Newtec

Configuration Guidelines

Configuration Guidelines for Point to Point Setup MDM6000

V1.4

Table of Contents

1 About this manual

This manual provides a step by step configuration guideline to get a point to point link up and running.

1.1 Cautions and Symbols

The following symbols appear in this manual:

A caution message indicates a hazardous situation that, if not avoided, may result in minor or moderate injury. It may also refer to a procedure or practice that, if not correctly followed, could result in equipment damage or destruction.

A hint message indicates information for the proper operation of your equipment, including helpful hints, shortcuts or important reminders.

A reference message is used to direct to a location in a document with related document or a web-link.

1.2 Version History and Applicability

Document version	Date	Comments
Version 1.0	June 2013	Initial Version
Version 1.1	July 2013	Usability changes + default config
Version 1.2	October 2013	Added Layer 2 support
Version 1.3	February 2014	• New GUI view; • New Encapsulation protocols (XPE, MPE & ULE).
Version 1.4	June 2014	Maintenance update

1.3 Related Documentation

- The MDM6000 Satellite Modem Reference Manual describes the parameters available in the device;
- The Automated Non Linear Equalink™ procedure, this document describes the different calibration procedures depending on transponder settings (FGM or ALC);
- Device leaflet (We refer to http://www.newtec.eu);
- The System Integration Guide for MDM6000 describes how to integrate the device into a network management environment;
- The User Manual for the MDM6000 Satellite Modem describes the different user interfaces and the different available features of the device;
- The MDM6000 Quick Start Guide describes how to set the Management IP Address of your device and how to install the sliders and device into the rack.

