Installation Guide

OpenNMS Horizon 27.0.3, Last updated 2021-01-05 16:00:30 UTC

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Chapter 1. Compatibility

OpenNMS Horizon 27.0.3 requires the following component versions:

Component	Version Compatibility
OpenNMS Helm	3+
OpenNMS Integration API	0.2.x
Cassandra	3.11.+
Elasticsearch	7.x
Java Development Kit	OpenJDK 8, OpenJDK 11
Kafka	1.x - 2.x
PostgreSQL	10.x - 12.x
RRDTool	1.7.x

RHEL 7 users must complete additional steps to install PostgreSQL 10+. Refer to PostgreSQL Yum Repository for instructions.

Chapter 2. Setting up a basic OpenNMS Horizon

The *OpenNMS Horizon* platform can be installed on multiple OS families. This guide provides instructions for installing the platform on *Red Hat Enterprise Linux (RHEL)*-based and *Debian*-based operating systems.

2.1. Objectives

- Installing *OpenNMS Horizon* components on a single node using the built-in *JRobin* as time series storage
- Setup *OpenNMS Horizon* on recommended operating systems
- Login the Web User Interface and change the default admin password

2.2. Before you begin

The following abbreviations will be used to refer to their respective entry through this documentation.

Table 1. Operating Systems

RHEL	Red Hat Enterprise Linux 7 or higher, CentOS 8* or higher
Debian	Debian 9 or higher, Ubuntu 16.04 LTS or higher
OpenJDK 11 Development Kit	Installed OpenJDK 11 Development Kit

* Technically, users can install OpenNMS on CentOS 7, but our convenient `opennms` meta RPM package, which resolves external things like PostgreSQL, will not work. You need to install Postgres10 by yourself.

2.2.1. What If I'm Running CentOS 7?

OpenNMS requires PostgreSQL as the database before installation. With `yum install opennms`, the package `opennms` is like a convenience package and depends on the PostgreSQL package coming with the CentOS Linux distribution. CentOS 7 comes only with PostgreSQL 9. Horizon 25+ and Meridian 2019+ require PostgreSQL 10+.

If you want to install Horizon 25+ or Meridian 2019+ on versions older than CentOS 8, the convenience package with `yum install opennms` will not work. Instead, you must first install PostgreSQL 10 manually, and then install OpenNMS with `yum install opennms-core opennms-webapp-jetty`.

We recommend you meet the following requirements:

Table 2. Installation Requirements

Minimal Hardware	2 CPU, 2 GB RAM, 20 GB disk
Operating System	*RHEL* or *Debian* in a current version is recommended. Please be aware *OpenNMS Horizon* is developed and mostly operated on Linux systems.
Internet	Access to *{yum,debian}.opennms.org* via *https*.
DNS Setup	Please make sure your DNS settings for the OpenNMS server are correct and the localhost name can be resolved. If there is an incorrect or missing *A Resource Record* for the server hostname, OpenNMS might not start correctly. The Java security manager might not initialize and an *RMI class loader disabled* exception will be shown.

Depending on the installed operating system, the path for *OpenNMS Horizon* is different. If the instruction refers to `${OPENNMS_HOME}`, the path is resolved to the following directories:

Table 3. Directory Structure

RHEL	`/opt/opennms`
Debian	`/usr/share/opennms`

2.3. Installing on RHEL

The following steps will be described:

1. Installation of the `opennms` meta package which handles all dependencies
2. Initialize *PostgreSQL* database and configure access
3. Initialize *OpenNMS Horizon* database and start
4. Log in to the Web User Interface and change default admin password

You must use *root* permissions to run all commands on the command line interface.

Commands and instructions are specific to RHEL 8. We provide RHEL 7 alternatives where applicable.

Step 1: Install OpenNMS Horizon

Add yum repository and import GPG key

```
dnf -y install https://yum.opennms.org/repofiles/opennms-repo-stable-rhel8.noarch.rpm
rpm --import https://yum.opennms.org/OPENNMS-GPG-KEY
```

RHEL 7:

```
yum -y install https://yum.opennms.org/repofiles/opennms-repo-stable-rhel7.noarch.rpm
--import https://yum.opennms.org/OPENNMS-GPG-KEY
```

Installation of OpenNMS Horizon with all built-in dependencies

```
dnf -y install opennms
```

RHEL 7:

```
yum -y install opennms
```

The following packages will be automatically installed:

- *jicmp6* and *jicmp*: *Java* bridge to allow sending *ICMP messages* from *OpenNMS Horizon* repository.
- *opennms-core*: *OpenNMS Horizon* core services, e.g. *Provisiond*, *Pollerd* and *Collectd* from *OpenNMS Horizon* repository.
- *opennms-webapp-jetty*: *OpenNMS Horizon* web application from *OpenNMS Horizon* repository
- *postgresql*: *PostgreSQL* database server from distribution repository
- *postgresql-libs*: *PostgreSQL* database from distribution repository

With the successful installed packages the *OpenNMS Horizon* is installed in the following directory structure:

```
[root@localhost /opt/opennms]# tree -L 1
.
└── opennms
    ├── bin
    ├── contrib
    ├── data
    ├── deploy
    ├── etc
    ├── jetty-webapps
    ├── lib
    ├── logs -> /var/log/opennms
    ├── share -> /var/opennms
    └── system
```

We recommend disabling the OpenNMS Horizon repository after installation to prevent unwanted upgrades while it is running. *OpenNMS Horizon* requires some manual steps upon upgrade configuration files or migrate database schemas to a new version. For this reason, it is recommended to exclude the OpenNMS Horizon packages from update except when you are planning on performing an upgrade.

```
dnf config-manager --disable opennms-repo-stable-*
```

RHEL 7:

```
yum config-manager --disable opennms-repo-stable-*
```

Step 2: Initialize and set up PostgreSQL

Initialization of the PostgreSQL database

```
postgresql-setup --initdb --unit postgresql
```

System startup configuration for PostgreSQL

```
systemctl enable postgresql
```

Startup PostgreSQL database

```
systemctl start postgresql
```

Create an opennms database user with a password and create an opennms database which is owned by the user opennms

```
su - postgres
createuser -P opennms
createdb -O opennms opennms
```

Set a password for Postgres super user

```
psql -c "ALTER USER postgres WITH PASSWORD 'YOUR-POSTGRES-PASSWORD';"
exit
```

The super user is required to be able to initialize and change the database schema for installation and updates.

Change the access policy for PostgreSQL

```
vi /var/lib/pgsql/data/pg_hba.conf
```

Allow OpenNMS Horizon accessing the database over the local network with a MD5 hashed password

```
host    all             all             127.0.0.1/32            md5①
host    all             all             ::1/128                 md5①
```

① Change method from `ident` to `md5` for *IPv4* and *IPv6* on localhost.

Apply configuration changes for PostgreSQL

```
systemctl reload postgresql
```

Configure database access in OpenNMS Horizon

```
vi ${OPENNMS_HOME}/etc/opennms-datasources.xml
```

Set credentials to access the PostgreSQL database

```
<jdbc-data-source name="opennms"
                  database-name="opennms"①
                  class-name="org.postgresql.Driver"
                  url="jdbc:postgresql://localhost:5432/opennms"
                  user-name="** YOUR-OPENNMS-USERNAME **"②
                  password="** YOUR-OPENNMS-PASSWORD **" />③

<jdbc-data-source name="opennms-admin"
                  database-name="template1"
                  class-name="org.postgresql.Driver"
                  url="jdbc:postgresql://localhost:5432/template1"
                  user-name="postgres"④
                  password="** YOUR-POSTGRES-PASSWORD **" />⑤
```

① Set the database name *OpenNMS Horizon* should use

② Set the user name to access the *opennms* database table

③ Set the password to access the *opennms* database table

④ Set the *postgres* user for administrative access to PostgreSQL

⑤ Set the password for administrative access to PostgreSQL

Step 3: Initialize and start OpenNMS Horizon

Detect of Java environment and persist in /opt/opennms/etc/java.conf

```
${OPENNMS_HOME}/bin/runjava -s
```

Initialize the database and detect system libraries persisted in /opt/opennms/etc/libraries.properties

```
${OPENNMS_HOME}/bin/install -dis
```

Configure systemd to start OpenNMS Horizon on system boot

```
systemctl enable opennms
```

Start OpenNMS Horizon

```
systemctl start opennms
```

Allow connection to the Web UI from your network

```
firewall-cmd --permanent --add-port=8980/tcp
systemctl reload firewalld
```

If you want to receive SNMP Traps or Syslog messages you have to allow incoming traffic on your host firewall as well. By default OpenNMS SNMP trap daemon is listening on 162/udp and Syslog daemon is listening on 10514/udp. The SNMP Trap daemon is enabled by default, the OpenNMS Syslog daemon is disabled.

Step 4: First Login and change default password

After starting OpenNMS the web application can be accessed on http://<ip-or-fqdn-of-your-server>:8980/opennms. The default login user is *admin* and the password is initialized to *admin*.

1. Open in your browser http://<ip-or-fqdn-of-your-server>:8980/opennms
2. Login with with admin/admin
3. Click in main navigation menu on "admin → Change Password → Change Password"
4. Set as current password *admin* and set a new password and confirm your newly set password
5. Click "Submit"
6. Logout and login with your new password

Next Steps

Additional information can be found in these follow up documents:

- Getting Started Guide

  Learn the first steps to setup, configure, and maintain an *OpenNMS Horizon*.

- Reference Guide

  Find in-depth information on the detecters, monitors, collectors, and configuration files used by the *OpenNMS Horizon* platform.

2.4. Installing on Debian

The following steps will be described:

1. Installation of the `opennms` meta package which handles all dependencies
2. Initialize *PostgreSQL* database and configure access

3. Initialize *OpenNMS Horizon* database and start
4. Log in to the Web User Interface and change default admin password

All commands on the command line interface need to be executed with *root* permissions.

