

Application notes



RAY2 - NMS - Zabbix

version 1.3
2023-03-07

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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 RAY2 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.

¹ <https://www.racom.eu/eng/products/microwave-link.html#download>

² <https://www.racom.eu/eng/products/m/ripex/demo/zabbix.html>

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
- Open BSD
- 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 RAY2 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 (RAy2) allowing quick access to the required values.

2.1. What Templates do we Provide?

The Templates list:

- Name: RAY2 Template
 - Consists of all specific OIDs provided by RACOM for RAY2 units RAY2-11, RAY2-17, ... and OIDs for the Ethernet statistics
- Name: PING Template
 - Pings a defined host and triggers whenever the host is unreachable

All templates can be downloaded from the RAY2 download site at https://www.racom.eu/download/hw/ray/potencial/eng/02_fw/RAy2_Zabbix_templ.zip



Note

For RAY1 templates, see the Archive section on our WEB page at https://www.racom.eu/download/hw/ray/free/eng/08_ray1/RAy-AppNote-en.pdf

2.1.1. How do I Import the RAY2 Templates?

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

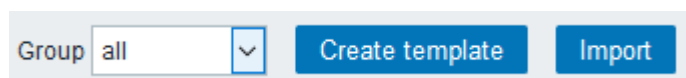


Fig. 2.1: Importing Template button



Note

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

Import file Procházet... zbx_export_ray2.xml

Rules	UPDATE EXISTING	CREATE NEW	DELETE	MISSING
Groups		<input checked="" type="checkbox"/>		
Hosts	<input type="checkbox"/>	<input type="checkbox"/>		
Templates	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
Template screens	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input type="checkbox"/>
Template linkage		<input checked="" type="checkbox"/>		
Applications		<input checked="" type="checkbox"/>		<input type="checkbox"/>
Items	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input type="checkbox"/>
Discovery rules	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input type="checkbox"/>
Triggers	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input type="checkbox"/>
Graphs	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input type="checkbox"/>
Screens	<input type="checkbox"/>	<input type="checkbox"/>		
Maps	<input type="checkbox"/>	<input type="checkbox"/>		
Images	<input type="checkbox"/>	<input type="checkbox"/>		
Value mappings	<input type="checkbox"/>	<input checked="" type="checkbox"/>		

Import Cancel

Fig. 2.2: Importing Template options

Now you can see the RAY2 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 RAY2 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, RAY2 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 RAY2 -> Macros -> Inherited and host macros. Edit any value and all Items will be automatically updated.

Fig. 2.3: Template Macros

2.3. RAY2 Firmware and Template Compatibility

Since RAY2 FW 2.2.5.0, 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 RAY2 firmware.

Firmware versions < 2.2.5.0 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. SolarWinds does not accept such replies.

Suggested way of updating the RAY2 template is very straight-forward. Download the latest template from our website, see *Firmware RAY2 section*¹. The name of the template is "RAY2 Template". There are two possible procedures and situations.

1. Your current template has the same name "RAY2 Template". In such a case, template import overwrites the old template and all RAY2 units using this template in your Zabbix NMS will start using the new template. Both units with old and new firmware will reply correctly.

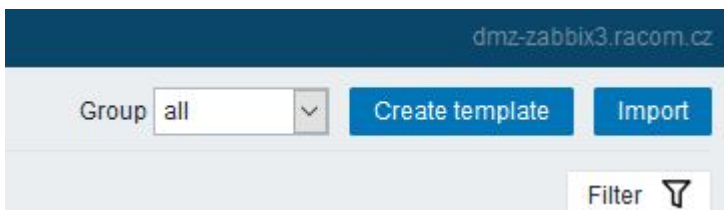


Fig. 2.4: Importing RAY2 template

2. Your current template has different name. You can rename it to "RAY2 Template" and import the new one to have the same situation as above. Or you can replace templates for selected hosts via "Mass update" option for hosts. Mark selected hosts and use "Mass update" button.

