Users Guide

OpenNMS Meridian 2017.1.18, Last updated 2019-06-20 11:57:58 EDT

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Chapter 1. Service Assurance

This section will cover the basic functionalities how *OpenNMS* monitors availability and latency from applications or management agents. To change the behavior of how *OpenNMS* monitors applications or status information from management agents please see the *Administration Guide*. To extend the *Service Monitor* framework please see the *Development Guide*.

Measuring availability and latency of network services or applications is an important part in fault and performance management. In *OpenNMS* this task is provided by a *Service Monitor* framework. The main component is *Pollerd* which provides the following functionalities:

- Track the status of a management resource or an application for availability calculations
- Measure response times for service quality
- Correlation of node and interface outages based on a Critical Service

The following image shows the model and representation of availability and response time.

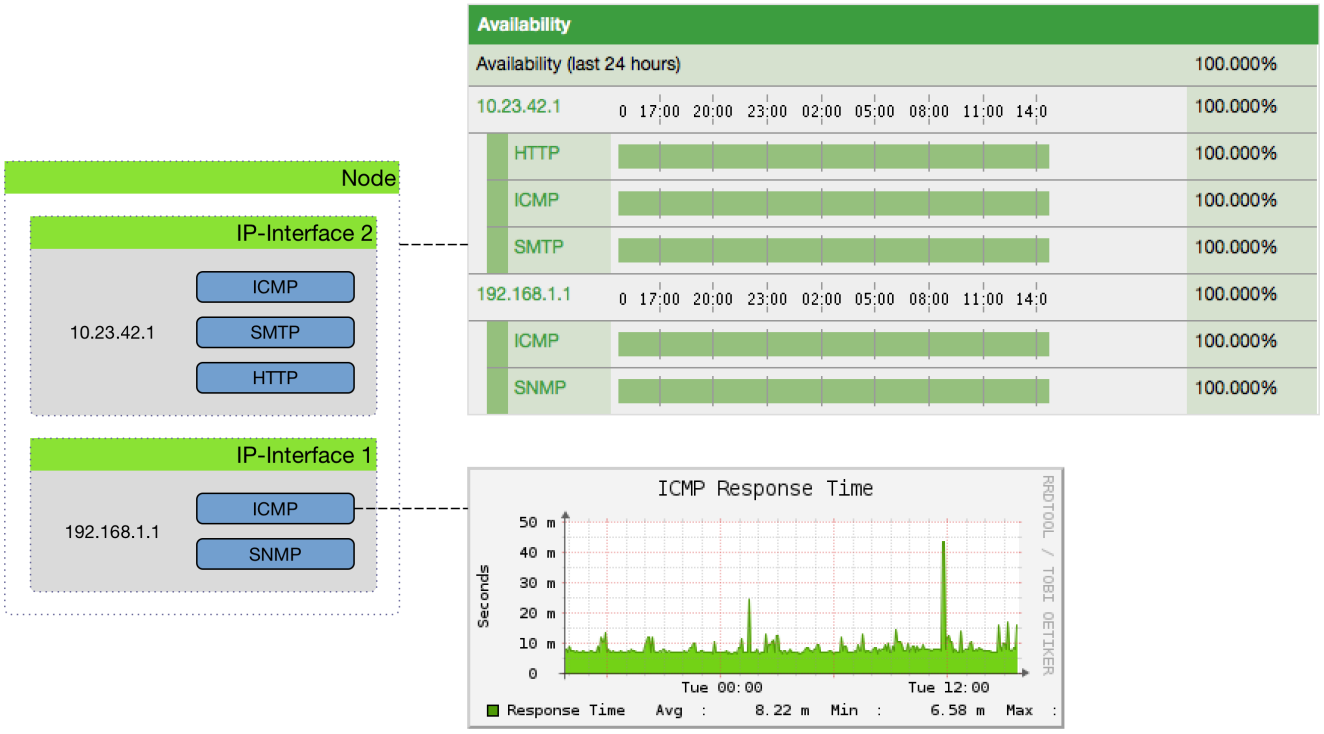


Figure 1. Representation of latency measurement and availability

This information is based on *Service Monitors* which are scheduled and executed by *Pollerd*. A *Service* can have any arbitrary name and is associated with a *Service Monitor*. For example, we can define two *Services* with the name *HTTP* and *HTTP-8080*, both are associated with the *HTTP Service Monitor* but use a different *TCP port* configuration parameter. The following figure shows how *Pollerd* interacts with other components in *OpenNMS* and applications or agents to be monitored.

The availability is calculated over the last 24 hours and is shown in the *Surveillance Views*, *SLA Categories* and the *Node Detail Page*. Response times are displayed as *Resource Graphs* of the *IP Interface* on the *Node Detail Page*. Configuration parameters of the *Service Monitor* can be seen in the *Service Page* by clicking on the *Service Name* on the *Node Detail Page*. The status of a *Service* can be *Up* or *Down*.

When a *Service Monitor* detects an outage, *Pollerd* sends an *Event* which is used to create an *Alarm*. *Events* can also be used to generate *Notifications* for on-call network or server administrators. The following images shows the interaction of *Pollerd* in *OpenNMS*.

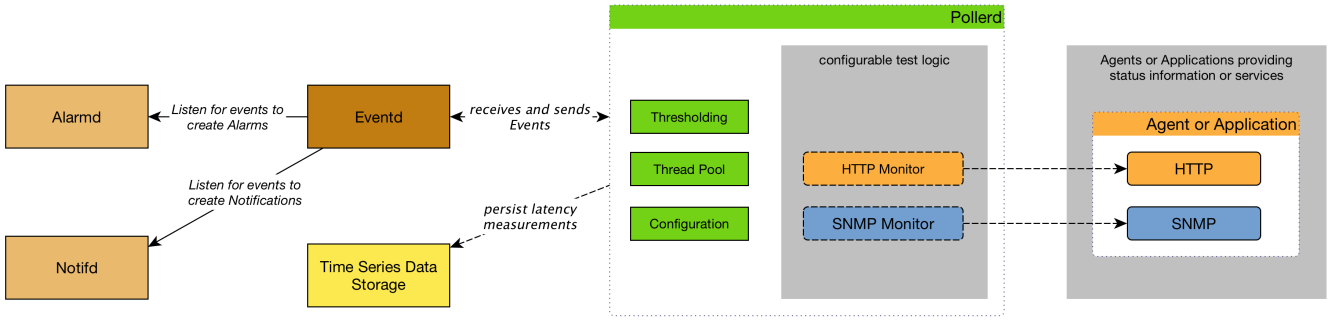


Figure 2. Service assurance with Pollerd in OpenNMS platform

Pollerd can generate the following *Events* in *OpenNMS*:

Event name	Description
`uei.opennms.org/nodes/nodeLostService`	*Critical Services* are still up, just this service is lost.
`uei.opennms.org/nodes/nodeRegainedService`	Service came back up
`uei.opennms.org/nodes/interfaceDown`	*Critical Service* on an IP interface is down or all services are down.
`uei.opennms.org/nodes/interfaceUp`	*Critical Service* on that interface came back up again
`uei.opennms.org/nodes/nodeDown`	All critical services on all IP interfaces are down from node. The whole host is unreachable over the network.
`uei.opennms.org/nodes/nodeUp`	Some of the *Critical Services* came back online.

The behavior to generate *interfaceDown* and *nodeDown* events is described in the Critical Service section.

This assumes that node-outage processing is enabled.

1.1. Critical service

Monitoring services on an *IP network* can be resource expensive, especially in cases where many of these services are not available. When a service is offline, or unreachable, the monitoring system spends most of it's time waiting for retries and timeouts.

In order to improve efficiency, *OpenNMS* deems all services on a interface to be *Down* if the critical service is *Down*. By default *OpenNMS* uses *ICMP* as the critical service.

The following image shows, how a *Critical Services* is used to generate these events.

