Installation Guide

Copyright (c) 2015-2016 The OpenNMS Group, Inc.

OpenNMS Horizon 17.0.1-SNAPSHOT
Last updated 2016-06-13 17:19:06 -04:00

Table of Contents

1. Installation Overview 1
2. Yum/APT Package Repositories 2
   2.1. RHEL Yum Repository 2
   2.2. Debian APT Repository 2
3. OpenNMS 3
   3.1. RHEL 3
      3.1.1. Install OpenNMS 3
      3.1.2. Prepare PostgreSQL 4
      3.1.3. Initialize OpenNMS 5
   3.2. Debian 6
      3.2.1. Install OpenNMS 6
      3.2.2. Prepare PostgreSQL 7
      3.2.3. Initialize OpenNMS 8
   3.3. Microsoft Windows 8
      3.3.1. Install PostgreSQL 9
      3.3.2. Install OpenNMS with GUI installer 9
4. Oracle Java SE Development Kit 8 12
   4.1. RHEL 12
   4.2. Debian 12
   4.3. Microsoft Windows 13
   4.4. Java Environment 13
      4.4.1. Set JAVA_HOME on Linux 13
      4.4.2. Set JAVA_HOME on Microsoft Windows 13
5. RRDtool 15
   5.1. RHEL 15
   5.2. Debian 15
   5.3. Source 15
   5.4. Install jrrd2 Interface 15
   5.5. Configure OpenNMS Horizon 16
6. Newts 17
   6.1. Setting up Cassandra 17
      6.1.1. RHEL 17
      6.1.2. Debian 18
      6.1.3. Microsoft Windows 18
   6.2. Configure OpenNMS Horizon 19
7. R Statistics System 20
   7.1. RHEL 20
   7.2. Debian 20

Chapter 1. Installation Overview

The *OpenNMS* platform can be installed in several ways. This guide describes the installation of the platform on *Red Hat Enterprise Linux (RHEL)*-based, *Debian*-based and *Microsoft Windows* operating systems. The following abbreviations will be used to refer to the following operating systems:

- *RHEL*: Red Hat Enterprise Linux 6 or higher, CentOS 6 or higher, Fedora 20 or higher
- *Debian*: Debian 7 or higher, Ubuntu 14.04 or higher
- *Microsoft Windows*: Windows 8.1, Windows Server 2012, Windows 10

Installable, precompiled software packages are provided through *RHEL Yum* and *Debian APT* repository servers and from the OpenNMS Sourceforge project page. Installing *OpenNMS* requires the following prerequisites:

- A configured Yum or APT Package Repository for your platform (Linux only)
- Internet access to download and verify *OpenNMS* packages from the Yum or APT package repositories
- Oracle Java SE Development Kit 8 environment
- PostgreSQL database version 9.1 or higher
- A time-series database engine to persist long-term performance data:
  - JRobin: The default choice. JRobin is included inside OpenNMS and doesn't require additional software to be installed.
  - RRDtool: A higher performance, file-based database.
  - Newts: The highest performance solution. Newts uses an Apache Cassandra database for clustered scalability.

NOTE *OpenJDK 8* can be used, but for production and critical environments *Oracle Java SE Development Kit 8* is recommended.

NOTE `${OPENNMS_HOME}` will be used to refer to the path where *OpenNMS* is installed. It is different depending on your platform:

- *RHEL*: `/opt/opennms`
- *Debian*: `/usr/share/opennms`
- *Microsoft Windows*: `C:\Program Files\opennms`

With the *opennms* meta package all dependencies needed for the components mentioned above are maintained. The following sections describe how to install *OpenNMS* on a single system. Dependencies for *Java* and the *PostgreSQL* database are maintained with the *opennms* meta installation package.

Chapter 2. Yum/APT Package Repositories

Installation packages are available for different releases of *OpenNMS*. You 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 1. 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 http://yum.opennms.org/branches/ or http://debian.opennms.org/dists/branches/.

