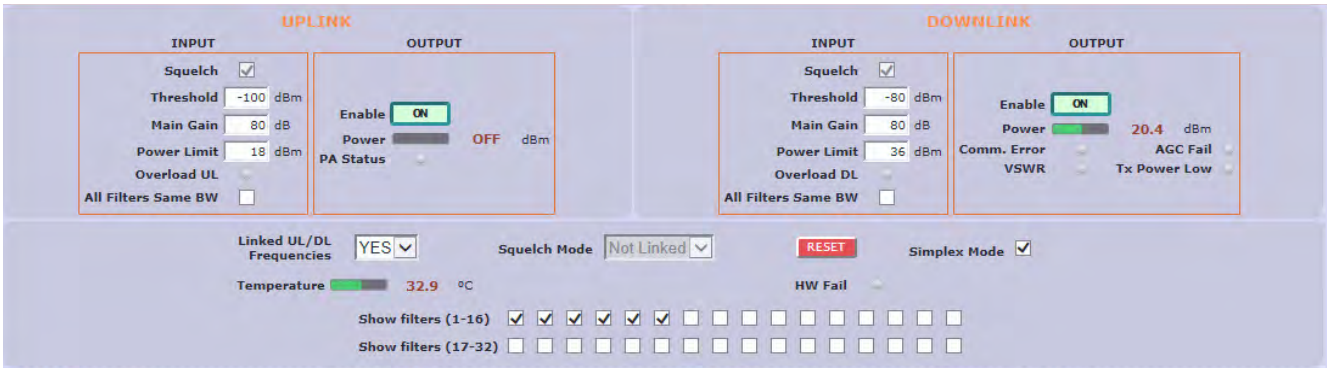
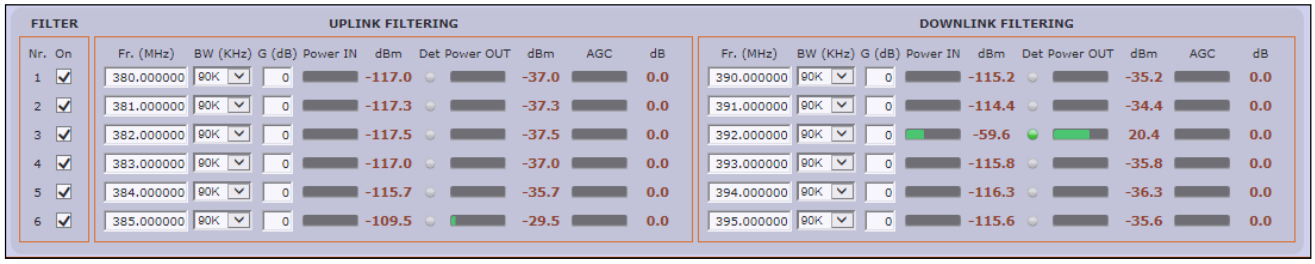
Firmware selection (only for dual version)	User can change filtering mode in case of dual version signal booster

Simplex mode checkbox control is only visible in devices with such capability. It allows signal flow only in one direction, either uplink or downlink, at any given time. The chosen direction is made automatically based on signal detection which, in turn, depends on squelch. Therefore, turning on simplex mode automatically turns on squelch, both in uplink and downlink sections, and disables these controls for the user. Besides, it also sets squelch mode to "Not Linked" and disables this control, too. This is necessary since otherwise the lack of RF input signal in downlink would mute the uplink RF input, thus blocking all communication. The look of the general control frame in simplex mode is as in next image:

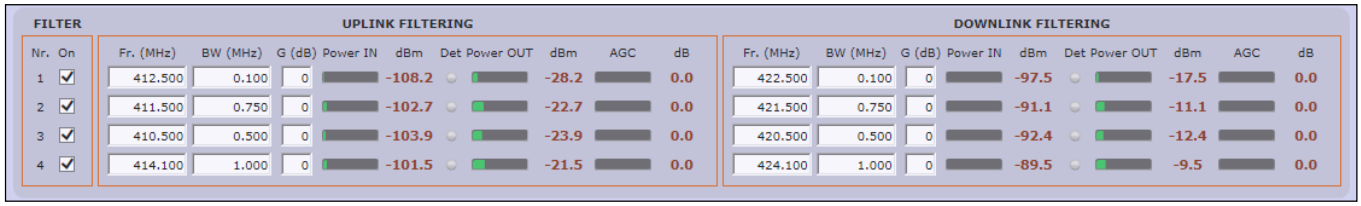


Filter control frame for narrow-band version

- Filtering control frame.



Filter control frame for narrow-band version



Filter control frame for adjustable bandwidth version

- Filter control frame: shows configuration and monitoring information of all filters. The frame is divided in two: uplink and downlink. Data showed in each half is symmetric.

Filter control frame

Parameter	Description
On	Allows to enable/disable each filter
Frequency	Configures center frequency of each filter
Bandwidth filter control for narrow-band version only	There are up to five available filters (depending on factory setup) to adjust the trade-off between rejection to undesired signals and delay
Fine gain control	Each channel gain can be fine adjusted
RF input power	Shows RF input level for each channel
Signal detection	With this indicator, system shows if signal is detected at input, according to squelch threshold. Moreover, with Squelch Mode = ‘Linked’, UL shows no signal if signal is not detected in the same DL channel even if UL signal exceed squelch threshold. Similarly, with simplex mode enabled, if one signal is detected at DL band, all UL filters will show “No signal”

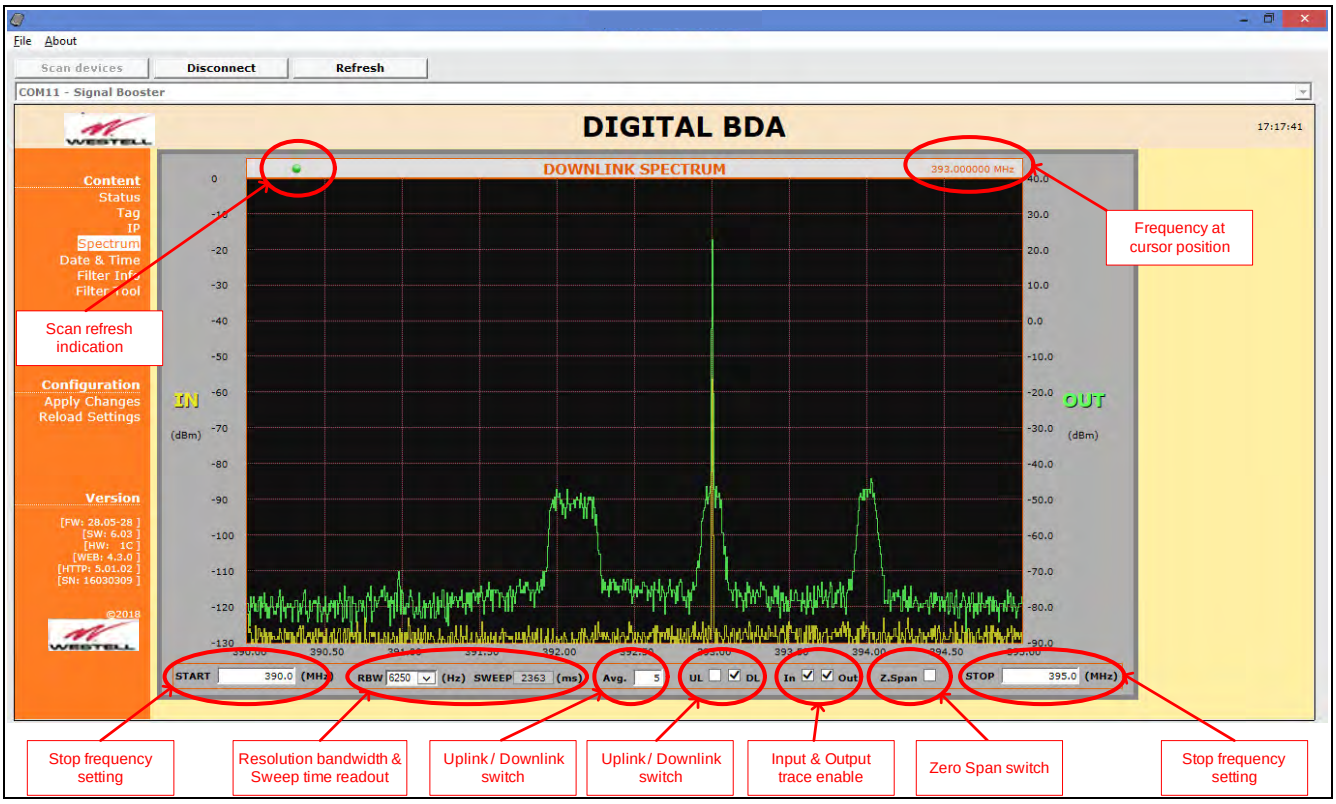
RF output power	Shows estimation for RF output level for each channel, according to programmed gain and AGC control. Shows 'OFF' in the same cases that signal detection shows 'No signal'
AGC	Indicates gain reduction due to power limitation control.