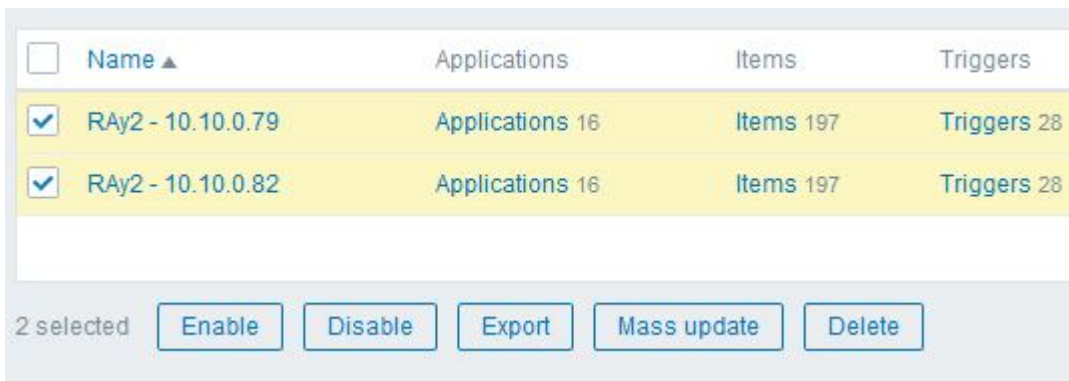


Fig. 2.5: Mass update of RAY2 units

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

¹ <https://www.racom.eu/eng/products/microwave-link.html#download>

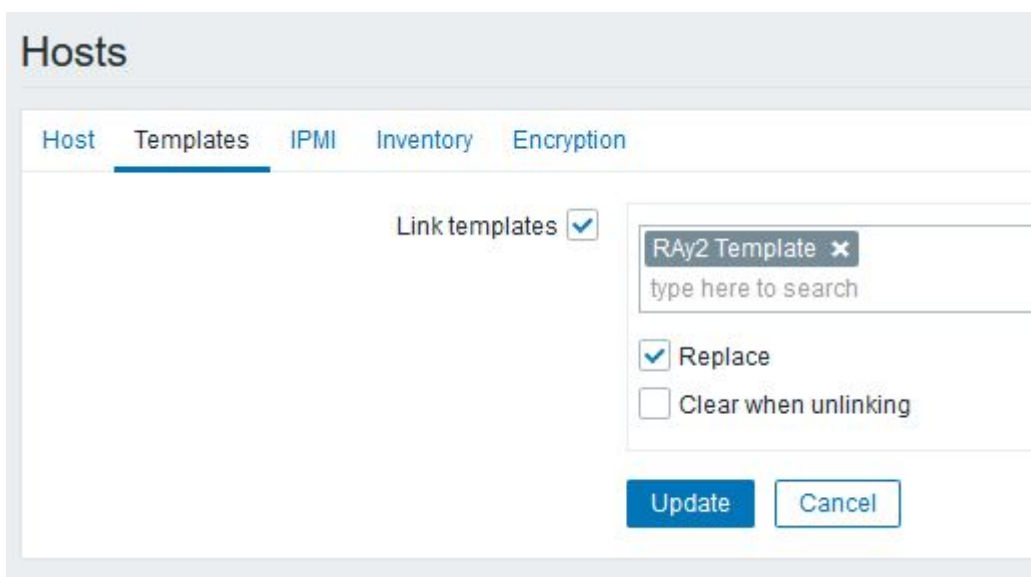


Fig. 2.6: Replacing RAY2 template for selected units

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

NOTE: If you have any issues updating RAY2 firmware and/or Zabbix templates, contact our technical support group via support@racom.eu².

² <mailto:support@racom.eu>

3. RAY2 Templates in Detail

Approximately 90 enabled items are included in RAY2 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 SNR 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 RAY2 template (enabled values only), you approximately need about 0.75 GB of data for one RAY2 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 RAY2 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 RAY2 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 RAY2 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.



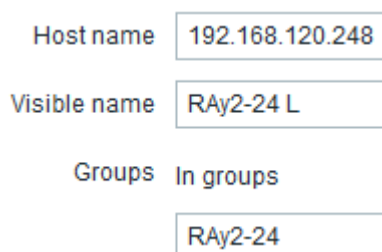
Note

You can define the default Inventory mode in the Administration - Others menu.

4. How to Import Monitored RAY2 Stations?

Now you have a working template, you need to define hosts (RAY2 stations). Each RAY2 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.



Host name: 192.168.120.248

Visible name: RAY2-24 L

Groups: In groups

RAY2-24

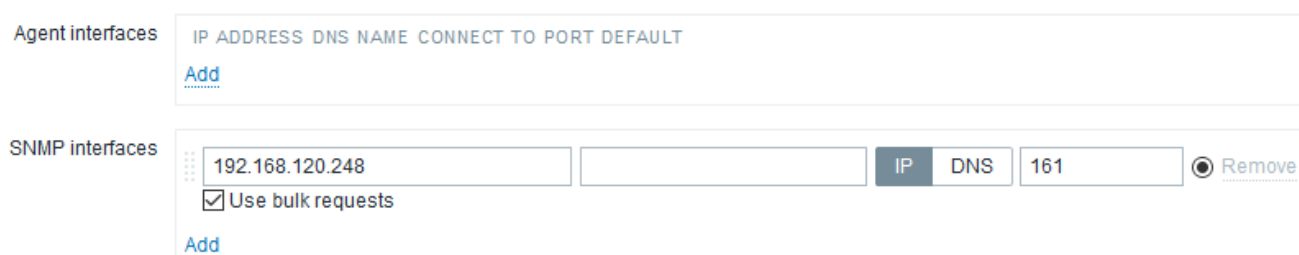
Fig. 4.1: Defining the Host name and its IP address

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 RAY2 units. This feature enables sending multiple SNMP queries within one UDP datagram.



Agent interfaces: IP ADDRESS DNS NAME CONNECT TO PORT DEFAULT

Add

SNMP interfaces:

192.168.120.248		IP	DNS	161	Remove
-----------------	--	----	-----	-----	--------

☒ Use bulk requests

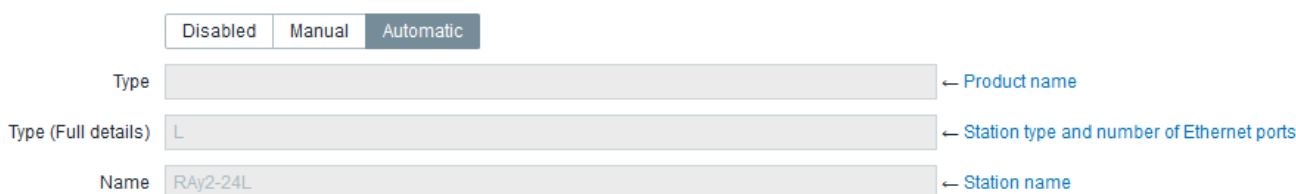
Add

Fig. 4.2: Defining the SNMP interface



Note

In this Host configuration menu, configure the Host Inventory to be filled in automatically.



Disabled Manual Automatic

Type: Product name

Type (Full details): L Station type and number of Ethernet ports

Name: RAY2-24L Station name

Fig. 4.3: Defining the Host Inventory

4.1. Where can I See the RAY2 Monitored Values?

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

NAME ▲	LAST CHECK	LAST VALUE	CHANGE
Interface - Ethernet (12 Items)			
Interface - radio (11 Items)			
<input type="checkbox"/> Channel arrangement	2016-03-18 10:00:31	accp (1)	Graph
<input type="checkbox"/> Channel matching	2016-03-18 10:00:32	on (1)	Graph
<input type="checkbox"/> Configured RF Power in dBm	2016-03-18 10:00:38	3 dBm	Graph
<input type="checkbox"/> Current net bitrate in bps	2016-03-18 10:51:16	170.69 Mbps	Graph
<input type="checkbox"/> Current RF Power in dBm	2016-03-18 10:51:16	-3 dBm	Graph
<input type="checkbox"/> Maximum net bitrate in bps	2016-03-18 10:00:26	358 Mbps	Graph

Fig. 4.4: RAY2 latest data

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.

