RAy3 - NMS - Zabbix

version 1.2
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Introduction

To access our SNMP values, any Network Management System (NMS) can be used. However, we recommend using the ZABBIX open source monitoring system. It can be downloaded at: http://www.zabbix.com/download.php.

The Zabbix website provides the following short description: *Zabbix is the ultimate enterprise-level software designed for monitoring availability and performance of IT infrastructure components. Zabbix is open source and comes at no cost.*

If you have chosen the Zabbix software, please read the following pages where we offer a basic Starting Guide to RAy3 and Zabbix co-working.

Whatever your choice of NMS, these sections may provide general hints and tips.

**Note**

The following guide was tested with Zabbix release 5.0.x. If you use any older release, refer to the previous version of this Application note (in the RACOM website firmware archive\(^1\)).

Take the opportunity to remotely access and test a *live Zabbix demo\(^2\)*. Contact us for *access\(^3\)* details.

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\(^1\) [https://www.racom.eu/eng/products/microwave-link.html#download](https://www.racom.eu/eng/products/microwave-link.html#download)

\(^2\) [http://www.racom.eu/eng/products/m/ripex/demo/zabbix.html](http://www.racom.eu/eng/products/m/ripex/demo/zabbix.html)

\(^3\) [http://www.racom.eu/eng/products/remote-access.html#load(product=zabbix)](http://www.racom.eu/eng/products/remote-access.html#load(product=zabbix))
1. Installation and Documentation

Due to security requirements and the mission-critical nature of the monitoring server, we believe UNIX is the only operating system that can consistently deliver the necessary performance, fault tolerance and resilience.

Zabbix has been tested on the following platforms:

- Linux
- IBM AIX
- FreeBSD
- NetBSD
- OpenBSD
- HP-UX
- Mac OS X
- Solaris
- Windows: all desktop and server versions since XP (Zabbix agent only)

For further details, visit Zabbix Documentation at http://www.zabbix.com/documentation.php. It contains a large body of information about installation steps, configuration, performance etc. If you are unsure how to proceed with any task, refer to the Zabbix documentation first. You can find an installation guide there, too.

This Guide does not present all Zabbix settings, but should help you incorporate the RAY3 SNMP functionality into the Zabbix software.

**Note**

The following guide requires the use of MySQL database in Zabbix. If you choose other software, you will need to alter at least the trap handling bash script provided. This guide was tested in the CentOS7 and CentOS8 operating systems; some tasks may require a different approach in other systems.

1.1. Windows Installation

If you choose to use the Windows platform as the host operating system for Zabbix, then use VMware/VirtualBox software and then continue with the Zabbix Appliance. The Zabbix Appliance can be downloaded from http://www.zabbix.com/download.php. Please remember that Zabbix Appliance is not intended for serious production use at this time.

VMware download: https://www.vmware.com/support/
VirtualBox download: https://www.virtualbox.org/wiki/Downloads
See the respective documentation to install and use virtualisation software.
2. Templates

After successful installation, you can import any of the predefined templates. Each template is the collection of Zabbix items corresponding to a set of OIDs, triggers, graphs, and applications. The template can be easily linked to any monitored host (RAy3) allowing quick access to the required values.

2.1. What Templates do we Provide?

The Templates list:

- Name: RAy3 Template (file “zbx_export_ray3.xml” in Zabbix zip file)
  ○ Consists of all specific OIDs provided by RACOM for RAy3 and OIDs for the Ethernet statistics
- Name: PING Template (file “zbx_export_ping.xml” in Zabbix zip file)
  ○ Pings a defined host and triggers whenever the host is unreachable

All templates can be downloaded from the RAy3 Firmware download site.

2.1.1. How do I Import the RAy3 Templates?

In order to import the template, click on the Configuration → Templates button at the top of the Zabbix webpage. Select the Import Template button at the top right corner.

![Fig. 2.1: Importing Template button](https://www.racom.eu/eng/products/microwave-link-detail#dnl_fw3)

Note

Since Zabbix 3, Value mappings can be imported together with the template.

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1. https://www.racom.eu/eng/products/microwave-link-detail#dnl_fw3
Fig. 2.2: Importing Template options

Now you can see the RAY3 template in the Template list window along with the other default templates.

**Note**

If you already imported the template and you need to update it, just import the newer version with the same name and the current template will be automatically overwritten.

Each **Item** has a Description, SNMP OID number, community string, UDP port (161), key, update interval and other parameters assigned to it. One of the key parameters is the update interval, because it defines how often Zabbix will request various replies from the RAY3 stations. These intervals are different for individual OIDs and are predefined based on our experience. You could consider changing these to suit your needs. For more details, read *Chapter 3, RAY3 Templates in Detail*.

Individual items can be enabled or disabled.

**Only monitor the values which you really need and with reasonable update times.**

The items are divided into usage groups, called **Applications** in Zabbix. These applications serve to provide better clarification of the defined items.

If you wish to be notified whenever any monitored value is out of its threshold range, you can define a **Trigger** for this purpose. These notifications are viewable on the Zabbix dashboard, item history or
you can have e-mail / jabber / sms notifications enabled. Each notification can have one of six predefined severity levels (warning, critical, …).  