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

2.1. RHEL Yum Repository

Install the configuration for a package repository

```
rpm -Uvh http://yum.opennms.org/repofiles/opennms-repo-${RELEASE}-rhel7.noarch.rpm <1>
rpm --import http://yum.opennms.org/OPENNMS-GPG-KEY
```

① Replace `${RELEASE}` with a release name like `stable` (recommended), `testing`, or `snapshot`.

2.2. Debian APT Repository

Create a new apt source file (eg: `/etc/apt/sources.list.d/opennms.list`), and add the following 2 lines:

Package repository configuration for Debian-based systems

```
deb http://debian.opennms.org ${RELEASE} main <1>
deb-src http://debian.opennms.org ${RELEASE} main <1>
```

① Replace `${RELEASE}` with a release name like `stable` (recommended), `testing`, or `snapshot`.

Import the packages' authentication key with the following command:

GPG key import for Debian-based systems

```
wget -O - http://debian.opennms.org/OPENNMS-GPG-KEY | apt-key add -
```

Chapter 3. OpenNMS

After configuring the package repository, you are ready to install the *OpenNMS* packages, configure the database, and initialize the *OpenNMS* platform.

3.1. RHEL

This section describes how to install the *OpenNMS* platform on *CentOS 7.1*. The setup process is described in the following steps:

1. Installation of the *opennms* meta package which handles all dependencies
2. Initialize *PostgreSQL* database and configure access
3. Initialize *OpenNMS* and first start of the application

3.1.1. Install OpenNMS

Installation of the full application with all dependencies like PostgreSQL and Java

```
yum -y install opennms
```

The following packages will be automatically installed:

- *opennms*: The platform meta package which handles all dependencies from *OpenNMS* repository.
- *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
- *jdk1.8*: *Oracle Java SE Development Kit 8* environment from *OpenNMS* respository
- *postgresql*: *PostgreSQL* database server from distribution repository
- *postgresql-libs*: *PostgreSQL* database from distribution repository

TIP Verify the version of the *OpenNMS* packages that was installed with `yum info opennms`.

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

```
[root@localhost /opt/opennms]# tree -L 2
.
└── opennms
    ├── bin
    ├── contrib
    ├── data
    ├── deploy
    ├── etc
    ├── jetty-webapps
    ├── lib
    ├── logs -> /var/log/opennms
    ├── share -> /var/opennms
    └── system
```

3.1.2. Prepare PostgreSQL

The *CentOS* package installs but doesn't initialize the *PostgreSQL* database directory. Additionally *OpenNMS* requires authentication to access the database and are described in this section. Initialize the database directory with

Initialization of the PostgreSQL database

```
postgresql-setup initdb
```

System startup configuration for PostgreSQL

```
systemctl enable postgresql
```

Startup PostgreSQL database

```
systemctl start postgresql
```

The next step is setting the *postgres* super user password and creating an *opennms* database user with password. Additionally it is required to configure the authentication method to allow authentication from the local network.

Accounting and database management for OpenNMS

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

Set password for Postgres super user

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

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

To allow *OpenNMS* access to the database over the local network *PostgreSQL* has to be configured.

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

Configuration of network access for PostgreSQL

```
host    all             all             127.0.0.1/32            md5<1>
host    all             all             ::1/128                 md5<1>
```

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

Apply configuration changes for PostgreSQL

```
systemctl reload postgresql
```

In the next step configure the *OpenNMS* database configuration.

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

Configuration for database authentication in OpenNMS

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

<jdbc-data-source name="opennms-admin"
                  database-name="template1"
                  class-name="org.postgresql.Driver"
                  url="jdbc:postgresql://localhost:5432/template1"
                  user-name="postgres"<3>
                  password="** YOUR-POSTGRES-PASSWORD **" /><4>
```

① Set the user name to access the *OpenNMS* database table

② Set the password to access the *OpenNMS* database table

③ Set the *postgres* user for administrative access to PostgreSQL

④ Set the password for administrative access to PostgreSQL

3.1.3. Initialize OpenNMS

OpenNMS is now configured to access the database. It is required to set the *Java* environment running *OpenNMS* and initialize the database schema.

Configuration of Java environment for OpenNMS

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

Initialization of database and system libraries

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

System startup configuration for OpenNMS