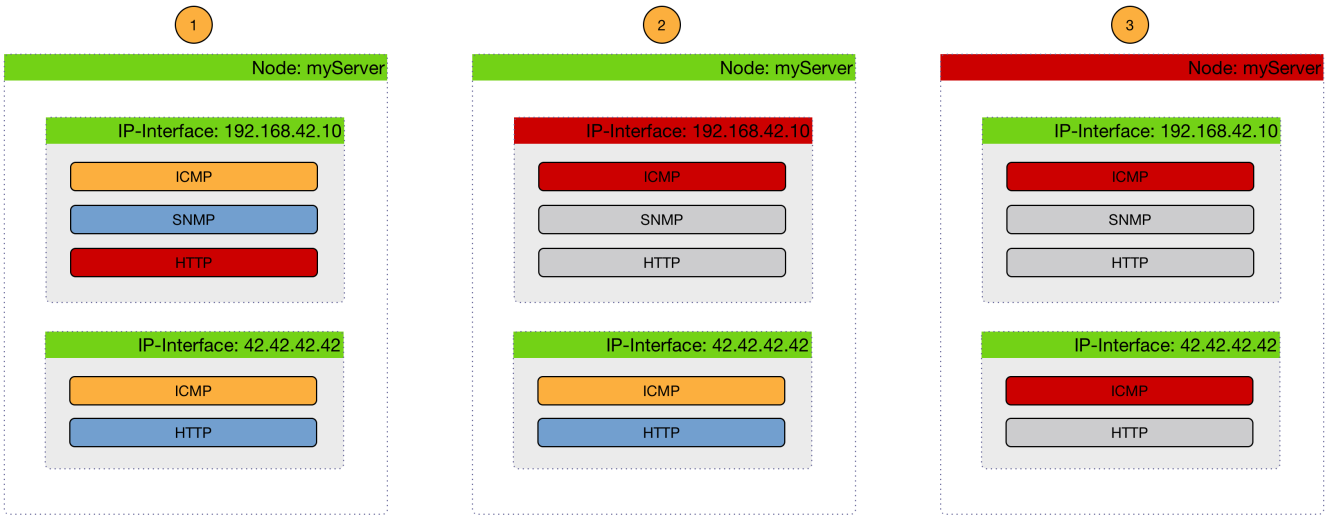


Figure 3. Service assurance with Pollerd in OpenNMS platform

- (1) Critical services are all *Up* on the *Node* and just a *nodeLostService* is sent.
- (2) Critical service of one of many *IP interface* is *Down* and *interfaceDown* is sent. All other services are not tested and no events are sent, the services are assumed as unreachable.
- (3) All Critical services on the *Node* are *Down* and just a *nodeDown* is sent. All other services on the other *IP Interfaces* are not tested and no events are sent, these services are assumed as unreachable.

1.2. Path Outage

An outage of a central core component can cause a lot of node outages and notifications. For this reason it is possible to define a *Critical Path*. The *Critical Path* has to be defined from the network perspective of the monitoring system. The following image shows a simple example how devices can be reached in a Layer 3 network topology.

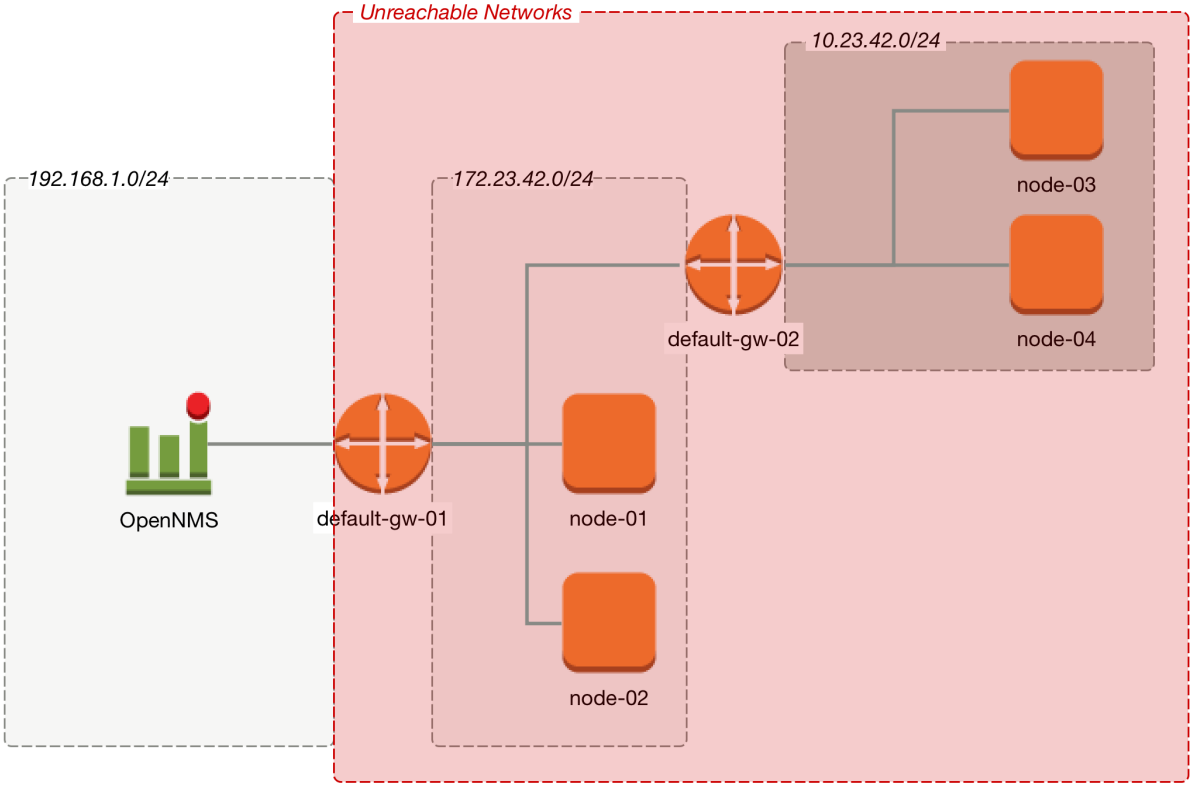


Figure 4. Path Outage example

In figure Path Outage example implies a network Layer 3 topology. From the perspective of the monitoring system, *default-gw-01* is on the *Critical Path* to two networks. In case *default-gw-01* is down, it is not possible to reach any node in the two networks behind *default-gw-01*. To guide a network administrator to the correct problem, *Notifications* to all other unreachable *Nodes* based on the *Critical Path* are suppressed. The administrator will get just one *Notification* for the *default-gw-01*.

Chapter 2. OpenNMS Meridian Surveillance View

When networks are larger and contain devices of different priority, it becomes interesting to show at a glance how the "whole system" is working. The surveillance view aims to do that. By using categories, you can define a matrix which allows to aggregate monitoring results. Imagine you have 10 servers with 10 internet connections and some 5 PCs with DSL lines:

	Servers	Internet Connections
Super important	1 of 10	0 of 10
Slightly important	0 of 10	0 of 10
Vanity	4 of 10	0 of 10

The whole idea is to give somebody at a glance a hint on where the trouble is. The matrix-type of display allows a significantly higher aggregation than the simple list. In addition, the surveillance view shows nodes rather than services - an important tidbit of information when you look at categories. At a glance, you want to know how many of my servers have an issue rather than how many services in this category have an issue.

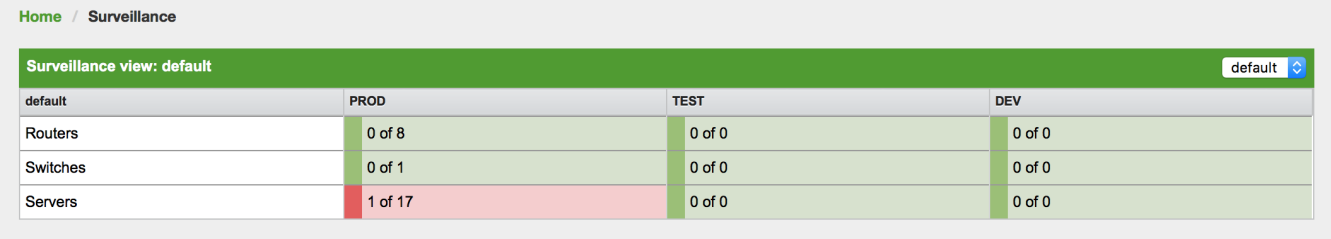


Figure 5. Example of a configured Surveillance View

The visual indication for outages in the surveillance view cells is defined as the following:

- No services down: green as normal
- One (1) service down: yellow as warning
- More than one (1) services down: red as critical

This *Surveillance View* model also builds the foundation of the Dashboard View.

2.1. Default Surveillance View Configuration

Surveillance Views are defined in the `surveillance-views.xml` file. This file resides in the *OpenNMS Meridian* `etc` directory.

This file can be modified in a text editor and is reread every time the *Surveillance View* page is loaded. Thus, changes to this file do not require *OpenNMS Meridian* to be restarted.