1.4 Product Range

M-Series

1.5 Software ID

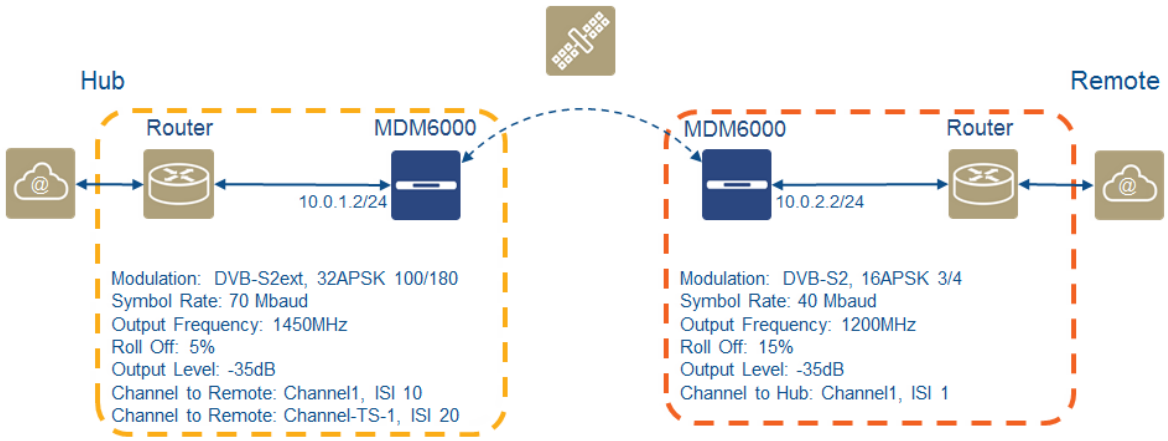
NTC/6437

2 Introduction

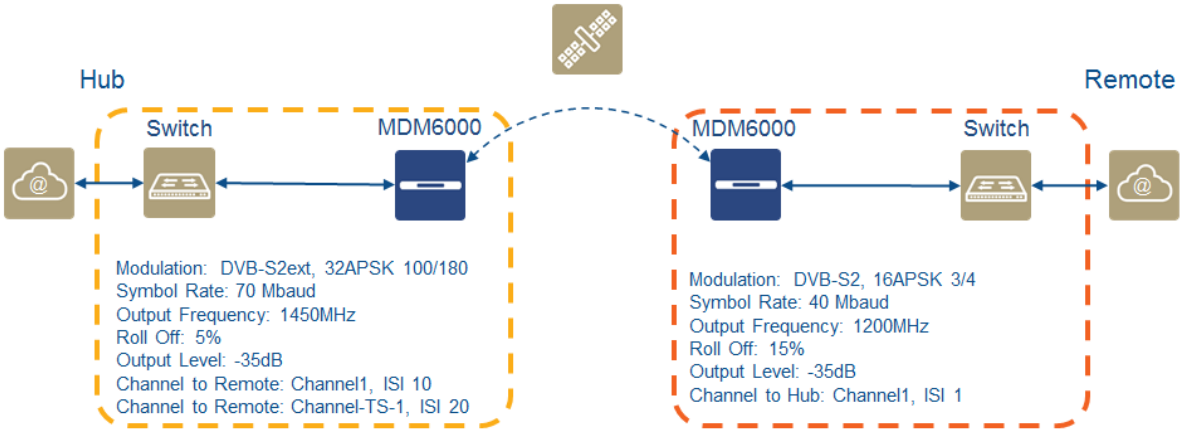
The goal of this configuration guideline is to set up a point to point network between two sites equipped with MDM6000 devices. In such a point-to-point setup, the MDM6000 devices can work in Layer 3 IP Router or in Layer 2 Ethernet Bridge.

Please refer to *Appendix C: Setup Templates on page 72* for a template of the previous drawing.

Layer 3 point-to-point



Layer 2 point-to-point



In the previous network diagrams we assume that the management plane of the setup is up and running. This means that the devices can be configured and managed through a GUI. The configuration guideline focuses on the data traffic that runs over the network.

Please refer to *Appendix C: Setup Templates on page 72* for a template of the previous drawings.

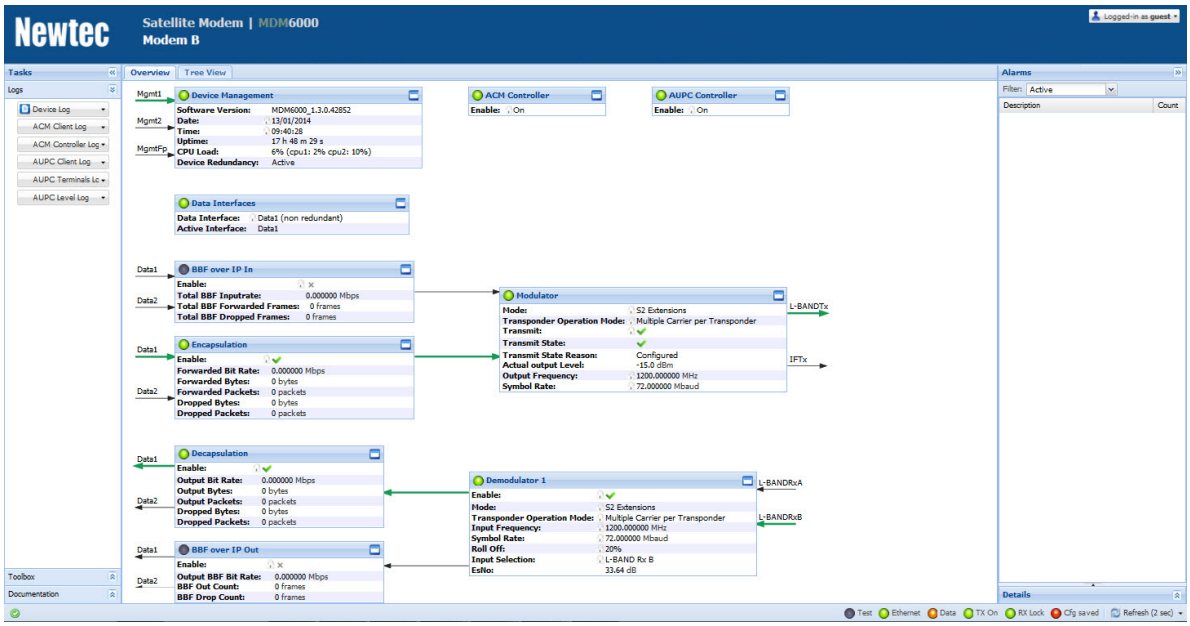
3 Log in as Operator

Do the following steps on the hub and remote devices of the satellite link:

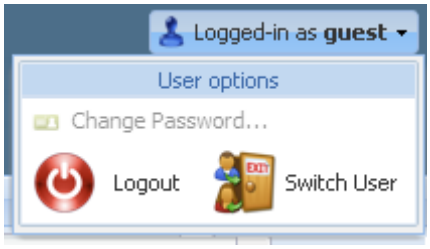
» Open a web browser;

» Type the MGMT IP address of the device in the address bar of the browser.
(The default IP address is 10.0.0.2/24.);

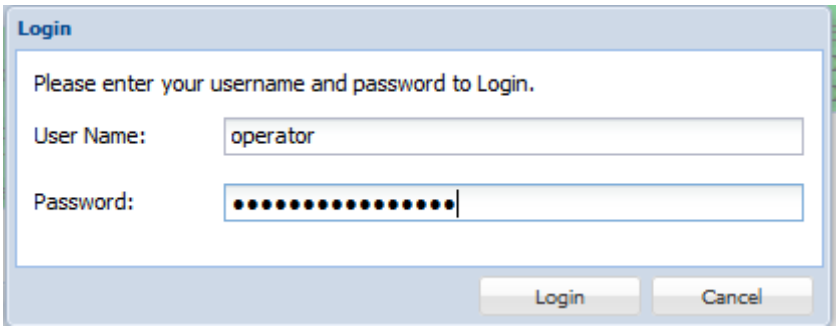
» Press Enter.
The following graphical user interface is displayed:



» Switch User Profile by clicking on, **logged in as Guest** (top right of the GUI):



» Click **Switch User** to change the user profile. (The Login window is displayed.)



- The default User Name and password for the operator profile is as follows:
  - User Name: operator
  - Password: operatoroperator

The bottom left row of the banner is editable and can be used to assign a unique identifier to the device. Do this by clicking on the label (in the previous figure, the label is marked: Site B).

4 Configure the Hub Site

This device has preconfigured settings which can be used in a back-to-back setup.
For more details, we refer to *Appendix B: Default Device Configuration on page 70*

The configuration of the HUB site can be split up into the following steps:

- Configure Encapsulation;
- Configure the Modulator;
- Configure the Demodulator;
- Configure Decapsulation.

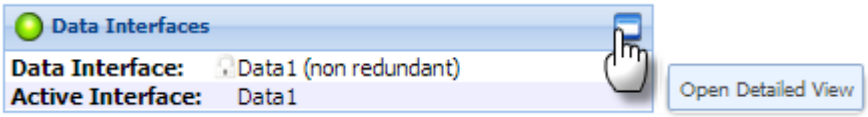
During the configuration, you can use the following icons:

Icon	Description
	Edit button
	Apply the selected setting
	Cancel button

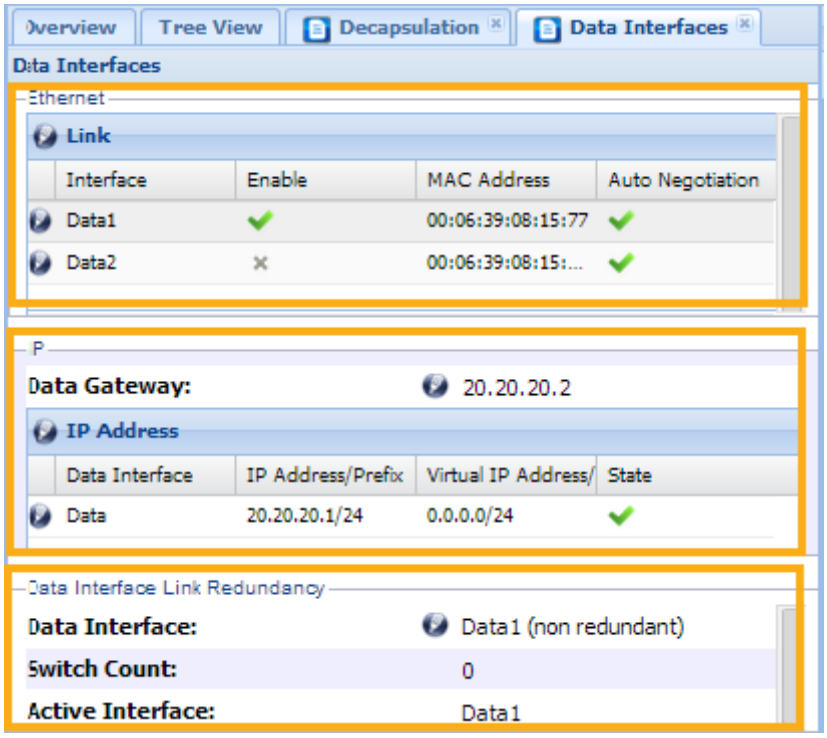
Do not use spaces or blanks when entering a name
(e.g. when configuring an encapsulation channel).

4.1 Configure the Data Interfaces

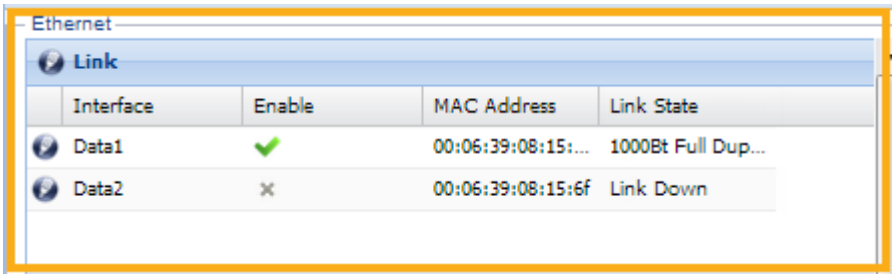
Log in as operator, please refer to chapter *Log in as Operator. on page 4*



» In the Overview tab, click on the top right icon to open the Data Interfaces functional block. Configuration of the Ethernet and IP Connectivity is split up into three parts as shown in the following figure.