In case of adjustable filter version, filter control frame is slightly different. According to entry mode button, frequency and bandwidth parameter configuration can be:

- Center frequency (in 25KHz steps) and bandwidth filters (50KHz steps)
- Start and stop frequencies (in 25KHz steps)

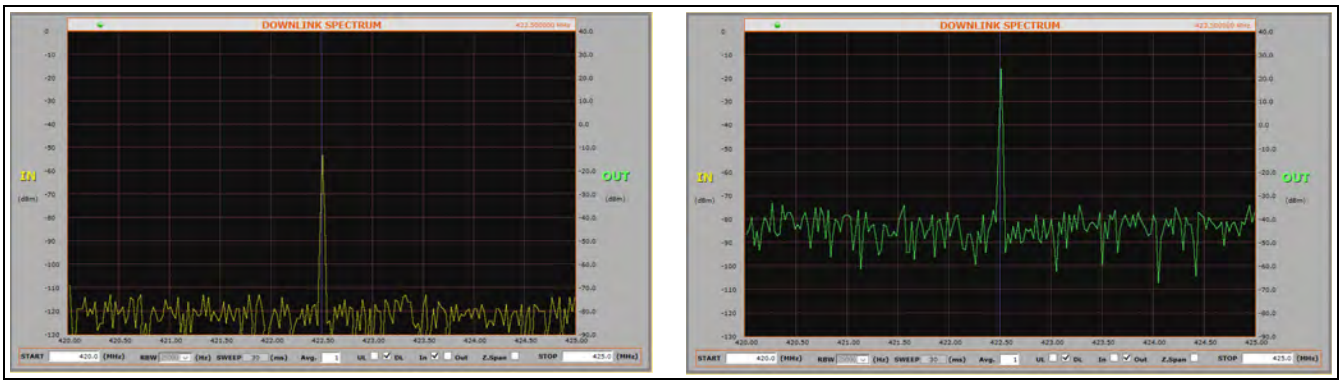
12 Spectrum Analyzer

The spectrum analyzer feature of the Signal Booster is a useful tool for commissioning and troubleshooting. This section explains how to use it.



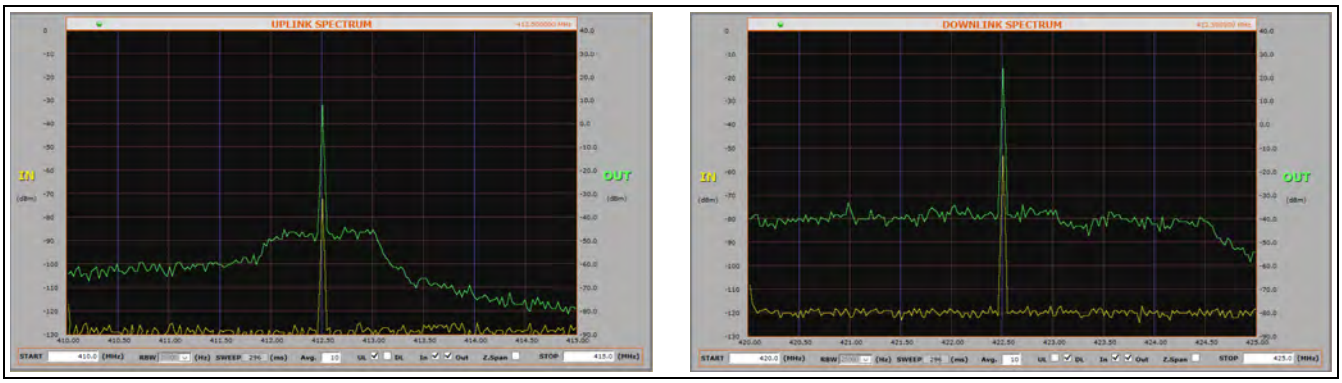
Spectrum analyzer settings

Input and output signals are scanned successively and can be shown or hidden independently:



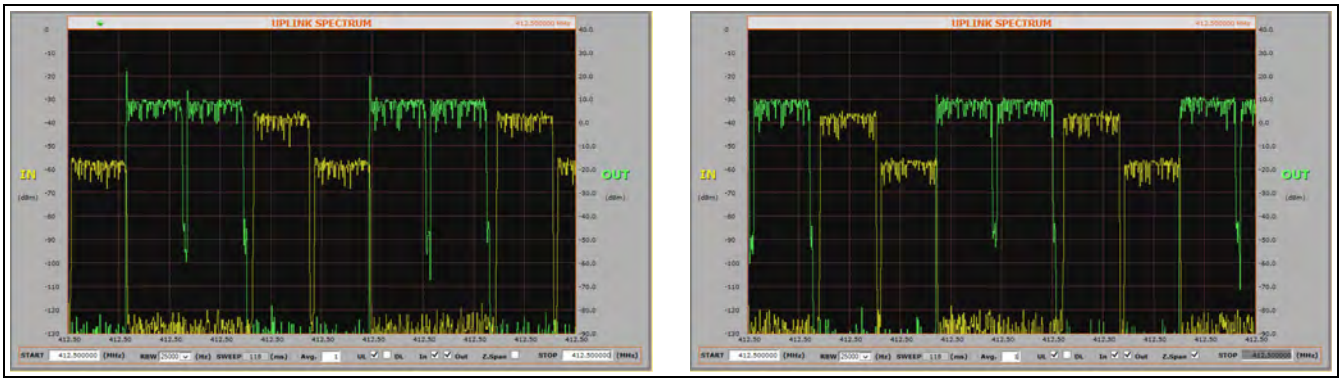
Spectrum input/output selection

Either uplink or downlink signal paths are chosen and average up to 32 can help to clean noise signals. Resolution bandwidth and sweep time are set automatically.



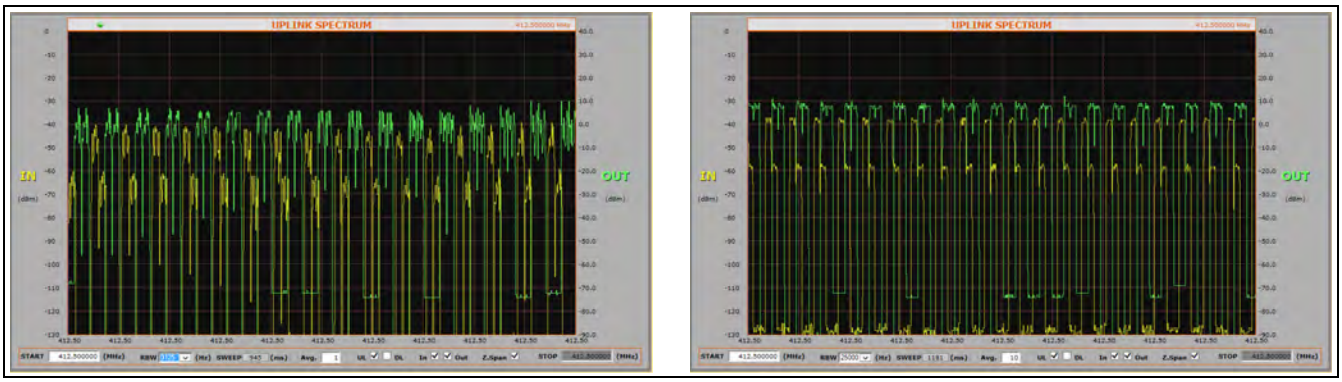
Spectrum UL / DL selection

When start and stop frequencies are set equal, then zero-span mode is activated to show evolution of signals with time, which may be of special interest with pulsed signals. The same thing can be achieved by setting the zero-span checkbox, with the convenience that start frequency change would also change stop frequency accordingly.



