/data/ca.crt"
      dest: "/etc/pki/ca-trust/source/anchors/ca.crt"

  - name: Configure connection
    ansible.builtin.include_role:
      name: rhel-system-roles.network
    vars:
      network_connections:
        - name: enp1s0
          type: ethernet
          autoconnect: yes
          ip:
            address:
              - 192.0.2.1/24
              - 2001:db8:1::1/64
            gateway4: 192.0.2.254
            gateway6: 2001:db8:1::fffe
            dns:
              - 192.0.2.200
              - 2001:db8:1::ffbb
            dns_search:
              - example.com
          ieee802_1x:
            identity: user_name
            eap: tls
            private_key: "/etc/pki/tls/private/client.key"
            private_key_password: "password"
            client_cert: "/etc/pki/tls/certs/client.crt"
            ca_cert: "/etc/pki/ca-trust/source/anchors/ca.crt"
            domain_suffix_match: example.com
          state: up
```

These settings define an Ethernet connection profile for the **enp1s0** device with the following settings:

- A static IPv4 address - **192.0.2.1** with a **/24** subnet mask
- A static IPv6 address - **2001:db8:1::1** with a **/64** subnet mask
- An IPv4 default gateway - **192.0.2.254**
- An IPv6 default gateway - **2001:db8:1::fffe**
- An IPv4 DNS server - **192.0.2.200**

- An IPv6 DNS server - **2001:db8:1::ffbb**
- A DNS search domain - **example.com**
- 802.1X network authentication using the **TLS** Extensible Authentication Protocol (EAP)

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

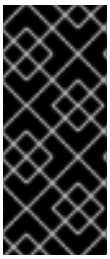
```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.network/README.md** file
- **/usr/share/doc/rhel-system-roles/network/** directory

19.11. SETTING THE DEFAULT GATEWAY ON AN EXISTING CONNECTION BY USING THE NETWORK RHEL SYSTEM ROLE

In most situations, administrators set the default gateway when they create a connection. However, you can also set or update the default gateway setting on a previously created connection by using the **network** RHEL system role to set the default gateway.



IMPORTANT

When you run a play that uses the **network** RHEL system role and if the setting values do not match the values specified in the play, the role overrides the existing connection profile with the same name. To prevent resetting these values to their defaults, always specify the whole configuration of the network connection profile in the play, even if the configuration, for example the IP configuration, already exists.

Depending on whether it already exists, the procedure creates or updates the **enp1s0** connection profile with the following settings:

- A static IPv4 address - **198.51.100.20** with a **/24** subnet mask
- A static IPv6 address - **2001:db8:1::1** with a **/64** subnet mask
- An IPv4 default gateway - **198.51.100.254**
- An IPv6 default gateway - **2001:db8:1::fffe**
- An IPv4 DNS server - **198.51.100.200**
- An IPv6 DNS server - **2001:db8:1::ffbb**
- A DNS search domain - **example.com**

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Configure the network
  hosts: managed-node-01.example.com
  tasks:
    - name: Configure an Ethernet connection with static IP and default gateway
      ansible.builtin.include_role:
        name: rhel-system-roles.network
      vars:
        network_connections:
          - name: enp1s0
            type: ethernet
            autoconnect: yes
            ip:
              address:
                - 198.51.100.20/24
                - 2001:db8:1::1/64
              gateway4: 198.51.100.254
              gateway6: 2001:db8:1::fffe
              dns:
                - 198.51.100.200
                - 2001:db8:1::ffbb
              dns_search:
                - example.com
            state: up
```

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

   Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.network/README.md** file
- **/usr/share/doc/rhel-system-roles/network/** directory

19.12. CONFIGURING A STATIC ROUTE BY USING THE NETWORK RHEL SYSTEM ROLE

You can use the **network** RHEL system role to configure static routes.

IMPORTANT

When you run a play that uses the **network** RHEL system role and if the setting values do not match the values specified in the play, the role overrides the existing connection profile with the same name. To prevent resetting these values to their defaults, always specify the whole configuration of the network connection profile in the play, even if the configuration, for example the IP configuration, already exists.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Configure the network
  hosts: managed-node-01.example.com
  tasks:
    - name: Configure an Ethernet connection with static IP and additional routes
      ansible.builtin.include_role:
        name: rhel-system-roles.network
      vars:
        network_connections:
          - name: enp7s0
            type: ethernet
            autoconnect: yes
            ip:
              address:
                - 192.0.2.1/24
                - 2001:db8:1::1/64
              gateway4: 192.0.2.254
              gateway6: 2001:db8:1::fffe
              dns:
                - 192.0.2.200
                - 2001:db8:1::ffbb
              dns_search:
                - example.com
              route:
                - network: 198.51.100.0
                  prefix: 24
                  gateway: 192.0.2.10
                - network: 2001:db8:2::
```

```
            prefix: 64
            gateway: 2001:db8:1::10
        state: up
```

Depending on whether it already exists, the procedure creates or updates the **enp7s0** connection profile with the following settings:

- A static IPv4 address - **192.0.2.1** with a **/24** subnet mask
- A static IPv6 address - **2001:db8:1::1** with a **/64** subnet mask
- An IPv4 default gateway - **192.0.2.254**
- An IPv6 default gateway - **2001:db8:1::fffe**
- An IPv4 DNS server - **192.0.2.200**
- An IPv6 DNS server - **2001:db8:1::ffbb**
- A DNS search domain - **example.com**
- Static routes:
  - **198.51.100.0/24** with gateway **192.0.2.10**
  - **2001:db8:2::/64** with gateway **2001:db8:1::10**

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

1. On the managed nodes:

   a. Display the IPv4 routes:

```
# ip -4 route
...
198.51.100.0/24 via 192.0.2.10 dev enp7s0
```

   b. Display the IPv6 routes:

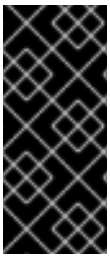
```
# ip -6 route
...
2001:db8:2::/64 via 2001:db8:1::10 dev enp7s0 metric 1024 pref medium
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.network/README.md** file
- **/usr/share/doc/rhel-system-roles/network/** directory

19.13. CONFIGURING AN ETHTOOL OFFLOAD FEATURE BY USING THE NETWORK RHEL SYSTEM ROLE

You can use the **network** RHEL system role to configure **ethtool** features of a NetworkManager connection.



IMPORTANT

When you run a play that uses the **network** RHEL system role and if the setting values do not match the values specified in the play, the role overrides the existing connection profile with the same name. To prevent resetting these values to their defaults, always specify the whole configuration of the network connection profile in the play, even if the configuration, for example the IP configuration, already exists.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Configure the network
  hosts: managed-node-01.example.com
  tasks:
    - name: Configure an Ethernet connection with ethtool features
      ansible.builtin.include_role:
        name: rhel-system-roles.network
      vars:
        network_connections:
          - name: enp1s0
            type: ethernet
            autoconnect: yes
            ip:
              address:
                - 198.51.100.20/24
                - 2001:db8:1::1/64
              gateway4: 198.51.100.254
              gateway6: 2001:db8:1::fffe
              dns:
                - 198.51.100.200
                - 2001:db8:1::ffbb
              dns_search:
                - example.com
            ethtool:
```

```
    features:
      gro: "no"
      gso: "yes"
      tx_sctp_segmentation: "no"
  state: up
```

This playbook creates the **enp1s0** connection profile with the following settings, or updates it if the profile already exists:

- A static **IPv4** address - **198.51.100.20** with a **/24** subnet mask
- A static **IPv6** address - **2001:db8:1::1** with a **/64** subnet mask
- An **IPv4** default gateway - **198.51.100.254**
- An **IPv6** default gateway - **2001:db8:1::fffe**
- An **IPv4** DNS server - **198.51.100.200**
- An **IPv6** DNS server - **2001:db8:1::ffbb**
- A DNS search domain - **example.com**
- **ethtool** features:
  - Generic receive offload (GRO): disabled
  - Generic segmentation offload (GSO): enabled
  - TX stream control transmission protocol (SCTP) segmentation: disabled

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

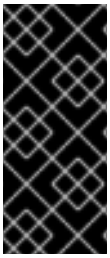
```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.network/README.md** file
- **/usr/share/doc/rhel-system-roles/network/** directory

19.14. CONFIGURING AN ETHTOOL COALESCE SETTINGS BY USING THE NETWORK RHEL SYSTEM ROLE

You can use the **network** RHEL system role to configure **ethtool** coalesce settings of a NetworkManager connection.



IMPORTANT

When you run a play that uses the **network** RHEL system role and if the setting values do not match the values specified in the play, the role overrides the existing connection profile with the same name. To prevent resetting these values to their defaults, always specify the whole configuration of the network connection profile in the play, even if the configuration, for example the IP configuration, already exists.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Configure the network
  hosts: managed-node-01.example.com
  tasks:
    - name: Configure an Ethernet connection with ethtool coalesce settings
      ansible.builtin.include_role:
        name: rhel-system-roles.network
      vars:
        network_connections:
          - name: enp1s0
            type: ethernet
            autoconnect: yes
            ip:
              address:
                - 198.51.100.20/24
                - 2001:db8:1::1/64
              gateway4: 198.51.100.254
              gateway6: 2001:db8:1::fffe
              dns:
                - 198.51.100.200
                - 2001:db8:1::ffbb
              dns_search:
                - example.com
            ethtool:
              coalesce:
                rx_frames: 128
                tx_frames: 128
            state: up
```

This playbook creates the **enp1s0** connection profile with the following settings, or updates it if the profile already exists:

- A static IPv4 address - **198.51.100.20** with a **/24** subnet mask
- A static IPv6 address - **2001:db8:1::1** with a **/64** subnet mask

- An IPv4 default gateway - **198.51.100.254**
- An IPv6 default gateway - **2001:db8:1::fffe**
- An IPv4 DNS server - **198.51.100.200**
- An IPv6 DNS server - **2001:db8:1::ffbb**
- A DNS search domain - **example.com**
- **ethtool** coalesce settings:
  - RX frames: **128**
  - TX frames: **128**

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.network/README.md** file
- **/usr/share/doc/rhel-system-roles/network/** directory

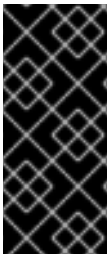
19.15. INCREASING THE RING BUFFER SIZE TO REDUCE A HIGH PACKET DROP RATE BY USING THE NETWORK RHEL SYSTEM ROLE

Increase the size of an Ethernet device's ring buffers if the packet drop rate causes applications to report a loss of data, timeouts, or other issues.

Ring buffers are circular buffers where an overflow overwrites existing data. The network card assigns a transmit (TX) and receive (RX) ring buffer. Receive ring buffers are shared between the device driver and the network interface controller (NIC). Data can move from NIC to the kernel through either hardware interrupts or software interrupts, also called SoftIRQs.