The default configuration looks like this:

```
<?xml version="1.0" encoding="UTF-8"?>
<surveillance-view-configuration
  xmlns:this="http://www.opennms.org/xsd/config/surveillance-views"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.opennms.org/xsd/config/surveillance-views
http://www.opennms.org/xsd/config/surveillance-views.xsd"
  default-view="default" >
  <views >
    <view name="default" refresh-seconds="300" >
      <rows>
        <row-def label="Routers" >
          <category name="Routers"/>
        </row-def>
        <row-def label="Switches" >
          <category name="Switches" />
        </row-def>
        <row-def label="Servers" >
          <category name="Servers" />
        </row-def>
      </rows>
      <columns>
        <column-def label="PROD" >
          <category name="Production" />
        </column-def>
        <column-def label="TEST" >
          <category name="Test" />
        </column-def>
        <column-def label="DEV" >
          <category name="Development" />
        </column-def>
      </columns>
    </view>
  </views>
</surveillance-view-configuration>
```

Please note, that the old `report-category` attribute is deprecated and is no longer supported.

2.2. Configuring Surveillance Views

The *Surveillance View* configuration can also be modified using the *Surveillance View Configurations* editor on the *OpenNMS Meridian Admin* page.

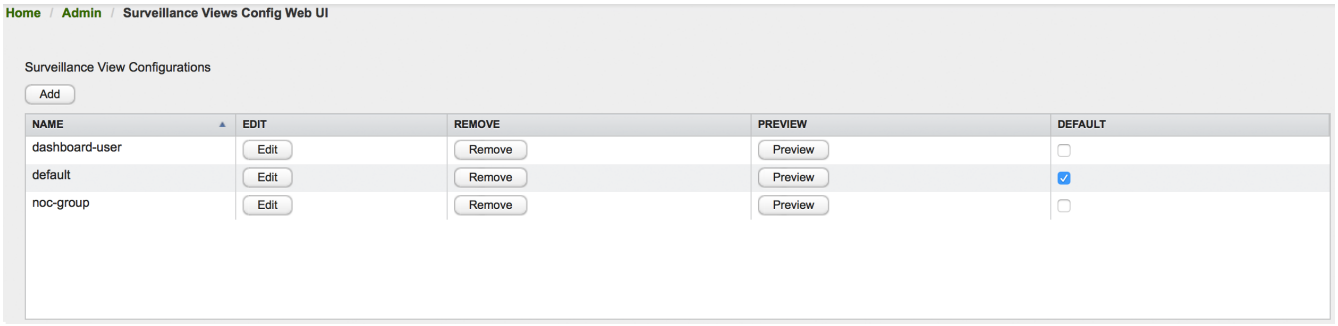


Figure 6. The Surveillance View Configurations UI

This page gives an overview of the configured *Surveillance Views* and allows the user to edit, remove or even preview the defined *Surveillance View*. Furthermore, the default *Surveillance View* can be selected using the checkbox in the *DEFAULT* column.

When editing a *Surveillance View* the user has to define the view's title and the time in seconds between successive refreshes. On the left side of this dialog the defined rows, on the right side the defined columns are listed. Beside adding new entries an user can modify or delete existing entries. Furthermore, the position of an entry can be modified using the up/down buttons.

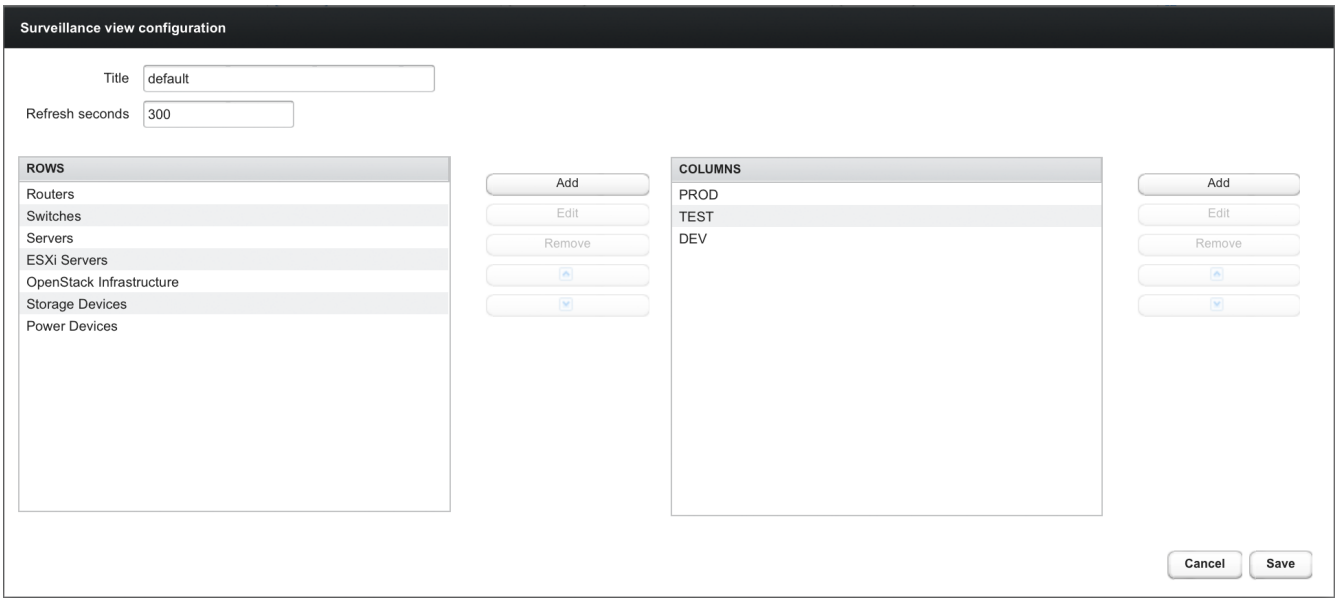


Figure 7. Editing a Surveillance View

Editing row or column definitions require to choose an unique label for this entry and at least one *OpenNMS Meridian* category. When finished you can hit the *Save* button to persist your modified configuration or *Cancel* to close this dialog.

2.3. Categorizing Nodes

In order to categorize nodes in the Surveillance View, choose a node and click *Edit* beside *Surveillance Category Memberships*. Recalling from your *Surveillance View*, choose two categories that represent a column and a row, for example, *Servers* and *Test*, then click *Add*.

2.4. Creating Views for Users and Groups

You can use user and group names for *Surveillance Views*. When the *Surveillance View* page is

invoked the following criteria selects the proper *Surveillance View* to be displayed. The first matching item wins:

1. Surveillance View name equal to the user name they used when logging into OpenNMS Meridian.
2. Surveillance View name equal to the user's assigned OpenNMS Meridian group name
3. Surveillance View name equal to the `default-view` attribute in the `surveillance-views.xml` configuration file.

Chapter 3. OpenNMS Meridian Dashboard

In Network Operation Centers *NOC* an overview about issues in the network is important and often described as *Dashboards*. Large networks have people (Operator) with different responsibilities and the *Dashboard* should show only information for a given *monitoring context*. Network or Server operator have a need to customize or filter information on the *Dashboard*. A *Dashboard* as an At-a-glance overview is also often used to give an entry point for more detailed diagnosis through the information provided by the monitoring system. The *Surveillance View* allows to reduce the visible information by selecting rows, columns and cells to quickly limit the amount of information to navigate through.

3.1. Dashboard Components

The *Dashboard* is built with five components:

- *Surveillance View*: Allows to model a *monitoring context* for the *Dashboard*.
- *Alarms*: Shows unacknowledged *Alarms* which should be escalated by an *Operator*.
- *Notifications*: Shows outstanding and unacknowledged notifications sent to *Engineers*.
- *Node Status*: Shows all ongoing network *Outages*.
- *Resource Graph Viewer*: Shows performance time series reports for performance diagnosis.

The following screenshot shows a configured *Dashboard* and which information are displayed in the components.