```
systemctl enable opennms
```

Startup OpenNMS

```
systemctl start opennms
```

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*.

IMPORTANT	Change the default admin password to a secure password immediately.

3.2. Debian

IMPORTANT	This guide does not apply to OpenNMS Meridian, which can be installed only on Red Hat Enterprise Linux or CentOS systems.

This section describes how to install the *OpenNMS* platform on *Ubuntu 14.04 LTS*. The setup process is described in the following steps:

1. Installation of the *opennms* meta package which handles all dependencies
2. Initialize *PostgreSQL* database and configure access
3. Initialize *OpenNMS* and first start of the application

3.2.1. Install OpenNMS

Installation of the full application with all dependencies like PostgreSQL and Java

```
apt-get update
apt-get install -y opennms
```

The following packages will be automatically installed:

- *opennms*: The platform meta package which handles all dependencies from *OpenNMS* repository.
- *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
- *jdk1.8*: *Oracle Java 8* environment from *OpenNMS* respository
- *postgresql*: *PostgreSQL* database server from distribution repository
- *postgresql-libs*: *PostgreSQL* database from distribution repository

TIP	Verify the version of the *OpenNMS* packages that was installed with `apt-cache show opennms`.

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

```
[root@localhost /usr/share/opennms]# tree -L 2
.
└── opennms
    ├── bin
    ├── data
    ├── deploy
    ├── etc -> /etc/opennms
    ├── instances
    ├── jetty-webapps
    ├── lib -> ../java/opennms
    ├── logs -> /var/log/opennms
    ├── share -> /var/lib/opennms
    └── system
```

3.2.2. Prepare PostgreSQL

The *Debian* package installs also *PostgreSQL* database and is already initialized and added in the runlevel configuration. It is only necessary to start the *PostgreSQL* database without a restart.

Startup PostgreSQL database

```
service postgresql start
```

The next step is creating an *opennms* database user with password and configure the authentication method.

Accounting and database management for OpenNMS

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

NOTE It is not necessary to change the authentication method in `pg_hba.conf`, it is by default set to `md5` for localhost connections.

Set password for Postgres super user

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

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

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

Configuration for database authentication in OpenNMS

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

<jdbc-data-source name="opennms-admin"
                  database-name="template1"
                  class-name="org.postgresql.Driver"
                  url="jdbc:postgresql://localhost:5432/template1"
                  user-name="postgres"<3>
                  password="** YOUR-POSTGRES-PASSWORD **" /><4>
```

① Set the user name to access the *OpenNMS* database table

② Set the password to access the *OpenNMS* database table

③ Set the *postgres* user for administrative access to PostgreSQL

④ Set the password for administrative access to PostgreSQL

3.2.3. Initialize OpenNMS

OpenNMS is now configured to access the database. It is required to set the *Java* environment running *OpenNMS* and initialize the database schema.

Configuration of Java environment for OpenNMS

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

Initialization of database and system libraries

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

NOTE It is not necessary to add *OpenNMS* to the run level manually, it is automatically added after setup.

Startup OpenNMS

```
service opennms start
```

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*.

IMPORTANT Change the default admin password to a secure password immediately.

3.3. Microsoft Windows

IMPORTANT This guide does not apply to OpenNMS Meridian, which can be installed only on Red Hat Enterprise Linux or CentOS systems.

OpenNMS is mostly developed on Unix/Linux based systems, nevertheless it is possible to install the platform on *Microsoft Windows* operating systems. To install the application a graphical installer is provided and can be used to install *OpenNMS* on *Microsoft Windows*. This section describes how to install the *OpenNMS* platform on *Microsoft Windows 2012 Server*.

NOTE The standalone installer for *Microsoft Windows* is only available for the most recent stable version of *OpenNMS*.

IMPORTANT It is required to have Oracle JDK 8 installed. The *JRE* is **NOT** sufficient.

TIP To edit *OpenNMS* configuration files on *Microsoft Windows* the tool Notepad++ can deal with the formatting of *.property* and *.xml* files.