The kernel uses the RX ring buffer to store incoming packets until the device driver can process them. The device driver drains the RX ring, typically by using SoftIRQs, which puts the incoming packets into a kernel data structure called an **sk_buff** or **skb** to begin its journey through the kernel and up to the application that owns the relevant socket.

The kernel uses the TX ring buffer to hold outgoing packets which should be sent to the network. These ring buffers reside at the bottom of the stack and are a crucial point at which packet drop can occur, which in turn will adversely affect network performance.



IMPORTANT

When you run a play that uses the **network** RHEL system role and if the setting values do not match the values specified in the play, the role overrides the existing connection profile with the same name. To prevent resetting these values to their defaults, always specify the whole configuration of the network connection profile in the play, even if the configuration, for example the IP configuration, already exists.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- You know the maximum ring buffer sizes that the device supports.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Configure the network
  hosts: managed-node-01.example.com
  tasks:
    - name: Configure an Ethernet connection with increased ring buffer sizes
      ansible.builtin.include_role:
        name: rhel-system-roles.network
      vars:
        network_connections:
          - name: enp1s0
            type: ethernet
            autoconnect: yes
            ip:
              address:
                - 198.51.100.20/24
                - 2001:db8:1::1/64
              gateway4: 198.51.100.254
              gateway6: 2001:db8:1::fffe
              dns:
                - 198.51.100.200
                - 2001:db8:1::ffbb
              dns_search:
                - example.com
            ethtool:
              ring:
                rx: 4096
                tx: 4096
            state: up
```

This playbook creates the **enp1s0** connection profile with the following settings, or updates it if the profile already exists:

- A static **IPv4** address - **198.51.100.20** with a **/24** subnet mask

- A static **IPv6** address - **2001:db8:1::1** with a **/64** subnet mask
- An **IPv4** default gateway - **198.51.100.254**
- An **IPv6** default gateway - **2001:db8:1::fffe**
- An **IPv4** DNS server - **198.51.100.200**
- An **IPv6** DNS server - **2001:db8:1::ffbb**
- A DNS search domain - **example.com**
- Maximum number of ring buffer entries:
  - Receive (RX): 4096
  - Transmit (TX): 4096

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.network/README.md** file
- **/usr/share/doc/rhel-system-roles/network/** directory

19.16. NETWORK STATES FOR THE NETWORK RHEL SYSTEM ROLE

The **network** RHEL system role supports state configurations in playbooks to configure the devices. For this, use the **network_state** variable followed by the state configurations.

Benefits of using the **network_state** variable in a playbook:

- Using the declarative method with the state configurations, you can configure interfaces, and the NetworkManager creates a profile for these interfaces in the background.
- With the **network_state** variable, you can specify the options that you require to change, and all the other options will remain the same as they are. However, with the **network_connections** variable, you must specify all settings to change the network connection profile.

For example, to create an Ethernet connection with dynamic IP address settings, use the following **vars** block in your playbook:

Playbook with state configurations	Regular playbook

```
vars:
  network_state:
    interfaces:
    - name: enp7s0
      type: ethernet
      state: up
      ipv4:
        enabled: true
        auto-dns: true
        auto-gateway: true
        auto-routes: true
        dhcp: true
      ipv6:
        enabled: true
        auto-dns: true
        auto-gateway: true
        auto-routes: true
        autoconf: true
        dhcp: true
```

```
vars:
  network_connections:
    - name: enp7s0
      interface_name: enp7s0
      type: ethernet
      autoconnect: yes
      ip:
        dhcp4: yes
        auto6: yes
      state: up
```

For example, to only change the connection status of dynamic IP address settings that you created as above, use the following **vars** block in your playbook:

Playbook with state configurations

```
vars:
  network_state:
    interfaces:
    - name: enp7s0
      type: ethernet
      state: down
```

Regular playbook

```
vars:
  network_connections:
    - name: enp7s0
      interface_name: enp7s0
      type: ethernet
      autoconnect: yes
      ip:
        dhcp4: yes
        auto6: yes
      state: down
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.network/README.md** file
- **/usr/share/doc/rhel-system-roles/network/** directory

CHAPTER 20. MANAGING CONTAINERS BY USING THE PODMAN RHEL SYSTEM ROLE

With the **podman** RHEL system role, you can manage Podman configuration, containers, and **systemd** services that run Podman containers.

20.1. CREATING A ROOTLESS CONTAINER WITH BIND MOUNT

You can use the **podman** RHEL system role to create rootless containers with bind mount by running an Ansible playbook and with that, manage your application configuration.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
- hosts: managed-node-01.example.com
  vars:
    podman_create_host_directories: true
    podman_firewall:
      - port: 8080-8081/tcp
        state: enabled
      - port: 12340/tcp
        state: enabled
    podman_selinux_ports:
      - ports: 8080-8081
        setype: http_port_t
    podman_kube_specs:
      - state: started
        run_as_user: dbuser
        run_as_group: dbgroup
        kube_file_content:
          apiVersion: v1
          kind: Pod
          metadata:
            name: db
          spec:
            containers:
              - name: db
                image: quay.io/db/db:stable
                ports:
                  - containerPort: 1234
                    hostPort: 12340
                volumeMounts:
                  - mountPath: /var/lib/db:Z
                    name: db
            volumes:
```

```
            - name: db
              hostPath:
                path: /var/lib/db
      - state: started
        run_as_user: webapp
        run_as_group: webapp
        kube_file_src: /path/to/webapp.yml
  roles:
    - linux-system-roles.podma
```

This procedure creates a pod with two containers. The **podman_kube_specs** role variable describes a pod.

- The **run_as_user** and **run_as_group** fields specify that containers are rootless.
- The **kube_file_content** field containing a Kubernetes YAML file defines the first container named **db**. You can generate the Kubernetes YAML file using the **podman kube generate** command.
  - The **db** container is based on the **quay.io/db/db:stable** container image.
  - The **db** bind mount maps the **/var/lib/db** directory on the host to the **/var/lib/db** directory in the container. The **Z** flag labels the content with a private unshared label, therefore, only the **db** container can access the content.
- The **kube_file_src** field defines the second container. The content of the **/path/to/webapp.yml** file on the controller node will be copied to the **kube_file** field on the managed node.
- Set the **podman_create_host_directories: true** to create the directory on the host. This instructs the role to check the kube specification for **hostPath** volumes and create those directories on the host. If you need more control over the ownership and permissions, use **podman_host_directories**.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check --ask-vault-pass ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook --ask-vault-pass ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.podman/README.md** file
- **/usr/share/doc/rhel-system-roles/podman/** directory

20.2. CREATING A ROOTFUL CONTAINER WITH PODMAN VOLUME

You can use the **podman** RHEL system role to create a rootful container with a Podman volume by running an Ansible playbook and with that, manage your application configuration.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
- hosts: managed-node-01.example.com
  vars:
    podman_firewall:
      - port: 8080/tcp
        state: enabled
    podman_kube_specs:
      - state: started
        kube_file_content:
          apiVersion: v1
          kind: Pod
          metadata:
            name: ubi8-httpd
          spec:
            containers:
              - name: ubi8-httpd
                image: registry.access.redhat.com/ubi8/httpd-24
                ports:
                  - containerPort: 8080
                    hostPort: 8080
                volumeMounts:
                  - mountPath: /var/www/html:Z
                    name: ubi8-html
            volumes:
              - name: ubi8-html
                persistentVolumeClaim:
                  claimName: ubi8-html-volume
  roles:
    - linux-system-roles.podman
```

The procedure creates a pod with one container. The **podman_kube_specs** role variable describes a pod.

- By default, the **podman** role creates rootful containers.
- The **kube_file_content** field containing a Kubernetes YAML file defines the container named **ubi8-httpd**.
  - The **ubi8-httpd** container is based on the **registry.access.redhat.com/ubi8/httpd-24** container image.
    - The **ubi8-html-volume** maps the **/var/www/html** directory on the host to the container. The **Z** flag labels the content with a private unshared label, therefore, only the **ubi8-httpd** container can access the content.

- The pod mounts the existing persistent volume named **ubi8-html-volume** with the mount path **/var/www/html**.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.podman/README.md** file
- **/usr/share/doc/rhel-system-roles/podman/** directory

20.3. CREATING A QUADLET APPLICATION WITH SECRETS

You can use the **podman** RHEL system role to create a Quadlet application with secrets by running an Ansible playbook.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- The certificate and the corresponding private key that the web server in the container should use are stored in the **~/certificate.pem** and **~/key.pem** files.

Procedure

1. Display the contents of the certificate and private key files:

```
$ cat ~/certificate.pem
-----BEGIN CERTIFICATE-----
...
-----END CERTIFICATE-----

$ cat ~/key.pem
-----BEGIN PRIVATE KEY-----
...
-----END PRIVATE KEY-----
```

You require this information in a later step.

2. Store your sensitive variables in an encrypted file:

   a. Create the vault:

```
$ ansible-vault create vault.yml
New Vault password: <vault_password>
Confirm New Vault password: <vault_password>
```

b. After the **ansible-vault create** command opens an editor, enter the sensitive data in the ***<key>: <value>*** format:

```
root_password: <root_password>
certificate: |-
  -----BEGIN CERTIFICATE-----
  ...
  -----END CERTIFICATE-----
key: |-
  -----BEGIN PRIVATE KEY-----
  ...
  -----END PRIVATE KEY-----
```

Ensure that all lines in the **certificate** and **key** variables start with two spaces.

c. Save the changes, and close the editor. Ansible encrypts the data in the vault.

3. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
- name: Deploy a wordpress CMS with MySQL database
  hosts: managed-node-01.example.com
  vars_files:
    - vault.yml
  tasks:
  - name: Create and run the container
    ansible.builtin.include_role:
      name: rhel-system-roles.podman
    vars:
      podman_create_host_directories: true
      podman_activate_systemd_unit: false
      podman_quadlet_specs:
        - name: quadlet-demo
          type: network
          file_content: |
            [Network]
            Subnet=192.168.30.0/24
            Gateway=192.168.30.1
            Label=app=wordpress
        - file_src: quadlet-demo-mysql.volume
        - template_src: quadlet-demo-mysql.container.j2
        - file_src: envoy-proxy-configmap.yml
        - file_src: quadlet-demo.yml
        - file_src: quadlet-demo.kube
          activate_systemd_unit: true
      podman_firewall:
        - port: 8000/tcp
          state: enabled
        - port: 9000/tcp
          state: enabled
      podman_secrets:
        - name: mysql-root-password-container
```

```
    state: present
    skip_existing: true
    data: "{{ root_password }}"
  - name: mysql-root-password-kube
    state: present
    skip_existing: true
    data: |
      apiVersion: v1
      data:
        password: "{{ root_password | b64encode }}"
      kind: Secret
      metadata:
        name: mysql-root-password-kube
  - name: envoy-certificates
    state: present
    skip_existing: true
    data: |
      apiVersion: v1
      data:
        certificate.key: {{ key | b64encode }}
        certificate.pem: {{ certificate | b64encode }}
      kind: Secret
      metadata:
        name: envoy-certificates
```

The procedure creates a WordPress content management system paired with a MySQL database. The **podman_quadlet_specs role** variable defines a set of configurations for the Quadlet, which refers to a group of containers or services that work together in a certain way. It includes the following specifications:

- The Wordpress network is defined by the **quadlet-demo** network unit.
- The volume configuration for MySQL container is defined by the **file_src: quadlet-demo-mysql.volume** field.
- The **template_src: quadlet-demo-mysql.container.j2** field is used to generate a configuration for the MySQL container.
- Two YAML files follow: **file_src: envoy-proxy-configmap.yml** and **file_src: quadlet-demo.yml**. Note that .yml is not a valid Quadlet unit type, therefore these files will just be copied and not processed as a Quadlet specification.
- The Wordpress and envoy proxy containers and configuration are defined by the **file_src: quadlet-demo.kube** field. The kube unit refers to the previous YAML files in the **[Kube]** section as **Yaml=quadlet-demo.yml** and **ConfigMap=envoy-proxy-configmap.yml**.

4. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check --ask-vault-pass ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

5. Run the playbook:

```
$ ansible-playbook --ask-vault-pass ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.podman/README.md** file
- **/usr/share/doc/rhel-system-roles/podman/** directory

CHAPTER 21. CONFIGURING POSTFIX MTA BY USING THE RHEL SYSTEM ROLE

With the **postfix** RHEL system role, you can consistently streamline automated configurations of the Postfix service, a Sendmail-compatible mail transfer agent (MTA) with modular design and a variety of configuration options. The **rhel-system-roles** package contains this RHEL system role, and also the reference documentation.

21.1. USING THE POSTFIX RHEL SYSTEM ROLE TO AUTOMATE BASIC POSTFIX MTA ADMINISTRATION

You can install, configure and start the Postfix Mail Transfer Agent on the managed nodes by using the **postfix** RHEL system role.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Manage postfix
  hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.postfix
  vars:
    postfix_conf:
      relay_domains: $mydestination
        relayhost: example.com
```

- If you want Postfix to use a different hostname than the fully-qualified domain name (FQDN) that is returned by the **gethostname()** function, add the **myhostname** parameter under the **postfix_conf:** line in the file:

```
myhostname = smtp.example.com
```

- If the domain name differs from the domain name in the **myhostname** parameter, add the **mydomain** parameter. Otherwise, the **$myhostname** minus the first component is used.

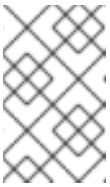
```
mydomain = <example.com>
```

- Use **postfix_manage_firewall: true** variable to ensure that the SMTP port is open in the firewall on the servers.
  Manage the SMTP related ports, **25/tcp**, **465/tcp**, and **587/tcp**. If the variable is set to **false**, the **postfix** role does not manage the firewall. The default is **false**.

NOTE

The **postfix_manage_firewall** variable is limited to adding ports. It cannot be used for removing ports. If you want to remove ports, use the **firewall** RHEL system role directly.

- If your scenario involves using non-standard ports, set the **postfix_manage_selinux: true** variable to ensure that the port is properly labeled for SELinux on the servers.



NOTE

The **postfix_manage_selinux** variable is limited to adding rules to the SELinux policy. It cannot remove rules from the policy. If you want to remove rules, use the **selinux** RHEL system role directly.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.postfix/README.md** file
- **/usr/share/doc/rhel-system-roles/postfix/** directory

CHAPTER 22. INSTALLING AND CONFIGURING POSTGRESQL BY USING THE RHEL SYSTEM ROLE

As a system administrator, you can use the **postgresql** RHEL system role to install, configure, manage, start, and improve performance of the PostgreSQL server.

22.1. INTRODUCTION TO THE POSTGRESQL RHEL SYSTEM ROLE

To install, configure, manage, and start the PostgreSQL server using Ansible, you can use the **postgresql** RHEL system role.

You can also use the **postgresql** role to optimize the database server settings and improve performance.

The role supports the currently released and supported versions of PostgreSQL on RHEL 8 and RHEL 9 managed nodes.

22.2. CONFIGURING THE POSTGRESQL SERVER BY USING THE POSTGRESQL RHEL SYSTEM ROLE

You can use the **postgresql** RHEL system role to install, configure, manage, and start the PostgreSQL server.

WARNING

The **postgresql** role replaces PostgreSQL configuration files in the **/var/lib/pgsql/data/** directory on the managed hosts. Previous settings are changed to those specified in the role variables, and lost if they are not specified in the role variables.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Manage PostgreSQL
  hosts: managed-node-01.example.com
  roles:
```

```
    - rhel-system-roles.postgresql
  vars:
    postgresql_version: "13"
```

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.postgresql/README.md** file
- **/usr/share/doc/rhel-system-roles/postgresql/** directory
- Using PostgreSQL

CHAPTER 23. REGISTERING THE SYSTEM BY USING THE RHEL SYSTEM ROLE

The **rhc** RHEL system role enables administrators to automate the registration of multiple systems with Red Hat Subscription Management (RHSM) and Satellite servers. The role also supports Insights-related configuration and management tasks by using Ansible.

23.1. INTRODUCTION TO THE RHC RHEL SYSTEM ROLE

RHEL system role is a set of roles that provides a consistent configuration interface to remotely manage multiple systems. The remote host configuration (**rhc**) RHEL system role enables administrators to easily register RHEL systems to Red Hat Subscription Management (RHSM) and Satellite servers. By default, when you register a system by using the **rhc** RHEL system role, the system is connected to Insights. Additionally, with the **rhc** RHEL system role, you can:

- Configure connections to Red Hat Insights
- Enable and disable repositories
- Configure the proxy to use for the connection
- Configure insights remediations and, auto updates
- Set the release of the system
- Configure insights tags

23.2. REGISTERING A SYSTEM BY USING THE RHC RHEL SYSTEM ROLE

You can register your system to Red Hat by using the **rhc** RHEL system role. By default, the **rhc** RHEL system role connects the system to Red Hat Insights when you register it.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Store your sensitive variables in an encrypted file:
   a. Create the vault:

```
$ ansible-vault create vault.yml
New Vault password: <password>
Confirm New Vault password: <vault_password>
```

   b. After the **ansible-vault create** command opens an editor, enter the sensitive data in the ***<key>: <value>*** format:

```
activationKey: <activation_key>
username: <username>
password: <password>
```

c. Save the changes, and close the editor. Ansible encrypts the data in the vault.

2. Create a playbook file, for example ~/**playbook.yml**, with the following content:

- To register by using an activation key and organization ID (recommended), use the following playbook:

```
---
- name: Registering system using activation key and organization ID
  hosts: managed-node-01.example.com
  vars_files:
    - vault.yml
  roles:
    - role: rhel-system-roles.rhc
  vars:
    rhc_auth:
      activation_keys:
        keys:
          - "{{ activationKey }}"
    rhc_organization: organizationID
```

- To register by using a username and password, use the following playbook:

```
---
- name: Registering system with username and password
  hosts: managed-node-01.example.com
  vars_files:
    - vault.yml
  vars:
    rhc_auth:
      login:
        username: "{{ username }}"
        password: "{{ password }}"
  roles:
    - role: rhel-system-roles.rhc
```

3. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check --ask-vault-pass ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

4. Run the playbook:

```
$ ansible-playbook --ask-vault-pass ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.rhc/README.md** file

- **/usr/share/doc/rhel-system-roles/rhc/** directory
- Ansible Vault

23.3. REGISTERING A SYSTEM WITH SATELLITE BY USING THE RHC RHEL SYSTEM ROLE

When organizations use Satellite to manage systems, it is necessary to register the system through Satellite. You can remotely register your system with Satellite by using the **rhc** RHEL system role.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Store your sensitive variables in an encrypted file:
   a. Create the vault:

   ```
   $ ansible-vault create vault.yml
   New Vault password: <password>
   Confirm New Vault password: <vault_password>
   ```

   b. After the **ansible-vault create** command opens an editor, enter the sensitive data in the ***<key>: <value>*** format:

   ```
   activationKey: <activation_key>
   ```

   c. Save the changes, and close the editor. Ansible encrypts the data in the vault.
2. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Register to the custom registration server and CDN
  hosts: managed-node-01.example.com
  vars_files:
    - vault.yml
  roles:
    - role: rhel-system-roles.rhc
  vars:
    rhc_auth:
      login:
        activation_keys:
          keys:
            - "{{ activationKey }}"
        rhc_organization: organizationID
    rhc_server:
      hostname: example.com
```

```
    port: 443
    prefix: /rhsm
  rhc_baseurl: http://example.com/pulp/content
```

3. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check --ask-vault-pass ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

4. Run the playbook:

```
$ ansible-playbook --ask-vault-pass ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.rhc/README.md** file
- **/usr/share/doc/rhel-system-roles/rhc/** directory
- Ansible Vault

23.4. DISABLING THE CONNECTION TO INSIGHTS AFTER THE REGISTRATION BY USING THE RHC RHEL SYSTEM ROLE

When you register a system by using the **rhc** RHEL system role, the role by default, enables the connection to Red Hat Insights. You can disable it by using the **rhc** RHEL system role, if not required.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- You have registered the system.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Disable Insights connection
  hosts: managed-node-01.example.com
  roles:
    - role: rhel-system-roles.rhc
  vars:
    rhc_insights:
      state: absent
```

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.rhc/README.md** file
- **/usr/share/doc/rhel-system-roles/rhc/** directory

23.5. ENABLING REPOSITORIES BY USING THE RHC RHEL SYSTEM ROLE

You can remotely enable or disable repositories on managed nodes by using the **rhc** RHEL system role.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- You have details of the repositories which you want to enable or disable on the managed nodes.
- You have registered the system.