**Note**

You can use a Clone option to create a copy of any template item or trigger for an individual host. In this case, you can edit its predefined values to meet your requirements for each host separately.

**Graphs** are automatically created for each monitored numeric value, but you can also create special graphs with several values on a single graph. We provide 3 predefined graphs containing for example Ethernet throughput (in, out) within one graph.

For more information, see the Zabbix documentation. You can delete, add or edit any template component. The predefined state serves as a quick start, but you do not have to use these at all and you can create your own set of monitored values/items.

### 2.2. MACROS

Macros are variables, identified by a specific syntax: `{MACRO}`. MACROs resolve to a specific value depending on the context. Effective use of MACROs allows to save time and make Zabbix configuration more transparent.

With our templates, each RipEX automatically obtains the following MACROs:

- `{HOST.SSHKEY}` - Full path to a stored admin SSH key to access the unit (by default "/home/zabbix/.ssh/id_rsa")
- `{HOST.SSHPORT}` - SSH port to access the unit (by default "22")
- `{SNMP_COMMUNITY}` - SNMPv2c community string (security parameter in SNMP version 2, by default "mwl-snmp")

You can edit the values in Configuration -> Hosts -> choose the particular RAY3 -> Macros -> Inherited and host macros. Edit any value and all Items will be automatically updated.

#### Templates

<table>
<thead>
<tr>
<th>Template</th>
<th>Linked templates</th>
<th>Macros</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Fig. 2.3: Template Macros**
2.3. RAy3 Firmware and Template Compatibility

Since RAy3 FW 1.0.14.0, the SNMP non-table items OIDs are defined in accordance with the RFC (ending '.0') - to improve SolarWinds compatibility. Keep this in mind when upgrading RAy3 firmware. Firmware < 1.0.14.0 are able to reply to SNMP queries with OIDs ending with .0, but the reply does not contain .0 in its OID. This works fine (for example) with Zabbix NMS, but (for example) SolarWinds does not accept such replies.

Since RAy3 FW 1.0.16.0, the SNMP product OID of RAy3 changed from '1' to '4'. The old template will NOT work with new RAy3 firmware. See the procedure below.

Suggested way of updating the RAy3 template is very straight-forward. Download the latest template from our RAy3 Firmware download site\(^2\). The name of the template is "RAy3 Template". There are two possible procedures and situations.

1. All RAy3 units in your NMS already have firmware >= 1.0.16.0. Rename your current RAy3 template to "RAy3 Template" and import the new one with the same name. This will replace the older template.

![Fig. 2.4: Importing RAy3 template](image)

2. You operate both RAy3 links with newer and older firmware. In such a case, you need two different templates. Make sure that your current template in Zabbix has a different name than "RAy3 Template", e.g. "RAy3 old firmware Template". Then, import the new template.

Mark hosts with new firmware (>= 1.0.16.0) and use "Mass update" button.

![Fig. 2.5: Mass update of RAy3 units](image)

Select the "Templates" submenu and select a new template. Check the "replace" box and apply the changes.

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\(^2\) [https://www.racom.eu/eng/products/microwave-link-detail#dnl_fw3](https://www.racom.eu/eng/products/microwave-link-detail#dnl_fw3)
Fig. 2.6: Replacing RAy3 template for selected units

In both situations, the history values should still be available and new values will be queried successfully.

NOTE: If you have any issues updating RAy3 firmware and/or Zabbix templates, contact our technical support group via support@racom.eu.

Note

If you use template utilizing Item’s KEYs of non-table items with ‘.0’ at the end, you need to check the "Clear when unlinking" box once replacing hosts’ template, because you would double the Items of each host. Unfortunately, you lose your historical data. You could manually edit all Item keys with trailing .0 manually in Zabbix GUI.

Fig. 2.7: Replacing RAy3 template for selected units with Clearing the hosts' items

3 mailto: support@racom.eu
3. RAY3 Templates in Detail

Approximately 90 enabled items are included in RAY3 templates. Most items are implemented by RACOM, but there are also items from the well-known MIB files IF-MIB and RMON.

Note

Some items are disabled by default.

The provided templates have predefined update intervals and for how many days each item keeps its history and trend values. All of these parameters define the requirements for the Zabbix server performance and the database size.

Update interval [seconds] – Refresh the item every N seconds.

Keep history [days] – Number of days to keep detailed history in the database. Older data will be removed by the Housekeeper.

Keep trends [days] – Keep aggregated (hourly min, max, avg, count) detailed history for N days in the database. Older data will be removed by the Housekeeper. Note that trends are only stored for numerical items.

Based on these parameters, items are divided into four groups:

1. Update interval = 1 day (86400 seconds), History = 30 days, Trends = 400 days
2. Update interval = 1 hour (3600 seconds), History = 30 days, Trends = 200 days
3. Update interval = 5 minutes (300 seconds), History = 60 days, Trends = 400 days
4. Update interval = 1 minute (60 seconds), History = 400 days, Trends = 400 days

Group 4 consists of the most useful values to watch:

- Input "Ethernet1" data port throughput in bps
- Output "Ethernet1" data port throughput in bps
- Current net bitrate in bps
- Current RF Power in dBm
- Receive RSS indicator in dBm
- Receive MSE indicator in dB

From our experience, all these values are important to watch and to have them updated each 60 seconds. It is also useful to be able to display these values in detail even if they are one-year-old.