The setup process is described in the following steps:

1. Installation of *PostgreSQL* database service
2. Download and install the graphical *OpenNMS* installer
3. First start of the *OpenNMS* application

3.3.1. Install PostgreSQL

PostgreSQL is available for *Microsoft Windows* and latest version can be downloaded from Download PostgreSQL page. Follow the on-screen instructions of the graphical installer.

NOTE The placeholder `{PG-VERSION}` represents the *PostgreSQL* version number. A version of *9.1+* is required for *OpenNMS*.

The following information has to be provided:

- Installation directory for *PostgreSQL*, e.g. `C:\Program Files\PostgreSQL{PG-VERSION}`
- Password for the database superuser (*postgres*), this password will be used during the *OpenNMS* setup.
- Port to listen for *PostgreSQL* connections, default is `5432` and can normally be used.
- Locale for the database, keep `[Default locale]`, if you change the locale, *OpenNMS* may not be able to initialize the database.

TIP It is not required to install anything additional from the *PostgreSQL Stack Builder*.

NOTE The database data directory is automatically initialized during the setup and the *postgresql-x64-{PG-VERSION}* is already added as service and automatically started at system boot.

NOTE It is not necessary to change the authentication method in `pg_hba.conf`, it is by default set to `md5` for localhost connections.

3.3.2. Install OpenNMS with GUI installer

For *Microsoft Windows* environments download the *standalone-opennms-installer-{ONMS-VERSION}.zip* file from the OpenNMS SourceForge repository. Extract the downloaded *ZIP* file.

NOTE The `{ONMS-VERSION}` has to be replaced with the latest stable version.

Start the graphical installer and follow the on screen instructions. The following information has to be provided:

- Path to *Oracle JDK*, e.g. `C:\Program Files\Java\jdk1.8.0_51`

- Installation path for *OpenNMS*, e.g. `C:\Program Files\OpenNMS`
- Select packages which has to be installed, the minimum default selection is *Core* and *Docs*
- PostgreSQL Database connection
  - Host: Server with *PostgreSQL* running, e.g. `localhost`
  - Name: Database name for *OpenNMS*, e.g. `opennms`
  - Port: *TCP* port connecting to *PostgreSQL* server, e.g. `5432`
  - Username (administrative superuser): *PostgreSQL* superuser, e.g. `postgres`
  - Password (administrative superuser): Password given during *PostgreSQL* setup for the superuser
  - Username (runtime user for opennms): Username to connect to the *OpenNMS* database, e.g. `opennms`
  - Password (runtime user for opennms): Password to connect to the *OpenNMS* database, e.g. `opennms`
- Configure a discovery range for an initial node discovery. If you don't want any discovery set begin and end to the same unreachable address.

IMPORTANT	Choose secure passwords for all database users and don't use the example passwords above in production.
WARNING	There is currently an open issue in the installer NMS-7831. Username and password are not written to the `opennms-datasources.xml` file and has to be changed manually. The initialize of the database will fail with an authentication error.

Configuration for database authentication in OpenNMS

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

<jdbc-data-source name="opennms-admin"
                  database-name="template1"
                  class-name="org.postgresql.Driver"
                  url="jdbc:postgresql://localhost:5432/template1"
                  user-name="postgres"<3>
                  password="** YOUR-POSTGRES-PASSWORD **" /><4>
```

① Set the user name to access the *OpenNMS* database table

② Set the password to access the *OpenNMS* database table

③ Set the *postgres* user for administrative access to PostgreSQL

④ Set the password for administrative changes of the *OpenNMS* database table

After setting the username and passwords in `opennms-datasources.xml` re-run the graphical installer and also initialize the database. *OpenNMS* can be started and stopped with the `start.bat` and `stop.bat` script located in `%OPENNMS_HOME%\bin` directory.

After starting *OpenNMS* with the `start.bat` file 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*.

IMPORTANT Change the default admin password to a secure password immediately.

TIP The Wiki article Configuring OpenNMS as Windows Service describes how to create a *Windows Service* from the `start.bat` files. There is also a Java Wrapper which allows to install *Java* applications as *Windows Service*.

Chapter 4. Oracle Java SE Development Kit 8

Installing the *Oracle Java SE Development Kit 8* (*JDK8*) requires installation packages provided by *Oracle* or a 3rd-party maintainer for *Debian*-based Linux distributions. The following tools should be installed to follow this installation manual:

- Download files and tools with `wget` and `curl`
- Extract archives with `tar`
- Text manipulation with `sed`
- Editing text, e.g. `vi`, `nano` or `joe`
- Internet access

WARNING By downloading the *Oracle Java SE Development Kit 8* RPM installer, you will accept the license agreement from *Oracle* which can be found on the Java distribution web site.

4.1. RHEL

This section describes how to install *Oracle Java SE Development Kit 8* on a *RPM-based* system like *Red Hat Enterprise Linux 7* or *CentOS 7.1*.

Download Oracle JDK RPM