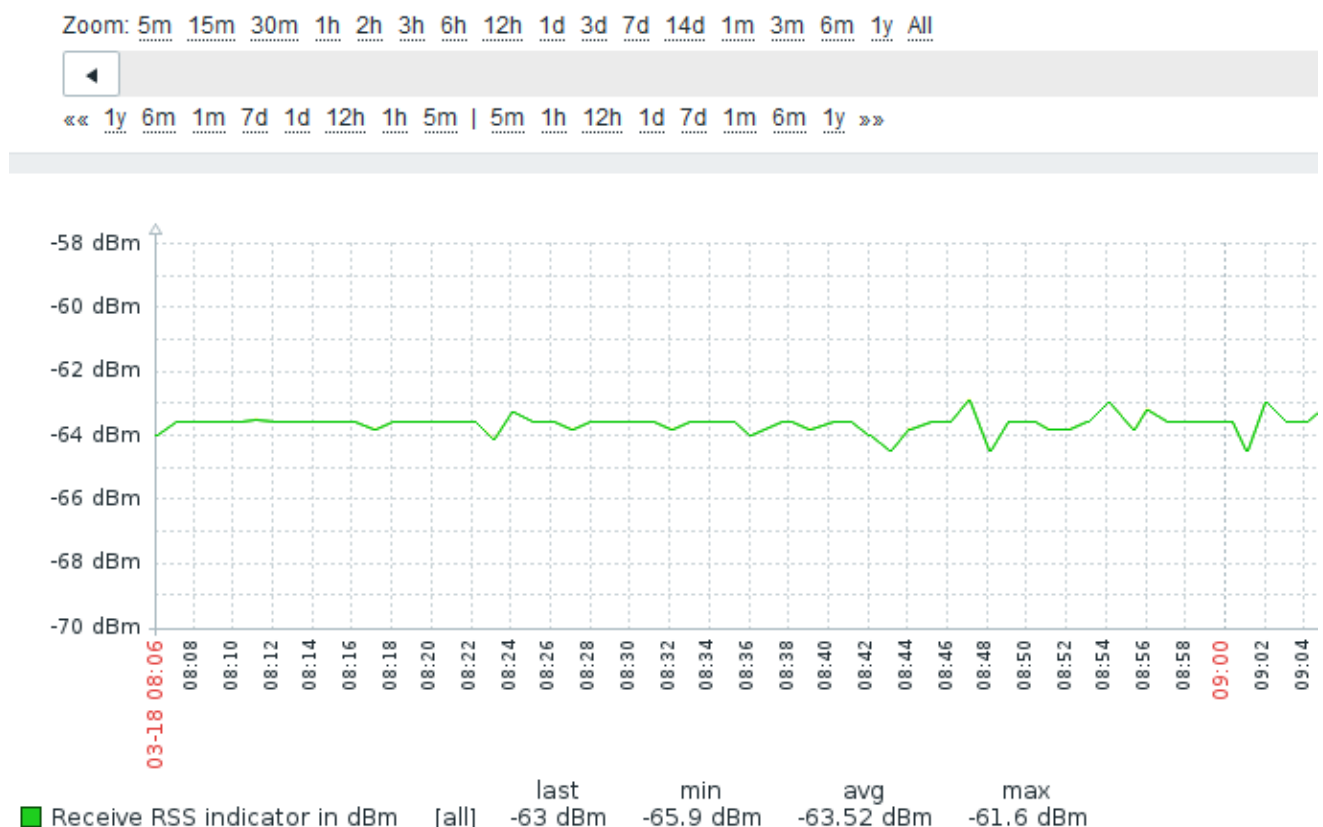


Fig. 4.5: RAY2 graph

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 RAY2 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 RAY 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

0 → na
1 → up
2 → down
3 → ack

Items:

Temperature alarm state
Low voltage alarm state
High voltage alarm state
RSS alarm state
SNR 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

0 → na
1 → accp
2 → acap
3 → ccdp

Items:

Channel arrangement

RacomRay.duplex

0 → na

Items:

Ethernet\$1 duplex

RacomRay.duplex

- 1 → full
- 2 → half

Items:**RacomRay.lineStatusII**

- 0 → na
- 1 → setup
- 2 → single
- 3 → connecting
- 4 → authorizing
- 5 → ok
- 6 → analyzer

Items:

Radio link status

RacomRay.mdix

- 0 → na
- 1 → mdi
- 2 → mdi-x

Items:

Ethernet\$1 MDI-X / MDI

RacomRay.modulationIndex

- 0 → na
- 1 → qpsk
- 2 → qam16
- 3 → qam32
- 4 → qam64
- 5 → qam128
- 6 → qam256

Items:

Tx modulation index

Rx modulation index

RacomRay.OptionSetting

- 0 → na
- 1 → on
- 2 → off
- 3 → auto

Items:

Management interface: Telnet

Management interface: VLAN on/off

Management interface: HTTP

Secure peer mode

Channel matching

Ethernet\$1 pause

Ethernet\$1 autonego

Ethernet\$1 asymmetric pause

RacomRay.rfPowerStatus

- 0 → na
- 1 → ok
- 2 → fail

Items:

RF Power amplifier OK/Failure

RacomRay.ServiceState

0 → na
1 → up
2 → down

Items:

Peer station user Ethernet \$1 link status

RacomRay.sshd

1 → na
2 → onlykey
3 → off

Items:

Management interface: SSH

RacomRay.systemStatus

0 → na
1 → ok
2 → warning
3 → alarm

Items:

Unit status

RacomRay.voltageSource

0 → na
1 → aux
2 → poe

Items:

Source of supply voltage

ICMP ping - Accessibility

0 → ICMP ping fails
1 → ICMP ping successful

Items:

ICMP ping - Accessibility

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

Name

Type

Key

SNMP OID

SNMP community

Port

Type of information

Data type

Units

Use custom multiplier ☐

Update interval (in sec)

Custom intervals

TYPE	INTERVAL	PERIOD	ACTION
<input checked="" type="checkbox"/> Flexible <input type="checkbox"/> Scheduling	<input type="text" value="50"/>	<input type="text" value="1-7,00:00-24:00"/>	Remove
Add			

History storage period (in days)

Trend storage period (in days)

Store value

Show value [show value mappings](#)

New application

Applications

- 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 RAY2 Station?