If you need to have even more accurate values, you can decrease the update interval. The smallest useful value for the throughput items is 10 seconds. Reading RSS or SNR can be done every second, because its value is always the current one.

Important

We calculated that with the predefined RAY3 template (enabled values only), you approximately need about 0.75 GB of data for one RAY3 link (two units). Have this in mind when considering the database size. It can be increased a lot in case of many traps being sent from the RAY3 units.
Hints & Tips

The link reliability, link uptime, downtime or BER can be read because of our own OIDs. These values are updated every 5 minutes by default.

Watching the number of CRC errors can detect faulty cables and the number of dropped packets can warn you about high Ethernet traffic (bursts) so RAy3 drops some of them.

By default, the templates automatically populate the Inventory of individual hosts (serial number, unit type, MAC address, ...). If you enable Inventory of your RAy3 hosts (in the host configuration menu), you’ll be able to see those values within the unit's Inventory without any additional steps or without configuring them manually.

Note

You can define the default Inventory mode in the Administration - Others menu.
4. How to Import Monitored RAy3 Stations?

Now you have a working template, you need to define hosts (RAy3 stations). Each RAy3 station has its own IP address. The following steps will guide you through the Host Configuration.

To create a host, go to Configuration → Hosts and click on the Create Host button. Define the Host name and its IP address.

![Fig. 4.1: Defining the Host name and its IP address](image)

Alternatively, you can define a Group for the hosts. Creating a Group is straightforward. You can create a new one while creating a host or you can do so by going to the Configuration → Groups tab and clicking on the Create Group button.

Linking a template to the host(s) is achieved under the same tab or you can open Template settings and link any desired host to it.

You have to set the IP address and the port number (161) for the SNMP interface. Otherwise, you won't be able to use any SNMP item.

The option "Use bulk requests" can be enabled with RAy3 units. This feature enables sending multiple SNMP queries within one UDP datagram.

![Fig. 4.2: Defining the SNMP interface](image)

**Note**

In this Host configuration menu, configure the Host Inventory to be filled in automatically.
### 4.1. Where can I See the RAy3 Monitored Values?

To check monitored values, go to the Monitoring → Latest data tab and choose the desired host from the Menu.

For each item, you can see a graph or a history table. If a trigger is configured for the item, the graph shows a line with a threshold value.
5. Value Mappings

Responses from Several OID objects are unsigned integers, but these values do have a special meaning.

Example RacomRay.systemStatus

- “0” stands for “na” (not available)
- “1” stands for “ok”
- “2” stands for “warning”
- “3” stands for “alarm”

Unfortunately, by default, you can see only the numeric values at the Zabbix front-end. The Value mappings are automatically imported with the RAy3 template or it can be imported separately in the Administration - General - Value Mappings menu.

**Note**

This syntax feature is used throughout all MIB tables, not only the RAy3 MIB table.

If you create any Value map manually, follow this procedure.

To add new value mappings, go to Administration → General → Value Mapping. Click on the “Create value map” button and insert the values, which are mentioned on the following lines. There is an Item list, which uses these value mappings (either link them manually or automatically by importing the template).

**RacomRay.AlarmState**

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>na</td>
</tr>
<tr>
<td>1</td>
<td>up</td>
</tr>
<tr>
<td>2</td>
<td>down</td>
</tr>
<tr>
<td>3</td>
<td>ack</td>
</tr>
</tbody>
</table>

**Items:**

- Temperature alarm state
- Low voltage alarm state
- High voltage alarm state
- RSS alarm state
- MSE alarm state
- Local Ethernet $1 Link Down alarm state
- RF Power Fail alarm state
- Net bitrate (air speed) below Limit alarm state
- BER alarm state
- Peer disconnect alarm state
- WiFi Host Access Point on alarm state

**RacomRay.channelArrangement**

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>na</td>
</tr>
<tr>
<td>1</td>
<td>accp</td>
</tr>
<tr>
<td>2</td>
<td>acap</td>
</tr>
<tr>
<td>3</td>
<td>ccdp</td>
</tr>
</tbody>
</table>

**Items:**

- Channel arrangement

**RacomRay.duplex**

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>na</td>
</tr>
</tbody>
</table>

**Items:**

- Ethernet$1 duplex
Value Mappings

RacomRay.duplex

Items:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>full</td>
</tr>
<tr>
<td>2</td>
<td>half</td>
</tr>
</tbody>
</table>

RacomRay.lineStatusII

Items:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>na</td>
</tr>
<tr>
<td>1</td>
<td>setup</td>
</tr>
<tr>
<td>2</td>
<td>single</td>
</tr>
<tr>
<td>3</td>
<td>connecting</td>
</tr>
<tr>
<td>4</td>
<td>authorizing</td>
</tr>
<tr>
<td>5</td>
<td>ok</td>
</tr>
<tr>
<td>6</td>
<td>analyzer</td>
</tr>
</tbody>
</table>

RacomRay.mdix

Items:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>na</td>
</tr>
<tr>
<td>1</td>
<td>mdi</td>
</tr>
<tr>
<td>2</td>
<td>mdi-x</td>
</tr>
</tbody>
</table>