Step 1: Install OpenNMS Horizon

Add apt repository in /etc/apt/sources.list.d/opennms.list and add GPG key

```
cat << EOF | sudo tee /etc/apt/sources.list.d/opennms.list
deb https://debian.opennms.org stable main
deb-src https://debian.opennms.org stable main
EOF
wget -O - https://debian.opennms.org/OPENNMS-GPG-KEY | apt-key add -
apt update
```

Installation of OpenNMS Horizon with all built-in dependencies

```
apt -y install opennms
```

The following packages are required by the `opennms` package and will be automatically installed:

- *jicmp6* and *jicmp*: *Java* bridge to allow sending *ICMP messages* from *OpenNMS* repository.
- *opennms-core*: *OpenNMS* core services, e.g. *Provisiond*, *Pollerd* and *Collectd* from *OpenNMS* repository.
- *opennms-webapp-jetty*: *OpenNMS* web application from *OpenNMS* repository
- *postgresql*: *PostgreSQL* database server from distribution repository
- *postgresql-libs*: *PostgreSQL* database from distribution repository

With the successful installed packages the *OpenNMS Horizon* is installed in the following directory structure:

```
[root@localhost /usr/share/opennms]# tree -L 1
.
└── opennms
    ├── bin
    ├── data
    ├── deploy
    ├── etc -> /etc/opennms
    ├── instances
    ├── jetty-webapps
    ├── lib -> ../java/opennms
    ├── logs -> /var/log/opennms
    ├── share -> /var/lib/opennms
    └── system
```

We recommend disabling the OpenNMS Horizon repository after installation to prevent unwanted upgrades while it is running. *OpenNMS Horizon* requires some manual steps upon upgrade configuration files or migrate database schemas to a new version. For this reason, it is recommended to exclude the OpenNMS Horizon packages from update except when you are planning on performing an upgrade.

```
apt-mark hold libopennms-java \
              libopennmsdeps-java \
              opennms-common \
              opennms-db
```

Step 2: Initialize and setup PostgreSQL

The *Debian* package installs the *PostgreSQL* database and is already initialized. The *PostgreSQL* service is already added in the runlevel configuration for system startup.

Startup PostgreSQL database

```
systemctl start postgresql
```

Create an opennms database user with a password and create an opennms database which is owned by the user opennms

```
su - postgres
createuser -P opennms
createdb -O opennms opennms
```

Set a password for Postgres super user

```
psql -c "ALTER USER postgres WITH PASSWORD 'YOUR-POSTGRES-PASSWORD';"
exit
```

The super user is required to be able to initialize and change the database schema for installation and updates.

Configure database access in OpenNMS Horizon

```
vi ${OPENNMS_HOME}/etc/opennms-datasources.xml
```

Set credentials to access the PostgreSQL database

```
<jdbc-data-source name="opennms"
                  database-name="opennms"①
                  class-name="org.postgresql.Driver"
                  url="jdbc:postgresql://localhost:5432/opennms"
                  user-name="** YOUR-OPENNMS-USERNAME **"②
                  password="** YOUR-OPENNMS-PASSWORD **" />③

<jdbc-data-source name="opennms-admin"
                  database-name="template1"
                  class-name="org.postgresql.Driver"
                  url="jdbc:postgresql://localhost:5432/template1"
                  user-name="postgres"④
                  password="** YOUR-POSTGRES-PASSWORD **" />⑤
```

① Set the database name *OpenNMS Horizon* should use

② Set the user name to access the *opennms* database table

③ Set the password to access the *opennms* database table

④ Set the *postgres* user for administrative access to PostgreSQL

⑤ Set the password for administrative access to PostgreSQL

Step 3: Initialize and start OpenNMS Horizon

Detect of Java environment and persist in /usr/share/opennms/etc/java.conf

```
${OPENNMS_HOME}/bin/runjava -s
```

Initialize the database and detect system libraries persisted in /opt/opennms/etc/libraries.properties

```
${OPENNMS_HOME}/bin/install -dis
```

Configure systemd to start OpenNMS Horizon on system boot

```
systemctl enable opennms
```

Start OpenNMS Horizon

```
systemctl start opennms
```

If you want to receive SNMP Traps or Syslog messages you have to allow incoming traffic on your host firewall as well. By default OpenNMS SNMP trap daemon is listening on 162/udp and Syslog daemon is listening on 10514/udp. The SNMP Trap daemon is enabled by default, the OpenNMS Syslog daemon is disabled.

Step 4: First Login and change default password

After starting OpenNMS the web application can be accessed on http://<ip-or-fqdn-of-your-server>:8980/opennms. The default login user is *admin* and the password is initialized to *admin*.

1. Open in your browser http://<ip-or-fqdn-of-your-server>:8980/opennms
2. Login with with admin/admin
3. Click in main navigation menu on "admin → Change Password → Change Password"
4. Set as current password *admin* and set a new password and confirm your newly set password
5. Click "Submit"
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Next Steps

Additional information can be found in these follow up documents:

- Getting Started Guide

  Learn the first steps to setup, configure, and maintain an *OpenNMS Horizon*.

- Reference Guide

  Find in-depth information on the detecters, monitors, collectors, and configuration files used by the *OpenNMS Horizon* platform.

2.5. Run with Docker

Modern infrastructure allows you to deploy and run workloads in containers. *OpenNMS Horizon* provides and publishes container images on DockerHub.

We don't install all available plugins in our published Docker image. If you want to customize and maintain your own image, you can find the *Dockerfiles* in our source repository.

2.5.1. Objectives

- Run *OpenNMS Horizon* using *Docker Compose* with a basic setup and *PostgreSQL* on your local system as a quickstart
- Persist RRD files from *OpenNMS Horizon* and *PostgreSQL* in a volume
- Introduce a reference with all available configuration and mount conventions for more advanced setups

2.5.2. Before you begin

You must have at least the following components installed:

- Current stable *Docker* release installed, e.g., installed from Docker Documentation
- Current stable *Docker Compose* installed, e.g., installed from Docker Compose instructions You should have a basic knowledge of *Docker*, *Docker Compose* with networking, persisting files and mounting directories

2.5.3. Quickstart service stack

Step 1: Create service stack for PostgreSQL and *OpenNMS Horizon*

The first section describes how to set up *OpenNMS Horizon* service stack in a `docker-compose.yml` file. Create a project directory with `mkdir opennms-horizon` and create a `docker-compose.yml` file in that directory with the following content:

```
---
version: '3'

volumes:
  data-postgres: {}①
  data-opennms: {}②

services:
  database:③
    image: postgres:12④
    container_name: database⑤
    environment:⑥
      - TZ=Europe/Berlin
      - POSTGRES_USER=postgres
      - POSTGRES_PASSWORD=postgres
    volumes:⑦
      - data-postgres:/var/lib/postgresql/data
    healthcheck:⑧
      test: [ "CMD-SHELL", "pg_isready -U postgres" ]
      interval: 10s
      timeout: 30s
      retries: 3

  horizon:
    image: opennms/horizon:27.0.3⑨
    container_name: horizon
    environment:⑩
      - TZ=Europe/Berlin
      - POSTGRES_HOST=database
      - POSTGRES_PORT=5432
      - POSTGRES_USER=postgres
      - POSTGRES_PASSWORD=postgres
      - OPENNMS_DBNAME=opennms
      - OPENNMS_DBUSER=opennms
      - OPENNMS_DBPASS=opennms
    volumes:
      - data-opennms:/opt/opennms/share/rrd⑪
      - ./overlay:/opt/opennms-overlay⑫
    command: ["-s"]
    ports:⑬
      - "8980:8980/tcp"
      - "8101:8101/tcp"
      - "61616:61616/tcp"
    healthcheck:⑭
      test: [ "CMD", "curl", "-f", "-I", "http://localhost:8980/opennms/login.jsp" ]
      interval: 1m
      timeout: 5s
      retries: 3
```

① Volume definition to persist the *PostgreSQL* database permanently

② Volume definition to persist the *RRD* files from *OpenNMS Horizon* permanently

③ Service name `database` for the *PostgreSQL* instance

④ Image reference for the vanilla *PostgreSQL* Docker image with a fixed version

⑤ Friendly container name

⑥ Environment variables to initialize a postgres user with a password

⑦ Assign volume to persist the *PostgreSQL* database

⑧ Create a health check for the *PostgreSQL* database

⑨ Image reference for the *OpenNMS Horizon* container image using the latest stable version

⑩ Set up a database connection using the `postgres` root user and initialize an `opennms` database with user and credentials

⑪ Assign the volume to persist the *RRD* files permanently

⑫ Mount the configuration files to make them accessible in a local directory

⑬ Publish ports for the web user interface, *Karaf Shell* and *ActiveMQ*

⑭ Create a health check against the login page from *OpenNMS Horizon*

Step 2: Start the service stack

```
cd opennms-horizon
docker-compose up -d
```

The startup and download can take a while; you can use the `docker-compose ps` command and wait until the health check for the `horizon` service is `up (healthy)`.

Step 3: Log in to the Web UI

After download and startup, verify that you can access the web user interface by going to http://localhost:8980. The default login is `admin` with password `admin`.

Please immediately change your admin account and set a strong password.

2.5.4. Configuration Reference

Startup Arguments

Argument	Description
`-h`	Display help with available arguments.
`-f`	Start the process in the foreground and use existing data and configuration.
`-i`	One-time command to initialize or update database and configuration files and do **NOT** start.

Argument	Description
`-s`	Command to initialize or update database and configuration files and start OpenNMS in the foreground.
`-t`	One-time command to run the config-tester against the configuration.