There are two ways to check the RAY2 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 RAY2 itself. For example, an RSS value is too low: RAY2 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 `RAY2_Zabbix_tmpl.zip` file downloadable from *RACOM website*¹. Copy the script file into `/usr/lib/zabbix/externalscripts/` directory and change the file privileges and make it executable.

```
# 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/potencial/eng/02_fw/RAY2_Zabbix_tmpl.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/snmptrap/snmptrap.log. Create the directory if it is not already created and edit this in the snmptrap.sh script file.

```
LOGFILE=/var/log/snmptrap/snmptrap.log
```



Note

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

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

If you have not done so, import the RAY2 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: RAY2-17-L-1

SNMP interface: 192.168.10.1, port 161, IP

Along with this template, 13 new items and triggers appear at each used host. That is exactly the number of SNMP traps defined at the RAY2. Each trap should be recognized and the Zabbix should display the correct information message at the dashboard.

The template Application consists of 13 traps which correspond with number of traps implemented in RAY2.

How do I Know that Something Has Happened to the RAY2 Station?

<input type="checkbox"/>	...	RAY2 Template: Air channel capacity changed	Triggers 1	tr2AirCapacity	400d	Zabbix trapper	TRAPS	Enabled
<input type="checkbox"/>	...	RAY2 Template: Netbitrate (air speed) below threshold	Triggers 1	tr2NetBitrate	400d	Zabbix trapper	TRAPS	Enabled
<input type="checkbox"/>	...	RAY2 Template: Temperature exceeded the threshold	Triggers 1	tr2TemperatureAlarm	400d	Zabbix trapper	TRAPS	Enabled
<input type="checkbox"/>	...	RAY2 Template: WiFi Host Access Point is on	Triggers 1	tr2WifiOn	400d	Zabbix trapper	TRAPS	Enabled
<input type="checkbox"/>	...	RAY2 Template: Supply voltage above maximal threshold	Triggers 1	tr2VoltageHighAlarm	400d	Zabbix trapper	TRAPS	Enabled
<input type="checkbox"/>	...	RAY2 Template: RF Power amplifier failure	Triggers 1	tr2RfPowerFail	400d	Zabbix trapper	TRAPS	Enabled
<input type="checkbox"/>	...	RAY2 Template: SNR exceeded the threshold	Triggers 1	tr2SnrAlarm	400d	Zabbix trapper	TRAPS	Enabled
<input type="checkbox"/>	...	RAY2 Template: Local station Ethernet 2 link Up/Down	Triggers 1	tr2Eth2LinkDown	400d	Zabbix trapper	TRAPS	Enabled
<input type="checkbox"/>	...	RAY2 Template: Supply voltage below minimal threshold	Triggers 1	tr2VoltageLowAlarm	400d	Zabbix trapper	TRAPS	Enabled
<input type="checkbox"/>	...	RAY2 Template: BER exceeded the threshold	Triggers 1	tr2BerAlarm	400d	Zabbix trapper	TRAPS	Enabled
<input type="checkbox"/>	...	RAY2 Template: RSS exceeded the threshold	Triggers 1	tr2RssAlarm	400d	Zabbix trapper	TRAPS	Enabled
<input type="checkbox"/>	...	RAY2 Template: Local station Ethernet 1 link Up/Down	Triggers 1	tr2Eth1LinkDown	400d	Zabbix trapper	TRAPS	Enabled
<input type="checkbox"/>	...	RAY2 Template: Air line disconnected	Triggers 1	tr2AirDisconnect	400d	Zabbix trapper	TRAPS	Enabled

Displaying 13 of 13 found

Fig. 6.1: RAY2 traps definition

RAY2 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 third trap state on the RAY2 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-snmpt
traphandle default /bin/bash /usr/lib/zabbix/externalscripts/snmpttrap.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 RAY2 community name is "mwl-snmpt", configure `snmptrapd.conf` accordingly.

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