RacomRay3.modulationIndex

Items:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>na</td>
</tr>
<tr>
<td>1</td>
<td>qpskS</td>
</tr>
<tr>
<td>2</td>
<td>qpsk</td>
</tr>
<tr>
<td>3</td>
<td>qam16</td>
</tr>
<tr>
<td>4</td>
<td>qam32</td>
</tr>
<tr>
<td>5</td>
<td>qam64</td>
</tr>
<tr>
<td>6</td>
<td>qam128</td>
</tr>
<tr>
<td>7</td>
<td>qam256</td>
</tr>
<tr>
<td>8</td>
<td>qam512</td>
</tr>
<tr>
<td>9</td>
<td>qam1024</td>
</tr>
<tr>
<td>10</td>
<td>qam2048</td>
</tr>
<tr>
<td>11</td>
<td>qam4096</td>
</tr>
</tbody>
</table>

RacomRay.OptionSetting

Items:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>na</td>
</tr>
<tr>
<td>1</td>
<td>on</td>
</tr>
<tr>
<td>2</td>
<td>off</td>
</tr>
<tr>
<td>3</td>
<td>auto</td>
</tr>
</tbody>
</table>

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Value Mappings

<table>
<thead>
<tr>
<th>Item</th>
<th>Items:</th>
</tr>
</thead>
<tbody>
<tr>
<td>RacomRay.ServiceState</td>
<td>Peer station user Ethernet $1 link status</td>
</tr>
<tr>
<td></td>
<td>0 → na</td>
</tr>
<tr>
<td></td>
<td>1 → up</td>
</tr>
<tr>
<td></td>
<td>2 → down</td>
</tr>
<tr>
<td>RacomRay.sshd</td>
<td>Management interface: SSH</td>
</tr>
<tr>
<td></td>
<td>1 → na</td>
</tr>
<tr>
<td></td>
<td>2 → onlykey</td>
</tr>
<tr>
<td></td>
<td>3 → off</td>
</tr>
<tr>
<td>RacomRay.systemStatus</td>
<td>Unit status</td>
</tr>
<tr>
<td></td>
<td>0 → na</td>
</tr>
<tr>
<td></td>
<td>1 → ok</td>
</tr>
<tr>
<td></td>
<td>2 → warning</td>
</tr>
<tr>
<td></td>
<td>3 → alarm</td>
</tr>
<tr>
<td>RacomRay.voltageSource</td>
<td>Source of supply voltage</td>
</tr>
<tr>
<td></td>
<td>0 → na</td>
</tr>
<tr>
<td></td>
<td>1 → aux</td>
</tr>
<tr>
<td></td>
<td>2 → poe</td>
</tr>
<tr>
<td>ICMP ping - Accessibility</td>
<td>ICMP ping - Accessibility</td>
</tr>
<tr>
<td></td>
<td>0 → ICMP ping fails</td>
</tr>
<tr>
<td></td>
<td>1 → ICMP ping successful</td>
</tr>
</tbody>
</table>

5.1. How can I Edit an Item to Link with a Value Map?

Go to Configuration → Templates and choose one of the imported template. Open the item configuration window and click on the chosen item to view and edit its settings.

Choose the appropriate value map in the Menu “Show value” and save the changes.

Example: RacomRay.sshd
### Value Mappings

<table>
<thead>
<tr>
<th>Name</th>
<th>Management interface: SSH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>SNMPv2 agent</td>
</tr>
<tr>
<td>Key</td>
<td>sshd</td>
</tr>
<tr>
<td>SNMP OID</td>
<td>1.3.6.1.4.1.33555.1.1.6.1</td>
</tr>
<tr>
<td>SNMP community</td>
<td>public</td>
</tr>
<tr>
<td>Port</td>
<td></td>
</tr>
<tr>
<td>Type of information</td>
<td>Numeric (unsigned)</td>
</tr>
<tr>
<td>Data type</td>
<td>Decimal</td>
</tr>
<tr>
<td>Units</td>
<td></td>
</tr>
<tr>
<td>Use custom multiplier</td>
<td></td>
</tr>
<tr>
<td>Update interval (in sec)</td>
<td>3500</td>
</tr>
<tr>
<td>Custom intervals</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TYPE</th>
<th>INTERVAL</th>
<th>PERIOD</th>
<th>ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexible</td>
<td>Scheduling</td>
<td>50</td>
<td>1-7:00:00-24:00</td>
</tr>
</tbody>
</table>

| History storage period (in days) | 30 |
| Trend storage period (in days)  | 200 |

**Show value**

Show value mappings

**New application**

- None
- IF-MIB
- Interface - Ethernet
- Interface - radio
- RMON
- Station - access
- Station - alarm
- Station - chassis
- Station - info
- Station - product

---

Fig. 5.1: Linking a value map to an item
6. How do I Know that Something Has Happened to the RAy3 Station?

There are two ways to check the RAy3 stations. You can actively query the station in the defined time intervals or you can just wait for the trap to be received.

6.1. Active Querying

If you have a defined item which is updated e.g. every 10 seconds. Zabbix requests a reply to the SNMP GET message for the specific OID object and it stores this value in the database at 10 second intervals.