Environment Variables

Table 4. Java options

Environment variable	Description	Required	Default value
`JAVA_OPTS`	Allows to add additional Java options	optional	`-`

Table 5. PostgreSQL connection configuration in opennms-datasources.xml

Environment variable	Description	Required	Default value
`OPENNMS_DBNAME`	Database name used for *OpenNMS Horizon*	required	-
`OPENNMS_DBUSER`	Username with access to the database	required	-
`OPENNMS_DBPASS`	Password for user with acccess to the database	required	-
`POSTGRES_HOST`	Host with the PostgreSQL server instance running	required	-
`POSTGRES_PORT`	PostgreSQL server port	optional	`5432`
`POSTGRES_USER`	PostgreSQL super user to initialize database schema specified in `OPENNMS_DBNAME`	required	-
`POSTGRES_PASSWORD`	PostgreSQL super user password	required	-
`OPENNMS_DATABASE_CONNECTION_POOLFACTORY`	Database connection pool factory	optional	`org.opennms.core.db.HikariCPConnectionFactory`
`OPENNMS_DATABASE_CONNECTION_IDLETIMEOUT`	Database connection pool idle timeout	optional	`600`
`OPENNMS_DATABASE_CONNECTION_LOGINTIMEOUT`	Database connection pool login timeout	optional	`3`

Environment variable	Description	Required	Default value
OPENNMS_DATABASE_CONNECTION_MINPOOL	Minimal connection pool size	optional	50
OPENNMS_DATABASE_CONNECTION_MAXPOOL	Maximum connection pool size	optional	50
OPENNMS_DATABASE_CONNECTION_MAXSIZE	Maximum connections	optional	50

Table 6. Timeseries storage configuration in opennms.properties.d/_confd.timeseries.properties

Environment variable	Description	Required	Default value
OPENNMS_TIMESERIES_STRATEGY	Used Timeseries storage strategy	optional	rrd
OPENNMS_RRD_STOREBYFOREIGNSOURCE	Store timeseries data by foreign source instead of the database node id	optional	true
OPENNMS_RRD_STRATEGYCLASS	Java RRD Strategy class	optional	org.opennms.netmgt.rrd.rrdtool.MultithreadedJniRrdStrategy
OPENNMS_RRD_INTERFACEJAR	Java RRD Interface library	optional	/usr/share/java/jrrd2.jar
OPENNMS_LIBRARY_JRRD2	JRRD2 libray path	optional	/usr/lib64/libjrrd2.so

Table 7. SNMP Trap receiver configuration in trapd-configuration.xml

Environment variable	Description	Required	Default value
OPENNMS_TRAPD_ADDRESS	Listen interface for *SNMP Trapd*	optional	*
OPENNMS_TRAPD_PORT	Port to listen for *SNMP Traps*	optional	1162
OPENNMS_TRAPD_NEWSUSPECTONTRAP	Create new suspect event based Trap recepient for unknown devices	optional	false
OPENNMS_TRAPD_INCLUDERAWMESSAGE	Preserve raw messages in *SNMP Traps*	optional	false
OPENNMS_TRAPD_THREADS	Set maximum thread size to process SNMP Traps	optional	0

Environment variable	Description	Required	Default value
OPENNMS_TRAPD_QUEUESIZE	Set maximum queue for *SNMP Trap* processing	optional	10000
OPENNMS_TRAPD_BATCHSIZE	Set batch size for *SNMP Trap* processing	optional	1000
OPENNMS_TRAPD_BATCHINTERVAL	Set batch processing interval in milliseconds	optional	500

Table 8. Karaf Shell configuration in org.apache.karaf.shell.cfg

Environment variable	Description	Required	Default value
OPENNMS_karaf_SSH_HOST	Listen interface for *Karaf* shell	optional	0.0.0.0
OPENNMS_karaf_SSH_PORT	*SSH* Port for *Karaf* shell	optional	8101

Table 9. Cassandra and Newts configuration in opennms.properties.d/_confd.newts.properties

Environment variable	Description	Required	Default value
REPLICATION_FACTOR	Set *Cassandra* replication factor for the newts keyspace if *Newts* is used	optional	1
OPENNMS_CASSANDRA_HOSTNAMES	A comma separated list with *Cassandra* hosts for *Newts*	optional	localhost
OPENNMS_CASSANDRA_KEYSPACE	Name of the keyspace used by *Newts*	optional	newts
OPENNMS_CASSANDRA_PORT	*Cassandra* server port	optional	9042
OPENNMS_CASSANDRA_USERNAME	Username with access to *Cassandra*	optional	cassandra
OPENNMS_CASSANDRA_PASSWORD	Password for user with access to *Cassandra*	optional	cassandra

Directory Conventions

Mountpoint	Description
/opt/opennms-overlay	Allows to overwrite files relative to /opt/opennms
/opennms-data	Directory with RRDTool/JRobin files and generated PDF reports sent to the file system

Chapter 3. Installing and Configuring a Minion

A Minion is an instance of the Karaf OSGi service that enables OpenNMS to monitor devices and services in locations that an OpenNMS instance cannot reach. Minions communicate with these remote devices while OpenNMS performs coordination and task delegation.

Minions can operate behind a firewall and/or network address translation (NAT) as long as they can communicate with OpenNMS via ActiveMQ, Apache Kafka, or gRPC.

This chapter describes how to install a Minion and configure an authenticated unencrypted communication between Minion and OpenNMS Horizon using ActiveMQ and REST.

3.1. Requirements

- Identical version numbers for OpenNMS Horizon instance and Minion package
- OpenNMS Horizon installed and communication to the REST (8980/tcp) and ActiveMQ (616161/tcp) endpoints is possible

For communication between OpenNMS Horizon and Kafka, see Setup using Apache Kafka. For gRPC, see Minion with gRPC strategy.

Packages are available as RPMs for RHEL-based systems and DEBs for Debian-based systems

If the instruction refers to `${MINION_HOME}`, the path for Minion resolves to the following directory, depending on the operating system:

Table 10. Directory Structure

RHEL	`/opt/minion`
Debian	`/usr/share/minion`

3.2. Set Up OpenNMS Horizon to allow Minion communication

Communication between a Minion and OpenNMS Horizon uses the REST API and a messaging system, by default ActiveMQ. Before installing a Minion, you need to create an authenticated user with the *ROLE_MINION* security role for these communication channels.

For information on setting up communication between OpenNMS Horizon and Kafka, see Setup using Apache Kafka. For gRPC, see Minion with gRPC strategy.

This guide uses the user name *minion* with password *minion* as an example. Change your credentials accordingly.

Create a minion user in the OpenNMS Horizon web UI:

1. Log in to the web UI as an administrative user.
2. Click on the gears icon and choose **Configure Users, Groups and On-Call Roles → Configure Users**.
3. Add a new user with login name *minion* and password *minion* and click **OK**.
4. In the **Security Roles** area, assign the *ROLE_MINION* security role.
    a. Optional: fill in a comment for the Minion user's location and purpose.
5. Click **Finish**.

The *minion* user should now be listed in the user List.

Configure ActiveMQ to allow communication on public network interface:

```
vi ${OPENNMS_HOME}/etc/opennms-activemq.xml
```

Remove comments for the transport connector listening on 0.0.0.0 and save

```
<transportConnector name="openwire" uri="tcp://0.0.0.0:61616?useJmx=false
&amp;maximumConnections=1000&amp;wireformat.maxFrameSize=104857600"/>
```

Restart OpenNMS Horizon

```
systemctl restart opennms
```

Verify that port 61616/tcp is listening on all interfaces

```
ss -lnpt sport = :61616
State   Recv-Q  Send-Q  Local Address:Port  Peer  Address:Port
LISTEN  0       128     *:61616             *:*   users:(("java",pid=1,fd=706))
```

3.3. Installing on RHEL

Use the following commands to install the Minion package, start the Minion, test access to the Karaf shell, configure Minion to communicate with OpenNMS Horizon, and verify connectivity.

You must run all commands on the command line interface as the *root* user.

Make sure you have set up OpenNMS Horizon to allow communication with the Minion before completing the steps in this section.

For miscellaneous installation information including Minion directory structure, startup configuration, and an alternate way to configure credentials, see Information about Minion Packages and Configuration.

Commands and instructions are specific to RHEL 8. We provide RHEL 7 alternatives where applicable. Red text in commands indicates text inthat you must substitute for your own values (e.g., "Office Pittsboro" means substitute your own office name.)

Step 1: Install the repository and Minion package

Connect with SSH to your remote RHEL system where you want to install a Minion.

Install the Yum repository

```
dnf -y install https://yum.opennms.org/repofiles/opennms-repo-stable-rhel8.noarch.rpm
rpm --import https://yum.opennms.org/OPENNMS-GPG-KEY
```

RHEL 7:

```
yum -y install https://yum.opennms.org/repofiles/opennms-repo-stable-rhel7.noarch.rpm
rpm --import https://yum.opennms.org/OPENNMS-GPG-KEY
```

Install the Minion package

```
dnf -y install opennms-minion
```

RHEL 7:

```
yum -y install opennms-minion
```

Step 2: Start the Minion and test access to Karaf Shell

Configure systemd to start Minion on system boot

```
systemctl enable minion
```

Start up Minion

```
systemctl start minion
```

Test access to Karaf shell with user `admin` and password `admin` and configure the Minion

```
ssh -p 8201 admin@localhost

config:edit org.opennms.minion.controller
config:property-set location <span class="red">Office-Pittsboro</span>
config:property-set http-url <span class="red">http://opennms-fqdn:8980/opennms</span>
config:property-set broker-url <span class="red">failover:tcp://opennms-
fqdn:61616</span>
config:update
```

Include the `failover:` portion of the broker URL to allow the Minion to re-establish connectivity on failure. For a reference on the different URL formats, see ActiveMQ URI Protocols.

Configure the credentials to use when communicating with OpenNMS Horizon and exit Karaf shell

```
opennms:scv-set opennms.http <span class="red">minion username minion password</span>
opennms:scv-set opennms.broker <span class="red">minion username minion
password</span>
<ctrl-d>
```

Another way to configure credentials is to use the `scvcli` utility in your Minion `bin` directory (see Alternate way to configure credentials).

Restart the Minion after updating the credentials

```
systemctl restart minion
```

The credentials are configured separately since they are encrypted on disk.

Step 3: Verify Connectivity

Connect to Karaf Shell of the Minion and verify connectivity

```
ssh -p 8201 admin@localhost
opennms:health-check
```

You should see the following message:

```
Connecting to OpenNMS ReST API   [ Success  ]
Verifying installed bundles      [ Success  ]
Connecting to JMS Broker         [ Success  ]
=> Everything is awesome
admin@minion()>
```

3.4. Installing on Debian

Use the following commands to install the Minion package, start the Minion, test access to the Karaf shell, configure Minion to communicate with OpenNMS Horizon, and verify connectivity.

You must run all commands on the command line interface as the *root* user.

Make sure you have set up OpenNMS Horizon to allow communication with the Minion before completing the steps in this section.

For miscellaneous installation information including Minion directory structure, startup configuration, and an alternate way to configure credentials, see Information about Minion Packages and Configuration.

Red text in commands indicates text that you must substitute for your own values (e.g., "Office Pittsboro" means substitute your own office name).