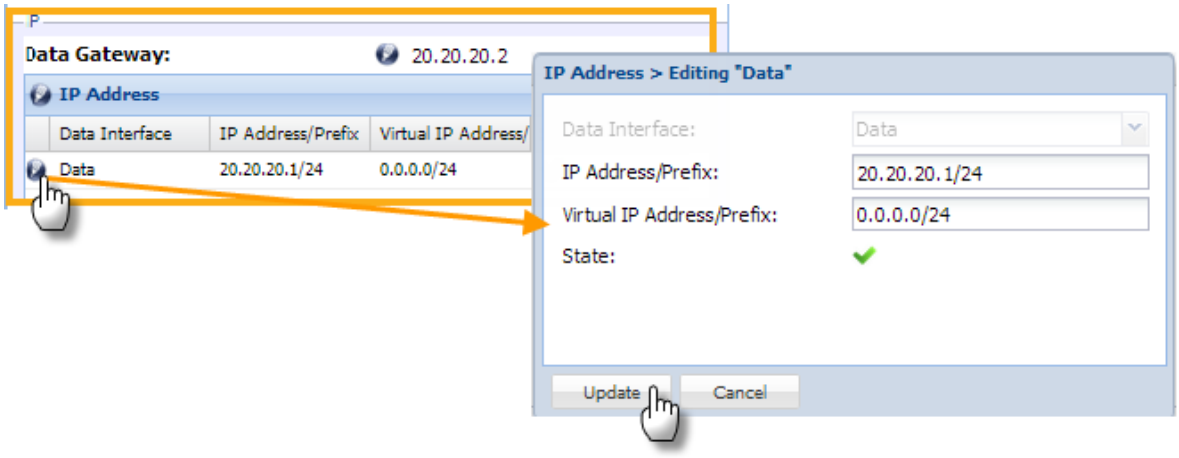


4.1.1 Enable the Ethernet Ports



Parameter	Value	Description
Ethernet Link		
Data1	✔	Enable Data1; to make a connection between the Backbone Provider and the MDM6000.
Data2	✖	Disable Data2; in this example it is not foreseen to setup link redundancy between the Backbone provider and the MDM6000.

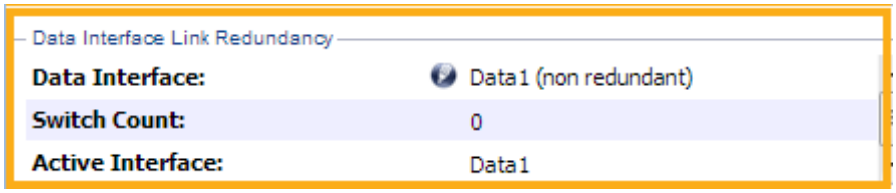
4.1.2 Configure the IP Addresses and its Prefixes



Make sure that the IP Addresses between the different devices belong to the same IP range.

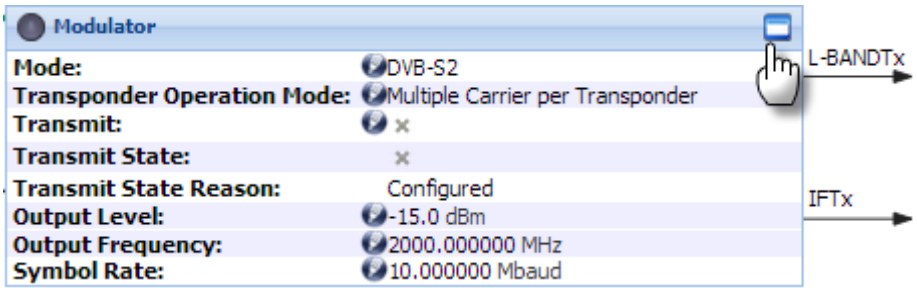
Parameter	Value	Description
IP Address		
Data Gateway	0.0.0.0	
Data	20.20.20.1/24	Configure the IP Address and its prefix (Net Mask) of Data1. Data coming from the customer equipment is received on this interface.