```
OPTIONS="-Lsd -p /var/run/snmptrapd.pid -On"
```

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 RAY2 stations and enter them into the database properly. In order to test it, force the trap to be sent from any RAY2 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 Tcpcdump 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 RAY2 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:

- *tr2TemperatureAlarm* - Temperature exceeded the threshold
- *tr2VoltageLowAlarm* - Supply voltage below minimal threshold
- *tr2VoltageHighAlarm* - Supply voltage above maximal threshold
- *tr2RssAlarm* - RSS exceeded the threshold
- *tr2SnrAlarm* - SNR exceeded the threshold
- *tr2BerAlarm* - BER exceeded the threshold
- *tr2AirDisconnect* - Air line disconnected
- *tr2Eth1LinkDown* - Peer station Ethernet 1 link Up/Down
- *tr2Eth2LinkDown* - Peer station Ethernet 2 link Up/Down
- *tr2RfPowerFail* - RF Power amplifier failure
- *tr2NetBitrate* - Air speed below threshold
- *tr2WifiOn* - WiFi Host Access Point is on
- *tr2AirCapacity* - 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".



Note

Air channel capacity changed trap is, in fact, Event. RAY2 sends information about air capacity every time it is changed. In Zabbix, it is cleared after 5 minutes of being stable.

Last 20 issues							...	^
HOST	ISSUE	LAST CHANGE	AGE	INFO	ACK	ACTIONS		
RAY2-17-U	TRAP: Temperature exceeded the threshold	2016-03-17 14:39:04	1d 1h 35m		Yes 1			
1 of 1 issue is shown							Updated: 16:14:45	

Fig. 6.2: RAY2 temperature trap triggered

You can also see Trap's output in **Monitoring** → **Latest Data** → **TRAPS of your RAY2 station** → **History**. The displayed information differs based on the trap received. See the detailed description in the respective Zabbix item.

7. How to Access RAY2 GUI from Zabbix

Zabbix can offer various ways of accessing the RAY2 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.

URLs	NAME	URL	ACTION
	RAY2-234 URL	http://10.250.2.234	Remove
Add			

[Apply](#)
[Remove](#)
[Close](#)

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 RAY2 web interface appears.

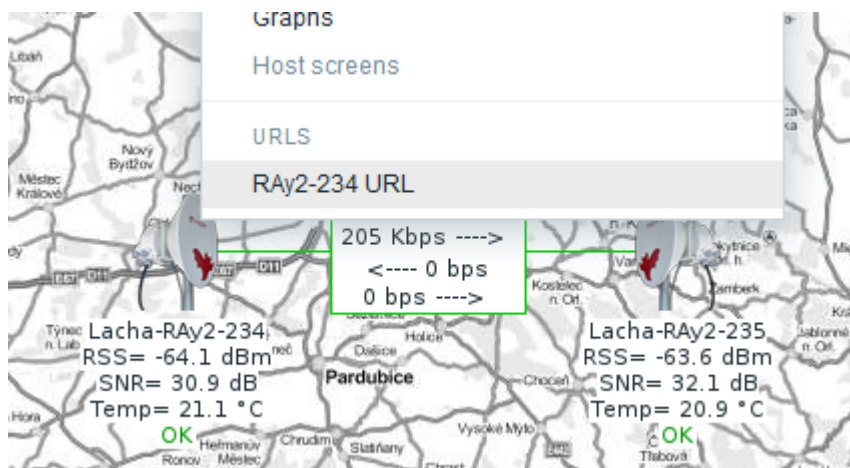


Fig. 7.2: RAY2 URL Link in maps

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.

URL

Severity Not classified Information Warning Average Major Critical

Enabled ☒

Update Clone Delete Cancel

Fig. 7.3: Trigger URL definition

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.

Last 20 issues

HOST	ISSUE	LAST CHANGE	AGE	INFO	ACK	ACTIONS
MIDGE	MIDGE station - The WAN link came DOWN	2016-03-18 16:17:58	5m 10s		No	
RAy2-17-U	TRAP: Temperature exceeded the threshold	2016-03-17 14:39:04	1d 1h 44m		Yes 1	

<http://demo.racom.eu:8003>

Web monitoring

HOST GROUP	TIME	STATUS	DURATION	AGE	ACK
	2016-03-17 14:39:04	PROBLEM	1d 1h 44m	1d 1h 44m	Yes 1
	2016-03-16 17:16:28	OK	21h 22m 36s	1d 23h 6m	No

Fig. 7.4: Issue description used as a link

A simple click can forward you to the RAY2 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.

Zabbix

- GO TO
- Host inventory
- Latest data
- Triggers
- Graphs
- Host screens

La

HO

MIDGE

RAy2-17-U

TRAP: Temperature exceeded t

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.

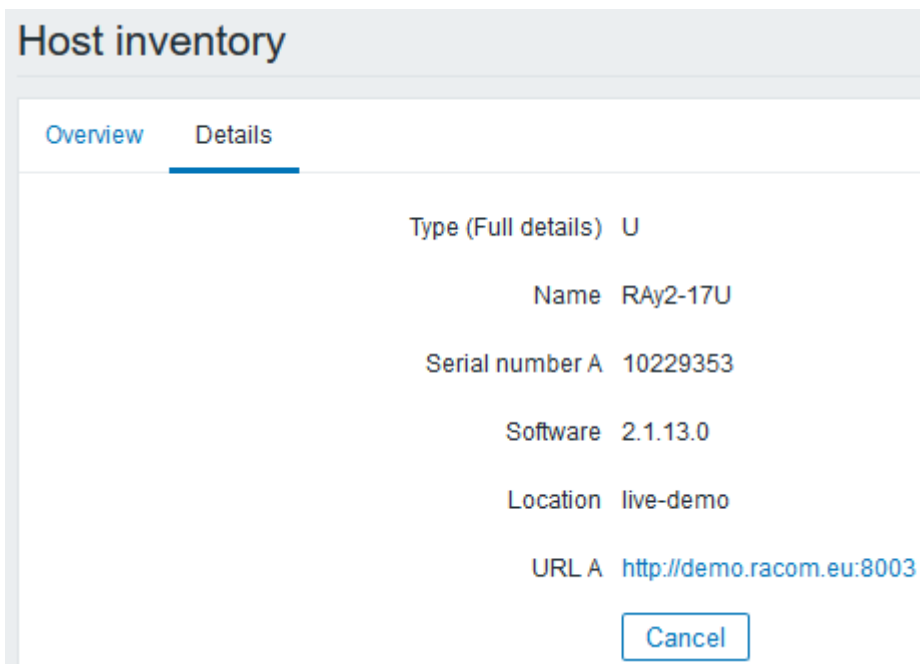


Fig. 7.6: RAY2 URL link in the Inventory

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.

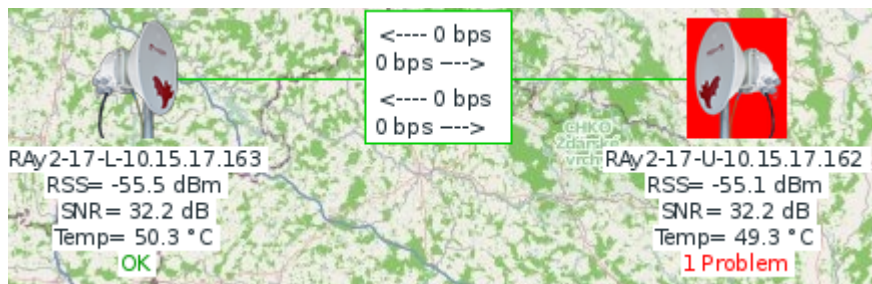


Fig. 8.1: Basic map with two RAY2 stations

A short example of RAY2 station configuration in Maps:

```
RAY2 {HOSTNAME}
RSS= {{HOSTNAME}}:rss.last(0)
SNR= {{HOSTNAME}}:snr.last(0)
Temp= {{HOSTNAME}}:temperatureModem.last(0)
```

Type

Label
 RSS= {{HOSTNAME}}:rss.last(0)}
 SNR= {{HOSTNAME}}:snr.last(0)}
 Temp= {{HOSTNAME}}:temperatureModem.last(0)}

Label location

* Host

Application

Fig. 8.2: Definition of RAY2 station in maps

For the link, you can define the throughput variables to be displayed.

```
{10.10.0.1:netBitrate.last(0)}  
{10.10.0.2:netBitrate.last(0)}
```

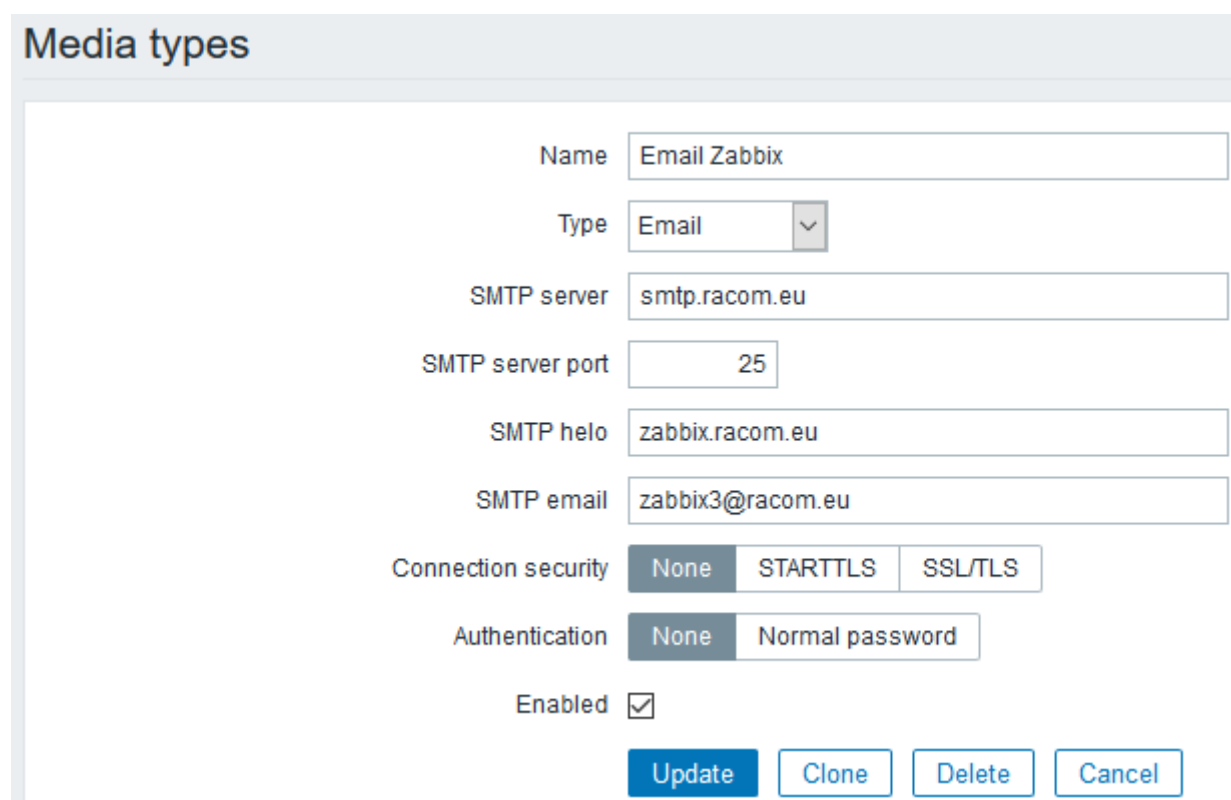
Each map can be divided into several sub-maps. It can be useful for various levels of detail.

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.



The screenshot shows the 'Media types' configuration page in Zabbix. The 'Name' field is 'Email Zabbix'. The 'Type' dropdown is set to 'Email'. The 'SMTP server' is 'smtp.racom.eu', 'SMTP server port' is '25', 'SMTP helo' is 'zabbix.racom.eu', and 'SMTP email' is 'zabbix3@racom.eu'. For 'Connection security', 'None' is selected. For 'Authentication', 'None' is selected. The 'Enabled' checkbox is checked. At the bottom are buttons for 'Update', 'Clone', 'Delete', and 'Cancel'.

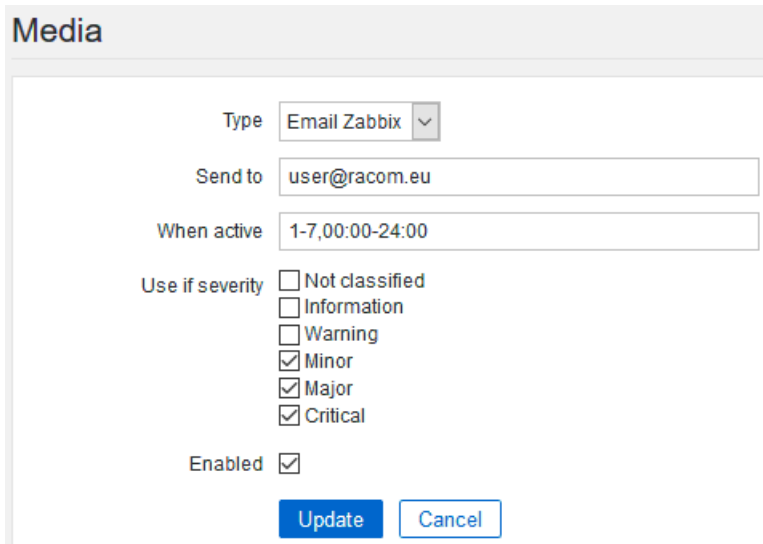
Name	Email Zabbix
Type	Email
SMTP server	smtp.racom.eu
SMTP server port	25
SMTP helo	zabbix.racom.eu
SMTP email	zabbix3@racom.eu
Connection security	None
Authentication	None
Enabled	<input checked="" type="checkbox"/>

[Update](#) [Clone](#) [Delete](#) [Cancel](#)

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).



The screenshot shows the 'Media' configuration form in Zabbix. It includes a 'Type' dropdown set to 'Email Zabbix', a 'Send to' text field with 'user@racom.eu', and a 'When active' time range field with '1-7,00:00-24:00'. Under 'Use if severity', there are checkboxes for 'Not classified', 'Information', 'Warning', 'Minor', 'Major', and 'Critical', with the last three being checked. An 'Enabled' checkbox is also checked. At the bottom are 'Update' and 'Cancel' buttons.

Type	Email Zabbix
Send to	user@racom.eu
When active	1-7,00:00-24:00
Use if severity	<input type="checkbox"/> Not classified <input type="checkbox"/> Information <input type="checkbox"/> Warning <input checked="" type="checkbox"/> Minor <input checked="" type="checkbox"/> Major <input checked="" type="checkbox"/> Critical
Enabled	<input checked="" type="checkbox"/>

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.

Actions

[Action](#)
[Operations](#)
[Recovery operations](#)
[Update operations](#)

* Default operation step duration

Default subject

Default message