Step 1: Install the repository and Minion package

Add apt repository in /etc/apt/sources.list.d/opennms.list and add GPG key

```
echo 'deb https://debian.opennms.org stable main \
      deb-src https://debian.opennms.org stable main' >
/etc/apt/sources.list.d/opennms.list
wget -O - https://debian.opennms.org/OPENNMS-GPG-KEY |apt-key add -
apt update
```

Install the Minion package

```
apt -y install opennms-minion
```

Step 2: Start the Minion and test access to Karaf Shell

Configure systemd to start Minion on system boot

```
systemctl enable minion
```

Start up Minion

```
systemctl start minion
```

Test access to Karaf shell with user `admin` and password `admin` and configure the Minion

```
ssh -p 8201 admin@localhost

config:edit org.opennms.minion.controller
config:property-set location <span class="red">Office-Pittsboro</span>
config:property-set http-url <span class="red">http://opennms-fqdn:8980/opennms</span>
config:property-set broker-url <span class="red">failover:tcp://opennms-
fqdn:61616</span>
config:update
```

Include the `failover:` portion of the broker URL to allow the Minion to re-establish connectivity on failure. For a reference on the different URL formats, see ActiveMQ URI Protocols.

Configure the credentials to use when communicating with OpenNMS Horizon and exit Karaf shell

```
opennms:scv-set opennms.http <span class="red">minion username minion password</span>
opennms:scv-set opennms.broker <span class="red">minion username minion
password</span>
<ctrl-d>
```

Another way to configure credentials is to use the `scvcli` utility in your Minion `bin` directory (see Alternate way to configure credentials).

Restart the Minion after updating the credentials

```
systemctl restart minion
```

The credentials are configured separately since they are encrypted on disk.

Step 3: Verify Connectivity

Connect to Karaf Shell of the Minion and verify connectivity

```
ssh -p 8201 admin@localhost
opennms:health-check
```

You should see the following message:

```
Connecting to OpenNMS ReST API   [ Success  ]
Verifying installed bundles      [ Success  ]
Connecting to JMS Broker         [ Success  ]
=> Everything is awesome
admin@minion()>
```

3.5. Information about Minion Packages and Configuration

This section contains miscellaneous information about the Minion installation.

3.5.1. Directory structure

A successful installation means the Minion is installed in the following directory structure:

```
[root@localhost /opt/minion]# $ tree -L 1
.
├── bin
├── deploy
├── etc
├── lib
├── repositories
└── system
```

In Debian, symbolic links are set up pointing to `/etc/minion` and `/var/log/minion` to match Debian's expected filesystem layout.

3.5.2. Startup configuration

Edit `/etc/sysconfig/minion` file (RHEL) or the `/etc/default/minion` file (Debian) to change the Minion's startup configuration, if you want to override the defaults used at start up including:

- Location of the JDK
- Memory usage
- User to run as

3.5.3. Alternate way to configure credentials

You can also configure credentials by using the `scvcli` utility in your Minion `bin` directory:

```
cd /opt/minion
./bin/scvcli set opennms.http #minion user name minion password
./bin/scvcli set opennms.broker #minion user name minion password
```

3.6. Run with Docker

Modern infrastructure allows you to deploy and run workloads in containers. *OpenNMS Horizon* provides and publishes container images on DockerHub.

3.6.1. Objectives

- Run and configure a *Minion* in, and connect it to, the *OpenNMS Horizon* instance using environment variables
- Introduce a reference with all available configuration and mount conventions for more advanced setups

3.6.2. Before you begin

You must have at least the following components installed:

- Current stable *Docker* release installed, e.g., installed from Docker Documentation
- Current stable *Docker Compose* installed, e.g., installed from Docker Compose instructions You should have a basic knowledge of *Docker*, *Docker Compose* with networking, persisting files and mounting directories *OpenNMS Horizon* is configured to accept connections via *ActiveMQ* and a Minion user with *ROLE_MINION* The *Minion* can connect to *OpenNMS Horizon* with port `61616/TCP` for *ActiveMQ* and *REST* on port `8980/TCP`

3.6.3. Quickstart service stack

Step 1: Create service stack with a Minion

Create a project directory with `mkdir opennms-minion` and create a `docker-compose.yml` file in that directory with the following content:

```
---
version: '3'

services:
  minion:
    image: opennms/minion:27.0.3
    container_name: minion①
    network_mode: host②
    environment:
      - TZ=Europe/Berlin③
      - MINION_ID=my-minion④
      - MINION_LOCATION=my-location⑤
      - OPENNMS_BROKER_URL=failover:tcp://horizon-instance:61616⑥
      - OPENNMS_BROKER_USER=minion-user⑦
      - OPENNMS_BROKER_PASS=minion-password
      - OPENNMS_HTTP_URL=http://horizon-instance:8980/opennms⑧
      - OPENNMS_HTTP_USER=minion-user⑨
      - OPENNMS_HTTP_PASS=minion-password
    command: ["-c"]
    healthcheck:
      test: "/health.sh"⑩
      interval: 15s
      timeout: 6s
      retries: 1
```

① Friendly container name

② If you process UDP data like SNMP traps, Syslogs or flows, `network_mode: host` ensures the UDP source addresses are not modified

③ Time zone for the *Minion*

④ A defined identifier for this *Minion*. If not set, a unique user identifier (*UUID*) will be generated

⑤ The name of the location of the *Minion* and the connection to the *ActiveMQ* broker running in *OpenNMS Horizon*

⑥ *ActiveMQ* broker endpoint from *OpenNMS Horizon*

⑦ Authentication for ActiveMQ broker

⑧ *REST* endpoint to connect to the *OpenNMS Horizon* instance

⑨ Authentication for the *REST* endpoint

⑩ Run our health check to indicate the Minion is ready. It uses the `opennms:health-check` internally running in Karaf.

In this example we haven't set credentials to connect the *Minion* via *REST* and the *ActiveMQ Message Broker*. The *Minion* will fall back and uses the default admin/admin credentials for communication. Permissions for *ActiveMQ* and *REST* are assigned with the role *ROLE_MINION* on the *OpenNMS Horizon* instance.

If you process UDP data and you don't use `network_mode: host`, the UDP source address from your packets will be modified from Docker. The source address is your Docker internal gateway instead of the source address of your device. Source addresses associate the Syslog or SNMP traps to the nodes in the OpenNMS database. You can use an isolated network and publish ports as usual if you don't receive UDP-based monitoring data. If you don't use `network_mode: host` you have to publish the listener ports manually.

Step 2: Start the service stack and test the functionality

```
cd opennms-minion
docker-compose up -d
```

Step 3: Run *Minion* Health Check

Log in to the Minion Karaf Shell and run the health check

```
ssh admin@localhost -p 8201

admin@minion> opennms:health-check
Verifying the health of the container

Connecting to OpenNMS ReST API   [ Success  ]
Verifying installed bundles      [ Success  ]
Connecting to JMS Broker         [ Success  ]

=> Everything is awesome
```

The default admin password for the *Minion Karaf Shell* is *admin*.

Step 4: Verify status in the web UI

- Log in as admin in the *OpenNMS Horizon* web interface
- *Configure OpenNMS → Manage Minions*. The *Minion* should be registered and the status should be *up*
- Verify that *Minion* is provisioned automatically by going to *Info → Nodes* and selecting the *Minion*. The services *JMX-Minion*, *Minion-Heartbeat* and *Minion-RPC* should be *up* and provisioned on the local loop-back interface

3.6.4. Startup Arguments

Argument	Description
`-h`	Display help with available arguments.

Argument	Description
`-c`	Start Minion and use environment credentials to register *Minion* on *OpenNMS Horizon*.
`-s`	One-time command to initialze an encrypted keystore file with credentials in `/keystory/scv.jce`.
`-f`	Initialize and start *Minion* in foreground.

3.6.5. Environment Variables

Table 11. Generic Minion settings

Environment variable	Description	Required	Default value
`MINION_ID`	Unique *Minion* identifier	optional	generated UUID
`MINION_LOCATION`	Name of the location the *Minion* is associated	required	-

Table 12. Settings when ActiveMQ is used

Environment variable	Description	Required	Default value
`OPENNMS_HTTP_URL`	Web user interface base *URL* for *REST*	required	-
`OPENNMS_HTTP_USER`	User name for the *ReST API*	optional	`admin`
`OPENNMS_HTTP_PASS`	Password for the *ReST API*	optional	`admin`
`OPENNMS_BROKER_URL`	*ActiveMQ* broker URL	required	-
`OPENNMS_BROKER_USER`	Username for *ActiveMQ* authentication	optional	`admin`
`OPENNMS_BROKER_PASS`	Password for *ActiveMQ* authentication	optional	`admin`

Apache Kafka Configuration

If you want to use *Apache Kafka* the environment variable names are converted with a prefix convention:

- Prefix `KAFKA_RPC_` will be written to `org.opennms.core.ipc.rpc.kafka.cfg`
- Prefix `KAFKA_SINK_` will be written to `org.opennms.core.ipc.sink.kafka.cfg`
- Everything behind will be converted to lower case and `_` is replaced with `.`

As an example:

```
environment:
  - KAFKA_RPC_BOOTSTRAP_SERVERS=192.168.1.1,192.168.1.2
```

This will create the file `org.opennms.core.ipc.rpc.kafka.cfg` with the content:

```
bootstrap.servers=192.168.1.1,192.168.1.2
```

3.6.6. Directory Conventions

Mountpoint	Description
`/opt/minion-etc-overlay`	Allows to overwrite files relative to `/opt/minion/etc`
`/keystore`	Directory with credentials for encrypted keystore file

Chapter 4. Sentinel

This section describes how to install the *Sentinel* to scale individual components of OpenNMS Horizon.

At the moment only flows can be distributed using *Sentinel*. In the future more components will follow.

4.1. Before you begin

Setting up a *OpenNMS Horizon* with *Sentinel* requires:

- Instance of *OpenNMS Horizon* needs to be exact same version as *Sentinel* packages
- Packages are available as *RPMs* for *RHEL*-based systems and *DEBs* for *Debian*-based systems
- *OpenNMS Horizon* needs to be installed and communication to the *REST (8980/tcp)* and *ActiveMQ (616161/tcp)* endpoints is possible
- At least one *Minion* needs to be installed and successful communicate with the *OpenNMS Horizon*

Depending on the installed operating system, the path for *Sentinel* is different. If the instruction refers to `${SENTINEL_HOME}`, the path is resolved to the following directories:

Table 13. Directory Structure

RHEL	`/opt/sentinel`
Debian	`/usr/share/sentinel`

4.2. Installing on RHEL

Commands and instructions are specific to RHEL 8. We provide RHEL 7 alternatives where applicable.