4.1.3 Configure the Data Interface Link Redundancy

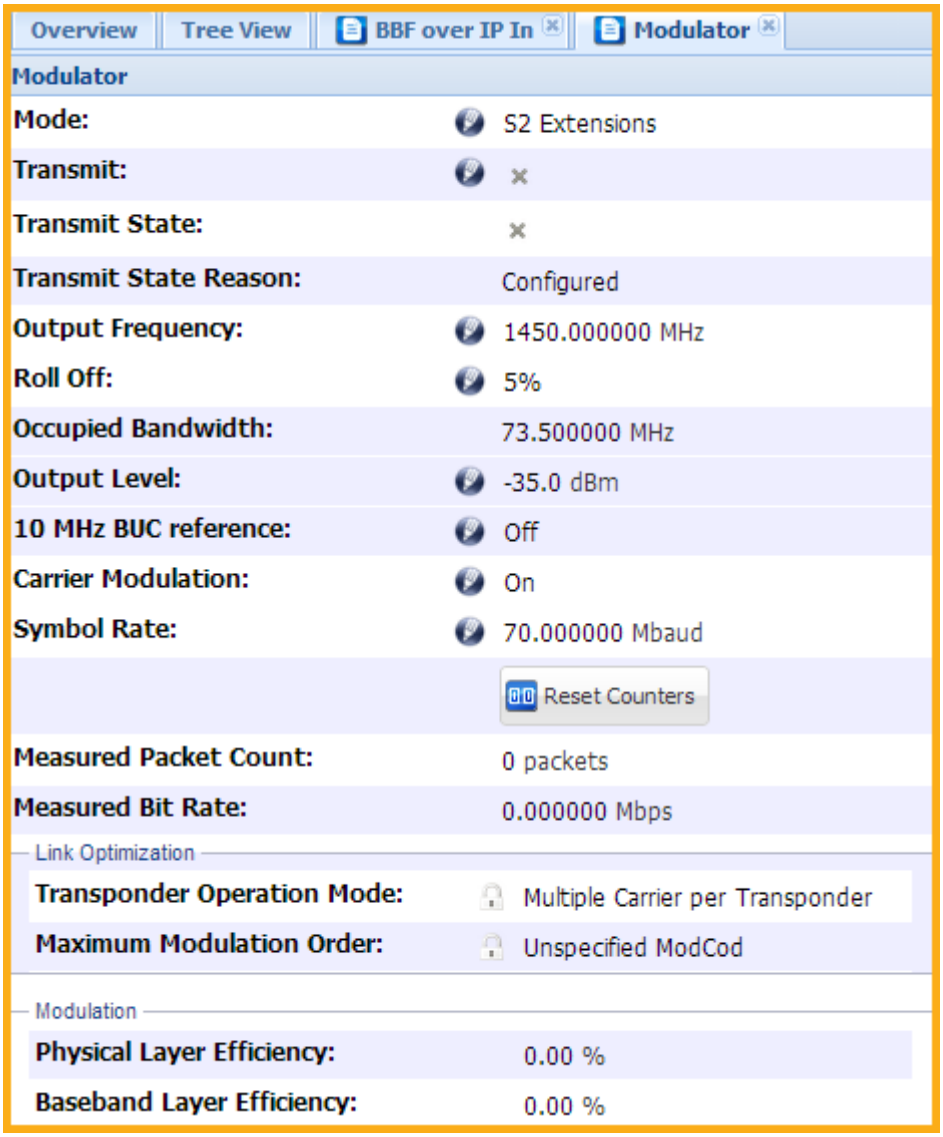


Parameter	Value	Description
Data Interface Link Redundancy		
Data Interface	Data1 (non redundant)	Select Data 1 (non redundant) in this case no bonding (link redundancy) is performed. When link redundancy is required, configure the Data2 interface and select a redundant option from the drop down list.
Switch Count		This counter is only active in case data link redundancy is active. This indicates the amount of switches between Data1 and Data2.
Active Interface	Data1	Indicates which physical Data Interface is active at the moment.

4.2 Configure the Modulator



» In the Overview tab, click on the top right icon to open the Modulator functional block.



Parameter	Value	Description
Modulator		
Mode	S2-Extensions	Select the modulation mode as defined by the system setup requirements.
Transmit	✗	Activate the transmission over satellite. Wait until the configuration is completed before enabling this parameter.
Output Frequency	1450MHz	Set the output frequency according to the requirements of the system setup.
Roll Off	5%	Select the appropriate roll off factor, according to the requirements of the system setup.
Output Level	-35dBm	Enter the value as defined by the link provider. Please contact your link provider to define the output level.
Clock Output	✗	Enables or disables the transmission of a 10MHz clock signal on the RF output interface. This reference signal can be multiplexed on the L-band output interface.
Carrier Modulation	✓	The modulated RF signal is available on the L-BAND Tx interface.
Symbol Rate	70Mbaud	Enter the available symbol rate.

Only enable Transmit when the Encapsulation block is configured.!