Procedure

1. Create a playbook file, for example **~/playbook.yml**, with the following content:
   - To enable a repository:

```
---
- name: Enable repository
  hosts: managed-node-01.example.com
  roles:
    - role: rhel-system-roles.rhc
  vars:
    rhc_repositories:
      - {name: "RepositoryName", state: enabled}
```

   - To disable a repository:

```
---
- name: Disable repository
  hosts: managed-node-01.example.com
  vars:
    rhc_repositories:
```

```
    - {name: "RepositoryName", state: disabled}
roles:
  - role: rhel-system-roles.rhc
```

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.rhc/README.md** file
- **/usr/share/doc/rhel-system-roles/rhc/** directory

23.6. SETTING RELEASE VERSIONS BY USING THE RHC RHEL SYSTEM ROLE

You can limit the system to use only repositories for a particular minor RHEL version instead of the latest one. This way, you can lock your system to a specific minor RHEL version.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- You know the minor RHEL version to which you want to lock the system. Note that you can only lock the system to the RHEL minor version that the host currently runs or a later minor version.
- You have registered the system.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Set Release
  hosts: managed-node-01.example.com
  roles:
    - role: rhel-system-roles.rhc
  vars:
    rhc_release: "8.6"
```

2. Validate the playbook syntax:

```
-
```

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.rhc/README.md** file
- **/usr/share/doc/rhel-system-roles/rhc/** directory

23.7. USING A PROXY SERVER WHEN REGISTERING THE HOST BY USING THE RHC RHEL SYSTEM ROLE

If your security restrictions allow access to the Internet only through a proxy server, you can specify the proxy's settings in the playbook when you register the system using the **rhc** RHEL system role.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Store your sensitive variables in an encrypted file:
   a. Create the vault:

```
$ ansible-vault create vault.yml
New Vault password: <password>
Confirm New Vault password: <vault_password>
```

   b. After the **ansible-vault create** command opens an editor, enter the sensitive data in the ***<key>: <value>*** format:

```
username: <username>
password: <password>
proxy_username: <proxyusernme>
proxy_password: <proxypassword>
```

   c. Save the changes, and close the editor. Ansible encrypts the data in the vault.

2. Create a playbook file, for example ~/**playbook.yml**, with the following content:
   - To register to the Red Hat Customer Portal by using a proxy:

```
---
- name: Register using proxy
  hosts: managed-node-01.example.com
  vars_files:
    - vault.yml
  roles:
    - role: rhel-system-roles.rhc
  vars:
    rhc_auth:
      login:
        username: "{{ username }}"
        password: "{{ password }}"
    rhc_proxy:
      hostname: proxy.example.com
      port: 3128
      username: "{{ proxy_username }}"
      password: "{{ proxy_password }}"
```

- To remove the proxy server from the configuration of the Red Hat Subscription Manager service:

```
---
- name: To stop using proxy server for registration
  hosts: managed-node-01.example.com
  vars_files:
    - vault.yml
  vars:
    rhc_auth:
      login:
        username: "{{ username }}"
        password: "{{ password }}"
    rhc_proxy: {"state":"absent"}
  roles:
    - role: rhel-system-roles.rhc
```

3. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check --ask-vault-pass ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

4. Run the playbook:

```
$ ansible-playbook --ask-vault-pass ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.rhc/README.md** file
- **/usr/share/doc/rhel-system-roles/rhc/** directory
- Ansible Vault

23.8. DISABLING AUTO UPDATES OF INSIGHTS RULES BY USING THE RHC RHEL SYSTEM ROLE

You can disable the automatic collection rule updates for Red Hat Insights by using the **rhc** RHEL system role. By default, when you connect your system to Red Hat Insights, this option is enabled. You can disable it by using the **rhc** RHEL system role.

NOTE

If you disable this feature, you risk using outdated rule definition files and not getting the most recent validation updates.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- You have registered the system.

Procedure

1. Store your sensitive variables in an encrypted file:
   a. Create the vault:

```
$ ansible-vault create vault.yml
New Vault password: <password>
Confirm New Vault password: <vault_password>
```

   b. After the **ansible-vault create** command opens an editor, enter the sensitive data in the ***<key>: <value>*** format:

```
username: <username>
password: <password>
```

   c. Save the changes, and close the editor. Ansible encrypts the data in the vault.
2. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Disable Red Hat Insights autoupdates
  hosts: managed-node-01.example.com
  vars_files:
    - vault.yml
  roles:
    - role: rhel-system-roles.rhc
  vars:
    rhc_auth:
      login:
        username: "{{ username }}"
        password: "{{ password }}"
```

```
    rhc_insights:
      autoupdate: false
      state: present
```

3. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check --ask-vault-pass ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

4. Run the playbook:

```
$ ansible-playbook --ask-vault-pass ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.rhc/README.md** file
- **/usr/share/doc/rhel-system-roles/rhc/** directory
- Ansible Vault

23.9. DISABLING INSIGHTS REMEDIATIONS BY USING THE RHC RHEL SYSTEM ROLE

You can configure systems to automatically update the dynamic configuration by using the **rhc** RHEL system role. When you connect your system to Red hat Insights, it is enabled by default. You can disable it, if not required.

NOTE

Enabling remediation with the **rhc** RHEL system role ensures your system is ready to be remediated when connected directly to Red Hat. For systems connected to a Satellite, or Capsule, enabling remediation must be achieved differently. For more information about Red Hat Insights remediations, see Red Hat Insights Remediations Guide .

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- You have Insights remediations enabled.
- You have registered the system.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Disable remediation
  hosts: managed-node-01.example.com
  roles:
    - role: rhel-system-roles.rhc
  vars:
    rhc_insights:
      remediation: absent
      state: present
```

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.rhc/README.md** file
- **/usr/share/doc/rhel-system-roles/rhc/** directory

23.10. CONFIGURING INSIGHTS TAGS BY USING THE RHC RHEL SYSTEM ROLE

You can use tags for system filtering and grouping. You can also customize tags based on the requirements.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Store your sensitive variables in an encrypted file:
   a. Create the vault:

```
$ ansible-vault create vault.yml
New Vault password: <password>
Confirm New Vault password: <vault_password>
```

   b. After the **ansible-vault create** command opens an editor, enter the sensitive data in the ***<key>*: *<value>*** format:

```
username: <username>
password: <password>
```

c. Save the changes, and close the editor. Ansible encrypts the data in the vault.

2. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Creating tags
  hosts: managed-node-01.example.com
  vars_files:
    - vault.yml
  roles:
    - role: rhel-system-roles.rhc
  vars:
    rhc_auth:
      login:
        username: "{{ username }}"
        password: "{{ password }}"
    rhc_insights:
      tags:
        group: group-name-value
        location: location-name-value
        description:
          - RHEL8
          - SAP
        sample_key:value
      state: present
```

3. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check --ask-vault-pass ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

4. Run the playbook:

```
$ ansible-playbook --ask-vault-pass ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.rhc/README.md** file
- **/usr/share/doc/rhel-system-roles/rhc/** directory
- System Filtering and groups Red Hat Insights .
- Ansible Vault

23.11. UNREGISTERING A SYSTEM BY USING THE RHC RHEL SYSTEM ROLE

You can unregister the system from Red Hat if you no longer need the subscription service.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- The system is already registered.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Unregister the system
  hosts: managed-node-01.example.com
  roles:
    - role: rhel-system-roles.rhc
  vars:
    rhc_state: absent
```

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

   Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.rhc/README.md** file
- **/usr/share/doc/rhel-system-roles/rhc/** directory

CHAPTER 24. CONFIGURING SELINUX BY USING THE RHEL SYSTEM ROLE

You can configure and manage SELinux permissions on other systems by using the **selinux** RHEL system role.

24.1. INTRODUCTION TO THE SELINUX RHEL SYSTEM ROLE

RHEL system roles is a collection of Ansible roles and modules that provide a consistent configuration interface to remotely manage multiple RHEL systems. You can perform the following actions by using the **selinux** RHEL system role:

- Cleaning local policy modifications related to SELinux booleans, file contexts, ports, and logins.
- Setting SELinux policy booleans, file contexts, ports, and logins.
- Restoring file contexts on specified files or directories.
- Managing SELinux modules.

The **/usr/share/doc/rhel-system-roles/selinux/example-selinux-playbook.yml** example playbook installed by the **rhel-system-roles** package demonstrates how to set the targeted policy in enforcing mode. The playbook also applies several local policy modifications and restores file contexts in the **/tmp/test_dir/** directory.

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.selinux/README.md** file
- **/usr/share/doc/rhel-system-roles/selinux/** directory

24.2. USING THE SELINUX RHEL SYSTEM ROLE TO APPLY SELINUX SETTINGS ON MULTIPLE SYSTEMS

With the **selinux** RHEL system role, you can prepare and apply an Ansible playbook with your verified SELinux settings.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Prepare your playbook. You can either start from scratch or modify the example playbook installed as a part of the **rhel-system-roles** package:

```
# cp /usr/share/doc/rhel-system-roles/selinux/example-selinux-playbook.yml <my-selinux-playbook.yml>
# vi <my-selinux-playbook.yml>
```

2. Change the content of the playbook to fit your scenario. For example, the following part ensures that the system installs and enables the **selinux-local-1.pp** SELinux module:

```
selinux_modules:
- { path: "selinux-local-1.pp", priority: "400" }
```

3. Save the changes, and exit the text editor.

4. Validate the playbook syntax:

```
# ansible-playbook <my-selinux-playbook.yml> --syntax-check
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

5. Run your playbook:

```
# ansible-playbook <my-selinux-playbook.yml>
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.selinux/README.md** file
- **/usr/share/doc/rhel-system-roles/selinux/** directory
- SELinux hardening with Ansible Knowledgebase article

24.3. MANAGING PORTS BY USING THE SELINUX RHEL SYSTEM ROLE

You can automate managing port access in SELinux consistently across multiple systems by using the **selinux** RHEL system role. This might be useful, for example, when configuring an Apache HTTP server to listen on a different port. You can do this by creating a playbook with the **selinux** RHEL system role that assigns the **http_port_t** SELinux type to a specific port number. After you run the playbook on the managed nodes, specific services defined in the SELinux policy can access this port.

You can automate managing port access in SELinux either by using the **seport** module, which is quicker than using the entire role, or by using the **selinux** RHEL system role, which is more useful when you also make other changes in SELinux configuration. The methods are equivalent, in fact the **selinux** RHEL system role uses the **seport** module when configuring ports. Each of the methods has the same effect as entering the command **semanage port -a -t http_port_t -p tcp *<port_number>*** on the managed node.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- Optional: To verify port status by using the **semanage** command, the **policycoreutils-python-utils** package must be installed.

Procedure

- To configure just the port number without making other changes, use the **seport** module:

```
- name: Allow Apache to listen on tcp port <port_number>
  community.general.seport:
    ports: <port_number>
    proto: tcp
    setype: http_port_t
    state: present
```

Replace ***<port_number>*** with the port number to which you want to assign the **http_port_t** type.

- For more complex configuration of the managed nodes that involves other customizations of SELinux, use the **selinux** RHEL system role. Create a playbook file, for example, ~/**playbook.yml**, and add the following content:

```
---
- name: Modify SELinux port mapping example
  hosts: all
  vars:
    # Map tcp port <port_number> to the 'http_port_t' SELinux port type
    selinux_ports:
      - ports: <port_number>
        proto: tcp
        setype: http_port_t
        state: present

  tasks:
    - name: Include selinux role
      ansible.builtin.include_role:
        name: rhel-system-roles.selinux
```

Replace ***<port_number>*** with the port number to which you want to assign the **http_port_t** type.