A trigger can also be configured for each item. For instance, temperature threshold alarm is set to 50°C. Whenever Zabbix receives an SNMP RESPONSE message from any monitored host with temperature higher than 50°C, an alarm is triggered. If the alarm is triggered, it is displayed at the Zabbix Dashboard. The Alarm will be visible in the “Last 20 issues” table and you will see which host is having an issue in the “Host status” table.

When the temperature falls back into the allowed range, the issue will be deleted from the Zabbix dashboard.

6.2. SNMP Traps

The key aspect of the SNMP are the TRAPS. These OID objects are not actively monitored by the Zabbix manager but by the RAy3 itself. For example, an RSS value is too low: RAy3 sends a trap to the defined IP address of your NMS (Zabbix) which triggers an alarm.

6.2.1. How to Configure Traps in Zabbix?

This, unfortunately, is a somewhat complex procedure. There are several ways to configure traps – only one of them will be explained in this guide.

Note

Another approach could be using SNMPTT functionality.

You have to install an snmptrapd, a daemon which receives SNMP traps and passes them into the Zabbix front-end.

You can use the script (snmptrap.sh) which is included in the ray3-zabbix.zip file downloadable from RACOM website. Copy the script file into /usr/lib/zabbix/externalscripts/ directory and change the file privileges and make it executable.

```bash
# chown zabbix:zabbix /usr/lib/zabbix/externalscripts/snmptrap.sh
# chmod +x /usr/lib/zabbix/externalscripts/snmptrap.sh
```

After that, you need to edit the file. By executing

```
$ which zabbix_sender
```

you will find the full path to this executable binary file. Change the path in the file, e.g.

```
1 https://www.racom.eu/download/hw/ray/free/eng/03b_fw/ray3-zabbix.zip
```
ZABBIX_SENDER="/usr/bin/zabbix_sender";

The script parses the output of each received SNMP trap, selects the appropriate host and declares an associative array containing trap descriptions. Eventually, it sends the whole message to your Zabbix server.

The script logs trap information into the /tmp/trap_messages.log file.

You should also check the LOG destination, which should be: /var/log/snmpttrap/snmpttrap.log. Create the directory if it is not already created and edit this in the snmpttrap.sh script file.

LOGFILE=/var/log/snmpttrap/snmpttrap.log

Note

The log file could also be located in /var/log/zabbix/snmpttrap.log if required.

Now we have our script prepared, let's configure the Zabbix front-end:

If you have not done so, import the RAy3 template. One application is called TRAPS and it consists of all traps. Link the template to desired hosts.

Note

If Zabbix receives a trap for an unknown host it will not be displayed.

The host MUST be configured using the IP address as the Host name, e.g.:

Host name: 192.168.10.1

Visible name: RAy3-L

SNMP interface: 192.168.10.1, port 161, IP

Along with this template, 12 new items and triggers appear at each used host. That is exactly the number of SNMP traps defined at the RAy3. Each trap should be recognized and the Zabbix should display the correct information message at the dashboard.

The template Application consists of 12 traps which correspond with number of traps implemented in RAy3.
RAy3 sends a trap whenever the watched value is out of range (or other configured condition is met) and whenever the value falls back within the corresponding range.

Every trap has two states in Zabbix. Each trap can either be in the alarm state (colors correspond to colors in the WEB interface) or in the OK state.

Note
There is a third trap state on the RAy3 WEB interface - "acknowledged". This is not recognized automatically within the Zabbix frontend, but you can acknowledge the trap in Zabbix separately from the Dashboard menu.

You can also define Zabbix to send you an e-mail whenever any trap is triggered. See the Zabbix Documentation or Chapter 9, Zabbix Alerting via e-mail of this Application not for the e-mail configuration.

Please, find the file snmptrapd.conf usually it's in the /etc/snmp/ directory. Edit or create the file as root with the following lines:

```
authCommunity log,execute mwl-snmp
traphandle default /bin/bash /usr/lib/zabbix/externalscripts/snmptrap.sh
```

The first line will allow all received traps with community snmp-racom to be parsed and the second line will force the snmptrapd to use our script.

If you do not know what community names you will receive, add the following line to accept all community names.

```
disableAuthorization yes
```

Note
The default RAy3 community name is "mwl-snmp", configure snmptrapd.conf accordingly.

Do not forget to restart snmptrapd. You should have similar snmptrapd parameters in the /etc/sysconfig/snmptrapd file:

```
authCommunity log,execute mwl-snmp
traphandle default /bin/bash /usr/lib/zabbix/externalscripts/snmptrap.sh
```
This ensures that snmptrapd daemon will not translate the numerical OID numbers which is important for our script to run properly.

**Important**

If you install Zabbix on the CentOS distribution, do not forget to enable snmptrapd within SELinux security rules.

SELinux is an important security part of CentOS. Running all the functionality of Zabbix will require configuring these rules. If you do not understand it, consult the required changes with our technical support.

### 6.2.2. Basic Trap Functionality Tests

Now Zabbix is ready to receive SNMP traps from all RAY3 stations and enter them into the database properly. In order to test it, force the trap to be sent from any RAY3 and see whether it appears in the Zabbix front-end. If not, check that the respective UDP port (162) is enabled at your firewall and check the settings again. You can also execute Tcpdump or Wireshark at the selected interface of your Zabbix server or somewhere along the intended packet path.