```
wget --no-cookies \
     --no-check-certificate \
     --header \
              "Cookie: oraclelicense=accept-securebackup-cookie" \
              "http://download.oracle.com/otn-pub/java/jdk/8u45-b14/jdk-8u45-linux-x64.rpm" \
     -O /tmp/jdk-8-linux-x64.rpm
```

Install Oracle JDK RPM file

```
yum install /tmp/jdk-8-linux-x64.rpm
```

4.2. Debian

This section describes how to install *Oracle Java SE Development Kit 8* on a *Debian-based* system like *Debian 8* or *Ubuntu 14.04 LTS*.

Add Java repository from webupd8 maintainer

```
su -
echo "deb http://ppa.launchpad.net/webupd8team/java/ubuntu trusty main" | tee
/etc/apt/sources.list.d/webupd8team-java.list
echo "deb-src http://ppa.launchpad.net/webupd8team/java/ubuntu trusty main" | tee -a
/etc/apt/sources.list.d/webupd8team-java.list
```

Add repository key server and update repository

```
apt-key adv --keyserver hkp://keyserver.ubuntu.com:80 --recv-keys EEA14886
apt-get update
```

Install Oracle Java SE Development Kit 8

```
apt-get install -y oracle-java8-installer
```

4.3. Microsoft Windows

This section describes how to install *Oracle Java SE Development Kit 8* on a system running the *Microsoft Windows Server 2012* operating system.

Download the Microsoft Windows Java SE Development Kit 8 installer with PowerShell or a browser

```
cd C:\Users\Administrator\Downloads
Invoke-WebRequest http://javadl.sun.com/webapps/download/AutoDL?BundleId=107944 -Outfile java8-
installer.exe
```

Start the `java8-installer.exe` from the command line or with *Windows Explorer* from the Administrator's *Download* folder.

NOTE The setup requires administrative privileges.

4.4. Java Environment

To locate the *Java* system files, applications typically use the `$JAVA_HOME` environment variable. The environment can be set for a specific user or globally for the whole system on boot time.

- RHEL: `/usr/java/jdk1.8.0_51`
- Debian: `/usr/lib/jvm/java-8-oracle`
- Microsoft Windows: `C:\Program Files\Java\jre1.8.0_51`

4.4.1. Set JAVA_HOME on Linux

Option 1: Set the Java environment for the current user

```
vi ~/.bash_profile
export JAVA_HOME=/path/to/java
```

Option 2: Set the Java environment for all users on boot time

```
vi /etc/profile
export JAVA_HOME=/path/to/java
```

4.4.2. Set JAVA_HOME on Microsoft Windows

Option 1: Set JAVA_HOME as user specific system variable

```
setx "JAVA_HOME" "path\to\java"
```

Option 2: Set JAVA_HOME as a System variable

```
setx /M "JAVA_HOME" "path\to\java"
```

Chapter 5. 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* 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* to use it. *RRDtool* can be installed from the official package repositories provided by *RHEL* and *Debian* based *Linux* distributions.

5.1. RHEL

Installation on RHEL/CentOS

```
yum install rrdtool
```

5.2. Debian

Installation of RRDtool on Debian/Ubuntu