Verification

- Verify that the port is assigned to the **http_port_t** type:

```
# semanage port --list | grep http_port_t
http_port_t                    tcp    <port_number>, 80, 81, 443, 488, 8008, 8009, 8443, 9000
```

Additional resources

- /**usr**/**share**/**ansible**/**roles**/**rhel-system-roles.selinux**/**README.md** file
- /**usr**/**share**/**doc**/**rhel-system-roles**/**selinux**/ directory

CHAPTER 25. SECURING FILE ACCESS BY USING THE RHEL SYSTEM ROLE

With the **fapolicyd** system role, you can prevent execution of unknown code on RHEL by using the Red Hat Ansible Automation Platform.

25.1. CONFIGURING PROTECTION AGAINST UNKNOWN CODE EXECUTION WITH THE FAPOLICYD RHEL SYSTEM ROLE

You can use the **fapolicyd** system role to prevent execution of unknown code by running an Ansible playbook.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Preventing execution of unknown code
  hosts: all
  vars:
    fapolicyd_setup_integrity: sha256
    fapolicyd_setup_trust: rpmdb,file
    fapolicyd_add_trusted_file:
      - </usr/bin/my-ls>
      - </opt/third-party/app1>
      - </opt/third-party/app2>
  roles:
    - rhel-system-roles.fapolicyd
```

You can further customize the protection by using the following variables of the **linux-system-roles.fapolicyd** RHEL system role:

fapolicyd_setup_integrity

You can set one of the following types of integrity: **none**, **sha256**, and **size**.

fapolicyd_setup_trust

You can set trust file types **file**,**rpmd**, and **deb**.

fapolicyd_add_trusted_file

You can list executable files that you trust and that **fapolicyd** does not prevent from executing.

2. Validate the playbook syntax:

```
# ansible-playbook ~/playbook.yml --syntax-check
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
# ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.fapolicyd/README.md** file

CHAPTER 26. CONFIGURING SECURE COMMUNICATION BY USING RHEL SYSTEM ROLES

As an administrator, you can use the **sshd** system role to configure SSH servers and the **ssh** system role to configure SSH clients consistently on any number of RHEL systems at the same time by using Red Hat Ansible Automation Platform.

26.1. VARIABLES OF THE SSHD RHEL SYSTEM ROLE

In an **sshd** system role playbook, you can define the parameters for the SSH configuration file according to your preferences and limitations.

If you do not configure these variables, the system role produces an **sshd_config** file that matches the RHEL defaults.

In all cases, Booleans correctly render as **yes** and **no** in **sshd** configuration. You can define multi-line configuration items using lists. For example:

```
sshd_ListenAddress:
  - 0.0.0.0
  - '::'
```

renders as:

```
ListenAddress 0.0.0.0
ListenAddress ::
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.sshd/README.md** file
- **/usr/share/doc/rhel-system-roles/sshd/** directory

26.2. CONFIGURING OPENSSH SERVERS BY USING THE SSHD RHEL SYSTEM ROLE

You can use the **sshd** system role to configure multiple SSH servers by running an Ansible playbook.

NOTE

You can use the **sshd** system role with other system roles that change SSH and SSHD configuration, for example the Identity Management RHEL system roles. To prevent the configuration from being overwritten, make sure that the **sshd** role uses namespaces (RHEL 8 and earlier versions) or a drop-in directory (RHEL 9).

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: SSH server configuration
  hosts: managed-node-01.example.com
  tasks:
    - name: Configure sshd to prevent root and password login except from particular subnet
      ansible.builtin.include_role:
        name: rhel-system-roles.sshd
      vars:
        sshd:
          PermitRootLogin: no
          PasswordAuthentication: no
          Match:
            - Condition: "Address 192.0.2.0/24"
              PermitRootLogin: yes
              PasswordAuthentication: yes
```

   The playbook configures the managed node as an SSH server configured so that:

   - password and **root** user login is disabled
   - password and **root** user login is enabled only from the subnet **192.0.2.0/24**

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

   Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

1. Log in to the SSH server:

```
$ ssh <username>@<ssh_server>
```

2. Verify the contents of the **sshd_config** file on the SSH server:

```
$ cat /etc/ssh/sshd_config
...
PasswordAuthentication no
PermitRootLogin no
...
Match Address 192.0.2.0/24
  PasswordAuthentication yes
  PermitRootLogin yes
...
```

3. Check that you can connect to the server as root from the **192.0.2.0/24** subnet:

   a. Determine your IP address:

   ```
   $ hostname -I
   192.0.2.1
   ```

   If the IP address is within the **192.0.2.1** - **192.0.2.254** range, you can connect to the server.

   b. Connect to the server as **root**:

   ```
   $ ssh root@<ssh_server>
   ```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.sshd/README.md** file
- **/usr/share/doc/rhel-system-roles/sshd/** directory

26.3. USING THE SSHD RHEL SYSTEM ROLE FOR NON-EXCLUSIVE CONFIGURATION

Normally, applying the **sshd** system role overwrites the entire configuration. This may be problematic if you have previously adjusted the configuration, for example, with a different system role or playbook. To apply the **sshd** system role for only selected configuration options while keeping other options in place, you can use the non-exclusive configuration.

You can apply a non-exclusive configuration:

- In RHEL 8 and earlier by using a configuration snippet.
- In RHEL 9 and later by using files in a drop-in directory. The default configuration file is already placed in the drop-in directory as **/etc/ssh/sshd_config.d/00-ansible_system_role.conf**.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

   - For managed nodes that run RHEL 8 or earlier:

   ```
   ---
   - name: Non-exclusive sshd configuration
     hosts: managed-node-01.example.com
     tasks:
       - name: <Configure SSHD to accept some useful environment variables>
         ansible.builtin.include_role:
   ```

```
      name: rhel-system-roles.sshd
    vars:
      sshd_config_namespace: <my-application>
      sshd:
        # Environment variables to accept
        AcceptEnv:
          LANG
          LS_COLORS
          EDITOR
```

- For managed nodes that run RHEL 9 or later:

```
- name: Non-exclusive sshd configuration
  hosts: managed-node-01.example.com
  tasks:
    - name: <Configure sshd to accept some useful environment variables>
      ansible.builtin.include_role:
        name: rhel-system-roles.sshd
      vars:
        sshd_config_file: /etc/ssh/sshd_config.d/<42-my-application>.conf
        sshd:
          # Environment variables to accept
          AcceptEnv:
            LANG
            LS_COLORS
            EDITOR
```

In the **sshd_config_file** variable, define the **.conf** file into which the **sshd** system role writes the configuration options. Use a two-digit prefix, for example ***42-*** to specify the order in which the configuration files will be applied.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

- Verify the configuration on the SSH server:
  - For managed nodes that run RHEL 8 or earlier:

```
# cat /etc/ssh/sshd_config.d/42-my-application.conf
# Ansible managed
#
AcceptEnv LANG LS_COLORS EDITOR
```

  - For managed nodes that run RHEL 9 or later:

```
# cat /etc/ssh/sshd_config
...
# BEGIN sshd system role managed block: namespace <my-application>
Match all
  AcceptEnv LANG LS_COLORS EDITOR
# END sshd system role managed block: namespace <my-application>
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.sshd/README.md** file
- **/usr/share/doc/rhel-system-roles/sshd/** directory

26.4. OVERRIDING THE SYSTEM-WIDE CRYPTOGRAPHIC POLICY ON AN SSH SERVER BY USING THE SSHD RHEL SYSTEM ROLE

You can override the system-wide cryptographic policy on an SSH server by using the **sshd** RHEL system role.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
- name: Overriding the system-wide cryptographic policy
  hosts: managed-node-01.example.com
  roles:
    - rhel_system_roles.sshd
  vars:
    sshd_sysconfig: true
    sshd_sysconfig_override_crypto_policy: true
    sshd_KexAlgorithms: ecdh-sha2-nistp521
    sshd_Ciphers: aes256-ctr
    sshd_MACs: hmac-sha2-512-etm@openssh.com
    sshd_HostKeyAlgorithms: rsa-sha2-512,rsa-sha2-256
```

- **sshd_KexAlgorithms**:: You can choose key exchange algorithms, for example, **ecdh-sha2-nistp256**, **ecdh-sha2-nistp384**, **ecdh-sha2-nistp521**,**diffie-hellman-group14-sha1**, or **diffie-hellman-group-exchange-sha256**.
- **sshd_Ciphers**:: You can choose ciphers, for example, **aes128-ctr**, **aes192-ctr**, or **aes256-ctr**.
- **sshd_MACs**:: You can choose MACs, for example, **hmac-sha2-256**, **hmac-sha2-512**, or **hmac-sha1**.

- **sshd_HostKeyAlgorithms**:: You can choose a public key algorithm, for example, **ecdsa-sha2-nistp256**, **ecdsa-sha2-nistp384**, **ecdsa-sha2-nistp521**, **ssh-rsa**, or **ssh-dss**.

On RHEL 9 managed nodes, the system role writes the configuration into the **/etc/ssh/sshd_config.d/00-ansible_system_role.conf** file, where cryptographic options are applied automatically. You can change the file by using the **sshd_config_file** variable. However, to ensure the configuration is effective, use a file name that lexicographicaly preceeds the **/etc/ssh/sshd_config.d/50-redhat.conf** file, which includes the configured crypto policies.