Spectrum zero-span mode

Resolution bandwidth becomes enabled in zero-span mode and sweep time is automatically set according to its setting, which is user selectable between 25.000Hz, 12.500Hz, 6.250Hz and 3.125Hz. Average setting will also impact sweep time in a similar way.



Zero span settings

13 SNMP Agent

Westell Signal Booster includes a SNMPv1 agent that allows user to supervise the device by means of 'SET' and 'GET' type commands and, asynchronous traps to notify alarm conditions can be sent. The device is intended to be monitored by a polling NMS but it can send traps to a NMS or Trap Receiver if enabled. Westell can provide a NMS system upon request.

The following sections will show the user configurable, relevant information that can be read via SNMP from the device. The tables will describe these values in order to explain how the information has to be read and interpreted.

MIB Description

The associated MIB document is WESTELL-BDA-SYSTEMv13-MIB.mib. The Westell MIB is divided into blocks. Each block describes the characteristics and values of a specific element but not all elements are implemented in this agent. Each MIB block is divided in two segments, named 1T and 2T. Segment 1T contains the information that is fixed & read only. Segment 2T has the information that can vary over time, regardless of it being read/only or read/write.

The following sections will show the user configurable, relevant information that can be read via SNMP from the device.

Manager

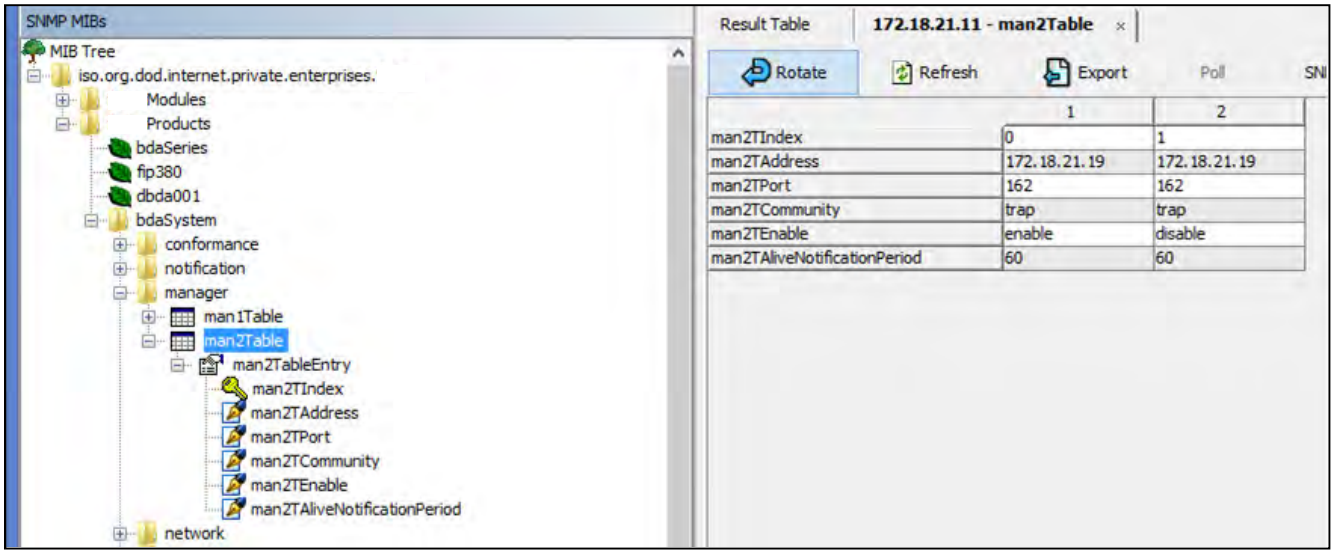
This is a table with 2 consecutive elements, one for each NMS. No checking is done of the validity of the information stored in the table, so extra care must be taken by the user.

SNMP Managers table

Field Name	OID	Description	Type
Man2TAddress[0]	1.3.6.1.4.1.26355.2.50.3.2.1.2.0	First NMS Address	R/W
Man2TAddress[1]	1.3.6.1.4.1.26355.2.50.3.2.1.2.1	Second NMS Address	R/W

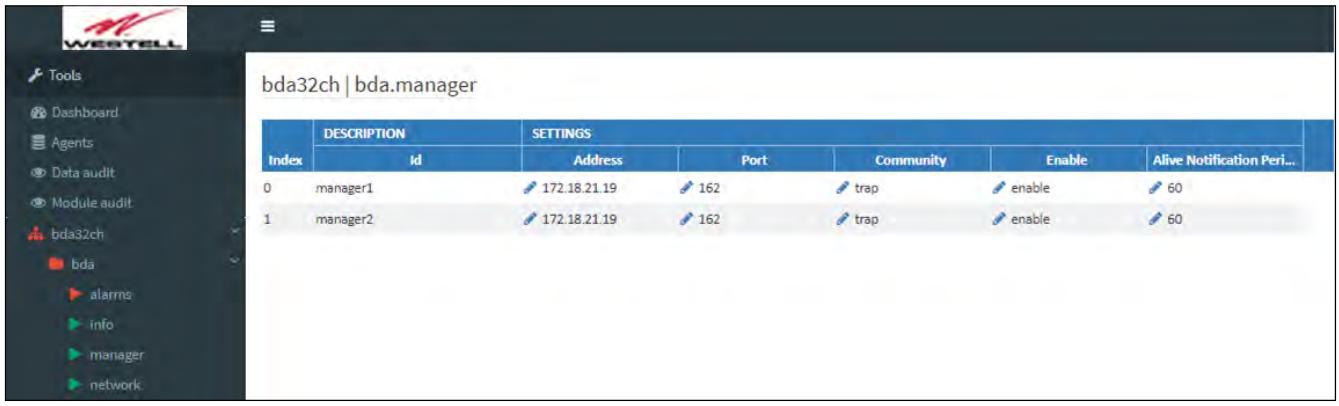
Man2TPort[0]	1.3.6.1.4.1.26355.2.50.3.2.1.3.0	First NMS Port where to send traps	R/W
Man2TPort[1]	1.3.6.1.4.1.26355.2.50.3.2.1.3.1	Second NMS Port where to send traps	R/W
Man2TEnable[0]	1.3.6.1.4.1.26355.2.50.3.2.1.5.0	First NMS. 1= Enabled, 2=Disabled	R/W
Man2TEnable[1]	1.3.6.1.4.1.26355.2.50.3.2.1.5.1	Second NMS. 1= Enabled, 2=Disabled.	R/W
Man2TAliveNotificationPeriod[0]	1.3.6.1.4.1.26355.2.50.3.2.1.6.0	First NMS. If enabled in Man2TEnable, defined time between keep-alive traps.	R/W
Man2TAliveNotificationPeriod[1]	1.3.6.1.4.1.26355.2.50.3.2.1.6.1	Second NMS. If enabled in Man2TEnable, defined time between keep-alive traps.	R/W

The following MIB tree representation shows this table:



SNMP Managers table

The following picture shows the same table as seen by the Westell NMS:



NMS: SNMP Managers table

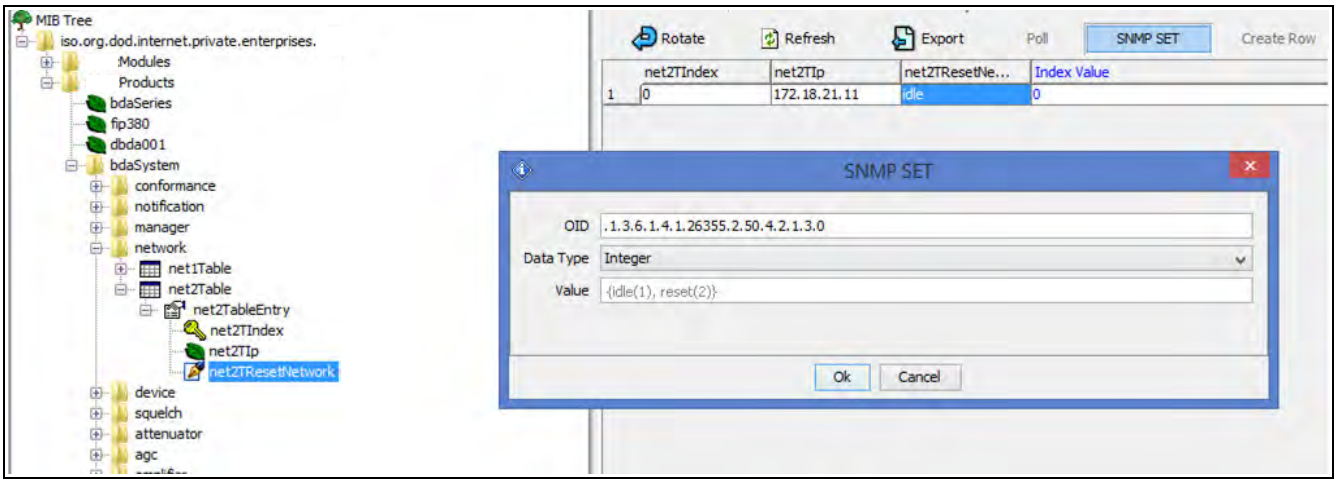
Network

This is a table has just one element with two items. The first one is the device's IP address and it is read-only to avoid unwanted miss-configuration. This can only be changed by means of the embedded web server or locally, through USB, by means of the Westell Control Software. The second item is a “kind” of button intended for resetting the embedded Ethernet hardware interface.

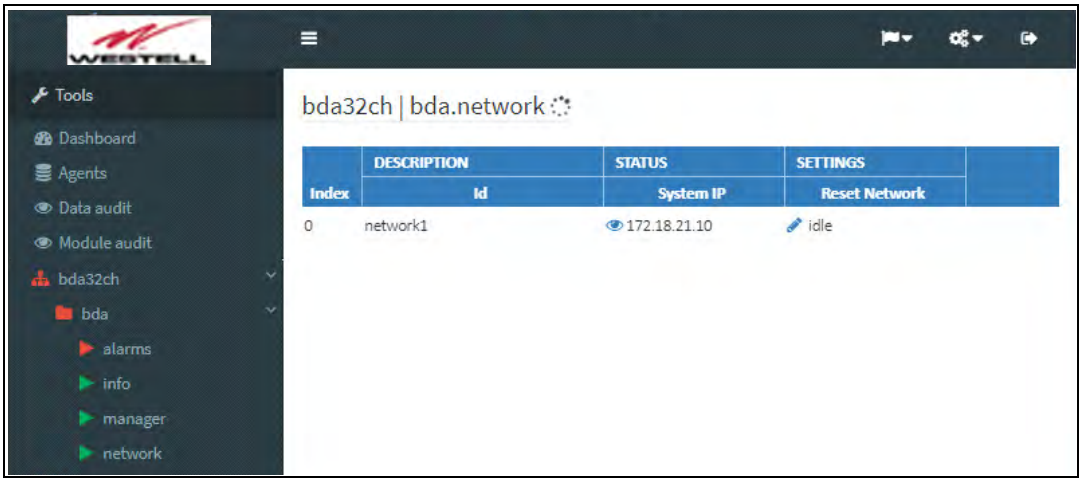
SNMP Network table

Field Name	OID	Description	Type
Net2TIp[0]	1.3.6.1.4.1.26355.2.50.4.2.1.2.0	IP address	R/O
Net2TResetNetwork[0]	1.3.6.1.4.1.26355.2.50.4.2.1.3.0	Network reset: reads as *idle*(1), sets to *reset*(2)	R/W

The following MIB tree representation shows this table and following there is the NMS view:



SNMP Network table



NMS: SNMP Network table

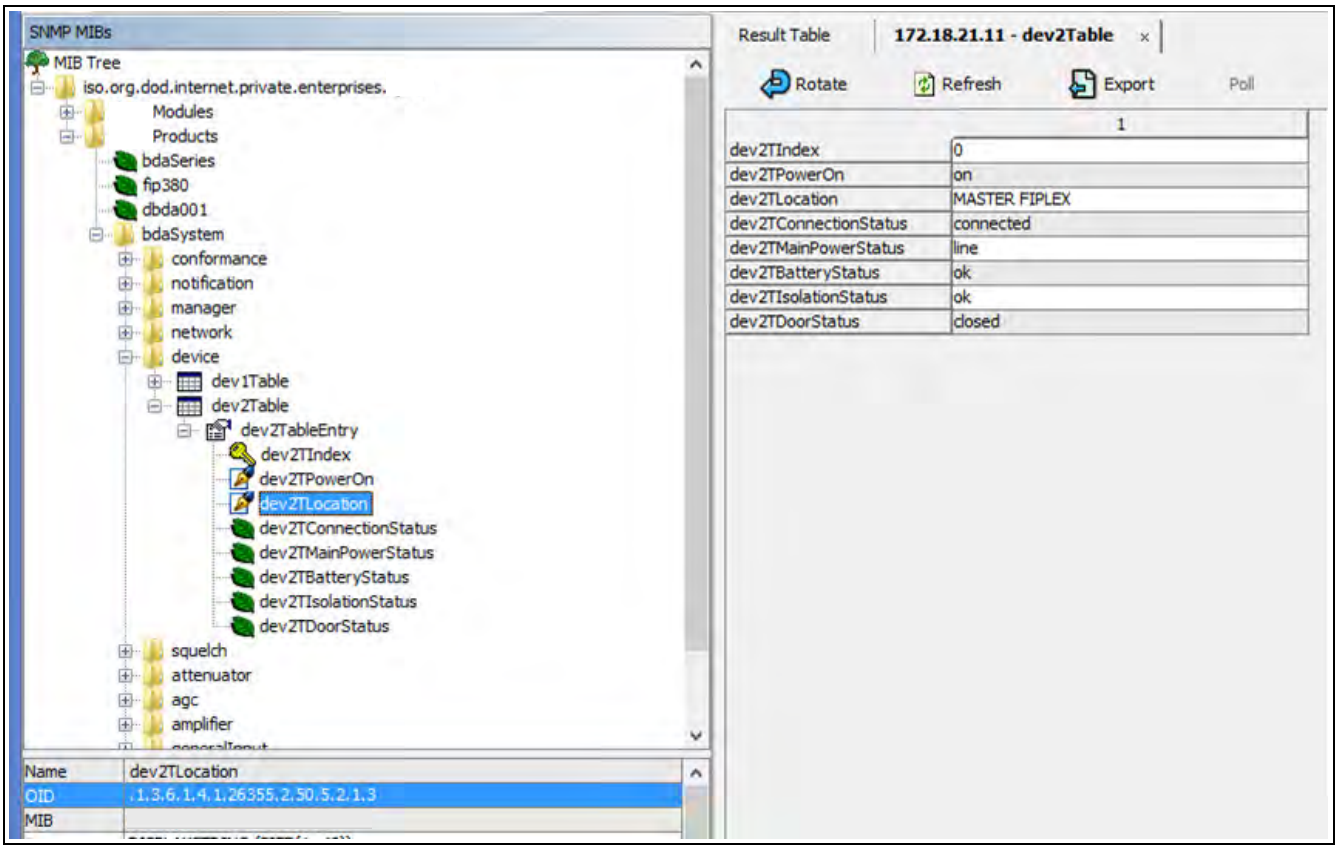
Device

This is also a one element table, providing several informative fields, but only relevant and implemented one is the “Location” field, which allows to easily identify a device by a name provided by the user, usually related to the place where it is located.