```

Trigger: {EVENT.NAME}
Trigger status: {TRIGGER.STATUS}
Trigger severity: {TRIGGER.SEVERITY}
Trigger URL: {TRIGGER.URL}

Item values:

1. {ITEM.NAME1} ({HOST.NAME1}:{ITEM.KEY1}): {ITEM.VALUE1}

```

Pause operations for suppressed problems ☒

Operations

Steps	Details
1	Send message to users: it_racom (it_racom it_racom), servis (servis servi: New

* At least one operation, recovery operation or update operation must exist

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".

[Action](#)
[Operations](#)
[Recovery operations](#)
[Update operations](#)

* Name

Type of calculation

Label	Name	Action
A	Trigger severity is greater than or equals <i>Warning</i>	Remove
B	Host group equals <i>RAy2-17</i>	Remove

New condition

[Add](#)

Enabled ☒

* At least one operation, recovery operation or update operation must exist

Fig. 9.4: Action conditions

The action is executed if it meets the conditions, e.g. the trigger severity is greater than or equals to “Warning” and the group is RAY2. The conditions can be combined with AND or OR statements.

Operation details

Steps - (0 - infinitely)

Step duration (0 - use action default)

Operation type

* At least one user or user group must be selected.

Send to User groups	User group	Action
	Add	

Send to Users	User	Action
	servis (servis servis)	Remove
	Add	

Send only to

Default message ☒

Conditions	Label	Name	Action
	New		

[Update](#) [Cancel](#)

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. RAY2 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 RAY2 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 RAY2 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 RAY2 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
```

```
-rw-r--r--. 1 zabbix zabbix 933 Mar 14 15:40 cli_upgrade_ray.sh
-rwxr-xr-x. 1 zabbix zabbix 649 Mar 9 16:58 ray_cli_cnf_backup_get.sh
-rwxr-xr-x. 1 zabbix zabbix 137 Mar 9 13:59 ray_cli_fw_show.sh
-rwxr-xr-x. 1 zabbix zabbix 3202 Mar 15 08:40 ray_cli_fw_upgrade.sh
-rw-r--r--. 1 zabbix zabbix 77 Mar 15 08:31 script-log.txt
-rwxr-xr-x. 1 zabbix zabbix 17200 Mar 1 13:24 snmptrap.sh
```

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 RAY2 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 RAY2 units using their password via scripts, we need to upload the SSH keys into every unit we want to control. You can either have your 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 RAY2 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 RAY2 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 RAY2 unit without writing the password.

10.1.5. Scripts in the Zabbix Web Interface

The script files can be downloaded within the *template ZIP file*¹. 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 RAY2 scripts.