On RHEL 8 managed nodes, you must enable override by setting the **sshd_sysconfig_override_crypto_policy** and **sshd_sysconfig** variables to **true**.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

- You can verify the success of the procedure by using the verbose SSH connection and check the defined variables in the following output:

```
$ ssh -vvv <ssh_server>
...
debug2: peer server KEXINIT proposal
debug2: KEX algorithms: ecdh-sha2-nistp521
debug2: host key algorithms: rsa-sha2-512,rsa-sha2-256
debug2: ciphers ctos: aes256-ctr
debug2: ciphers stoc: aes256-ctr
debug2: MACs ctos: hmac-sha2-512-etm@openssh.com
debug2: MACs stoc: hmac-sha2-512-etm@openssh.com
...
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.sshd/README.md** file
- **/usr/share/doc/rhel-system-roles/sshd/** directory

26.5. VARIABLES OF THE SSH RHEL SYSTEM ROLE

In an **ssh** system role playbook, you can define the parameters for the client SSH configuration file according to your preferences and limitations.

If you do not configure these variables, the system role produces a global **ssh_config** file that matches the RHEL defaults.

In all cases, booleans correctly render as **yes** or **no** in **ssh** configuration. You can define multi-line configuration items using lists. For example:

```
LocalForward:
  - 22 localhost:2222
  - 403 localhost:4003
```

renders as:

```
LocalForward 22 localhost:2222
LocalForward 403 localhost:4003
```

NOTE

The configuration options are case sensitive.

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.ssh/README.md** file
- **/usr/share/doc/rhel-system-roles/ssh/** directory

26.6. CONFIGURING OPENSSH CLIENTS BY USING THE SSH RHEL SYSTEM ROLE

You can use the **ssh** system role to configure multiple SSH clients by running an Ansible playbook.

NOTE

You can use the **ssh** system role with other system roles that change SSH and SSHD configuration, for example the Identity Management RHEL system roles. To prevent the configuration from being overwritten, make sure that the **ssh** role uses a drop-in directory (default in RHEL 8 and later).

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: SSH client configuration
  hosts: managed-node-01.example.com
  tasks:
    - name: "Configure ssh clients"
      ansible.builtin.include_role:
        name: rhel-system-roles.ssh
```

```
    vars:
      ssh_user: root
      ssh:
        Compression: true
        GSSAPIAuthentication: no
        ControlMaster: auto
        ControlPath: ~/.ssh/.cm%C
        Host:
          - Condition: example
            Hostname: server.example.com
            User: user1
      ssh_ForwardX11: no
```

This playbook configures the **root** user's SSH client preferences on the managed nodes with the following configurations:

- Compression is enabled.
- ControlMaster multiplexing is set to **auto**.
- The **example** alias for connecting to the **server.example.com** host is **user1**.
- The **example** host alias is created, which represents a connection to the **server.example.com** host the with the **user1** user name.
- X11 forwarding is disabled.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

- Verify that the managed node has the correct configuration by displaying the SSH configuration file:

```
# cat ~/root/.ssh/config
# Ansible managed
Compression yes
ControlMaster auto
ControlPath ~/.ssh/.cm%C
ForwardX11 no
GSSAPIAuthentication no
Host example
  Hostname example.com
  User user1
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.ssh/README.md** file
- **/usr/share/doc/rhel-system-roles/ssh/** directory

CHAPTER 27. MANAGING LOCAL STORAGE BY USING THE RHEL SYSTEM ROLE

To manage LVM and local file systems (FS) by using Ansible, you can use the **storage** role, which is one of the RHEL system roles available in RHEL 8.

Using the **storage** role enables you to automate administration of file systems on disks and logical volumes on multiple machines and across all versions of RHEL starting with RHEL 7.7.

27.1. INTRODUCTION TO THE STORAGE RHEL SYSTEM ROLE

The **storage** role can manage:

- File systems on disks which have not been partitioned
- Complete LVM volume groups including their logical volumes and file systems
- MD RAID volumes and their file systems

With the **storage** role, you can perform the following tasks:

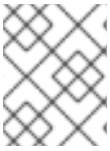
- Create a file system
- Remove a file system
- Mount a file system
- Unmount a file system
- Create LVM volume groups
- Remove LVM volume groups
- Create logical volumes
- Remove logical volumes
- Create RAID volumes
- Remove RAID volumes
- Create LVM volume groups with RAID
- Remove LVM volume groups with RAID
- Create encrypted LVM volume groups
- Create LVM logical volumes with RAID

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.storage/README.md** file
- **/usr/share/doc/rhel-system-roles/storage/** directory

27.2. CREATING AN XFS FILE SYSTEM ON A BLOCK DEVICE BY USING THE STORAGE RHEL SYSTEM ROLE

The example Ansible playbook applies the **storage** role to create an XFS file system on a block device using the default parameters.



NOTE

The **storage** role can create a file system only on an unpartitioned, whole disk or a logical volume (LV). It cannot create the file system on a partition.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.storage
  vars:
    storage_volumes:
      - name: barefs
        type: disk
        disks:
          - sdb
        fs_type: xfs
```

   - The volume name (***barefs*** in the example) is currently arbitrary. The **storage** role identifies the volume by the disk device listed under the **disks:** attribute.
   - You can omit the **fs_type: xfs** line because XFS is the default file system in RHEL 8.
   - To create the file system on an LV, provide the LVM setup under the **disks:** attribute, including the enclosing volume group. For details, see Managing logical volumes by using the storage RHEL system role.
     Do not provide the path to the LV device.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

   Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.storage/README.md** file
- **/usr/share/doc/rhel-system-roles/storage/** directory

27.3. PERSISTENTLY MOUNTING A FILE SYSTEM BY USING THE STORAGE RHEL SYSTEM ROLE

The example Ansible applies the **storage** role to immediately and persistently mount an XFS file system.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.storage
  vars:
    storage_volumes:
      - name: barefs
        type: disk
        disks:
          - sdb
        fs_type: xfs
        mount_point: /mnt/data
        mount_user: somebody
        mount_group: somegroup
        mount_mode: 0755
```

   - This playbook adds the file system to the **/etc/fstab** file, and mounts the file system immediately.
   - If the file system on the **/dev/sdb** device or the mount point directory do not exist, the playbook creates them.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

   Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.storage/README.md** file
- **/usr/share/doc/rhel-system-roles/storage/** directory

27.4. MANAGING LOGICAL VOLUMES BY USING THE STORAGE RHEL SYSTEM ROLE

The example Ansible playbook applies the **storage** role to create an LVM logical volume in a volume group.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example **~/playbook.yml**, with the following content:

```
- hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.storage
  vars:
    storage_pools:
      - name: myvg
        disks:
          - sda
          - sdb
          - sdc
        volumes:
          - name: mylv
            size: 2G
            fs_type: ext4
            mount_point: /mnt/dat
```

   - The **myvg** volume group consists of the following disks: **/dev/sda**, **/dev/sdb**, and **/dev/sdc**.
   - If the **myvg** volume group already exists, the playbook adds the logical volume to the volume group.
   - If the **myvg** volume group does not exist, the playbook creates it.
   - The playbook creates an Ext4 file system on the **mylv** logical volume, and persistently mounts the file system at **/mnt**.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.storage/README.md** file
- **/usr/share/doc/rhel-system-roles/storage/** directory

27.5. ENABLING ONLINE BLOCK DISCARD BY USING THE STORAGE RHEL SYSTEM ROLE

The example Ansible playbook applies the **storage** role to mount an XFS file system with online block discard enabled.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example **~/playbook.yml**, with the following content:

```
---
- hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.storage
  vars:
    storage_volumes:
      - name: barefs
        type: disk
        disks:
          - sdb
        fs_type: xfs
        mount_point: /mnt/data
        mount_options: discard
```

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.storage/README.md** file
- **/usr/share/doc/rhel-system-roles/storage/** directory

27.6. CREATING AND MOUNTING AN EXT4 FILE SYSTEM BY USING THE STORAGE RHEL SYSTEM ROLE

The example Ansible playbook applies the **storage** role to create and mount an Ext4 file system.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example **~/playbook.yml**, with the following content:

```
---
- hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.storage
  vars:
    storage_volumes:
      - name: barefs
        type: disk
        disks:
          - sdb
        fs_type: ext4
        fs_label: label-name
        mount_point: /mnt/data
```

   - The playbook creates the file system on the **/dev/sdb** disk.
   - The playbook persistently mounts the file system at the **/mnt/data** directory.
   - The label of the file system is **label-name**.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.storage/README.md** file
- **/usr/share/doc/rhel-system-roles/storage/** directory

27.7. CREATING AND MOUNTING AN EXT3 FILE SYSTEM BY USING THE STORAGE RHEL SYSTEM ROLE

The example Ansible playbook applies the **storage** role to create and mount an Ext3 file system.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example **~/playbook.yml**, with the following content:

```
---
- hosts: all
  roles:
    - rhel-system-roles.storage
  vars:
    storage_volumes:
      - name: barefs
        type: disk
        disks:
          - sdb
        fs_type: ext3
        fs_label: label-name
        mount_point: /mnt/data
        mount_user: somebody
        mount_group: somegroup
        mount_mode: 0755
```

- The playbook creates the file system on the **/dev/sdb** disk.
- The playbook persistently mounts the file system at the **/mnt/data** directory.
- The label of the file system is **label-name**.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.storage/README.md** file
- **/usr/share/doc/rhel-system-roles/storage/** directory

27.8. RESIZING AN EXISTING FILE SYSTEM ON LVM BY USING THE STORAGE RHEL SYSTEM ROLE

The example Ansible playbook applies the **storage** RHEL system role to resize an LVM logical volume with a file system.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example **~/playbook.yml**, with the following content:

```
---
- name: Create LVM pool over three disks
  hosts: managed-node-01.example.com
  tasks:
    - name: Resize LVM logical volume with file system
      ansible.builtin.include_role:
        name: rhel-system-roles.storage
      vars:
        storage_pools:
          - name: myvg
            disks:
              - /dev/sda
              - /dev/sdb
              - /dev/sdc
            volumes:
              - name: mylv1
                size: 10 GiB
                fs_type: ext4
                mount_point: /opt/mount1
              - name: mylv2
```

```
        size: 50 GiB
        fs_type: ext4
        mount_point: /opt/mount2
```

This playbook resizes the following existing file systems:

- The Ext4 file system on the **mylv1** volume, which is mounted at **/opt/mount1**, resizes to 10 GiB.
- The Ext4 file system on the **mylv2** volume, which is mounted at **/opt/mount2**, resizes to 50 GiB.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.storage/README.md** file
- **/usr/share/doc/rhel-system-roles/storage/** directory

27.9. CREATING A SWAP VOLUME BY USING THE STORAGE RHEL SYSTEM ROLE

This section provides an example Ansible playbook. This playbook applies the **storage** role to create a swap volume, if it does not exist, or to modify the swap volume, if it already exist, on a block device by using the default parameters.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example **~/playbook.yml**, with the following content:

```
---
- name: Create a disk device with swap
  hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.storage
  vars:
```

```
storage_volumes:
  - name: swap_fs
    type: disk
    disks:
      - /dev/sdb
    size: 15 GiB
    fs_type: swap
```

The volume name (***swap_fs*** in the example) is currently arbitrary. The **storage** role identifies the volume by the disk device listed under the **disks:** attribute.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.storage/README.md** file
- **/usr/share/doc/rhel-system-roles/storage/** directory

27.10. CONFIGURING A RAID VOLUME BY USING THE STORAGE RHEL SYSTEM ROLE

With the **storage** system role, you can configure a RAID volume on RHEL by using Red Hat Ansible Automation Platform and Ansible-Core. Create an Ansible playbook with the parameters to configure a RAID volume to suit your requirements.

WARNING

Device names might change in certain circumstances, for example, when you add a new disk to a system. Therefore, to prevent data loss, do not use specific disk names in the playbook.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Configure the storage
  hosts: managed-node-01.example.com
  tasks:
    - name: Create a RAID on sdd, sde, sdf, and sdg
      ansible.builtin.include_role:
        name: rhel-system-roles.storage
      vars:
        storage_safe_mode: false
        storage_volumes:
          - name: data
            type: raid
            disks: [sdd, sde, sdf, sdg]
            raid_level: raid0
            raid_chunk_size: 32 KiB
            mount_point: /mnt/data
            state: present
```

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

   Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.storage/README.md** file
- **/usr/share/doc/rhel-system-roles/storage/** directory
- Managing RAID

27.11. CONFIGURING AN LVM POOL WITH RAID BY USING THE STORAGE RHEL SYSTEM ROLE

With the **storage** system role, you can configure an LVM pool with RAID on RHEL by using Red Hat Ansible Automation Platform. You can set up an Ansible playbook with the available parameters to configure an LVM pool with RAID.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.

- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Configure LVM pool with RAID
  hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.storage
  vars:
    storage_safe_mode: false
    storage_pools:
      - name: my_pool
        type: lvm
        disks: [sdh, sdi]
        raid_level: raid1
        volumes:
          - name: my_volume
            size: "1 GiB"
            mount_point: "/mnt/app/shared"
            fs_type: xfs
            state: present
```

   To create an LVM pool with RAID, you must specify the RAID type by using the **raid_level** parameter.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

   Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.storage/README.md** file
- **/usr/share/doc/rhel-system-roles/storage/** directory
- Managing RAID

27.12. CONFIGURING A STRIPE SIZE FOR RAID LVM VOLUMES BY USING THE STORAGE RHEL SYSTEM ROLE

With the **storage** system role, you can configure a stripe size for RAID LVM volumes on RHEL by using Red Hat Ansible Automation Platform. You can set up an Ansible playbook with the available parameters to configure an LVM pool with RAID.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Configure stripe size for RAID LVM volumes
  hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.storage
  vars:
    storage_safe_mode: false
    storage_pools:
      - name: my_pool
        type: lvm
        disks: [sdh, sdi]
        volumes:
          - name: my_volume
            size: "1 GiB"
            mount_point: "/mnt/app/shared"
            fs_type: xfs
            raid_level: raid1
            raid_stripe_size: "256 KiB"
            state: present
```

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

   Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

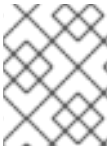
```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.storage/README.md** file
- **/usr/share/doc/rhel-system-roles/storage/** directory
- Managing RAID

27.13. COMPRESSING AND DEDUPLICATING A VDO VOLUME ON LVM BY USING THE STORAGE RHEL SYSTEM ROLE

The example Ansible playbook applies the **storage** RHEL system role to enable compression and deduplication of Logical Volumes (LVM) by using Virtual Data Optimizer (VDO).



NOTE

Because of the **storage** system role use of LVM VDO, only one volume per pool can use the compression and deduplication.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
- name: Create LVM VDO volume under volume group 'myvg'
  hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.storage
  vars:
    storage_pools:
      - name: myvg
        disks:
          - /dev/sdb
        volumes:
          - name: mylv1
            compression: true
            deduplication: true
            vdo_pool_size: 10 GiB
            size: 30 GiB
            mount_point: /mnt/app/shared
```

In this example, the **compression** and **deduplication** pools are set to true, which specifies that the VDO is used. The following describes the usage of these parameters:

- The **deduplication** is used to deduplicate the duplicated data stored on the storage volume.
- The compression is used to compress the data stored on the storage volume, which results in more storage capacity.
- The vdo_pool_size specifies the actual size the volume takes on the device. The virtual size of VDO volume is set by the **size** parameter.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.storage/README.md** file
- **/usr/share/doc/rhel-system-roles/storage/** directory

27.14. CREATING A LUKS2 ENCRYPTED VOLUME BY USING THE STORAGE RHEL SYSTEM ROLE

You can use the **storage** role to create and configure a volume encrypted with LUKS by running an Ansible playbook.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example **~/playbook.yml**, with the following content:

```
---
- name: Create and configure a volume encrypted with LUKS
  hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.storage
  vars:
    storage_volumes:
      - name: barefs
        type: disk
        disks:
          - sdb
        fs_type: xfs
        fs_label: label-name
        mount_point: /mnt/data
        encryption: true
        encryption_password: <password>
```

   You can also add other encryption parameters, such as **encryption_key**, **encryption_cipher**, **encryption_key_size**, and **encryption_luks**, to the playbook file.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

   Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

1. View the encryption status:

```
# cryptsetup status sdb

/dev/mapper/sdb is active and is in use.
type: LUKS2
cipher: aes-xts-plain64
keysize: 512 bits
key location: keyring
device: /dev/sdb
...
```

2. Verify the created LUKS encrypted volume:

```
# cryptsetup luksDump /dev/sdb

Version:        2
Epoch:          6
Metadata area:  16384 [bytes]
Keyslots area:  33521664 [bytes]
UUID:           a4c6be82-7347-4a91-a8ad-9479b72c9426
Label:          (no label)
Subsystem:      (no subsystem)
Flags:          allow-discards

Data segments:
  0: crypt
        offset: 33554432 [bytes]
        length: (whole device)
        cipher: aes-xts-plain64
        sector: 4096 [bytes]
...
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.storage/README.md** file
- **/usr/share/doc/rhel-system-roles/storage/** directory
- Encrypting block devices by using LUKS

27.15. EXPRESSING POOL VOLUME SIZES AS PERCENTAGE BY USING THE STORAGE RHEL SYSTEM ROLE

The example Ansible playbook applies the **storage** system role to enable you to express Logical Manager Volumes (LVM) volume sizes as a percentage of the pool's total size.

Prerequisites

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Express volume sizes as a percentage of the pool's total size
  hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.storage
  vars:
    storage_pools:
      - name: myvg
        disks:
          - /dev/sdb
        volumes:
          - name: data
            size: 60%
            mount_point: /opt/mount/data
          - name: web
            size: 30%
            mount_point: /opt/mount/web
          - name: cache
            size: 10%
            mount_point: /opt/cache/mount
```

   This example specifies the size of LVM volumes as a percentage of the pool size, for example: **60%**. Alternatively, you can also specify the size of LVM volumes as a percentage of the pool size in a human-readable size of the file system, for example, **10g** or **50 GiB**.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

   Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.storage/README.md** file
- **/usr/share/doc/rhel-system-roles/storage/** directory

CHAPTER 28. MANAGING SYSTEMD UNITS BY USING THE RHEL SYSTEM ROLE

With the **systemd** RHEL system role you can deploy unit files and manage **systemd** units on multiple systems by using the Red Hat Ansible Automation Platform.

You can use the **systemd_units** variable in **systemd** RHEL system role playbooks to gain insights into the status of **systemd** units on a target system. The variable displays a list of dictionaries. Each dictionary entry describes the state and configuration of one **systemd** unit present on the managed host. The **systemd_units** variable is updated as the final step of task execution and captures the state after the role has run all tasks.

28.1. DEPLOYING AND STARTING A SYSTEMD UNIT BY USING THE SYSTEMD RHEL SYSTEM ROLE

You can apply the **systemd** RHEL system role to perform tasks related to **systemd** unit management on the target hosts. You will set the **systemd** RHEL system role variables in a playbook to define which unit files **systemd** manages, starts, and enables.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Deploy and start systemd unit
  hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.systemd
  vars:
    systemd_unit_files:
      - <name1>.service
      - <name2>.service
      - <name3>.service
    systemd_started_units:
      - <name1>.service
      - <name2>.service
      - <name3>.service
    systemd_enabled_units:
      - <name1>.service
      - <name2>.service
      - <name3>.service
```

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.systemd/README.md** file
- **/usr/share/doc/rhel-system-roles/systemd/** directory

CHAPTER 29. CONFIGURING TIME SYNCHRONIZATION BY USING THE RHEL SYSTEM ROLE

With the **timesync** RHEL system role, you can manage time synchronization on multiple target machines on RHEL using Red Hat Ansible Automation Platform.

29.1. THE TIMESYNC RHEL SYSTEM ROLE

You can manage time synchronization on multiple target machines using the **timesync** RHEL system role.

The **timesync** role installs and configures an NTP or PTP implementation to operate as an NTP client or PTP replica in order to synchronize the system clock with NTP servers or grandmasters in PTP domains.

Note that using the **timesync** role also facilitates the Migrating to chrony, because you can use the same playbook on all versions of Red Hat Enterprise Linux starting with RHEL 6 regardless of whether the system uses **ntp** or **chrony** to implement the NTP protocol.

- **/usr/share/ansible/roles/rhel-system-roles.timesync/README.md** file
- **/usr/share/doc/rhel-system-roles/timesync/** directory

29.2. APPLYING THE TIMESYNC RHEL SYSTEM ROLE FOR A SINGLE POOL OF SERVERS

The following example shows how to apply the **timesync** role in a situation with just one pool of servers.

WARNING

The **timesync** role replaces the configuration of the given or detected provider service on the managed host. Previous settings are lost, even if they are not specified in the role variables. The only preserved setting is the choice of provider if the **timesync_ntp_provider** variable is not defined.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Manage time synchronization
```

```
hosts: managed-node-01.example.com
roles:
  - rhel-system-roles.timesync
vars:
  timesync_ntp_servers:
    - hostname: 2.rhel.pool.ntp.org
      pool: yes
      iburst: yes
```

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.timesync/README.md** file
- **/usr/share/doc/rhel-system-roles/timesync/** directory

29.3. APPLYING THE TIMESYNC RHEL SYSTEM ROLE ON CLIENT SERVERS

You can use the **timesync** role to enable Network Time Security (NTS) on NTP clients. Network Time Security (NTS) is an authentication mechanism specified for Network Time Protocol (NTP). It verifies that NTP packets exchanged between the server and client are not altered.