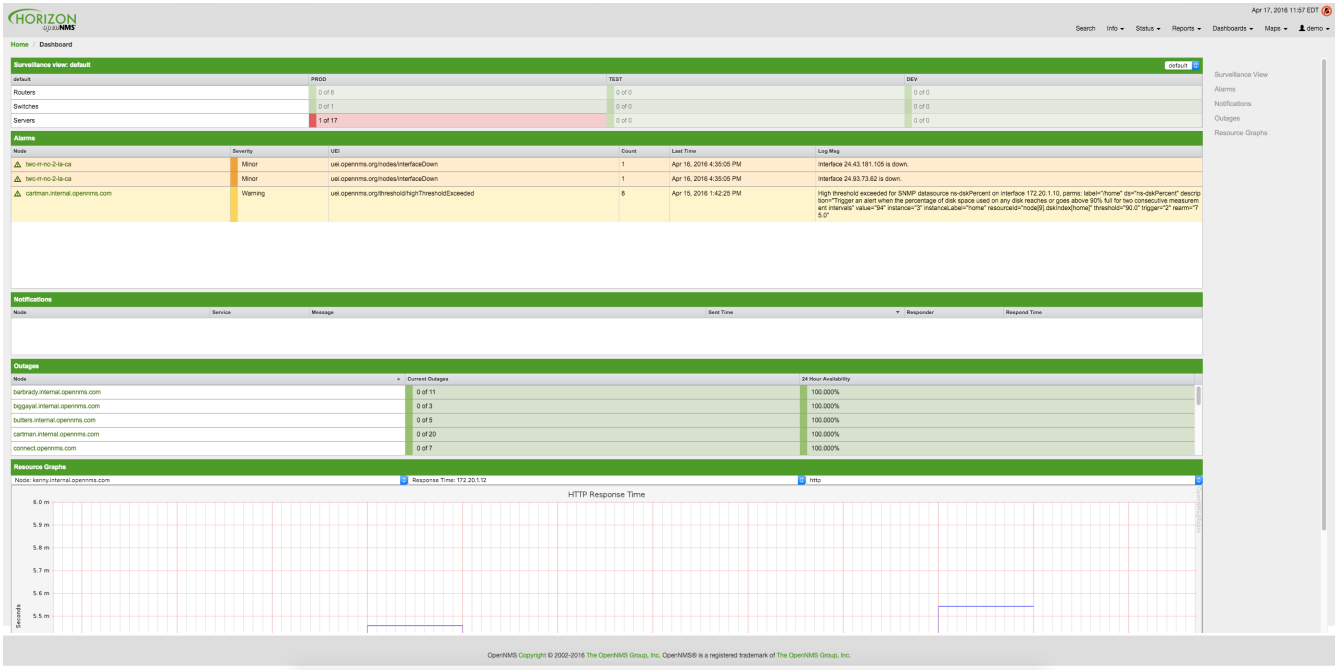


Figure 8. Dashboard with configured surveillance view and current outage

The following section describe the information shown in each component. All other components display information based on the *Surveillance View*.

3.1.1. Surveillance View

The *Surveillance View* has multiple functions.

- Allows to model the *monitoring context* and shows service and node *Outages* in compact matrix view.
- Allows to limit the number of information in the *Dashboard* by selecting rows, columns and cells.

You can select columns, rows, single cells and of course all entries in a *Surveillance View*. Please refer to the Surveillance View Section for details on how to configure *Surveillance Views*.

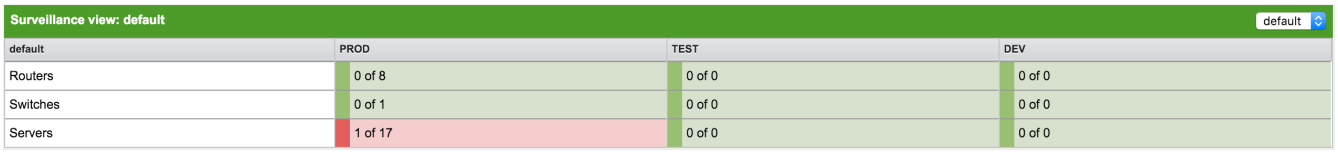


Figure 9. The Surveillance View forms the basis for the Dashboard page.

3.1.2. Alarms

The *Alarms* component gives an overview about all unacknowledged *Alarms* with a severity higher than *Normal(1)*. Acknowledged *Alarms* will be removed from the responsibility of the *Operator*. The following information are shown in:

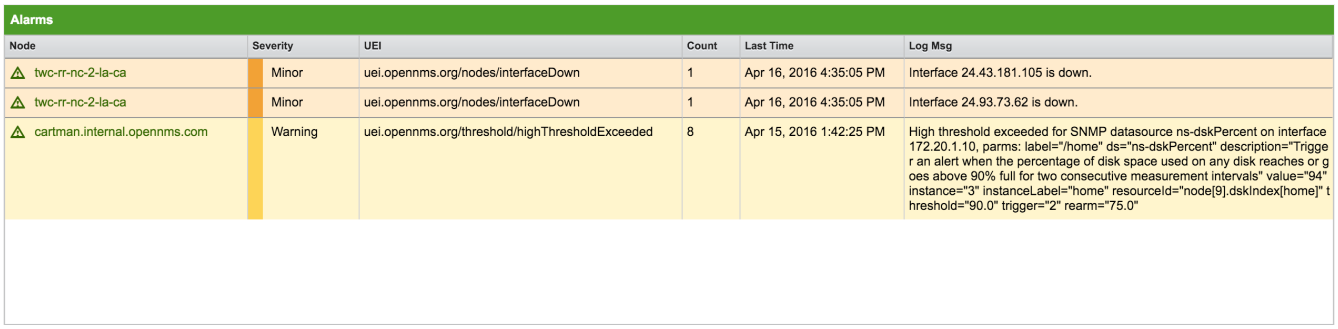


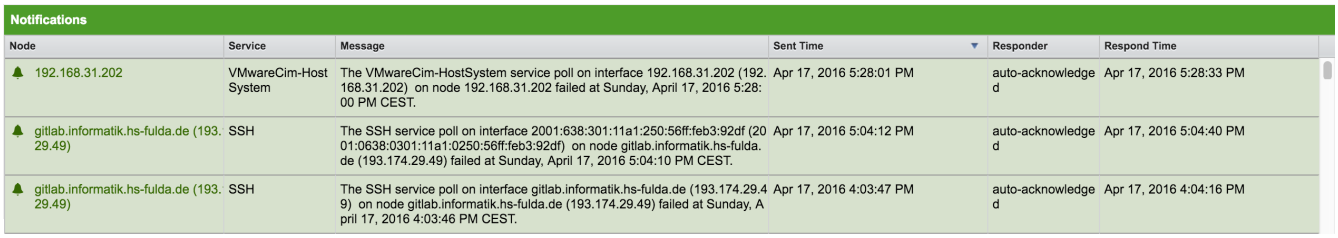
Figure 10. Information displayed in the Alarms component

1. *Node*: Node label of the node the *Alarm* is associated
2. *Severity*: Severity of the *Alarm*
3. *UEI*: Shows the *UEI* of the *Alarm*
4. *Count*: Number of *Alarms* deduplicated by the reduction key of the *Alarm*
5. *Last Time*: Time for the last occurrence of the *Alarm*
6. *Log Msg*: The log message from the *Event* which is the source for this *Alarm*. It is specified in the event configuration file in `<logmsg />`

The *Alarms* component shows the most recent *Alarms* and allows the user to scroll through the last 100 *Alarms*.

3.1.3. Notifications

To inform people on a duty schedule notifications are used and force action to fix or reconfigure systems immediately. In *OpenNMS Meridian* it is possible to acknowledge notifications to see who is working on a specific issue. The *Dashboard* should show outstanding notifications in the *NOC* to provide an overview and give the possibility for intervention.



Notifications

Node	Service	Message	Sent Time	Responder	Respond Time
192.168.31.202	VMwareCim-HostSystem	The VMwareCim-HostSystem service poll on interface 192.168.31.202 (192.168.31.202) on node 192.168.31.202 failed at Sunday, April 17, 2016 5:28:00 PM CEST.	Apr 17, 2016 5:28:01 PM	auto-acknowledged	Apr 17, 2016 5:28:33 PM
gitlab.informatik.hs-fulda.de (193.29.49)	SSH	The SSH service poll on interface 2001:638:301:11a1:250:56ff:feb3:92df (2001:0638:0301:11a1:0250:56ff:feb3:92df) on node gitlab.informatik.hs-fulda.de (193.174.29.49) failed at Sunday, April 17, 2016 5:04:10 PM CEST.	Apr 17, 2016 5:04:12 PM	auto-acknowledged	Apr 17, 2016 5:04:40 PM
gitlab.informatik.hs-fulda.de (193.29.49)	SSH	The SSH service poll on interface gitlab.informatik.hs-fulda.de (193.174.29.49) on node gitlab.informatik.hs-fulda.de (193.174.29.49) failed at Sunday, April 17, 2016 4:03:46 PM CEST.	Apr 17, 2016 4:03:47 PM	auto-acknowledged	Apr 17, 2016 4:04:16 PM