NAME	TYPE	EXECUTE ON	COMMANDS	USER GROUP	HOST GROUP	HOST ACCESS
<input type="checkbox"/> Detect operating system	Script	Server	sudo /usr/bin/hwmap -O \$(HOST.CONN) 2>&1	Zabbix administrators	All	Read
<input type="checkbox"/> Ping	Script	Server	/bin/ping -c 3 \$(HOST.CONN) 2>&1	All	All	Read
<input checked="" type="checkbox"/> RAY2 - Configuration backup	Script	Server	/usr/lib/zabbix/externalscripts/ray2_conf_backup_get.sh \$(HOST.CONN) \$(HOST.SSHKEY) \$(HOST.SSHPORT) 2>> /var/log/zabbix/scripts.log	All	RAY2	Read
<input checked="" type="checkbox"/> RAY2 - Upgrade firmware to 2.1.13.0 (both units)	Script	Server	/usr/lib/zabbix/externalscripts/ray2_fw_upgrade.sh \$(HOST.CONN) \$(HOST.SSHKEY) \$(HOST.SSHPORT) "home/zabbix/firmware/ray2m6-2.1.13.0.cpio" "2.1.13.0" 2>> /var/log/zabbix/scripts.log	All	RAY2	Read
<input checked="" type="checkbox"/> RAY2 - Display the firmware version	Script	Server	/usr/lib/zabbix/externalscripts/ray2_fw_show.sh \$(HOST.CONN) \$(HOST.SSHKEY) \$(HOST.SSHPORT) 2>> /var/log/zabbix/scripts.log	All	RAY2	Read
<input type="checkbox"/> RipEX - Configuration backup	Script	Server	/usr/lib/zabbix/externalscripts/ripex_conf_textile_get.sh \$(HOST.CONN) \$(HOST.SSHKEY) \$(HOST.SSHPORT) 2>> /var/log/zabbix/scripts.log	All	RipEX	Read
<input type="checkbox"/> RipEX - RSS SHOW	Script	Server	/usr/lib/zabbix/externalscripts/ripex_dl_rss_show.sh \$(HOST.CONN) \$(HOST.SSHKEY) \$(HOST.SSHPORT) 2>> /var/log/zabbix/scripts.log	All	RipEX	Read
<input type="checkbox"/> Traceroute	Script	Server	/usr/bin/traceroute \$(HOST.CONN) 2>&1	All	All	Read

Fig. 10.1: RAY2 script

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

¹ https://www.racom.eu/download/hw/ray/potencial/eng/02_fw/RAY2_Zabbix_templ.zip

Scripts

Name

Type Script

Execute on Zabbix agent Zabbix server

Commands

```
/usr/lib/zabbix/externalscripts
/ ray_cli_cnf_backup_get.sh {HOST.CONN}
{ $HOST.SSHKEY } { $HOST.SSHPORT } 2>> /var
/ log/zabbix/scripts.log
```

Command

Description

User group All

Host group Selected

RAY2 Select

Required host permissions Read

Enable confirmation ☐

Confirmation text Test confirmation

Update Clone Delete Cancel

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 “RAY2”.

The parameters are MACROS which should be enabled by default due to our Template. Each RAY2 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).

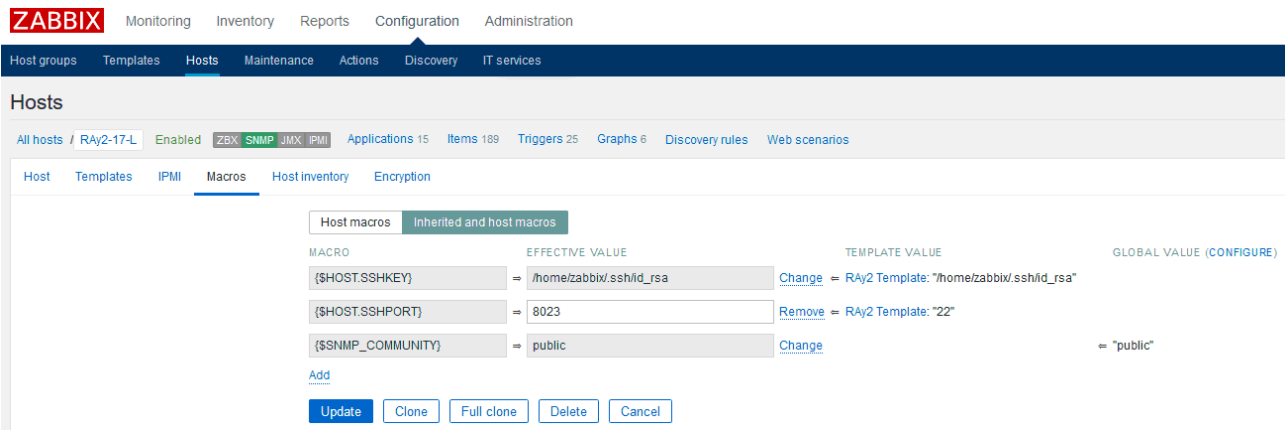


Fig. 10.3: Host MACROS

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.

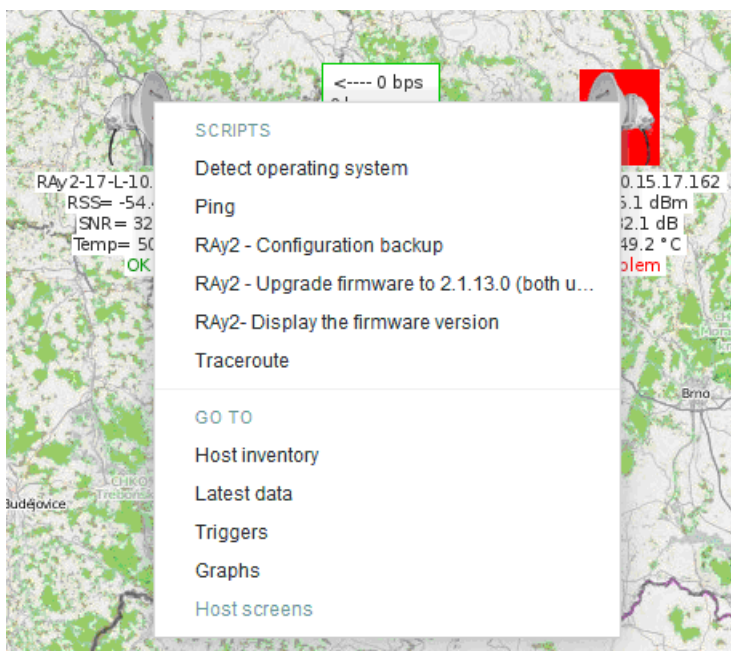


Fig. 10.4: Scripts in the Maps

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	2017-11-07
First issue	
Revision 1.1	2019-09-06
FW 2.2.5.0	
Revision 1.2	2019-11-29
SNMP non-table items OID now defined in accordance with RFC (ending '.0') related issues.	
Revision 1.3	2021-01-19
Small changes regarding CentOS8 and Zabbix5.	