WARNING

The **timesync** role replaces the configuration of the given or detected provider service on the managed host. Previous settings are lost even if they are not specified in the role variables. The only preserved setting is the choice of provider if the **timesync_ntp_provider** variable is not defined.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.
- The **chrony** NTP provider version is 4.0 or later.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Enable Network Time Security on NTP clients
  hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.timesync
  vars:
    timesync_ntp_servers:
      - hostname: ptbtime1.ptb.de
        iburst: yes
        nts: yes
```

   ptbtime1.ptb.de is an example of a public server. You may want to use a different public server or your own server.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

   Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

1. Perform a test on the client machine:

```
# chronyc -N authdata

Name/IP address         Mode KeyID Type KLen Last Atmp  NAK Cook CLen
==========================================================================
ptbtime1.ptb.de         NTS     1   15  256  157    0    0    8  100
```

2. Check that the number of reported cookies is larger than zero.

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.timesync/README.md** file
- **/usr/share/doc/rhel-system-roles/timesync/** directory

CHAPTER 30. CONFIGURING A SYSTEM FOR SESSION RECORDING BY USING THE RHEL SYSTEM ROLE

With the **tlog** RHEL system role, you can configure a system for terminal session recording on RHEL by using Red Hat Ansible Automation Platform.

30.1. THE TLOG RHEL SYSTEM ROLE

You can configure a RHEL system for terminal session recording on RHEL using the **tlog** RHEL system role.

You can configure the recording to take place per user or user group by means of the **SSSD** service.

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.ha_cluster/README.md** file
- **/usr/share/doc/rhel-system-roles/ha_cluster/** directory
- Recording Sessions

30.2. COMPONENTS AND PARAMETERS OF THE TLOG RHEL SYSTEM ROLE

The Session Recording solution has the following components:

- The **tlog** utility
- System Security Services Daemon (SSSD)
- Optional: The web console interface

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.ha_cluster/README.md** file
- **/usr/share/doc/rhel-system-roles/ha_cluster/** directory
- Recording Sessions

30.3. DEPLOYING THE TLOG RHEL SYSTEM ROLE

Follow these steps to prepare and apply an Ansible playbook to configure a RHEL system to log session recording data to the systemd journal.

The playbook installs the **tlog** RHEL system role on the system you specified. The role includes **tlog-rec-session**, a terminal session I/O logging program, that acts as the login shell for a user. It also creates an SSSD configuration drop file that can be used by the users and groups that you define. SSSD parses and reads these users and groups, and replaces their user shell with **tlog-rec-session**. Additionally, if the **cockpit** package is installed on the system, the playbook also installs the **cockpit-session-recording** package, which is a **Cockpit** module that allows you to view and play recordings in the web console interface.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Deploy session recording
  hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.tlog
  vars:
    tlog_scope_sssd: some
    tlog_users_sssd:
      - recorded-user
```

tlog_scope_sssd

The **some** value specifies you want to record only certain users and groups, not **all** or **none**.

tlog_users_sssd

Specifies the user you want to record a session from. Note that this does not add the user for you. You must set the user by yourself.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

1. Navigate to the folder where the SSSD configuration drop file is created:

```
# cd /etc/sssd/conf.d/
```

2. Check the file content:

```
# cat /etc/sssd/conf.d/sssd-session-recording.conf
```

You can see that the file contains the parameters you set in the playbook.

3. Log in as a user whose session will be recorded.

4. Play back a recorded session .

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.tlog/README.md** file
- **/usr/share/doc/rhel-system-roles/tlog/** directory

30.4. DEPLOYING THE TLOG RHEL SYSTEM ROLE FOR EXCLUDING LISTS OF GROUPS OR USERS

You can use the **tlog** system role to support the SSSD session recording configuration options **exclude_users** and **exclude_groups**. Follow these steps to prepare and apply an Ansible playbook to configure a RHEL system to exclude users or groups from having their sessions recorded and logged in the systemd journal.

The playbook installs the **tlog** RHEL system role on the system you specified. The role includes **tlog-rec-session**, a terminal session I/O logging program, that acts as the login shell for a user. It also creates an **/etc/sssd/conf.d/sssd-session-recording.conf** SSSD configuration drop file that can be used by users and groups except those that you defined as excluded. SSSD parses and reads these users and groups, and replaces their user shell with **tlog-rec-session**. Additionally, if the **cockpit** package is installed on the system, the playbook also installs the **cockpit-session-recording** package, which is a **Cockpit** module that allows you to view and play recordings in the web console interface.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
---
- name: Deploy session recording excluding users and groups
  hosts: managed-node-01.example.com
  roles:
    - rhel-system-roles.tlog
  vars:
    tlog_scope_sssd: all
    tlog_exclude_users_sssd:
      - jeff
      - james
    tlog_exclude_groups_sssd:
      - admins
```

tlog_scope_sssd

The value **all** specifies that you want to record all users and groups.

tlog_exclude_users_sssd

Specifies the user names of the users you want to exclude from the session recording.

tlog_exclude_groups_sssd

Specifies the group you want to exclude from the session recording.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

1. Navigate to the folder where the SSSD configuration drop file is created:

```
# cd /etc/sssd/conf.d/
```

2. Check the file content:

```
# cat sssd-session-recording.conf
```

You can see that the file contains the parameters you set in the playbook.

3. Log in as a user whose session will be recorded.
4. Play back a recorded session .

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.tlog/README.md** file
- **/usr/share/doc/rhel-system-roles/tlog/** directory

CHAPTER 31. CONFIGURING VPN CONNECTIONS WITH IPSEC BY USING THE RHEL SYSTEM ROLE

With the **vpn** system role, you can configure VPN connections on RHEL systems by using Red Hat Ansible Automation Platform. You can use it to set up host-to-host, network-to-network, VPN Remote Access Server, and mesh configurations.

For host-to-host connections, the role sets up a VPN tunnel between each pair of hosts in the list of **vpn_connections** using the default parameters, including generating keys as needed. Alternatively, you can configure it to create an opportunistic mesh configuration between all hosts listed. The role assumes that the names of the hosts under **hosts** are the same as the names of the hosts used in the Ansible inventory, and that you can use those names to configure the tunnels.

NOTE

The **vpn** RHEL system role currently supports only Libreswan, which is an IPsec implementation, as the VPN provider.

31.1. CREATING A HOST-TO-HOST VPN WITH IPSEC BY USING THE VPN RHEL SYSTEM ROLE

You can use the **vpn** system role to configure host-to-host connections by running an Ansible playbook on the control node, which configures all managed nodes listed in an inventory file.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
- name: Host to host VPN
  hosts: managed-node-01.example.com, managed-node-02.example.com
  roles:
    - rhel-system-roles.vpn
  vars:
    vpn_connections:
      - hosts:
          managed-node-01.example.com:
          managed-node-02.example.com:
    vpn_manage_firewall: true
    vpn_manage_selinux: true
```

This playbook configures the connection **managed-node-01.example.com-to-managed-node-02.example.com** by using pre-shared key authentication with keys auto-generated by the system role. Because **vpn_manage_firewall** and **vpn_manage_selinux** are both set to **true**, the **vpn** role uses the **firewall** and **selinux** roles to manage the ports used by the **vpn** role.

To configure connections from managed hosts to external hosts that are not listed in the inventory file, add the following section to the **vpn_connections** list of hosts:

```
vpn_connections:
  - hosts:
      managed-node-01.example.com:
      <external_node>:
        hostname: <IP_address_or_hostname>
```

This configures one additional connection: **managed-node-01.example.com-to-*<external_node>***

NOTE

The connections are configured only on the managed nodes and not on the external node.

2. Optional: You can specify multiple VPN connections for the managed nodes by using additional sections within **vpn_connections**, for example, a control plane and a data plane:

```
- name: Multiple VPN
  hosts: managed-node-01.example.com, managed-node-02.example.com
  roles:
    - rhel-system-roles.vpn
  vars:
    vpn_connections:
      - name: control_plane_vpn
        hosts:
          managed-node-01.example.com:
            hostname: 192.0.2.0 # IP for the control plane
          managed-node-02.example.com:
            hostname: 192.0.2.1
      - name: data_plane_vpn
        hosts:
          managed-node-01.example.com:
            hostname: 10.0.0.1 # IP for the data plane
          managed-node-02.example.com:
            hostname: 10.0.0.2
```

3. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

4. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

Verification

1. On the managed nodes, confirm that the connection is successfully loaded:

```
# ipsec status | grep <connection_name>
```

Replace *<connection_name>* with the name of the connection from this node, for example **managed_node1-to-managed_node2**.

NOTE

By default, the role generates a descriptive name for each connection it creates from the perspective of each system. For example, when creating a connection between **managed_node1** and **managed_node2**, the descriptive name of this connection on **managed_node1** is **managed_node1-to-managed_node2** but on **managed_node2** the connection is named **managed_node2-to-managed_node1**.

2. On the managed nodes, confirm that the connection is successfully started:

```
# ipsec trafficstatus | grep <connection_name>
```

3. Optional: If a connection does not successfully load, manually add the connection by entering the following command. This provides more specific information indicating why the connection failed to establish:

```
# ipsec auto --add <connection_name>
```

NOTE

Any errors that may occur during the process of loading and starting the connection are reported in the **/var/log/pluto.log** file. Because these logs are hard to parse, manually add the connection to obtain log messages from the standard output instead.

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.vpn/README.md** file
- **/usr/share/doc/rhel-system-roles/vpn/** directory

31.2. CREATING AN OPPORTUNISTIC MESH VPN CONNECTION WITH IPSEC BY USING THE VPN RHEL SYSTEM ROLE

You can use the **vpn** system role to configure an opportunistic mesh VPN connection that uses certificates for authentication by running an Ansible playbook on the control node, which will configure all the managed nodes listed in an inventory file.

Prerequisites

- You have prepared the control node and the managed nodes .
- You are logged in to the control node as a user who can run playbooks on the managed nodes.
- The account you use to connect to the managed nodes has **sudo** permissions on them.

- The IPsec Network Security Services (NSS) crypto library in the **/etc/ipsec.d/** directory contains the necessary certificates.

Procedure

1. Create a playbook file, for example ~/**playbook.yml**, with the following content:

```
- name: Mesh VPN
  hosts: managed-node-01.example.com, managed-node-02.example.com, managed-node-03.example.com
  roles:
    - rhel-system-roles.vpn
  vars:
    vpn_connections:
      - opportunistic: true
        auth_method: cert
        policies:
          - policy: private
            cidr: default
          - policy: private-or-clear
            cidr: 198.51.100.0/24
          - policy: private
            cidr: 192.0.2.0/24
          - policy: clear
            cidr: 192.0.2.7/32
    vpn_manage_firewall: true
    vpn_manage_selinux: true
```

Authentication with certificates is configured by defining the **auth_method: cert** parameter in the playbook. By default, the node name is used as the certificate nickname. In this example, this is **managed-node-01.example.com**. You can define different certificate names by using the **cert_name** attribute in your inventory.

In this example procedure, the control node, which is the system from which you will run the Ansible playbook, shares the same classless inter-domain routing (CIDR) number as both of the managed nodes (192.0.2.0/24) and has the IP address 192.0.2.7. Therefore, the control node falls under the private policy which is automatically created for CIDR 192.0.2.0/24.

To prevent SSH connection loss during the play, a clear policy for the control node is included in the list of policies. Note that there is also an item in the policies list where the CIDR is equal to default. This is because this playbook overrides the rule from the default policy to make it private instead of private-or-clear.

Because **vpn_manage_firewall** and **vpn_manage_selinux** are both set to **true**, the **vpn** role uses the **firewall** and **selinux** roles to manage the ports used by the **vpn** role.

2. Validate the playbook syntax:

```
$ ansible-playbook --syntax-check ~/playbook.yml
```

Note that this command only validates the syntax and does not protect against a wrong but valid configuration.

3. Run the playbook:

```
$ ansible-playbook ~/playbook.yml
```

-

Additional resources

- **/usr/share/ansible/roles/rhel-system-roles.vpn/README.md** file
- **/usr/share/doc/rhel-system-roles/vpn/** directory