4.3 Configure Encapsulation

4.3.1 Encapsulation

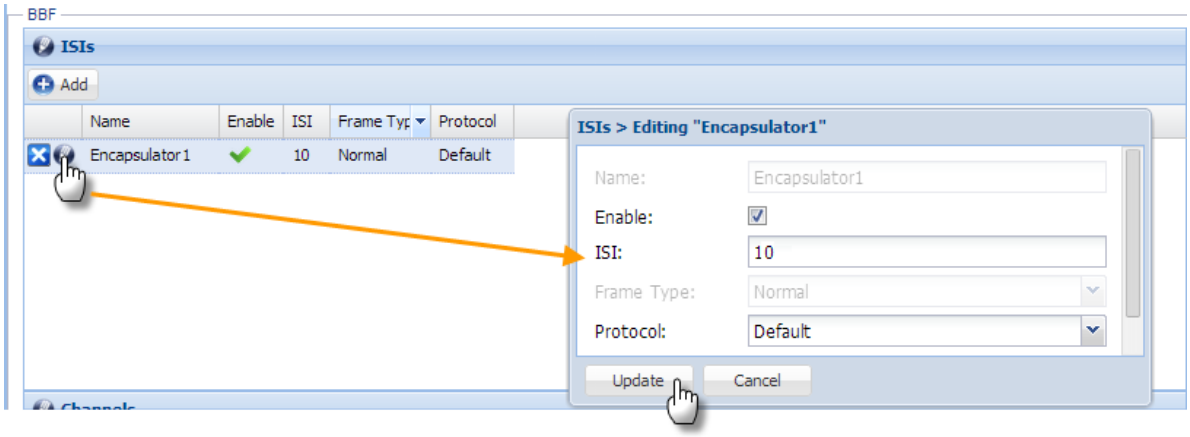
Before the IP traffic is modulated, the IP traffic is classified, shaped and encapsulated. There are different encapsulation protocols available that can be split up into two main groups, BBF Encapsulation Protocols and TS Encapsulation Protocols.

- The BBF Encapsulation Protocols directly insert IP packets into BBFs. The following protocols GSE or XPE can be used to do this;
- The TS Encapsulation Protocols first maps IP packets to TS packets and then encapsulated into baseband frames.

Depending on the protocol, BBF Encapsulation Protocol or TS Encapsulation Protocol, a different procedure is used.

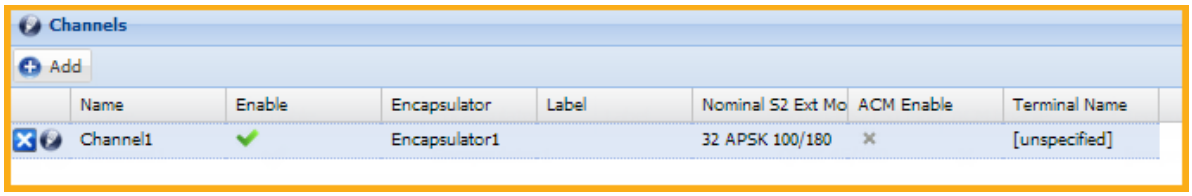
4.3.1.1 BBF Encapsulation

Configure a BBF Encapsulator (ISI)



Parameter	Value	Description
Encapsulators		
Name	Encapsulator1	This is the default name for the first BBF encapsulator. The name is fixed and cannot be overruled!
Enable		Enable the encapsulator.
ISI	10	Insert the Input Stream Identifier.  Note that this is a decimal value.
Frame Size	Normal	Normal frames = 64800 bits Short frames = 16200 bits At data rates under 4Mbps we recommend to use short frames. This to increase the BBF filling level.  In case of S2-Extensions, normal frames are mandatory and therefore enabled by default.
Protocol	Default	Here you have the possibility to overrule the default protocol that has been selected under the general encapsulation settings. Refer to *Configure the General Stream Encapsulation Settings. on page 34*