Another basic test can be run using the following command:

```
zabbix_sender -z localhost -p 10051 -s "192.168.10.1" -k tr2RssAlarm -o "tr2RssAlarm, ALARM: UP"
```

The IP address of your RAY3 station is 192.168.10.1, key is "tr2RssAlarm" and the message for the Zabbix server is "tr2RssAlarm, ALARM: UP". The command should trigger the host's "RSS exceeded the threshold" alarm. Note that you need to have a host configured with this IP address, otherwise the trap will not be shown.

It is important to set the KEY value correctly, otherwise the trap would not match the trigger. See more KEY values with their description below:

- **tr3TemperatureAlarm** - Temperature exceeded the threshold
- **tr3VoltageLowAlarm** - Supply voltage below minimal threshold
- **tr3VoltageHighAlarm** - Supply voltage above maximal threshold
- **tr3RssAlarm** - RSS exceeded the threshold
- **tr3MseAlarm** - MSE exceeded the threshold
- **tr3BerAlarm** - BER exceeded the threshold
- **tr3AirDisconnect** - Air line disconnected
- **tr3Eth1LinkDown** - Peer station Ethernet 1 link Up/Down
- **tr3Eth2LinkDown** - Peer station Ethernet 2 link Up/Down
- **tr3NetBitrate** - Air speed below threshold
- **tr3WifiOn** - WiFi Host Access Point is on
- **tr3AirCapacity** - Air channel capacity changed

If you want to clear the trap alarm, just repeat the same zabbix_sender command, but change the message to contain the word "DOWN", E.g. "ALARM DOWN".

---

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How do I Know that Something Has Happened to the RAy3 Station?

**Note**

Air channel capacity changed trap is, in fact, Event. RAy3 sends information about air capacity every time it is changed. In Zabbix, it is cleared after 5 minutes of being stable.

<table>
<thead>
<tr>
<th>Time</th>
<th>Recovery Time</th>
<th>Status</th>
<th>Info</th>
<th>Host</th>
<th>Problem + Severity</th>
<th>Duration</th>
<th>Ack</th>
</tr>
</thead>
<tbody>
<tr>
<td>2023-08-03 17:35:23</td>
<td>PROBLEM</td>
<td>RAy3 195 - testy SNMP - Mfrweek</td>
<td>ICMP ping - Host is NOT accessible for the last 2 hours</td>
<td>20h 22m 10s</td>
<td>No</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig. 6.2: RAy3 temperature trap triggered

You can also see Trap's output in **Monitoring → Latest Data → TRAPS of your RAy3 station → History**. The displayed information differs based on the trap received. See the detailed description in the respective Zabbix item.
7. How to Access RAY3 GUI from Zabbix

Zabbix can offer various ways of accessing the RAY3 web interface by clicking on the link within the Zabbix front-end.

7.1. Map URL

For every Host depicted in Maps, you can define its URL.

<table>
<thead>
<tr>
<th>URLS</th>
<th>Name</th>
<th>URL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RAY3 - 10.10.0.189 RACC</td>
<td><a href="http://10.10.0.189">http://10.10.0.189</a></td>
</tr>
</tbody>
</table>

Fig. 7.1: Map URL definition

After clicking on the Host, a new Item appears (URL), defined with the Name and the actual link. And when you click on this URL, the RAY3 web interface appears.

Fig. 7.2: RAY3 URL Link in maps
7.2. Trigger URL

Every host can have as many Triggers as required. And for every Trigger, the respective URL can be defined. Just add the URL in the Trigger configuration page.

![Figure 7.3: Trigger URL definition](image)

After you do so, every time the trigger is activated, you can click on the Issue description within Dashboard's "Last 20 Issues" window and then on the URL link.

![Figure 7.4: Issue description used as a link](image)

A simple click can forward you to the RAY3 web interface.
7.3. Inventory URL

The third option is to use Inventory for configuring URL. For every Host, you can enable the Inventory (serial number, OS, host type, ...). Within many Inventory options, the URL can be defined.

Fig. 7.5: Inventory URL definition

Every host's Inventory can be opened from the Dashboard's "Last 20 Issues" window. And in the Details, there is the configured URL displayed.

Fig. 7.6: RAy3 URL link in the Inventory
8. What Else does Zabbix Offer?

There are many features provided by the Zabbix software. They are described in the Zabbix Documentation. Below are just a few of them.

You can create Screens. A Screen is a set of various graphs on one page for better overview of your network (temperature, UCC, RF power, ...).

You can create Maps. If you administer many stations in many locations, a Map can be a good choice. You can define the background picture (e.g. real maps), various station pictures, station status, various statistics, etc. You can import any icon or background picture you want to use.

Fig. 8.1: Basic map with two RAY3 stations

A short example of RAY3 station configuration in Maps:

RAY3 {HOSTNAME}  
RSS= {{HOSTNAME}:rss.last(0)}  
MSE= {{HOSTNAME}:mse.last(0)}  
Temp= {{HOSTNAME}:temperatureModem.last(0)}
Fig. 8.2: Definition of RAy3 station in maps

For the link, you can e.g. define the current netbitrate to be displayed.