SNMP Device table

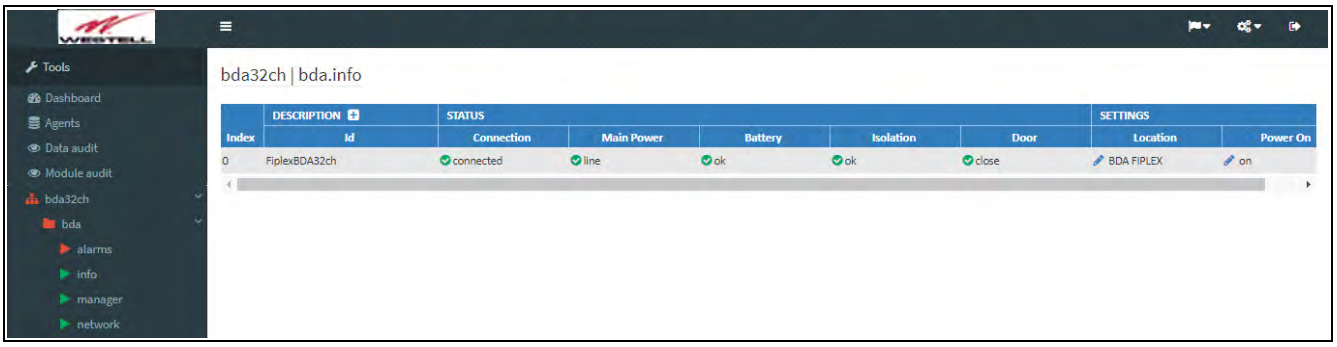
Field Name	OID	Description	Type
Dev2TPowerOn[0]	1.3.6.1.4.1.26355.2.50.5.2.1.2.0	-	R/W
Dev2TLocation[0]	1.3.6.1.4.1.26355.2.50.5.2.1.3.0	String with up to 30 characters	R/W
Dev2TConnectionStatus[0]	1.3.6.1.4.1.26355.2.50.5.2.1.4.0	-	R/O
Dev2TMainPowerStatus[0]	1.3.6.1.4.1.26355.2.50.5.2.1.5.0	-	R/O
Dev2TBatteryStatus[0]	1.3.6.1.4.1.26355.2.50.5.2.1.6.0	-	R/O
Dev2TIsolationStatus[0]	1.3.6.1.4.1.26355.2.50.5.2.1.7.0	-	R/O
Dev2TDoorStatus[0]	1.3.6.1.4.1.26355.2.50.5.2.1.8.0	-	R/O

MIB tree view:



SNMP Device table

The Westell NMS view shows this table under the tab named “info”:



NMS: SNMP Device table

Additional information is shown by clicking on the link named “Description”. This extra piece of information comes from the fixed table, Dev1Table. The most relevant items in this table are the following ones:

SNMP Device Group table

Field Name	OID	Description	Type
Dev1TGroup[0]	1.3.6.1.4.1.26355.2.50.5.1.1.3.0	das.info (conformance group)	R/O
Dev1TurlExtern[0]	1.3.6.1.4.1.26355.2.50.5.1.1.19.0	URL of embedded web server	R/O

Alarms

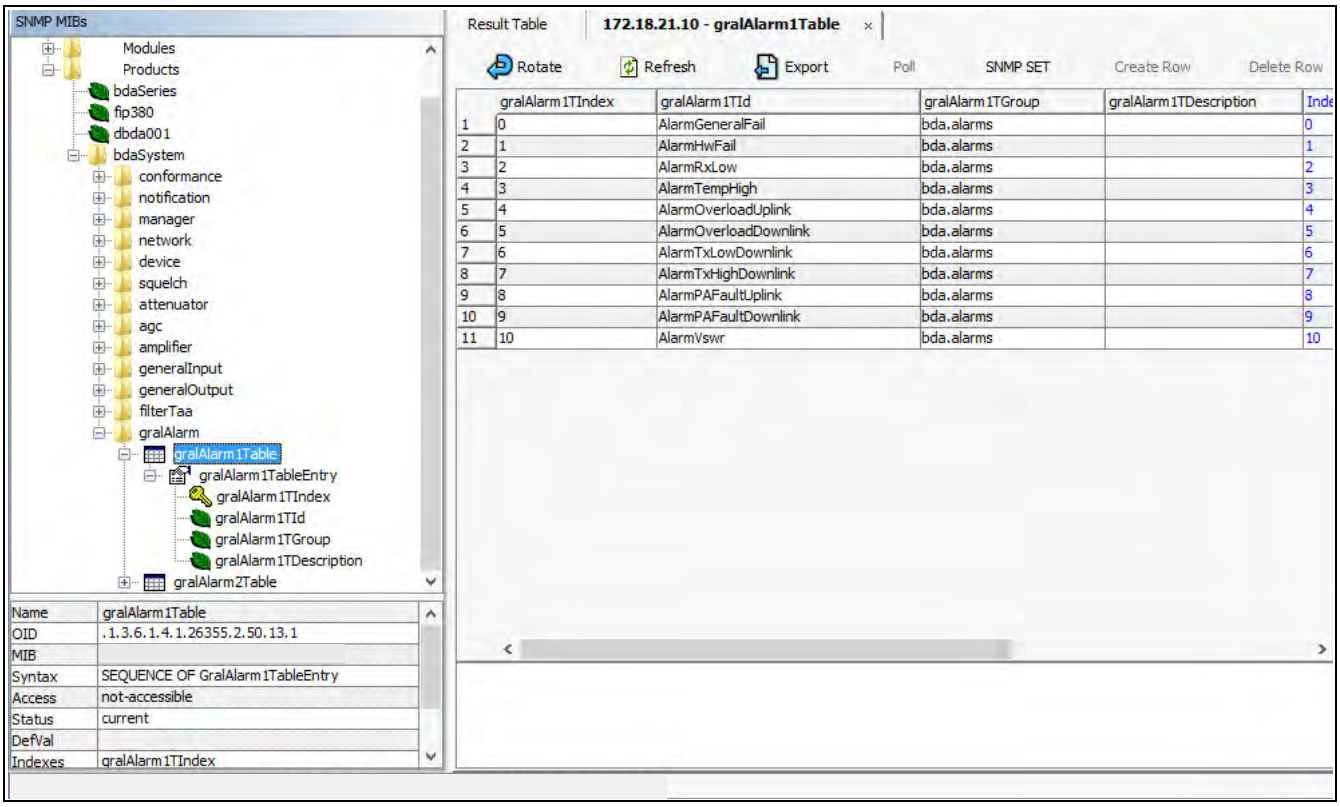
Alarms tables provide information regarding the status of key parts in the system. The fixed table *gralAlarm1Table* provides self-explanatory identifiers, *gralAlarm1TId,* for each relevant subject. The second item in each element of this table is the *gralAlarm1TGroup.* When the device being monitored is a Remote unit, this item just takes the value '*das.alarms* '. However, since the Master unit carries information from all the devices in the whole DAS system, it provides a different value for each device to which the alarm is assigned to, be it the Master unit, any of the Remote units or any of the Expansion units. Therefore, the actual number of elements in this table for the Master unit, depends on how many devices compose the DAS system. The third item of each element, *gralAlarm1TDescription*, is left blank, since the first one suffices for that purpose.

SNMP Alarm Group table

Field Name	OID	Description	Type
GralAlarm1TId[0]	1.3.6.1.4.1.26355.2.50.13.1.1.2.0	Descriptive identifier string	R/O
GralAlarm1TGroup[0]	1.3.6.1.4.1.26355.2.50.13.1.1.3.0	Conformance group for general alarms	R/O
GralAlarm1TDescription[0]	1.3.6.1.4.1.26355.2.50.13.1.1.4.0	-	R/O

The alarm identifiers available are the following ones:

- *AlarmGeneralFail* Board malfunction that cannot be determined.
- *AlarmHwFail* Digital signal processor failure.
- AlarmRxLow No input signal is detected in the downlink direction in any of the activated filters. Aside from a faulty part, as the donor antenna or RF cable, this also might be caused be a problem with the base station or frequency configuration. Notice also that signal detection is dependent on squelch threshold setting. Because of that, this is considered a warning instead of an alarm.
- *AlarmTempHigh* High device temperature (over 85ºC).
- *AlarmOverloadUplink* Excessive RF input signal in UL.
- *AlarmOverloadDownlink* Excessive RF input signal in DL.
- *AlarmTxLowDownlink* Detected RF output power much lower than expected. Since output power measurement is performed by the dedicated monitoring board, a fault in that board would make this item be set as *Unavailable* and *AlarmPAFaultDownlink* set to true.
- *AlarmTxHighDownlink* Excessive RF output power detected (3dB higher than rated). This is most likely due to bad gain settings, since AGC would limit output power otherwise.
- *AlarmPAFaultUplink* Uplink Power Amplifier failure. This alarm is available for certain amplifier types only, and for the rest an 'unavailable' status is set in the next table.
- *AlarmPAFaultDownlink* Downlink Power Amplifier failure. A communication failure with the dedicated monitoring board itself, throws this alarm, too.
- *AlarmVswr* RF mismatch of PA output is detected. Since VSWR measurement is performed by the dedicated monitoring board, a fault in that board would make this item be set as *Unavailable* and *AlarmPAFaultDownlink* set to true.