```
apt-get install rrdtool
```

5.3. Source

If you want the latest version of RRDtool, you may want to compile it from source. Instructions for doing so are at rrdbuild.

IMPORTANT	The latest version of RRDtool may not always be compatible with the version of *OpenNMS* that you want to run. Please ask about RRDtool support on the discussion lists or chat rooms if you have any problems running a new version of RRDtool.

NOTE	If you want to install the latest *RRDtool* from source, make sure the `rrdtool` binary is in search path. To make the setup easier, you can link the binary to `/usr/bin/rrdtool` which is the location where *OpenNMS* will expect to find the executable binary.

5.4. Install jrrd2 Interface

To get access from the *OpenNMS Java Virtual Machine* you have to install *jrrd2* as an interface. You can install it from the *OpenNMS* package repository with:

Installation of jrrd2 on RHEL/CentOS

```
yum install jrrd2
```

Installation of jrrd2 on Debian/Ubuntu

```
apt-get install jrrd2
```

NOTE	With OpenNMS 17.0.0 it is preferred to use *jrrd2* instead of *jrrd*. The *jrrd2* module is improved for performance by adding multithreading capabilities.

5.5. Configure OpenNMS Horizon

To configure *OpenNMS* to use *RRDtool* instead of *JRobin* configure the following properties in `rrd-configuration.properties`.

Configuration of RRDtool in OpenNMS on RHEL/CentOS

```
org.opennms.rrd.strategyClass=org.opennms.netmgt.rrd.rrdtool.MultithreadedJniRrdStrategy
org.opennms.rrd.interfaceJar=/usr/share/java/jrrd2.jar
opennms.library.jrrd2=/usr/lib64/libjrrd2.so
```

Configuration of RRDtool in OpenNMS on Debian/Ubuntu

```
org.opennms.rrd.strategyClass=org.opennms.netmgt.rrd.rrdtool.MultithreadedJniRrdStrategy
org.opennms.rrd.interfaceJar=/usr/share/java/jrrd2.jar
opennms.library.jrrd2=/usr/lib/jni/libjrrd2.so
```

TIP *OpenNMS* expects the *RRDtool* binary in `/usr/bin/rrdtool`.

Table 2. 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`

Chapter 6. Newts

Newts is a time-series data store based on Apache Cassandra. *Newts* is a persistence strategy, that can be used as an alternative to JRobin or RRDtool.

IMPORTANT	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-_based system.

6.1. Setting up Cassandra

WARNING	*Cassandra* is only required when using *Newts*. If your *OpenNMS Horizon* system is not using *Newts*, you can skip this section.

It is recommended to install *Cassandra* on a dedicated server, but is also possible to run a node on the *OpenNMS Horizon* server itself. This installation guide describes how to set up a single *Cassandra* instance on the same system as *OpenNMS Horizon* for the purpose of evaluating and testing *Newts*. These steps are not suitable for a production *Cassandra Cluster*. If you already have a running cluster you can skip this section.

For further information see Cassandra Getting Started Guide. Before setting up a production cluster make sure to consult Anti-patterns in Cassandra.

6.1.1. RHEL

This section describes how to install the latest *Cassandra 3.0.x* release on a *RHEL* based systems for *Newts*. The first step is to add the *DataStax* community repository and install the required *GPG Key* to verify the integrity of the *RPM packages*. After that install the package with *yum* and the *Cassandra* service is managed by *Systemd*.

NOTE	This description was built on *CentOS 7.2*.
NOTE	Cassandra 3.x requires Java 8+. See installing Java on RHEL for instructions.

Add the DataStax repository

```
vi /etc/yum.repos.d/datastax.repo
```

Content of the datastax.repo file

```
[datastax]
name = "DataStax Repo for Apache Cassandra"
baseurl = https://rpm.datastax.com/community
enabled = 1
gpgcheck = 1
```

Install GPG key to verify RPM packages

```
rpm --import https://rpm.datastax.com/rpm/repo_key
```

Install latest Cassandra 3.0.x package