1. Setup *OpenNMS Horizon* to allow *Sentinel* communication
2. Installation of the `opennms-sentinel` meta package which handles all dependencies
3. Starting *Sentinel* and access the *Karaf* console over *SSH*
4. Configure *Sentinel* to communicate with *OpenNMS Horizon*
5. Verify the connectivity between *Sentinel* and *OpenNMS Horizon*

All commands on the command line interface need to be executed with *root* permissions.

Step 1: Setup OpenNMS Horizon to allow Sentinel communication

This step is exactly the same as for *Minion*. Even the role name `ROLE_MINION` can be used, as there does not exist a dedicated role `ROLE_SENTINEL` yet.

Therefore, please refer to section Setup OpenNMS Horizon to allow Minion communication.

Even if we have to configure the communication to the *OpenNMS Horizon* exactly the same as for *Minion* no ReST requests are made and may be removed at a later state.

Step 2: Install the repository and Sentinel package

Connect with *SSH* to your remote *RHEL* system where the *Sentinel* should be installed.

Install the Yum repository

```
dnf install -y https://yum.opennms.org/repofiles/opennms-repo-stable-rhel8.noarch.rpm
rpm --import https://yum.opennms.org/OPENNMS-GPG-KEY
```

RHEL 7:

```
yum install -y https://yum.opennms.org/repofiles/opennms-repo-stable-rhel7.noarch.rpm
rpm --import https://yum.opennms.org/OPENNMS-GPG-KEY
```

Install the Sentinel package

```
dnf -y install opennms-sentinel
```

RHEL 7:

```
yum -y install opennms-sentinel
```

With the successful installed packages the *Sentinel* is installed in the following directory structure:

```
[root@localhost /opt/sentinel]# $ tree -L 1
.
|-- bin
|-- COPYING
|-- data
|-- deploy
|-- etc
|-- lib
`-- system
```

The Sentinel's startup configuration can be changed by editing the `/etc/sysconfig/sentinel` file. It allows to override the defaults used at startup including:

- Location of the JDK
- Memory usage
- User to run as

Step 3: Starting the Sentinel and test access to Karaf Shell

Configure systemd to start Sentinel on system boot

```
systemctl enable sentinel
```

Startup Sentinel

```
systemctl start sentinel
```

Test access to Karaf shell with user admin and password admin and exit with <ctrl-d>

```
ssh -p 8301 admin@localhost
```

Step 4: Configure Sentinel to communicate with OpenNMS Horizon

Login to the Karaf Shell on the system where your Sentinel is installed with SSH

```
ssh -p 8301 admin@localhost
```

Configure the Sentinel's location and endpoint URLs for communication with OpenNMS Horizon

```
[root@localhost /root]# $ ssh -p 8201 admin@localhost
...
admin@sentinel()> config:edit org.opennms.sentinel.controller
admin@sentinel()> config:property-set location Office-Pittsboro
admin@sentinel()> config:property-set http-url http://opennms-fqdn:8980/opennms
admin@sentinel()> config:property-set broker-url failover:tcp://opennms-fqdn:61616
admin@sentinel()> config:update
```

Include the `failover:` portion of the broker URL to allow the *Sentinel* to re-establish connectivity on failure. For a reference on the different URL formats, see ActiveMQ URI Protocols.

Even if the id, location and http-url must be set the same ways as for *Minion*, this may change in future versions of *Sentinel*.

Configure the credentials to use when communicating with OpenNMS Horizon

```
admin@sentinel()> opennms:scv-set opennms.http minion minion
admin@sentinel()> opennms:scv-set opennms.broker minion minion
```

Username and password is explicitly set to `minion` as it is assumed that they share the same credentials and roles.

Another way to configure credentials is to use the `scvcli` utility in your *Sentinel* `bin` directory.

Example of configuring credentials with the command line utility `scvcli`

```
[root@localhost /root]# $ cd /opt/sentinel
[root@localhost /opt/sentinel]# $ ./bin/scvcli set opennms.http minion minion
[root@localhost /opt/sentinel]# $ ./bin/scvcli set opennms.broker minion minion
```

Restart the Sentinel after updating the credentials

```
[root@localhost /root]# $ systemctl restart sentinel
```

The credentials are configured separately since they are encrypted on disk.

Step 5: Verifying Connectivity

Connect to Karaf Shell of the Sentinel

```
ssh -p 8301 admin@localhost
```

Verify connectivity with the OpenNMS Horizon

```
admin@sentinel()> feature:install sentinel-core
admin@sentinel> opennms:health-check
Verifying the health of the container

Verifying installed bundles      [ Success  ]
Connecting to OpenNMS ReST API   [ Success  ]

=> Everything is awesome
admin@sentinel()>
```

The `opennms:health-check` command is a newer and more flexibel version of the original `minion:ping` command. Therefore on *Sentinel* there is no equivalent such as `sentinel:ping`.

4.3. Installing on Debian

1. Setup *OpenNMS Horizon* to allow *Sentinel* communication
2. Installation of the `opennms-sentinel` meta package which handles all dependencies
3. Starting *Sentinel* and access the *Karaf* console over *SSH*
4. Configure *Sentinel* to communicate with *OpenNMS Horizon*
5. Verify the connectivity between *Sentinel* and *OpenNMS Horizon*

All commands on the command line interface need to be executed with *root* permissions.

Step 1: Setup OpenNMS Horizon to allow Sentinel communication

This step is exactly the same as for *Minion*. Even the role name `ROLE_MINION` can be used, as there does not exist a dedicated role `ROLE_SENTINEL` yet.

Therefore, please refer to section Setup OpenNMS Horizon to allow Minion communication.

Even if we have to configure the communication to the *OpenNMS Horizon* exactly the same as for *Minion* no ReST requests are made and may be removed at a later state.

Step 2: Install the repository and Sentinel package

Add apt repository in /etc/apt/sources.list.d/opennms.list and add GPG key

```
echo 'deb https://debian.opennms.org stable main \
      deb-src https://debian.opennms.org branches/features-sentinel main' >
/etc/apt/sources.list.d/opennms.list
wget -O - https://debian.opennms.org/OPENNMS-GPG-KEY | apt-key add -
apt update
```

Install the Sentinel package

```
apt -y install opennms-sentinel
```

The *Sentinel* packages setup the following directory structure:

```
[root@localhost /usr/share/sentinel]# $ tree -L 1
.
|-- bin
|-- COPYING
|-- data
|-- debian
|-- deploy
|-- etc
|-- lib
`-- system
```

Additionally, symbolic links are set up pointing to `/etc/sentinel` and `/var/log/sentinel` to match Debian's expected filesystem layout.

The Minion's startup configuration can be changed by editing the `/etc/default/sentinel` file. It allows to override the defaults used at startup including:

- Location of the JDK

- Memory usage
- User to run as

Step 3: Starting the Sentinel and test access to Karaf Shell

Configure systemd to start Sentinel on system boot

```
systemctl enable sentinel
```

Startup Sentinel

```
systemctl start sentinel
```

Test access to Karaf shell with user admin and password admin and exit with <ctrl-d>

```
ssh -p 8301 admin@localhost
```

Step 4: Configure Sentinel to communicate with OpenNMS Horizon

Login to the Karaf Shell on the system where your Sentinel is installed with SSH

```
ssh -p 8301 admin@localhost
```

Configure the Sentinel's location and endpoint URLs for communication with OpenNMS Horizon

```
[root@localhost /root]# $ ssh -p 8201 admin@localhost
...
admin@sentinel()> config:edit org.opennms.sentinel.controller
admin@sentinel()> config:property-set location Office-Pittsboro
admin@sentinel()> config:property-set http-url http://opennms-fqdn:8980/opennms
admin@sentinel()> config:property-set broker-url failover:tcp://opennms-fqdn:61616
admin@sentinel()> config:update
```

Include the `failover:` portion of the broker URL to allow the *Sentinel* to re-establish connectivity on failure. For a reference on the different URL formats, see ActiveMQ URI Protocols.

Even if the id, location and http-url must be set the same ways as for *Minion*, this may change in future versions of *Sentinel*.

Configure the credentials to use when communicating with OpenNMS Horizon

```
admin@sentinel()> opennms:scv-set opennms.http minion minion
admin@sentinel()> opennms:scv-set opennms.broker minion minion
```

Username and password is explicitly set to `minion` as it is assumed that they share the same credentials and roles.

Another way to configure credentials is to use the `scvcli` utility in your *Sentinel* `bin` directory.

Example of configuring credentials with the command line utility `scvcli`

```
[root@localhost /root]# $ cd /opt/sentinel
[root@localhost /usr/share/sentinel]# $ ./bin/scvcli set opennms.http minion minion
[root@localhost /usr/share/sentinel]# $ ./bin/scvcli set opennms.broker minion minion
```

Restart the Sentinel after updating the credentials

```
[root@localhost /root]# $ systemctl restart sentinel
```

The credentials are configured separately since they are encrypted on disk.