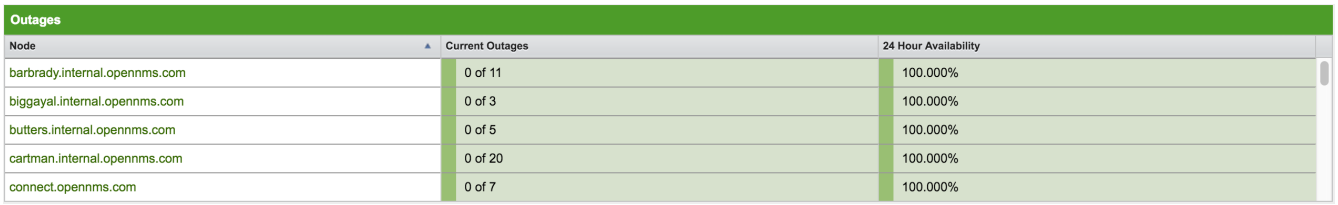
Figure 11. Information displayed in the Notifications component

1. *Node*: Label of the monitored node the notification is associated with
2. *Service*: Name of the service the notification is associated with
3. *Message*: Message of the notification
4. *Sent Time*: Time when the notification was sent
5. *Responder*: User name who acknowledged the notification
6. *Response Time*: Time when the user acknowledged the notification

The *Notifications* component shows the most recent unacknowledged notifications and allows the user to scroll through the last 100 *Notifications*.

3.1.4. Node Status

An acknowledged *Alarm* doesn't mean necessarily the outage is solved. To give an overview information about ongoing *Outages* in the network, the *Dashboard* shows an outage list in the *Node Status* component.



Outages

Node	Current Outages	24 Hour Availability
barbrady.internal.opennms.com	0 of 11	100.000%
biggayal.internal.opennms.com	0 of 3	100.000%
butters.internal.opennms.com	0 of 5	100.000%
cartman.internal.opennms.com	0 of 20	100.000%
connect.opennms.com	0 of 7	100.000%

Figure 12. Information displayed in the Node Status component

1. *Node*: Label of the monitored node with ongoing outages.
2. *Current Outages*: Number of services on the node with outages and total number of monitored services, e.g. with the natural meaning of *"3 of 3 services are affected"*.
3. *24 Hour Availability*: Availability of all services provided by the node calculated by the last 24 hours.

3.1.5. Resource Graph Viewer

To give a quick entry point diagnose performance issues a *Resource Graph Viewer* allows to

navigate to time series data reports which are filtered in the context of the *Surveillance View*.

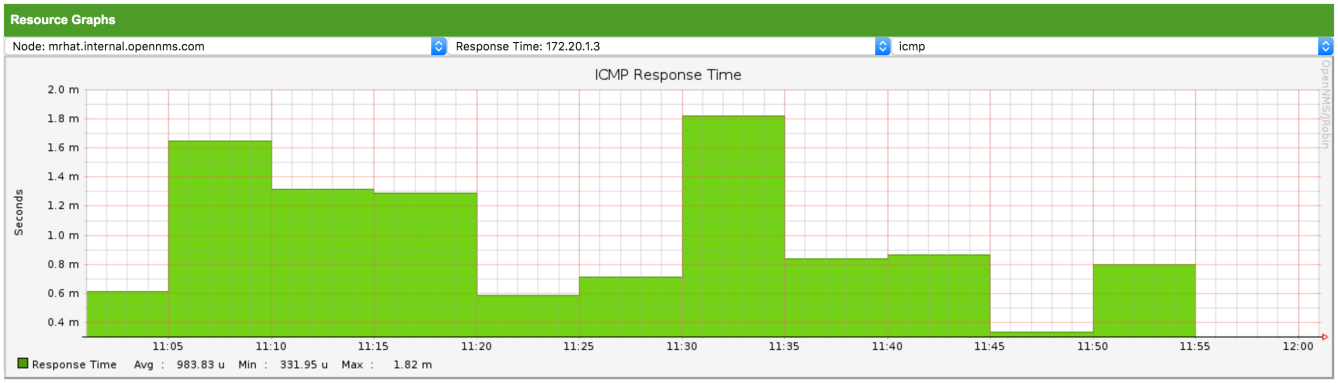


Figure 13. Show time series based performance with the Resource Graph Viewer

It allows to navigate sequentially through resource graphs provided by nodes filtered by the *Surveillance View* context and selection and shows one graph report at a time.

3.2. Advanced configuration

The *Surveillance View* component allows to model multiple views for different monitoring contexts. It gives the possibility to create special view as example for network operators or server operators. The *Dashboard* shows only ***one*** configured *Surveillance View*. To give different users the possibility using their *Surveillance View* fitting there requirements it is possible to map a logged in user to a given *Surveillance View* used in the *Dashboard*.

The selected nodes from the *Surveillance View* are also aware of *User Restriction Filter*. If you have a group of users, which should see just a subset of nodes the *Surveillance View* will filter nodes which are not related to the assigned user group.

The *Dashboard* is designed to focus, and therefore also restrict, a user's view to devices of their interest. To do this, a new role was added that can be assigned to a user that restricts them to viewing only the *Dashboard* if that is intended.

3.2.1. Using the *Dashboard* role

The following example illustrates how this *Dashboard* role can be used. For instance the user `drv4doe` is assigned the dashboard role. So, when logging in as `drv4doe`, the user is taking directly to the *Dashboard* page and is presented with a custom *Dashboard* based on the `drv4doe` *Surveillance View* definition.

Step 1: Create an user

The following example assigns a Dashboard to the user "drv4doe" (a router and switch jockey) and restricts the user for navigation to any other link in the OpenNMS Meridian WebUI.

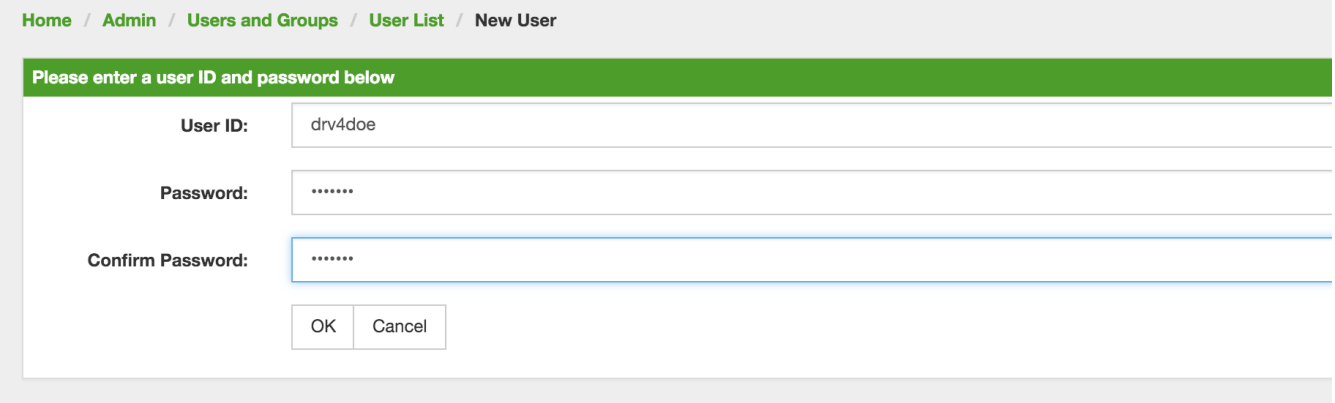


Figure 14. Creating the user `drv4doe` using the OpenNMS Meridian WebUI

Step 2: Change Security Roles

Now, add the `ROLE_PROVISION` role to the user through the WebUI or by manually editing the `users.xml` file in the `/opt/opennms/etc` directory for the user `drv4doe`.