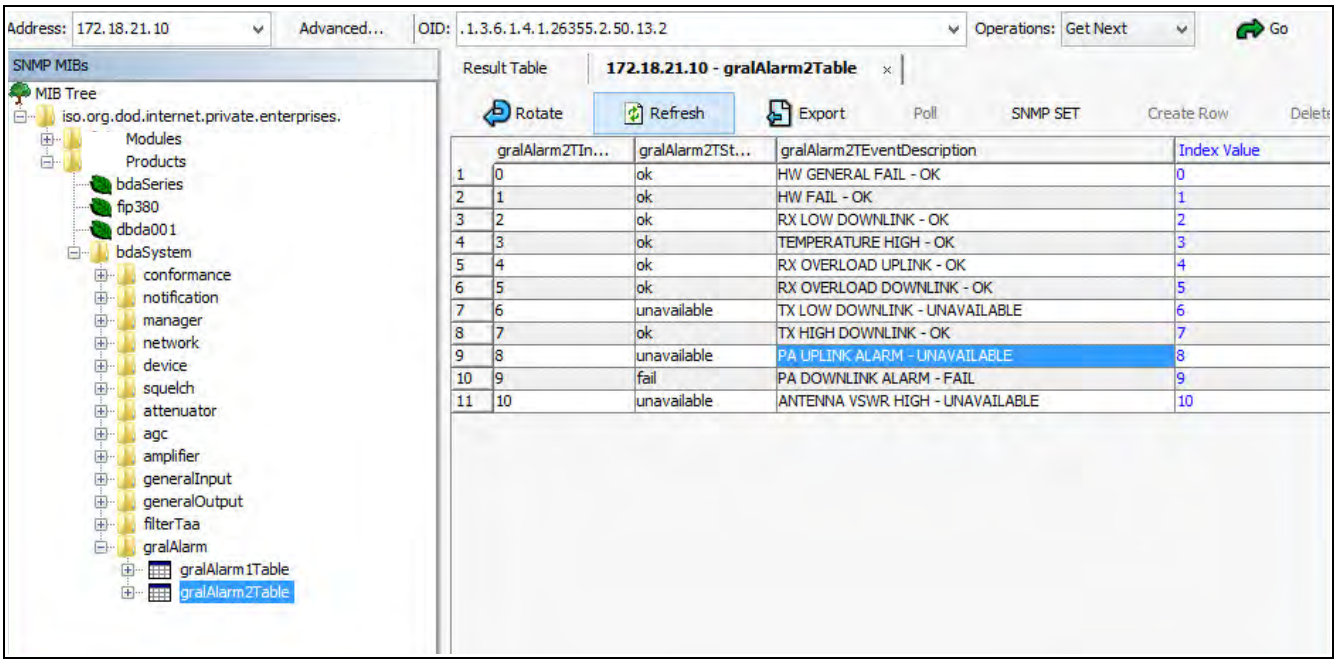
SNMP Alarms Group table

On the other hand, the mutable table *gralAlarm2Table* provides the actual status of each alarm. This table has one element for each element in *gralAlarm1Table*. Each element has two items. The first one is a status identifier, *gralAlarm2TStatus*, be it 'ok', 'warning', 'fail' or 'unavailable'. The second item is a short description of the fault, mainly for human readability.

SNMP Alarm table 2

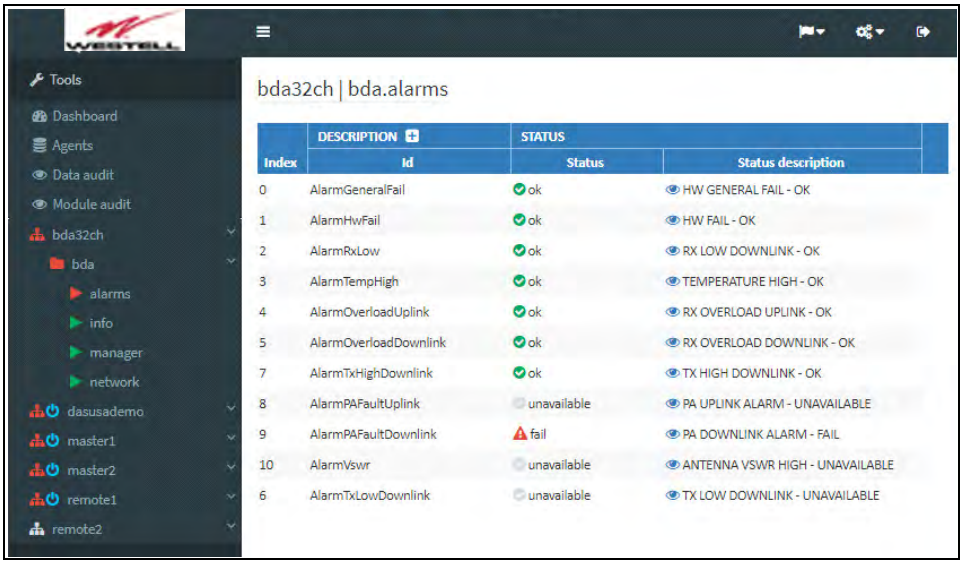
Field Name	OID	Description	Type
GralAlarm2TStatus[0]	1.3.6.1.4.1.26355.2.50.13.2.1.2.0	Status enumeration	R/O
GralAlarm2TEventDescription[0]	1.3.6.1.4.1.26355.2.50.13.2.1.3.0	Short descriptive string	R/O

The next picture is the MIB tree view of this table, and the Westell NMS provides a combined view of both tables and groups alarms:



	gralAlarm2TIn...	gralAlarm2TSt...	gralAlarm2TEventDescription	Index Value
1	0	ok	HW GENERAL FAIL - OK	0
2	1	ok	HW FAIL - OK	1
3	2	ok	RX LOW DOWNLINK - OK	2
4	3	ok	TEMPERATURE HIGH - OK	3
5	4	ok	RX OVERLOAD UPLINK - OK	4
6	5	ok	RX OVERLOAD DOWNLINK - OK	5
7	6	unavailable	TX LOW DOWNLINK - UNAVAILABLE	6
8	7	ok	TX HIGH DOWNLINK - OK	7
9	8	unavailable	PA UPLINK ALARM - UNAVAILABLE	8
10	9	fail	PA DOWNLINK ALARM - FAIL	9
11	10	unavailable	ANTENNA VSWR HIGH - UNAVAILABLE	10

SNMP Alarms table



Index	DESCRIPTION Id	STATUS Status	Status description
0	AlarmGeneralFail	ok	HW GENERAL FAIL - OK
1	AlarmHwFail	ok	HW FAIL - OK
2	AlarmRxLow	ok	RX LOW DOWNLINK - OK
3	AlarmTempHigh	ok	TEMPERATURE HIGH - OK
4	AlarmOverloadUplink	ok	RX OVERLOAD UPLINK - OK
5	AlarmOverloadDownlink	ok	RX OVERLOAD DOWNLINK - OK
7	AlarmTxHighDownlink	ok	TX HIGH DOWNLINK - OK
8	AlarmPAFaultUplink	unavailable	PA UPLINK ALARM - UNAVAILABLE
9	AlarmPAFaultDownlink	fail	PA DOWNLINK ALARM - FAIL
10	AlarmVswr	unavailable	ANTENNA VSWR HIGH - UNAVAILABLE
6	AlarmTxLowDownlink	unavailable	TX LOW DOWNLINK - UNAVAILABLE

NMS: SNMP Alarms table

14 SNMP Traps

General Explanation

For any event that may set or clear an alarm in the *gralAlarm2Table*, there is a SNMP trap that may be sent by the embedded SNMP agent to the manager, if enabled. Therefore, the list of traps closely reassembles the entries in the alarms table. Furthermore, there is also a keep-alive trap for letting the SNMP manager that the agent is working, in case that polling is not being done.