Step 5: Verifying Connectivity

Connect to Karaf Shell of the Sentinel

```
ssh -p 8301 admin@localhost
```

Verify connectivity with the OpenNMS Horizon

```
admin@sentinel()> feature:install sentinel-core
admin@sentinel> opennms:health-check
Verifying the health of the container

Verifying installed bundles      [ Success  ]
Connecting to OpenNMS ReST API   [ Success  ]

=> Everything is awesome
admin@sentinel()>
```

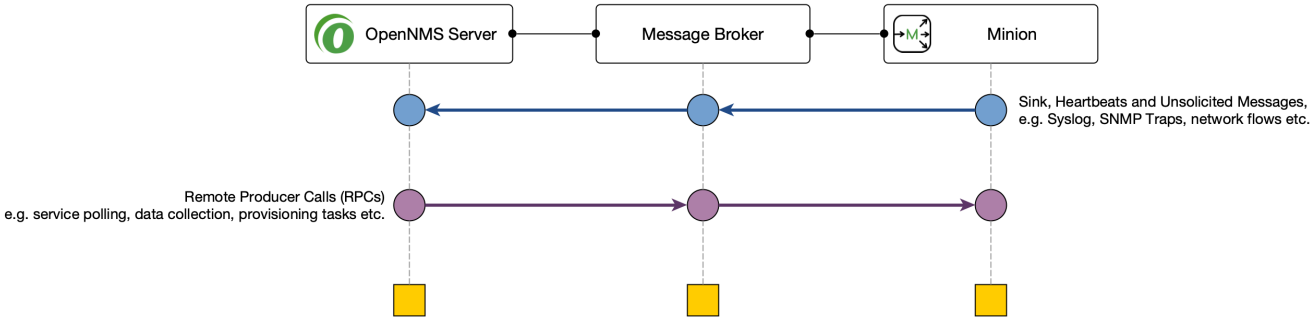
The `opennms:health-check` command is a newer and more flexibel version of the original `minion:ping` command. Therefore on *Sentinel* there is no equivalent such as `sentinel:ping`.

Chapter 5. Minion with custom messaging system

Minions and *OpenNMS Horizon* communicate via a messaging system. By default, an embedded *ActiveMQ* broker is used. *OpenNMS Horizon* is designed to work with different messaging systems and based on the system requirements or workload, an alternative to *ActiveMQ* can be used. In general, the communication between *OpenNMS Horizon* and *Minion* is provided by two patterns:

- *Remote Producer Calls (RPCs)* are used to issue specific tasks (such as a request to poll or perform data collection) from an *OpenNMS Horizon* instance to a *Minion* in a remote location.
  - These calls are normally self-contained and include all of the meta-data and information required for them to be performed.
- The *Sink* pattern is used to send unsolicited messages (i.e. *Syslog*, *SNMP Traps* or *Flows*) received from a *Minion* to an *OpenNMS Horizon* instance

High level components used for communication between OpenNMS Horizon and Minions



This section describes how you can setup *OpenNMS Horizon* to use other supported messaging systems for the communication with *Minions*.

5.1. Setup using Apache Kafka

This section describes how to use *Apache Kafka* as a messaging system between *OpenNMS Horizon* and *Minions* in a remote location.

5.1.1. Objectives

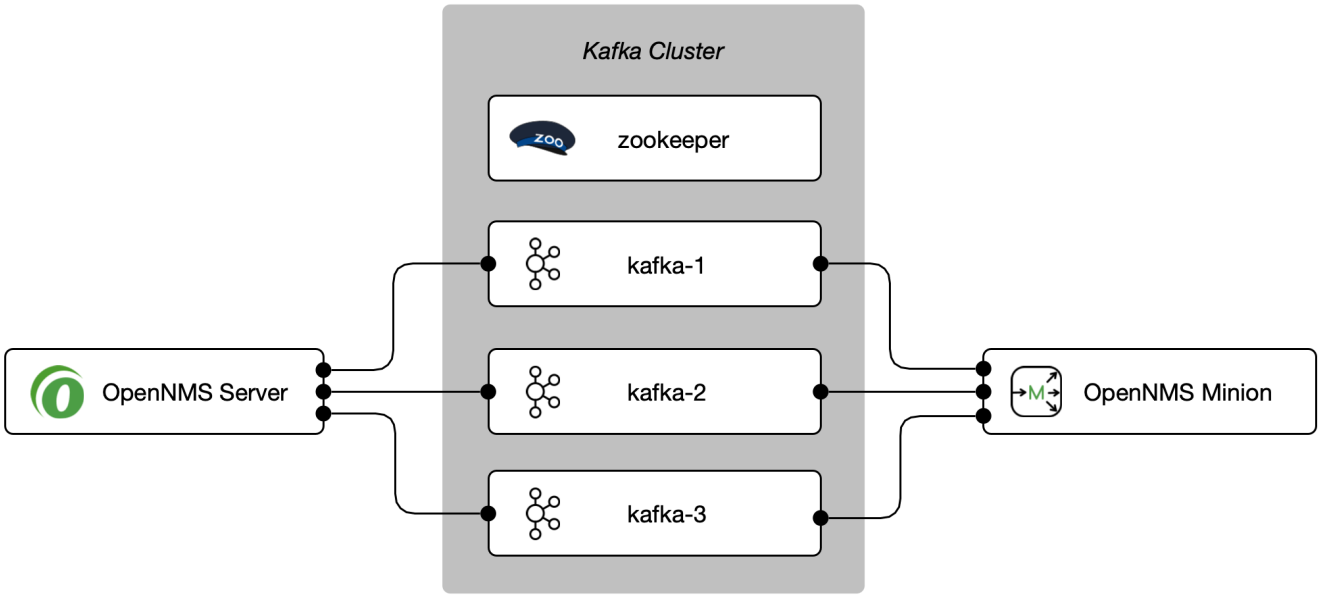
- Configure *OpenNMS Horizon* to forward *RPC* to a *Minion*
- Configure *Minion* to forward messages over the *Sink* component to an *OpenNMS Horizon* instance
- Disable the embedded *Active MQ* message broker on the *Minion*.
- Verify the functionality on the *Minion* using the `opennms:health-check` command and ensure the *Minion* is registered and monitored in the *OpenNMS Horizon* web interface

5.1.2. Before you begin

The following requirements should be satisfied before you can start with this tutorial:

- At least a minimal Kafka system up and running If you want to start in a lab, the Apache Kafka Quickstart guide is a good starting point
- An instance running with *OpenNMS Horizon* and at least one deployed *Minion*
- Communication between *OpenNMS Horizon*, *Minion* and *Apache Kafka* is possible on TCP port 9092

Network topology used for the following configuration example



	The example is used to describe how the components need to be configured. IP addresses and hostnames need to be adjusted accordingly.

	You can add more than one Kafka server to the configuration. The driver will attempt to connect to the first entry. If that is successful the whole broker topology will be discovered and will be known by the client. The other entries are only used if the connection to the first entry fails.

5.1.3. Configure OpenNMS Horizon

Step 1: Set Kafka as RPC strategy and add Kafka server

```
cat <<EOF >${OPENNMS_HOME}/etc/opennms.properties.d/kafka.properties
org.opennms.core.ipc.rpc.strategy=kafka
org.opennms.core.ipc.rpc.kafka.bootstrap.servers=kafka-1:9092,kafka-2:9092,kafka-
3:9092
EOF
```

Step 2: Set Kafka as Sink strategy and add Kafka server

```
cat <<EOF >>${OPENNMS_HOME}/etc/opennms.properties.d/kafka.properties
# Ensure that messages are not consumed from Kafka until the system has fully
initialized
org.opennms.core.ipc.sink.initialSleepTime=60000
org.opennms.core.ipc.sink.strategy=kafka
org.opennms.core.ipc.sink.kafka.bootstrap.servers=kafka-1:9092,kafka-2:9092,kafka-
3:9092
EOF
```

Step 3: Restart OpenNMS Horizon

```
systemctl restart opennms
```

5.1.4. Configure Minion

Step 1: Disable ActiveMQ for RPC and Sink

Disable ActiveMQ on Minion startup

```
cat <<EOF >${MINION_HOME}/etc/featuresBoot.d/disable-activemq.boot
!minion-jms
!opennms-core-ipc-rpc-jms
!opennms-core-ipc-sink-camel
EOF
```

Step 2: Enable Kafka for RPC and Sink

```
cat <<EOF >${MINION_HOME}/etc/featuresBoot.d/kafka.boot
opennms-core-ipc-rpc-kafka
opennms-core-ipc-sink-kafka
EOF
```

Step 3: Configure Kafka server

Add Kafka server for RPC communication

```
cat <<EOF >${MINION_HOME}/etc/org.opennms.core.ipc.rpc.kafka.cfg
bootstrap.servers=kafka-1:9092,kafka-2:9092,kafka-3:9092
acks=1
EOF
```

Add Kafka server for Sink communication

```
cat <<EOF >${MINION_HOME}/etc/org.opennms.core.ipc.sink.kafka.cfg
bootstrap.servers=kafka-1:9092,kafka-2:9092,kafka-3:9092
acks=1
EOF
```

Step 4: Restart Minion to apply changes

```
systemctl restart minion
```

Step 5: Verify Kafka configuration and connectivity

Login to Karaf Shell

```
ssh admin@localhost -p 8201
```

Test if Kafka RPC and Sink feature is started

```
feature:list | grep opennms-core-ipc-rpc-kafka
opennms-core-ipc-rpc-kafka  | 25.0.0           | x        | Started

feature:list | grep opennms-core-ipc-sink-kafka
opennms-core-ipc-sink-kafka | 25.0.0           | x        | Started
```

Test connectivity to Kafka

```
opennms:health-check
Verifying the health of the container

Connecting to OpenNMS ReST API   [ Success  ]
Verifying installed bundles      [ Success  ]
Connecting to Kafka from RPC     [ Success  ]
Connecting to Kafka from Sink    [ Success  ]

=> Everything is awesome
```

Step 6. Verify Minion functionality

Ensure the Minion is registered in the OpenNMS Horizon web interface

1. Login as Administrator
2. Configure OpenNMS
3. Manage Minions
4. Minion should be registered and should be shown as "Up"
5. Click on the name of the Minion and go to the node detail page

6. Verify if the services on the loopback interface *JMX-Minion*, *Minion-Heartbeat*, *Minion-RPC* are monitored and "Up"

5.1.5. Tuning Apache Kafka

The configuration is shipped with sane defaults, but depending on the size and network topology it can be required to tune the *Apache Kafka* environment to meet certain needs. *Apache Kafka* options can be set directly in the `org.opennms.core.ipc.rpc.kafka.cfg` and `org.opennms.core.ipc.sink.kafka.cfg` file.

Alternatively: *Kafka* producer/consumer options can be set by defining additional system properties prefixed with `org.opennms.core.ipc.rpc.kafka` and `org.opennms.core.ipc.sink.kafka`.

You can find available configuration parameters for *Kafka* here:

- Producer Configs for RPC communication
- New Consumer Configs for Sink communication

Multiple OpenNMS Horizon instances

Topics will be automatically created and are prefixed by default with `OpenNMS`. If you want to use an *Apache Kafka* cluster with multiple *OpenNMS Horizon* instances, the topic prefix can be customized by setting `org.opennms.core.ipc.rpc.kafka.group.id` and `org.opennms.core.ipc.sink.kafka.group.id` to a string value which identifies your instance.