```
yum install dsc30
```

Enable Cassandra to start on system boot

```
chkconfig cassandra on
```

Start cassandra service

```
service cassandra start
```

TIP Verify whether the *Cassandra* service is automatically started after rebooting the server.

6.1.2. Debian

This section describes how to install the latest *Cassandra 3.0.x* release on a *Debian*-based system for *Newts*. The first step is to add the *DataStax* community repository and install the required *GPG Key* to verify the integrity of the *DEB packages*. After that install the packages with *apt* and the *Cassandra* service is added to the runlevel configuration.

NOTE This description was built on *Debian 8.3* and *Ubuntu 16.04 LTS*.

NOTE Cassandra 3.x requires Java 8+. See installing Java on Debian for instructions.

Add the DataStax repository

```
vi /etc/apt/sources.list.d/cassandra.sources.list
```

Content of the cassandra.sources.list file

```
deb https://debian.datastax.com/community stable main
```

Install GPG key to verify DEB packages

```
wget -O - https://debian.datastax.com/debian/repo_key | apt-key add -
```

Install latest Cassandra 3.0.x package

```
apt-get update
apt-get install dsc30
```

The *Cassandra* service is added to the runlevel configuration and is automatically started after installing the package.

TIP Verify whether the *Cassandra* service is automatically started after rebooting the server.

6.1.3. Microsoft Windows

This section describes how to install the latest *Cassandra 3.0.x* release on a *Microsoft Windows Server* based systems for *Newts*. The first step is to download the graphical installer and register *Cassandra* as a *Windows Service* so it can be manged through the *Service Manager*.

NOTE This description was built on *Windows Server 2012*.

NOTE Cassandra 3.x requires Java 8+. See installing Java on Windows for instructions.

Download the DataStax graphical installer for Cassandra from PowerShell or a Browser

```
cd C:\Users\Administrator\Downloads
Invoke-WebRequest https://downloads.datastax.com/community/datastax-community-64bit_3.0.6.msi -Outfile
datastax-community-64bit_3.0.6.msi
```

Run the Windows Installer file from *PowerShell* or through *Windows Explorer* and follow the setup wizard to install. During the installation, accept the options to automatically start the services. By default the *DataStax Server*, *OpsCenter Server* and the *OpsCenter Agent* will be automatically installed and started.

NOTE The *DataStax OpsCenter Server* is only required to be installed once per *Cassandra Cluster*.

IMPORTANT If you install the *DataStax OpsCenter* make sure you have *Chrome* or *Firefox* installed.

6.2. Configure OpenNMS Horizon

Once *Cassandra* is installed, *OpenNMS Horizon* can be configured to use *Newts*. To enable and configure *Newts*, set the following properties in `${OPENNMS_HOME}/etc/opennms.properties`:

Configuration for OpenNMS Horizon

```
# Configure storage strategy
org.opennms.rrd.storeByForeignSource=true
org.opennms.timeseries.strategy=newts

# Configure Newts time series storage connection
org.opennms.newts.config.hostname=$ipaddress$
org.opennms.newts.config.keyspace=newts
org.opennms.newts.config.port=9042
```

NOTE The `org.opennms.newts.config.hostname` property also accepts a comma separated list of hostnames and or IP addresses.

Once *Newts* has been enabled, you can initialize the *Newts* schema in *Cassandra* with the following:

Initialize Newts keyspace in Cassandra

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

Optionally, you can now connect to your *Cassandra* cluster and verify that the keyspace has been properly initialized:

Verify if the keyspace is initialized with cqlsh

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

Restart *OpenNMS Horizon* to apply the changes.

Chapter 7. R Statistics System

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

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

IMPORTANT The *R* integration is not currently supported on *Microsoft Windows* systems.

7.1. RHEL

This section describes how to install *R* on a *RHEL* based system.

NOTE This description was built on *RHEL 7* and *CentOS 7.1*.

Install the EPEL repositories

```
yum install epel-release
```

Install R

```
yum install R
```

7.2. Debian

This section describes how to install *R* on a *Debian*-based system.

NOTE This description was built on *Debian 8* and *Ubuntu 14.04 LTS*.

Install R

```
sudo apt-get install r-recommended
```