Each trap message has the following fields (except for the *keepAlive* trap, whose only object is the agent's IP address

- An identification number associated to the event being signaled.
- A severity indication number.
- A short string description for human readability.

The following list gathers all the available identifiers:

SNMP Trap descriptions and Enterprise Specific IDs

Source event	*Description*	*ID*
Keep-alive	System sends this trap periodically. Period is set with *Keep-Alive Period* setting of the trap manager. When this trap is thrown, the trap counter is not incremented. It is always in *cleared* state.	3
General Failure	This trap indicates that the board controller is not responding to the remote supervision system.	5
Hardware Failure	This trap indicates malfunction related the Digital Signal Processor.	6
Rx Input Low DL	Downlink input signal is not detected in any active filters.	10
Temperature	Internal repeater temperature exceeds +85ºC.	11
Rx Overload UL	Uplink RF input level overload	20
Rx Overload DL	Downlink RF input level overload	21
Tx Low DL	Detected Downlink RF output power is lower than expected.	30

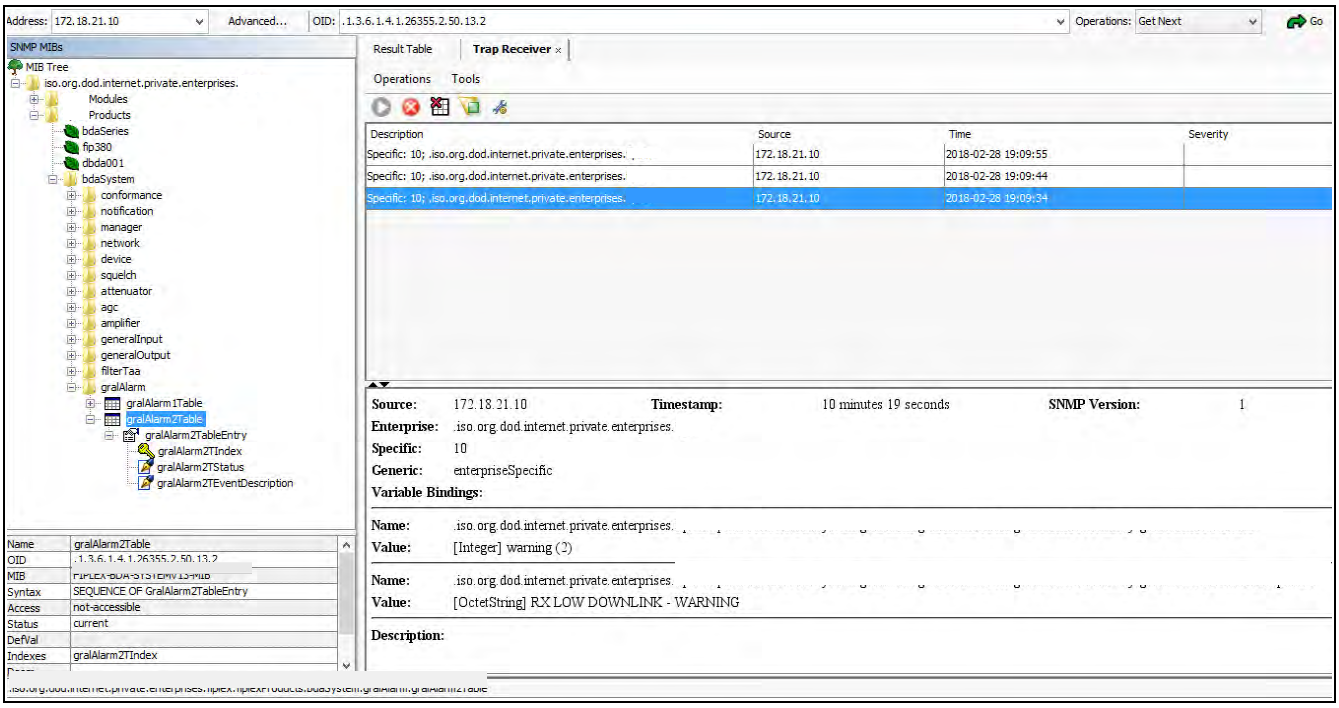
Source event	*Description*	*ID*
Tx High DL	Downlink RF output power too high	31
PA Fault UL	Alarm for the UL Power Amplifier if available.	40
PA Fault DL	Alarm for the DL Power Amplifier. It may be caused by communication error with PA monitoring module.	41
VSWR	Excessive DL output reflected power: antenna mismatch.	50

As it turns out from this list, there is a one-to-one relationship between events triggering traps and their notification identifiers. But the trap identifier does not tell whether the event was to trigger the alarm state or to cancel it. That is the purpose of the severity identification number in the trap message. The following table lists the severity numbers used:

SNMP Trap status binding

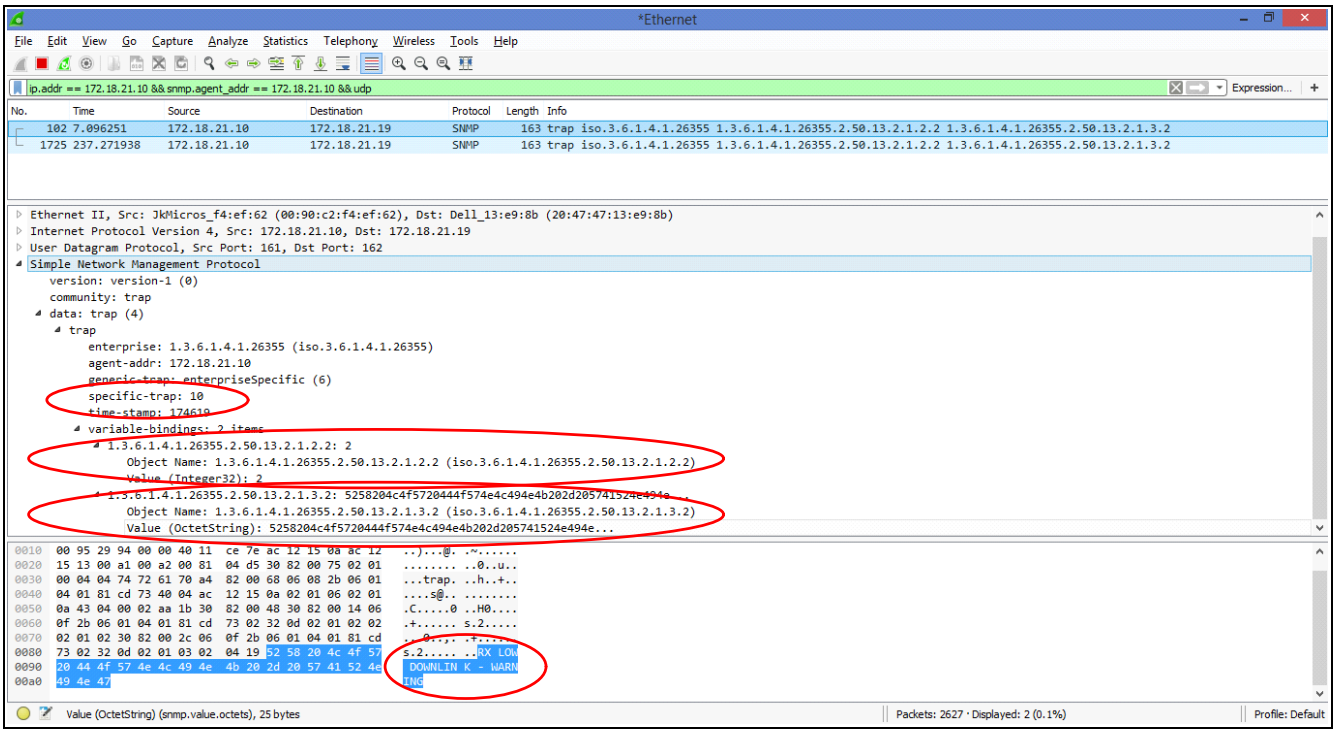
Severity	*Description*	*StatusID*	*Trap status binding*	*Binding string*
CRITICAL	System malfunction comes into effect	1	3	fail
WARNING	System warning comes into effect.	4	2	warning
CLEARED	System malfunction or warning is canceled.	5	1	ok
UNAVAILABLE	System state cannot be determined	6	99	unavailable

The character string attached to each trap message includes both a short event description plus a severity description such as “OK” or “FAIL”. As an example, the following picture shows a snapshot of a trap receiver getting traps from a unit at address 172.18.21.10. The *time-stamp* shows time since system boot and SNMP Version is '1'. The severity is set to 'warning'.