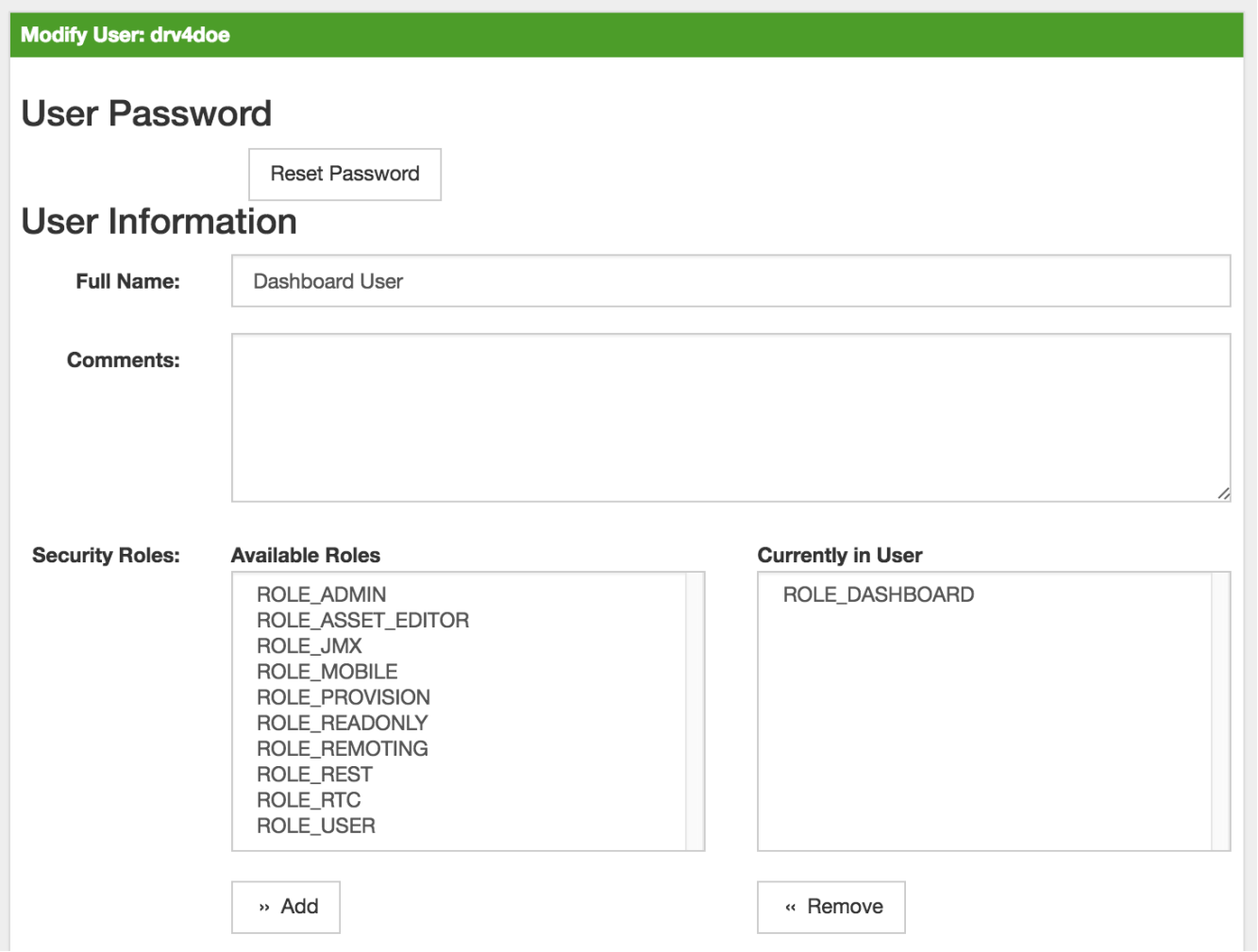


Figure 15. Adding dashboard role to the user `drv4doe` using the OpenNMS Meridian WebUI

```
<user>
    <user-id>drv4doe</user-id>
    <full-name>Dashboard User</full-name>
    <password
salt="true">6FOip6hgZsUwDhdzdPUVV5UhkSxdbZTlq8M5LXWG5586eDPa7BFizirjXEfV/srK</password
>
    <role>ROLE_DASHBOARD</role>
</user>
```

Step 3: Define Surveillance View

Edit the `$OPENNMS_HOME/etc/surveilliance-view.xml` file to add a definition for the user *drv4doe*, which you created in step 1.

```
<?xml version="1.0" encoding="UTF-8"?>
<surveillance-view-configuration
  xmlns:this="http://www.opennms.org/xsd/config/surveillance-views"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.opennms.org/xsd/config/surveillance-views
http://www.opennms.org/xsd/config/surveillance-views.xsd"
  default-view="default" >
  <views >
    <view name="drv4doe" refresh-seconds="300" >
      <rows>
        <row-def label="Servers" >
          <category name="Servers"/>
        </row-def>
      </rows>
      <columns>
        <column-def label="PROD" >
          <category name="Production" />
        </column-def>
        <column-def label="TEST" >
          <category name="Test" />
        </column-def>
      </columns>
    </view>
   <!-- default view here -->
    <view name="default" refresh-seconds="300" >
      <rows>
        <row-def label="Routers" >
          <category name="Routers"/>
        </row-def>
        <row-def label="Switches" >
          <category name="Switches" />
        </row-def>
        <row-def label="Servers" >
          <category name="Servers" />
        </row-def>
```

```
      </rows>
      <columns>
        <column-def label="PROD" >
          <category name="Production" />
        </column-def>
        <column-def label="TEST" >
          <category name="Test" />
        </column-def>
        <column-def label="DEV" >
          <category name="Development" />
        </column-def>
      </columns>
    </view>
  </views>
</surveillance-view-configuration>
```

This configuration and proper assignment of node categories will produce a default *Dashboard* for all users, other than `drv4doe`.

You can hide the upper navigation on any page by specifying `?quiet=true;` adding it to the end of the *OpenNMS Meridian* URL. This is very handy when using the dashboard on a large monitor or tv screen for office wide viewing.

However, when logging in as `drv4doe`, the user is taking directly to the *Dashboard* page and is presented with a *Dashboard* based on the custom *Surveillance View* definition.

The `drv4doe` user is not allowed to navigate to URLs other than the `dashboard.jsp` URL. Doing so will result in an *Access Denied* error.

3.2.2. Anonymous dashboards

You can modify the configuration files for the security framework to give you access to one or more dashboards without logging in. At the end you'll be able to point a browser at a special URL like `http://⋯/opennms/dashboard1` or `http://⋯/opennms/dashboard2` and see a dashboard without any authentication. First, configure surveillance views and create dashboard users as above. For example, make two dashboards and two users called `dashboard1` and `dashboard2`. Test that you can log in as each of the new users and see the correct dashboard. Now create some aliases you can use to distinguish between dashboards. In `/opt/opennms/jetty-webapps/opennms/WEB-INF`, edit `web.xml`. Just before the first `<servlet-mapping>` tag, add the following servlet entries:

```
<servlet>
     <servlet-name>dashboard1</servlet-name>
     <jsp-file>/dashboard.jsp</jsp-file>
</servlet>

<servlet>
     <servlet-name>dashboard2</servlet-name>
     <jsp-file>/dashboard.jsp</jsp-file>
</servlet>
```

Just before the first `<error-page>` tag, add the following servlet-mapping entries:

```
<servlet-mapping>
     <servlet-name>dashboard1</servlet-name>
     <url-pattern>/dashboard1</url-pattern>
</servlet-mapping>

<servlet-mapping>
     <servlet-name>dashboard2</servlet-name>
     <url-pattern>/dashboard2</url-pattern>
</servlet-mapping>
```

After the last `<filter-mapping>` tag, add the following filter-mapping entries:

```
<filter-mapping>
  <filter-name>AddRefreshHeader-120</filter-name>
  <url-pattern>/dashboard.jsp</url-pattern>
</filter-mapping>
<filter-mapping>
  <filter-name>AddRefreshHeader-120</filter-name>
  <url-pattern>/dashboard1</url-pattern>
</filter-mapping>
<filter-mapping>
  <filter-name>AddRefreshHeader-120</filter-name>
  <url-pattern>/dashboard2</url-pattern>
</filter-mapping>
```

Next edit `applicationContext-acegi-security.xml` to enable anonymous authentication for the `/dashboard1` and `/dashboard2` aliases. Near the top of the file, find `<bean id="filterChainProxy" ···>`. Below the entry for `/rss.jsp*`, add an entry for each of the dashboard aliases:

```
  <bean id="filterChainProxy" class="org.acegisecurity.util.FilterChainProxy">
    <property name="filterInvocationDefinitionSource">
      <value>
        CONVERT_URL_TO_LOWERCASE_BEFORE_COMPARISON
        PATTERN_TYPE_APACHE_ANT

/rss.jsp*=httpSessionContextIntegrationFilter,logoutFilter,authenticationProcessingFil
ter,basicProcessingFilter,securityContextHolderAwareRequestFilter,anonymousProcessingF
ilter,basicExceptionTranslationFilter,filterInvocationInterceptor

/dashboard1*=httpSessionContextIntegrationFilter,logoutFilter,securityContextHolderAwa
reRequestFilter,dash1AnonymousProcessingFilter,filterInvocationInterceptor

/dashboard2*=httpSessionContextIntegrationFilter,logoutFilter,securityContextHolderAwa
reRequestFilter,dash2AnonymousProcessingFilter,filterInvocationInterceptor

/**=httpSessionContextIntegrationFilter,logoutFilter,authenticationProcessingFilter,ba
sicProcessingFilter,securityContextHolderAwareRequestFilter,anonymousProcessingFilter,
exceptionTranslationFilter,filterInvocationInterceptor

...
```