{10.10.0.188:netBitrate.last(0)}
{10.10.0.189:netBitrate.last(0)}

Each map can be divided into several sub-maps. It can be useful for various levels of detail.
9. Zabbix Alerting via e-mail

In case of any issue within your network, e.g. drop in the signal quality, or the unit being unreachable, Zabbix can automatically send an e-mail to predefined e-mail addresses. The following example will show just one procedure, other ways are possible (e.g. via the script).

9.1. E-mail Configuration

The e-mail can be set in the Administration – Media Types menu. Edit the E-mail type corresponding to your server settings. In our example, we use our own SMTP server reachable from Zabbix server. No special security or password is required. You should be able to use any SMTP server.

![Media types]

Fig. 9.1: E-mail configuration
9.2. Users Configuration

The e-mails are sent to the users' e-mail addresses. Go to the Administration – Users menu and configure the required e-mail addresses within the user’s details (Media).

**Fig. 9.2: User’s e-mail**

You define the time when the e-mail will be sent (e.g. do not send it over the night) and the severity of the issue (e.g. send me the e-mail just in case of a critical issue).
9.3. Actions

The last step is to configure the action – configure which issue causes the e-mail to be sent. Go the Configuration – Actions menu and create a new Action.

Fig. 9.3: Action

Usually, you will use the MACROs for the e-mail body/subject. In this example, the Subject of the e-mail will consist of the host’s Name, Trigger status (Problem, OK) and Trigger Name. Within the body of the message, there are additional information such as the Trigger Severity, URL and the Issue details.

If the issue is fixed, we also send a recovery message. It is the same message, but saying “OK” instead of “PROBLEM”.
Fig. 9.4: Action conditions

The action is executed if it meets the conditions, e.g. the trigger severity is greater or equals to Warning and the group is RAY3. The conditions can be combined with AND or OR statements.

Fig. 9.5: Action Operation

The operation does not need to be just an e-mail. It can consist of sending SMS or jabber messages. Or based on the issue duration, it can perform different tasks. In the example above, we send the e-mail to the user “servis” immediately when the issue occurs. There are no additional steps.
10. RAy3 Firmware upgrade and other Useful Scripts

By default, there are no ready-to-be-used actions in Zabbix such as configuration backup or firmware upgrade. The Zabbix NMS is a general system which requires special features to be implemented by RACOM or by the user himself.

We provide the user with a guide how to use and define these special features and within the RAy3 template, we already prepared several examples:

- Configuration backup
- Displaying the current Firmware version
- Firmware upgrade

Note
If you have troubles running scripts or making your own, contact us on <support@racom.eu>.

The whole implementation can be quite time consuming, but once you successfully run the first script, the others are very similar and its implementation is straightforward.

Within the Template, there are three scripts. As you now realise, having the configuration backup files can be crucial if replacing the unit. There is nothing easier than just uploading the configuration file into a brand new RAy3 unit.

10.1. Zabbix Configuration

Before creating and running the first scripts, you need to prepare the Zabbix server (and the Linux operating system). In this example, we configure the CentOS 7 operating system with Zabbix 3 installed via packaging system.

The following steps can be done in different order, but following this order is absolutely fine.

10.1.1. Zabbix Server Configuration File

By default, the zabbix_server configuration file is located in the /etc/zabbix/zabbix_server.conf file. Find the line with "SSHKeyLocation" parameter and define it with this value:

```
SSHKeyLocation=/home/zabbix/.ssh
```

This is the location of the RSA private SSH key which will be used to access the RAy3 units.

Restart the Zabbix server afterwards.

```
# systemctl restart zabbix-server
```

10.1.2. Uploading the Template Scripts

The scripts must be uploaded to correct directory manually. The default directory is /usr/lib/zabbix/externalscripts/. Copy the script files from the ZIP Template file to this directory. The target state should look similar to this output:

```
# ls -l /usr/lib/zabbix/externalscripts/
total 48
```
There are three executable scripts via the Zabbix web interface (starting with "ray_") and one additional script "cli_upgrade_ray.sh" which is used by one of the previous script. The LOG output of those scripts is in script-log.txt file. There is also the snmptrap.sh file which you should have there for the SNMP TRAP functionality.

Make sure that the files have the zabbix user/group and are executable.

```
# chown zabbix:zabbix /usr/lib/zabbix/externalscripts/*
# chmod +x /usr/lib/zabbix/externalscripts/*
```

### 10.1.3. Zabbix User Configuration

The Zabbix user cannot login to the bash by default. We need modify the /etc/passwd file as follows:

```
# chsh -s /bin/bash zabbix
# cat /etc/passwd
zabbix:x:996:994:Zabbix Monitoring System:/home/zabbix:/bin/bash
```

Make sure that the last part after the `:` has a correct path to the bash binary.

Do not edit the UID and GID, these are created by CentOS automatically and can be different in your installation.

**Note**

You might need to install "util-linux-user" for the "chsh" command.

If not already created, create the HOME directory for the Zabbix user.

```
# usermod -m -d /home/zabbix zabbix
# chown zabbix:zabbix /home/zabbix
# chmod 700 /home/zabbix
```

**Note**

You may need to run the "usermod" command once again.