Tips for Kafka

For Kafka RPC, the number of partitions should always be greater than the number of minions at a location. When there are multiple locations, partitions >= max number of minions at a location.

By default, Kafka RPC supports buffers greater than >1MB by splitting large buffer into chunks of 900KB(912600). Max buffer size (900KB, by default) can be configured by setting org.opennms.core.ipc.rpc.kafka.max.buffer.size (in bytes).

Default time to live (time at which request will expire) is 20000 msec (20sec). It can be changed by configuring system property `org.opennms.core.ipc.rpc.kafka.ttl` in msec.

5.1.6. Using Single Topic for Kafka RPC

By default OpenNMS creates a request and response topic for each module at every location. When dealing with too many locations, these numerous topics can overbuden Kafka. A single topic structure creates one request topic for each location and one response topic for all modules, regardless of location. Note that all Minions at any location must be running the same features in order to make use of single topic.

Single topic must be configured on both Minion and OpenNMS.

Configure single topic on Minion

```
echo 'single-topic=true' >> "$MINION_HOME/etc/org.opennms.core.ipc.rpc.kafka.cfg"
```

On OpenNMS, enable single topic by setting the `org.opennms.core.ipc.rpc.kafka.single-topic` system property to true.

5.2. Minion with gRPC Strategy

Minions and *OpenNMS Horizon* can communicate via gRPC for both *RPC* and *Sink* patterns. While using `GRPC` strategy Minion runs a *gRPC* client that connects to *OpenNMS Horizon* gRPC server on a custom port.

RPC pattern on GRPC strategy uses bidirectional streaming to send requests from *OpenNMS Horizon* and get responses back from Minion. Sink pattern on GRPC strategy uses unidirectional streaming to send sink messages from Minion to *OpenNMS Horizon*.

This section describes how you can set up *OpenNMS Horizon* to use `gRPC` for communication with *Minions*.

5.2.1. Configure OpenNMS Horizon

Step 1: Set GRPC as IPC strategy.

```
cat <<EOF >${OPENNMS_HOME}/etc/opennms.properties.d/grpc.properties
org.opennms.core.ipc.strategy=osgi
EOF
```

Step 2: Add GRPC Server feature.

```
cat <<EOF >${OPENNMS_HOME}/etc/featuresBoot.d/grpc.boot
opennms-core-ipc-grpc-server
EOF
```

Step 3: Enable and configure TLS on gRPC server.

Enable TLS and configure TLS certificates and private keys.

```
cat <<EOF >${OPENNMS_HOME}/etc/org.opennms.core.ipc.grpc.server.cfg
tls.enabled=true
server.cert.filepath=/custom-path/server.crt
server.private.key.filepath=/custom-path/server.pem
client.cert.filepath=/custom-path/client.crt
EOF
```

Step 4: Configure max. message size if default of 10MB is not sufficient.

(needs to be configured on both server and client)

Configure max. message size

```
cat <<EOF >${OPENNMS_HOME}/etc/org.opennms.core.ipc.grpc.server.cfg
max.message.size=10485760
EOF
```

Step 5: Restart OpenNMS Horizon.

```
systemctl restart opennms
```

5.2.2. Configure Minion

Step 1: Disable ActiveMQ for RPC and Sink.

Disable ActiveMQ on Minion startup

```
cat <<EOF >${MINION_HOME}/etc/featuresBoot.d/disable-activemq.boot
!minion-jms
!opennms-core-ipc-rpc-jms
!opennms-core-ipc-sink-camel
EOF
```

Step 2: Enable GRPC for RPC and Sink.

```
cat <<EOF >${MINION_HOME}/etc/featuresBoot.d/grpc.boot
opennms-core-ipc-grpc-client
EOF
```

Step 3: Configure gRPC server information.

Add gRPC server for RPC/Sink communication.

```
cat <<EOF >${MINION_HOME}/etc/org.opennms.core.ipc.grpc.client.cfg
host=localhost
port=8990
EOF
```

Step 4: Enable and configure TLS on gRPC client.

Enable TLS and configure TLS certificates and private keys.

```
cat <<EOF >${MINION_HOME}/etc/org.opennms.core.ipc.grpc.client.cfg
tls.enabled=true
trust.cert.filepath=/custom-path/ca.crt
client.cert.filepath=/custom-path/client.crt
client.private.key.filepath=/custom-path/client.pem
EOF
```

Step 5: Configure max. message size if default of 10MB is not sufficient.

(needs to be configured on both server and client)

Configure max. message size

```
cat <<EOF >${MINION_HOME}/etc/org.opennms.core.ipc.grpc.client.cfg
max.message.size=10485760
EOF
```

Step 6: Restart Minion to apply changes.

```
systemctl restart minion
```

Step 7: Verify GRPC configuration and connectivity.

Login to Karaf shell

```
ssh admin@localhost -p 8201
```

Test if gRPC client can connect to OpenNMS Horizon gRPC server

```
feature:list | grep opennms-core-ipc-grpc-client
opennms-core-ipc-grpc-client                | 27.0.3   | x         | Started
```

Test connectivity to Kafka

```
opennms-health:check
Verifying the health of the container

Connecting to OpenNMS ReST API   [ Success  ]
Verifying installed bundles      [ Success  ]
Connecting to gRPC IPC Server    [ Success  ]

=> Everything is awesome
```

Step 8. Verify Minion functionality.

Ensure the Minion is registered in the OpenNMS Horizon web interface

1. Login as Administrator
2. Configure OpenNMS
3. Manage Minions
4. Minion should be registered and should be shown as "Up"
5. Click on the name of the Minion and go to the node detail page
6. Verify if the services on the loopback interface *JMX-Minion*, *Minion-Heartbeat*, *Minion-RPC* are monitored and "Up"

Chapter 6. Install other versions than stable

Installation packages are available for different releases of *OpenNMS Horizon* or *Minion*. You will need to choose which release you would like to run and then configure your package repository to point to that release. Configuring a package repository will enable you to install and update the software by using standard Linux software update tools like *yum* and *apt*.

The following package repositories are available:

Table 14. OpenNMS package repositories

Release	Description
`stable`	Latest stable release. This version is recommended for all users.
`testing`	Release candidate for the next stable release.
`snapshot`	Latest successful development build, the "nightly" build.
`branches/${BRANCH-NAME}`	Install from a specific branch name for testing a specific feature that is under development. Available branches can be found in https://yum.opennms.org/branches/ or https://debian.opennms.org/dists/branches/.

To install a different release the repository files have to be installed and manually modified.

In *Debian* systems modify the repository file in `/etc/apt/sources.list.d/opennms.list`.

```
deb https://debian.opennms.org snapshot main①
deb-src https://debian.opennms.org snapshot main①
EOF
wget -O - https://debian.opennms.org/OPENNMS-GPG-KEY | apt-key add -
apt update
```

① Change from `stable` to `snapshot`

On *RHEL* systems you can install a snapshot repository with:

```
yum -y install https://yum.opennms.org/repofiles/opennms-repo-snapshot-
rhel7.noarch.rpm
```

For branches use `repofiles/opennms-repo-branches-${branch-name}-rhel7.noarch.rpm`.

The installation procedure is the same as with the stable version.

Chapter 7. Setup Minion with a config file

Beside manually configuring a *Minion* instance via the *Karaf CLI* it is possibleto modify and deploy its configuration file through configuration management tools. The configuration file is located in `${MINION_HOME}/etc/org.opennms.minion.controller.cfg`. All configurations set in *Karaf CLI* will be persisted in this configuration file which can also be populated through configuration management tools.

Configuration file for Minion

```
id = 00000000-0000-0000-0000-deadbeef0001
location = MINION
broker-url = tcp://myopennms.example.org:61616
http-url = http://myopennms.example.org:8980/opennms
```

The *Minion* needs to be restarted when this configuration file is changed.

In case the credentials needs to be set through the *CLI* with configuration management tools or scripts, the `${MINION_HOME}/bin/client` command can be used which allows to execute *Karaf* commands through the Linux shell.

Chapter 8. Running in non-root environments

This section provides information running *OpenNMS Horizon* and *Minions* processes in non-root environments. Running with a system user have restricted possibilites. This section describes how to configure your *Linux* system related to:

- sending *ICMP* packages as an unprivileged user
- receiving *Syslog* on ports < 1023, e.g. 514/udp
- receiving *SNMP Trap* on ports < 1023,e.g. 162/udp

8.1. Send ICMP as non-root

By default, *Linux* does not allow regular users to perform `ping` operations from arbitrary programs (including *Java*). To enable the *Minion* or *OpenNMS Horizon* to ping properly, you must set a `sysctl` option.

Enable User Ping (Running System)d

```
# run this command as root to allow ping by any user (does not survive reboots)
sysctl net.ipv4.ping_group_range='0 429496729'
```

If you wish to restrict the range further, use the *GID* for the user the *Minion* or *OpenNMS Horizon* will run as, rather than `429496729`.

To enable this permanently, create a file in `/etc/sysctl.d/` to set the range:

/etc/sysctl.d/99-zzz-non-root-icmp.conf

```
# we start this filename with "99-zzz-" to make sure it's last, after anything else
that might have set it
net.ipv4.ping_group_range=0 429496729
```

8.2. Trap reception as non-root

If you wish your *Minion* or *OpenNMS Horizon* to listen to *SNMP Traps*, you will need to configure your firewall to port forward from the privileged trap port (162) to the Minion's default trap listener on port 1162.

Forward 162 to 1162 with Firewalld

```
# enable masquerade to allow port-forwards
firewall-cmd --add-masquerade
# forward port 162 TCP and UDP to port 1162 on localhost
firewall-cmd --add-forward-port=port=162:proto=udp:toport=1162:toaddr=127.0.0.1
firewall-cmd --add-forward-port=port=162:proto=tcp:toport=1162:toaddr=127.0.0.1
```

8.3. Syslog reception as non-root

If you wish your *Minion* or *OpenNMS Horizon* to listen to syslog messages, you will need to configure your firewall to port forward from the privileged *Syslog* port (514) to the Minion's default syslog listener on port 1514.