About halfway through the file, look for `<bean id="filterInvocationInterceptor" ···>`. Below the entry for `/dashboard.jsp`, add an entry for each of the aliases:

```
  <bean id="filterInvocationInterceptor" class=
"org.acegisecurity.intercept.web.FilterSecurityInterceptor">

...

        /frontpage.htm=ROLE_USER,ROLE_DASHBOARD
        /dashboard.jsp=ROLE_USER,ROLE_DASHBOARD
        /dashboard1=ROLE_USER,ROLE_DASHBOARD
        /dashboard2=ROLE_USER,ROLE_DASHBOARD
        /gwt.js=ROLE_USER,ROLE_DASHBOARD

...
```

Finally, near the bottom of the page, add a new instance of `AnonymousProcessingFilter` for each alias.

```
  <!-- Set the anonymous username to dashboard1 so the dashboard page
       can match it to a surveillance view of the same name. -->
  <bean id="dash1AnonymousProcessingFilter" class=
"org.acegisecurity.providers.anonymous.AnonymousProcessingFilter">
    <property name="key"><value>foobar</value></property>
    <property name="userAttribute"><value>dashboard1,ROLE_DASHBOARD</value></property>
  </bean>

  <bean id="dash2AnonymousProcessingFilter" class=
"org.acegisecurity.providers.anonymous.AnonymousProcessingFilter">
    <property name="key"><value>foobar</value></property>
    <property name="userAttribute"><value>dashboard2,ROLE_DASHBOARD</value></property>
  </bean>
```

Restart OpenNMS Meridian and you should bring up a dashboard at `http://…/opennms/dashboard1` without logging in.

There's no way to switch dashboards without closing the browser (or deleting the JSESSIONID session cookie).

If you accidentally click a link that requires full user privileges (e.g. Node List), you'll be given a login form. Once you get to the login form, there's no going back to the dashboard without restarting the browser. If this problem bothers you, you can set `ROLE_USER` in addition to `ROLE_DASHBOARD` in your `userAttribute` property. However this will give full user access to anonymous browsers.

Chapter 4. Business Service Monitoring

While OpenNMS detects issues in your network by device, interface or service, the *Business Service Monitoring (BSM)* takes it one step further. The *BSM* components allows you to monitor and model high level *Business Services (BS)* and helps quickly identify the most critical problems affecting these. With the *BSM* feature it is possible to model a high level *BS* context around the technical *Service Monitors* provided in *OpenNMS*. To indicate which *BS* is effected an *Operational Status* is calculated.

As an example, let's assume a company runs an online store. Customers enter through a login system, select items, place them in the shopping cart and checkout using a payment system. The whole service is provided by a few web servers and access data from databases. To monitor the status of the databases, a *SQL* service monitor on each database server is configured. For testing the web servers a *HTTP* service monitor is used for each of them. Covering the overall functionality a *Page Sequence Monitor (PSM)* is used to test the login, shop and payment workflow through the provided web portal. A possible representation of the whole system hierarchy is shown in figure Example scenario for a web shop.

Example scenario for a web shop

To be able to model this scenarios the *BSM* functions can be used. The following section describes the components, concepts and functions. For configuration and changing the behavior please go to the section *Business Service Monitoring* in the *Administration Guide*.

4.1. Business Service Hierarchy

BS can depend on each other and build together a *Business Service Hierarchy*. It can be visualized using the *Topology User Interface* with the *Business Services View*. The *Operational Status* of a *BS* is ultimately calculated from *Alarms* and their *Severity*. To define the class of *Alarms* a *Reduction Key* is used and is represented as an *Edge* of a *BS*. Giving more granularity than just *Up* or *Down*, the *Operational Status* uses the *Severities*, i.e. *Normal*, *Warning*, *Minor*, *Major*, *Critical*.

Based on the hierarchy, the *Operational Status* is calculated with *Map* and *Reduce Functions*. A *Map Function* influences which *Severity* from the *Edge* is used as an input to the *BS*. A *Reduce Function* is used to consolidate the *Severities* from all *Edges* of a BS and uses them as inputs and reduces them into a single *Severity*, which is the *Operational Status*.

The *Topology User Interface* allows users to traverse *Business Service Hierarchies* using the *Semantic Zoom Level (SZL)*. The *Semantic Zoom Level* (SZL, pronounced as 'sizzle') defines how many *Neighbors* are shown related to the elements which are in *Focus*. The number can be interpreted as how many *Hops* from the *Focus* should be shown on the *Topology User Interface*.

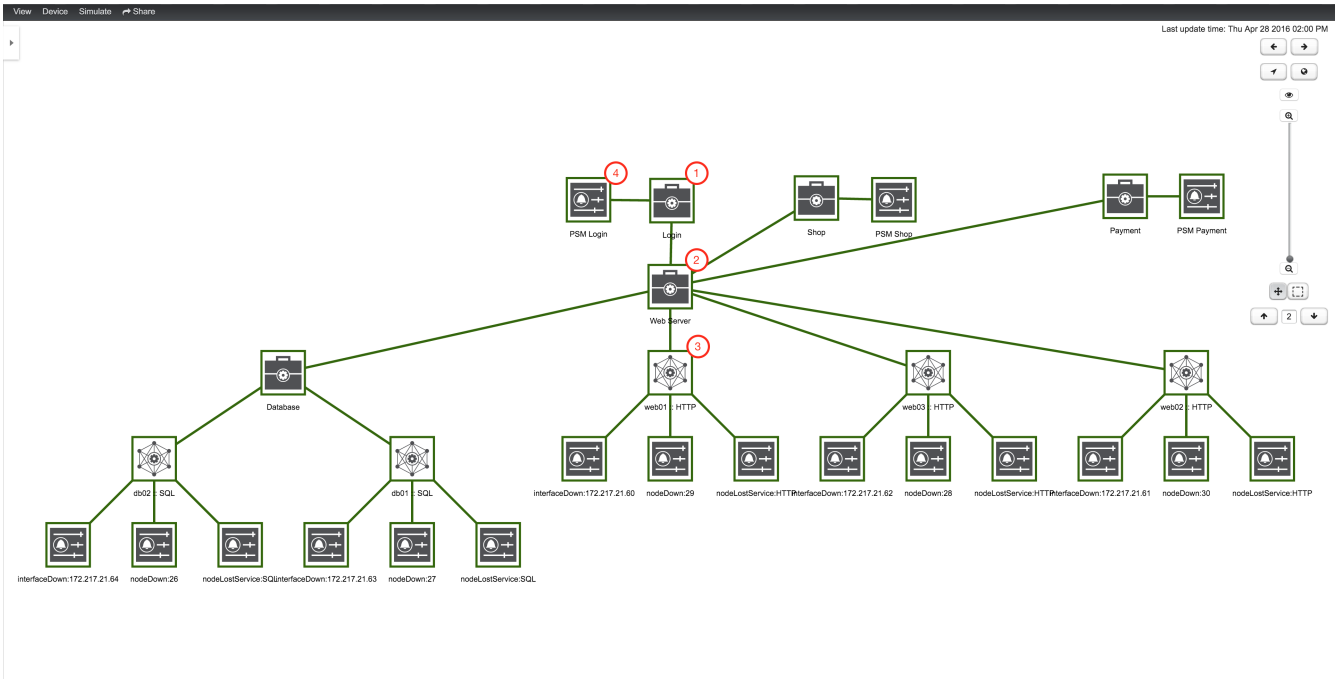


Figure 16. Business Service Hierarchy components

① A top-level *Business Service* which depends on other *Business Services*, *Monitored Services* and *Alarms* (referenced by *Reduction Key*)

② *Business Service* as child an the *Operational Status* is used as input for the top-level *Business Service*

③ *IP Service Edge* used as an input with auto generated *Reduction Keys* for node down, interface down and node lost service

④ *Reduction Key Edge* used as an input to the top-level *BS*, which references just a node lost service of a *Page Sequence Monitor* for the user login

To add or remove an additional selected *BS* or *Edge* to *Focus* use in the context menu *Add To Focus* or *Remove From Focus. If you want to have a specific _BS* or *Edge* as a single focus use *Set as Focal Point*. The *Eye* icon highlights all elements in the *Topology UI* which are set to *Focus*.