Create the directories for the saved configuration and firmware files and change the access rights.

```
# mkdir /home/zabbix/configuration-backup
# mkdir /home/zabbix/firmware
# mkdir /home/zabbix/configuration-backup/ray
# mkdir /home/zabbix/firmware/ray
# chown -R zabbix:zabbix /home/zabbix/
```
10.1.4. SSH Access to RAy3 units

The directory for the SSH key should now be located in /home/zabbix/.ssh directory. Change the current directory to this one and login as zabbix.

```
# su zabbix
```

A new prompt appears. Because, we cannot access the RAy3 units using their password via scripts, we need to upload the SSH keys into every unit we want to control. You can either have you own RSA/DSA key or you can create a new one following this example. Run

```
bash-4.2$ ssh-keygen -t rsa
```

Follow the guide of the ssh-keygen application and leave the passphrase empty.

To copy our RSA key into the RAy3 units, run the following command:

```
bash-4.2$ ssh-copy-id admin@10.250.2.225
```

Just replace 10.250.2.225 with the correct RAy3 IP address. The prompt will ask for the Admin password, fill it in and click Enter. Now, you should have the access into the unit without using a password. Check it via this command:

```
bash-4.2$ ssh admin@10.250.2.225
```

Note

You might need to define the key manually with -i parameter.

You should be logged in the RAy3 unit without writing the password.

10.1.5. Scripts in the Zabbix Web Interface

The script files can be downloaded within the template ZIP file¹. Save them in the correct directory (/usr/lib/zabbix/externalscripts/) of your Zabbix distribution. Then, the scripts must be manually created in the Zabbix Administration - Scripts menu. See the example below and create Zabbix scripts for all RAy3 scripts.

```
<table>
<thead>
<tr>
<th>Script Configuration backup</th>
<th>Script Server</th>
<th>exit</th>
<th>Hosts with latest version up to 1.0 or 2.0 (both units)</th>
<th>Script Server</th>
<th>exit</th>
<th>Hosts with latest version 1.0.5 or 1.0.8 (both units)</th>
</tr>
</thead>
</table>
```

```
RAy3Configuration backup | exit| Hosts with latest version up to 1.0 or 2.0 (both units) | exit| Hosts with latest version 1.0.5 or 1.0.8 (both units) |
```

Fig. 10.1: RAy3 script

If you open one of them, you can modify them as required.

¹ [https://www.racom.eu/download/hw/ray/free/eng/03b_fw/ray3-zabbix.zip](https://www.racom.eu/download/hw/ray/free/eng/03b_fw/ray3-zabbix.zip)
Fig. 10.2: Script configuration

The Type must be set to “Script” and the Execute on parameter to “Zabbix server”. The command can be modified as required. There is a full path to the script saved on the server and the parameters. The script output is appended to the mentioned log file.

The script can apply to ALL hosts or just one group – in our example, the group name is “RAy3”.

The parameters are MACROs which should be enabled by default due to our Template. Each RAy3 unit uses the SSH port 22 and the SSH key saved in /home/zabbix/.ssh/id_rsa file by default. If you need to modify any of these parameters, go to the Configuration – Hosts menu and edit the particular Host’s MACROs (Inherited and host macros submenu).
Fig. 10.3: Host MACROs

To edit any of the parameters, click on the “Change” button and Update the Host.

10.1.6. SELinux Restrictions

If the operating system is CentOS and has the SELinux security option enabled, the scripts will not run properly due to these restrictions. Please consult this with your IT department or contact RACOM technical support.

⚠️ Important

Do not rush with SELinux rules.

A similar approach is required for the Bash, SNMP traps, logging the script output, etc.

10.1.7. Testing Scripts

The scripts can be tested via clicking on the Hosts in the Web interface. You can click on them when they are displayed within the Last 20 Issues on your Dashboard, or within Maps where they are always displayed.
If you click on any of the scripts, the corresponding script runs and the output is displayed in the pop-up window. You can test the Zabbix general ones such as “Ping” or “Traceroute” first.

**Note**

You may be required to change the SELinux rules or to install “traceroute” application via the command line (yum install).

The easiest script displays the current firmware version. The version should be displayed within several seconds in the pop-up window.

Another script is the Configuration backup. The expected output should display a full path to the stored file (in the /home/zabbix/configuration-backup/ray directory).

The last script makes the Firmware upgrade. The script copies the firmware and another script into the unit and if successfully transmitted, it displays the information in the pop-up window. Due to Zabbix functionality, there is no way to wait for the upgrade to be finished and be informed about it within this pop-up window. Check the Firmware version after several minutes (e.g. 10 minutes) to check whether the upgrade was successful. Note that the script upgrades both units of the selected link! If the upgrade was not finished successfully, check the LOG file or login to the unit via SSH and check the internal log files (/var/log/) and the script log in the /tmp directory. You may also need to check the SELinux rules.

Once configured correctly, running the scripts is easy. If you need to add a new host, just copy the SSH key and you are ready to use it. And if a new script is required, see these examples and create your own scripts or consult creating them with our technical support at <support@racom.eu>.
Revision History

Revision 1.0 2019-09-11
First issue - FW 1.0.14.0

Revision 1.1 2019-11-29
The SNMP product OID of RAY3 changed from '1' to '4'. FW 1.0.16.0.

Revision 1.2 2021-01-19
Small changes regarding CentOS8 and Zabbix5.