SNMP Trap in trap receiver

Example trap capture



SNMP Trap capture

Trap data explained:

Enterprise: .1.3.6.1.4.1.26355 (Westell Inc.)

BDA System MIB: .1.3.6.1.4.1.26355.2.50 (applicable to BDA system)

Enterprise specific trap number: 10 (meaning '*Rx Input Low DL*' according to the table of trap identifiers).

Trap Bindings

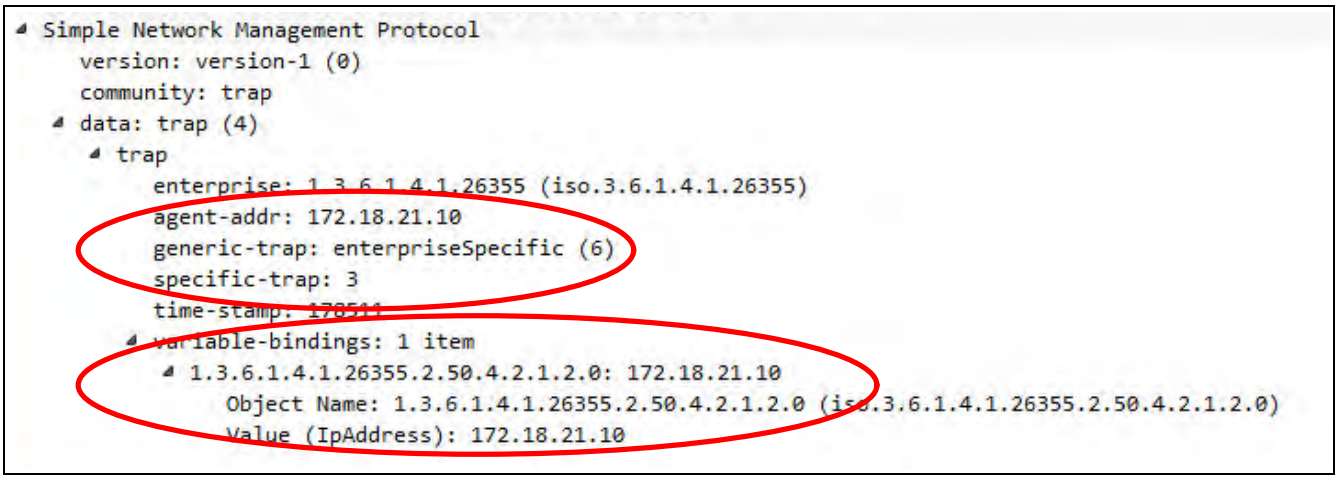
1) **gralAlarm2TStatus**. Value: 2 (see table below)
2) **gralAlarm2TEventDescription**: Value: "RX LOW DOWNLINK - WARNING"

The first binding in the trap is the *gralAlarm2TStatus* of *gralAlarm2T* table in the MIB:

```
gralAlarm2TStatus OBJECT-TYPE
        SYNTAX INTEGER { ok(1), warning(2), fail(3), unavailable(99) }
        MAX-ACCESS read-write
        STATUS current
        DESCRIPTION
        "-"
::= { gralAlarm2TableEntry 2 }
```

and its equivalence to the trap severity is explained in the table shown in previous section.

The second binding is the string used to be human-readable. The only different type of trap is the keep-alive one, which as an example is shown in next picture:



SNMP Keep-alive trap capture

and its only binding is the *net2TIp* part of the *net2Table* in the MIB

```
net2TIp OBJECT-TYPE
        SYNTAX IpAddress
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
        "-"
::= { net2TableEntry 2}
```

List of traps

The following table lists all bindings in each trap for convenience:

SNMP Trap list

Source event	*Specific Trap ID*	*Bindings*	*Value*
Keep-alive	3	1.3.6.1.4.1.26355.2.50.4.2.1.2.0	Ip Address
General Failure	5	1.3.6.1.4.1.26355.2.50.13.2.1.2.0	{1, 2, 3, 99}

Source event	*Specific Trap ID*	*Bindings*	*Value*
		1.3.6.1.4.1.26355.2.50.13.2.1.3.0	String
Hardware Failure	6	1.3.6.1.4.1.26355.2.50.13.2.1.2.1	{1, 2, 3, 99}
		1.3.6.1.4.1.26355.2.50.13.2.1.3.1	String
Rx Input Low DL	10	1.3.6.1.4.1.26355.2.50.13.2.1.2.2	{1, 2, 3, 99}
		1.3.6.1.4.1.26355.2.50.13.2.1.3.2	String
Temperature	11	1.3.6.1.4.1.26355.2.50.13.2.1.2.3	{1, 2, 3, 99}
		1.3.6.1.4.1.26355.2.50.13.2.1.3.3	String
Rx Overload UL	20	1.3.6.1.4.1.26355.2.50.13.2.1.2.4	{1, 2, 3, 99}
		1.3.6.1.4.1.26355.2.50.13.2.1.3.4	String
Rx Overload DL	21	1.3.6.1.4.1.26355.2.50.13.2.1.2.5	{1, 2, 3, 99}
		1.3.6.1.4.1.26355.2.50.13.2.1.3.5	String
Tx Low DL	30	1.3.6.1.4.1.26355.2.50.13.2.1.2.6	{1, 2, 3, 99}
		1.3.6.1.4.1.26355.2.50.13.2.1.3.6	String
Tx High DL	31	1.3.6.1.4.1.26355.2.50.13.2.1.2.7	{1, 2, 3, 99}
		1.3.6.1.4.1.26355.2.50.13.2.1.3.7	String
PA Fault UL	40	1.3.6.1.4.1.26355.2.50.13.2.1.2.8	{1, 2, 3, 99}
		1.3.6.1.4.1.26355.2.50.13.2.1.3.8	String
PA Fault DL	41	1.3.6.1.4.1.26355.2.50.13.2.1.2.9	{1, 2, 3, 99}
		1.3.6.1.4.1.26355.2.50.13.2.1.3.9	String
VSWR	50	1.3.6.1.4.1.26355.2.50.13.2.1.2.10	{1, 2, 3, 99}
		1.3.6.1.4.1.26355.2.50.13.2.1.3.10	String

Appendix A Important Product Information

A.1 Registration Number

FCC – NVRPSA41080-VHF

A.2 UL

This product is UL Listed.

Appendix B Acronyms and Abbreviations

Table B-1 contains the acronyms and abbreviations used in this manual, along with a definition for each one.

Table B-1: Acronyms and Abbreviations

AGC	Automatic Gain Control
AMPS	Advanced Mobile Phone Service
ARFCN	Absolute Radio Frequency Channel Number
BCCH	Broadcast Control Channel (GSM broadcast channel time slot)
BS	Base Station, BS antenna = towards the base station
CDMA	Code Division Multiple Access
DC	Direct Current
DCS	Digital Communication System (same as PCN)
DL	Downlink signal direction (from base station via Signal Booster / Master / Remote to mobile station)
DPLX	Duplex filter
EEPROM	Electrical Erasable Programmable Read Only Memory
EGSM	Extended Global System for Mobile communication
ETACS	Extended Total Access Communication System
ETSI	European Telecommunications Standard Institute
WCS	Westell Control Software
GSM	Global System for Mobile communication
HW	Hardware
LED	Light Emitting Diode
LNA	Low Noise Amplifier, uplink and downlink
MS	Mobile Station, MS antenna = towards the mobile station
OL	Overload
OMS	Operation and Maintenance System
PA	Power Amplifier
PCN	Personal Communication Network (same as DCS)
PCS	Personal Communication System
pWOMS	Portable Westell Operation and Maintenance Software
PS	Power Supply
RF	Radio Frequency
RSSI	Received Signal Strength Indication
SW	Software
UL	Uplink signal direction (from mobile station via Signal Booster / Master / Remote to base station)
WEEE	Waste of Electric and Electronic Equipment