Forward 514 to 1514 with Firewalld

```
# enable masquerade to allow port-forwards
firewall-cmd --add-masquerade
# forward port 514 TCP and UDP to port 1514 on localhost
firewall-cmd --add-forward-port=port=514:proto=udp:toport=1514:toaddr=127.0.0.1
firewall-cmd --add-forward-port=port=514:proto=tcp:toport=1514:toaddr=127.0.0.1
```

Chapter 9. Use R for statistical computing

R is a free software environment for statistical computing and graphics. *OpenNMS Horizon* can leverage the power of *R* for forecasting and advanced calculations on collected time series data.

OpenNMS Horizon interfaces with *R* via *stdin* and *stdout*, and for this reason, *R* must be installed on the same host as *OpenNMS Horizon*. Note that installing *R* is optional, and not required by any of the core components.

9.1. Install R on RHEL

Commands and instructions are specific to RHEL 8. For RHEL 7, replace `dnf` with `yum`.

Ensure the dnf (yum on RHEL 7) plugin config-manager is installed

```
dnf -y install dnf-plugins-core
```

Enable the PowerTools repository for R dependencies

```
dnf config-manager --set-enabled PowerTools
```

Install the epel-release repository with R packages

```
dnf -y install epel-release
```

Install R-core package

```
dnf -y install R-core
```

9.2. Install R on Debian

Install R

```
apt -y install r-recommended
```

Chapter 10. Using a different Time Series Storage

OpenNMS Horizon stores performance data in a time series storage which is by default JRobin. For different scenarios it is useful to switch to a different time series storage. The following implementations are supported:

Table 15. Supported Time Series Databasees

JRobin	*JRobin* is a clone of *RRDTool* written in *Java*, it does not fully cover the latest feature set of *RRDTool* and is the default when you install *OpenNMS Horizon*. Data is stored on the local file system of the OpenNMS Horizon node. Depending on I/O capabilities it works good for small to medium sized installations.
RRDTool	*RRDTool* is active maintained and the de-facto standard dealing with time series data. Data is stored on the local file system of the OpenNMS Horizon node. Depending on I/O capabilities it works good for small to medium sized installations.
Newts	Newts is a database schema for Cassandra. The time series is stored on a dedicated *Cassandra* cluster which gives growth flexibility and allows to persist time series data in a large scale.

This section describes how to configure *OpenNMS Horizon* to use *RRDTool* and *Newts*.

The way how data is stored in the different time series databases makes it extremely hard to migrate from one technology to another. Data loss can't be prevented when you switch from one to another.

10.1. RRDtool

In most *Open Source* applications, RRDtool is often used and is the de-facto open standard for *Time Series Data*. The basic installation of *OpenNMS Horizon* comes with *JRobin* but it is simple to switch the system to use *RRDtool* to persist *Time Series Data*. This section describes how to install *RRDtool*, the *jrrd2 OpenNMS Java Interface* and how to configure *OpenNMS Horizon* to use it.

10.1.1. Install RRDTool on RHEL

Following this guide does not cover data migration from *JRobin* to *RRDTool*.

To install *jrrd2* enable the OpenNMS YUM repository ensure the repositories are enabled. You can enable them with `dnf config-manager --enable opennms-repo-stable-*`.

Step 1: Install RRDTool and the jrrd2 interface

Installation on RHEL

```
dnf -y install rrdtool jrrd2
```

Step 2: Configure OpenNMS Horizon to use RRDTool

```
cat << EOF | sudo tee /opt/opennms/etc/opennms.properties.d/timeseries.properties
org.opennms.rrd.strategyClass=org.opennms.netmgt.rrd.rrdtool.MultithreadedJniRrdStrate
gy
org.opennms.rrd.interfaceJar=/usr/share/java/jrrd2.jar
opennms.library.jrrd2=/usr/lib64/libjrrd2.so
org.opennms.web.graphs.engine=rrdtool # optional, unset if you want to keep Backshift
as default
EOF
```

The visualization with the graph engine is optional. You can still use the default graphing engine `backshift` by not setting the `org.opennms.web.graphs.engine` property and use the system default.

Step 3: Restart OpenNMS Horizon and verify setup

```
find /opt/opennms/share/rrd -iname "*.rrd"
```

With the first data collection, *RRDTool* files with extension *.rrd* will be created. The *JRobin* files with extension *.jrb* are not used anymore and are not deleted automatically.

10.1.2. Reference

The following configuration files have references to the *RRDTool* binary and may be changed if you have a customized *RRDTool* setup.

Table 16. References to the RRDtool binary

Configuration file	Property
`opennms.properties`	`rrd.binary=/usr/bin/rrdtool`
`response-adhoc-graph.properties`	`command.prefix=/usr/bin/rrdtool`
`response-graph.properties`	`command.prefix=/usr/bin/rrdtool` `info.command=/usr/bin/rrdtool`
`snmp-adhoc-graph.properties`	`command.prefix=/usr/bin/rrdtool`
`snmp-graph.properties`	`command.prefix=/usr/bin/rrdtool` `command=/usr/bin/rrdtool info`

10.1.3. Install RRDTool on Debian

Following this guide does not cover data migration from *JRobin* to *RRDTool*.

A more current version of *RRDTool* is in the *OpenNMS* YUM repository. The provided versions can be shown with `apt show rrdtool`. This guide uses the *RRDTool* provided in the *OpenNMS* repository. When using the *Debian/Ubuntu* provided *RRDTool* package verify the path to the *rrdtool* binary file.

Step 1: Install RRDTool and the jrrd2 interface

Installation on RHEL

```
apt -y install rrdtool jrrd2
```

Step 2: Configure OpenNMS Horizon to use RRDTool

```
cat << EOF | sudo tee
/usr/share/opennms/etc/opennms.properties.d/timeseries.properties
org.opennms.rrd.strategyClass=org.opennms.netmgt.rrd.rrdtool.MultithreadedJniRrdStrate
gy
org.opennms.rrd.interfaceJar=/usr/share/java/jrrd2.jar
opennms.library.jrrd2=/usr/lib/jni/libjrrd2.so
org.opennms.web.graphs.engine=rrdtool # optional, unset if you want to keep Backshift
as default
EOF
```

The visualization with the graph engine is optional. You can still use the default graphing engine `backshift` by not setting the `org.opennms.web.graphs.engine` property and use the system default.

Step 3: Restart OpenNMS Horizon and verify setup

```
find /usr/share/opennms/share/rrd -iname "*.rrd"
```

With the first data collection, *RRDTool* files with extension *.rrd* will be created. The *JRobin* files with extension *.jrb* are not used anymore and are not deleted automatically.

10.1.4. Reference

The following configuration files have references to the *RRDTool* binary and may be changed if you have a customized *RRDTool* setup.

Table 17. References to the RRDtool binary

Configuration file	Property
opennms.properties	rrd.binary=/usr/bin/rrdtool
response-adhoc-graph.properties	command.prefix=/usr/bin/rrdtool
response-graph.properties	command.prefix=/usr/bin/rrdtool info.command=/usr/bin/rrdtool
snmp-adhoc-graph.properties	command.prefix=/usr/bin/rrdtool
snmp-graph.properties	command.prefix=/usr/bin/rrdtool command=/usr/bin/rrdtool info

10.2. Newts for Time Series data

Newts is a time-series data schema for Apache Cassandra. It enables horizontally scale capabilities for your time series storage and is an alternative to JRobin and RRDtool.

The *Cassandra* cluster design, setup, sizing, tuning and operation is out of scope for this section. To install and set up a *Cassandra* cluster please follow the Cassandra installation instructions. For further information see Cassandra Getting Started Guide.

To avoid unwanted updates disable the *Cassandra* repository on *DNF/YUM* based distributions or use `apt-mark hold cassandra` on *APT* based distributions.

For simplicity we use the `${OPENNMS_HOME}/bin/newts init` command which initializes a *Newts* keyspace for you and the defaults are not optimal tuned for a production-ready environment. If you want to build a production environment please consult Sizing Cassandra for Newts and planning Anti-patterns in Cassandra articles.

10.2.1. Objectives

- Configure *OpenNMS Horizon* to use an existing *Cassandra* cluster
- Initializing the *Newts* keyspace using `newts init` with *STCS* without production-ready tuning
- Verify time series data is stored and can be accessed

10.2.2. Before you begin

- A running instance of *OpenNMS Horizon* running on Linux
- Working data collection and response time metrics from *Collectd* and *Pollerd*
- *Cassandra* cluster with access to the *Cassandra* client port `TCP/9042`

It is currently not supported to initialize the *Newts* keyspace from *Microsoft Windows Server* operating system. *Microsoft Windows* based *Cassandra* server can be part of the cluster, but keyspace initialization is only possible using a *Linux* operating system.

10.2.3. Configure OpenNMS Horizon to use Newts

Step 1: Configure Cassandra endpoints, keyspace and time series strategy

```
cat << EOF | sudo tee /opt/opennms/etc/opennms.properties.d/timeseries.properties
# Configure storage strategy
org.opennms.rrd.storeByForeignSource=true①
org.opennms.timeseries.strategy=newts②

# Configure Newts time series storage connection
org.opennms.newts.config.hostname={cassandra-ip1,cassandra-ip2}③
org.opennms.newts.config.keyspace=newts④
org.opennms.newts.config.port=9042⑤

# One year in seconds
org.opennms.newts.config.ttl=31540000

# Seven days in seconds
org.opennms.newts.config.resource_shard=604800
EOF
```

① Associate time series data by the foreign ID instead of the database generated Node-ID

② Set time-series strategy to use `newts`

③ Host or IP addresses of the *Cassandra* cluster nodes can be a comma-separated list

④ Name of the keyspace which is initialized and used

⑤ Port to connect to *Cassandra*

Step 2: Initialize the *Newts* schema in *Cassandra*

```
${OPENNMS_HOME}/bin/newts init
```

Step 3: Verify if the keyspace was properly initialized

Connect to a *Cassandra* node with a CQL shell

```
cd $CASSANDRA_HOME/bin
./cqlsh

use newts;
describe table terms;
describe table samples;
```

Step 4: Apply changes and verify your configuration

```
systemctl restart opennms
```

Go to the Node detail page from a *SNMP* managed device and verify if you response time graphs for *ICMP* and *Node-level Performance data*.