4.2. Operational status

Every *Business Service* maintains an *Operational Status* that represents the overall status calculated by the *Map and Reduce Functions* from the *Edges*. The *Operational Status* uses the *Severities* known from *Events* and *Alarms*.

Table 1. Operational Status representation

Name	Numerical code	Color / Code	Description
`Critical`	*7*	Purple / `#c00`	This event means that a severe service affecting event has occurred.
`Major`	*6*	Red / `#f30`	Indicates serious disruption or malfunction of a service or system.
`Minor`	*5*	Orange / `#f90`	Used for troubles that have not immediate effect on service or system performance.
`Warning`	*4*	Yellow / `#fc0`	An event has occurred that may require action. This severity can also be used to indicate a condition that should be noted (logged) but does not require immediate action.
`Normal`	*3*	Dark green / `#360`	Informational message. No action required.
`Cleared`	*2*	Grey / `#eee`	This severity is reserved for use in alarms to indicate that an alarm describes a self-clearing error condition has been corrected and service is restored. This severity should never be used in event definitions. Please use "Normal" severity for events that clear an alarm.
`Indeterminate`	*1*	Light green / `#990`	No Severity could be associated with this event.

If a *Business Service* changes its *Operational Status* an *OpenNMS* event of the type `uei.opennms.org/bsm/serviceOperationalStatusChanged` is generated and sent to the *OpenNMS Event Bus*. In case the *Operational Status* changed from *Normal* to a higher *Severity* an *Event* of the type `uei.opennms.org/bsm/serviceProblem` is generated and has the *Severity* of the *BS*. When the *BS* goes back to normal a *Event* of the type `uei.opennms.org/bsm/serviceProblemResolved` is generated.

The *Service Problem* and *Service Problem Resolved* events can be used for notifications or ticketing integration.

The log message of the events have the following information:

- *Business Service Name*: `businessServiceName`
- *Business Service Identifier*: `id`
- *Previous Severity Identifier*: `prevSeverityId`
- *Previous Severity Label*: `prevSeverityLabel`
- *New Severity Identifier*: `newSeverityId`
- *New Severity Label*: `newSeverityLabel`

The *BSM* events are not associated to a *Node*, *Interface* or *Service*.

4.3. Root Cause and Impact Analysis

The *Root Cause* operation can be used to quickly identify the underlying *Reduction Keys* as *Edges* that contribute to the current *Operational Status* of an element. The *Impact Analysis* operation, converse to the *Root Cause* operation, can be used to identify all of the *BS* affected by a given element. Both of these options are available in the context menu of the *Topology User Interface* when visualizing *BS*.

The following example shows how to identify the *Root Cause* of the critical status of the *Shop* service. Use the *Context Menu* on the *BS* to investigate the *Root Cause* shown in figure View before performing Root Cause Analysis.

View before performing Root Cause Analysis

The *Topology UI* sets only elements to *Focus* which are the reason for the *Operational Status* of the selected *BS*. In figure View after performing Root Cause Analysis the *Page Sequence Monitor* which tests the user login is down and has set the *BS* to a critical status.

View after performing Root Cause Analysis

Similar to identifying a root cause for a *BS* it is also possible to identfy which *Business Services* from a specific *Edge* are affected. Use the *Context Menu* on a specific *Edge* element and select *Impact Analysis* shown in figure View before performing Impact Analysis.

View before performing Impact Analysis

In figure View after performing Impact Analysis the *Business Services* for *Login*, *Shop* and *Payment* are affected if this *HTTP* service is unavailable.

View after performing Impact Analysis

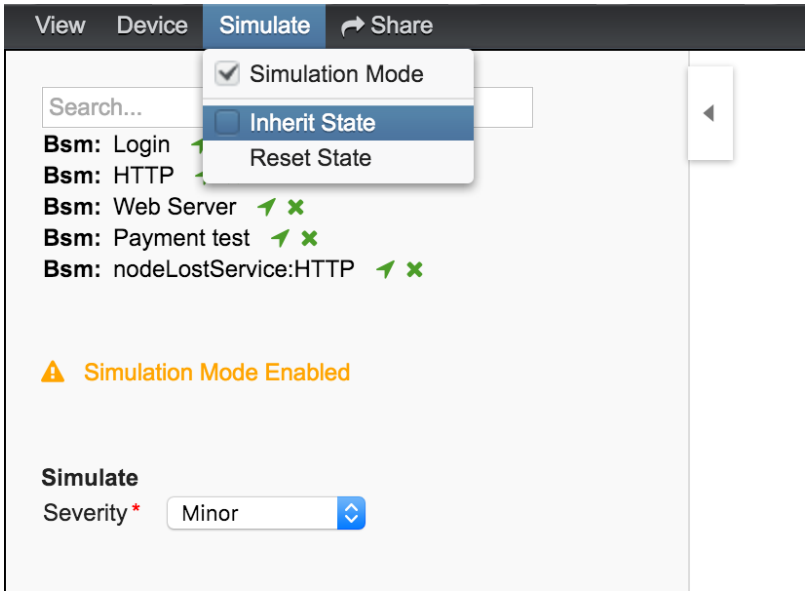
For the reason the service *PSM Shop* is introducing the critical status for the *Business Service Shop*, the *HTTP* service has no impact on the *Operational Status* of the *PSM Shop* and is not shown.

4.4. Simulation Mode

To visualize if the configured behavior works as expected, the *Simulation Mode* can be used to manually set an *Alarm* status of an *Edge* element. The *Operational Status* is calculated with the given *Map and Reduce Functions*. This allows users to validate and tune their *Business Service Hierarchies* until the desired status propagation is achieved.

In order to enter *Simulation Mode*, open the *Business Service View* in the *Topology User Interface* and toggle the *Simulation Mode* option in the *Simulate* menu at the top of the screen. The *Info Panel* on the left hand side allows to set the *Severity* of the selected *Edge* element. In figure BSM Simulation Mode the *Menu* and *Severity* setting is shown.

BSM Simulation Mode



The *Info Panel* can be hidden with the *Arrow* button in the top left corner.

In the *Simulate* menu there are *Inherite State* and *Reset State* as options available. With *Inherite State* the current *Severities* and *Operational Status* from monitoring is used for the *Simulation Mode*. By selecting *Reset State* all states will be set to *Normal* for simulation.

4.5. Share View

In some cases it is useful to share a specific view on a *Business Service Hierarchy*. For this reason the menu function *Share* can be used and generates a link for the current view and can be copied and sent to another user. In figure Share Business Service View the *Share* menu item was used and a link is generated. The link can be used with *Copy & Paste* and sent to another user to have access to exactly the same configured _Business Service View.

The user receiving the link needs an account in OpenNMS to be able to see the *Business Service View*.

4.6. Change Icons

Each element in the *Business Service View* has an icon which is assigned to a *BS* or an *Edge*. To be able to customize the *Business Service View* the icons for each element can be changed. Select the element in the *Business Service View* and choose *Change Icon* from the *Context Menu*. As shown in figure Change Icon for Business Service or Edges select the the new icon for the selected element and click *Ok* to permanently assign the new icon to the element.

Change Icon for Business Service or Edges

It is also possible create custom *Icon Sets* which is described in the *Business Service Monitoring* section of the *Developer Guide*.

Chapter 5. Alarms

5.1. Alarm Notes

OpenNMS Meridian creates an *Alarm* for issues in the network. Working with a few people in a team, it is helpful to share information about a current *Alarm*. *Alarm Notes* can be used to assign comments to a specific *Alarm* or a whole class of *Alarms*. . The figure Alarm Detail View shows the component to add these information in *Memos* to the *Alarm*.

Alarm Detail View

The *Alarm Notes* allows to add two types of notes on an existing *Alarm* or *Alarm Class*:

- *Sticky Memo*: A user defined note for a specific instance of an *Alarm*. Deleting the *Alarm* will also delete the sticky memo.
- *Journal Memo*: A user defined note for a whole class of alarms based on the resolved reduction key. The *Journal Memo* will be shown for all *Alarms* matching a specific reduction key. Deleting an *Alarm* doesn't remove the *Journal Memo*, they can be removed by pressing the "Clear" button on an *Alarm* with the existing *Journal Memo*.

If an *Alarm* has a sticky and/or a *Journal Memo* it is indicated with two icons on the "Alarm list Summary" and "Alarm List Detail".