Configure the Channel



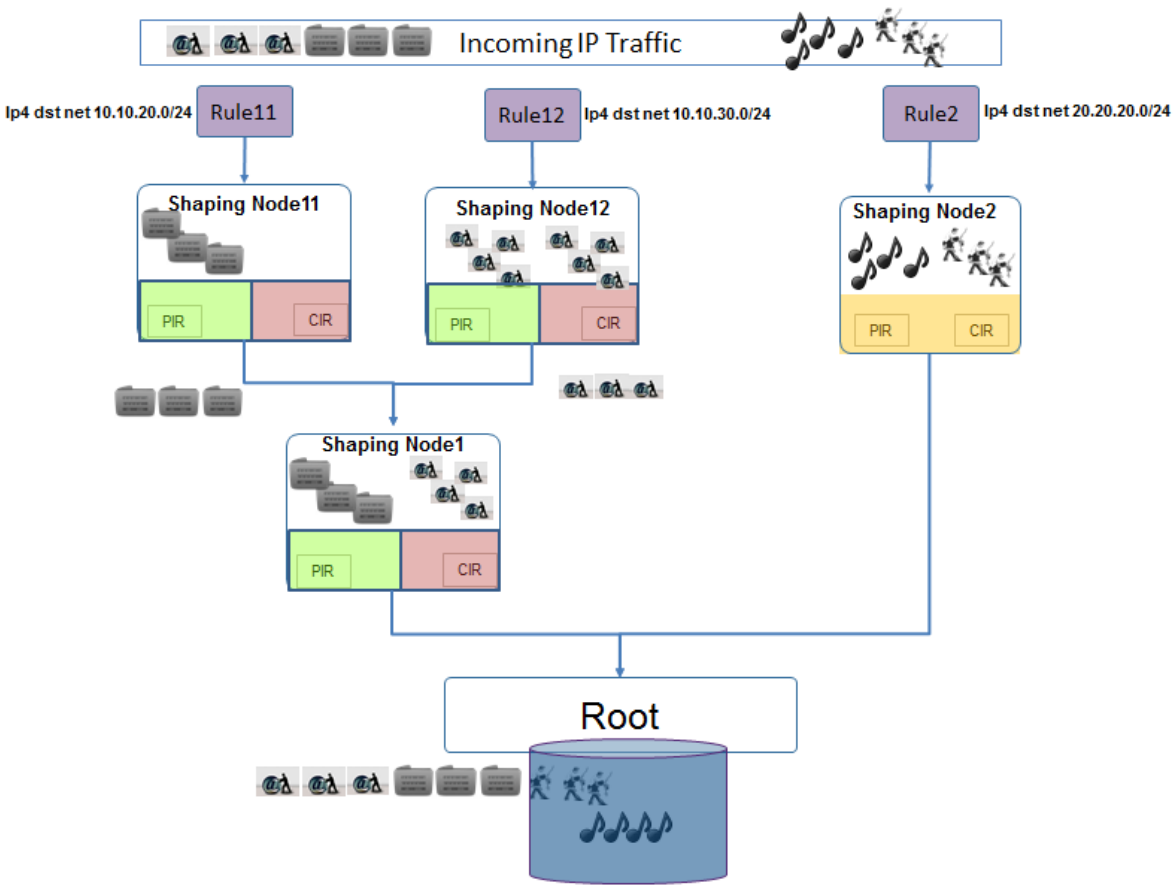
Parameter	Value	Description
Channels		
Name	Channel1	This is the default name for the first BBF channel. Note: The name is fixed and cannot be overruled.
Enable	✔	Activate the channel.
Encapsulator	Encapsulator1	Select the corresponding Encapsulator.
Label	-	Not used in this example. Use a label when you want to address a specific receiver.
Nominal DVB-S2 ModCod	32 APSK 100/180	Select the modcod to be used (overruled when ACM is enabled).
ACM Enable	✖	This configuration guideline does not cover ACM.
Terminal Name	-	Note: This selection becomes available when ACM is enabled. This configuration guideline does not cover ACM.

Configure the Traffic Shaping

Traffic shaping is used to do congestion control. Congestion control means defining how much of satellite capacity is distributed amongst the service providers. Furthermore it is possible to configure the quality of service by setting the priority and maximum queue time.

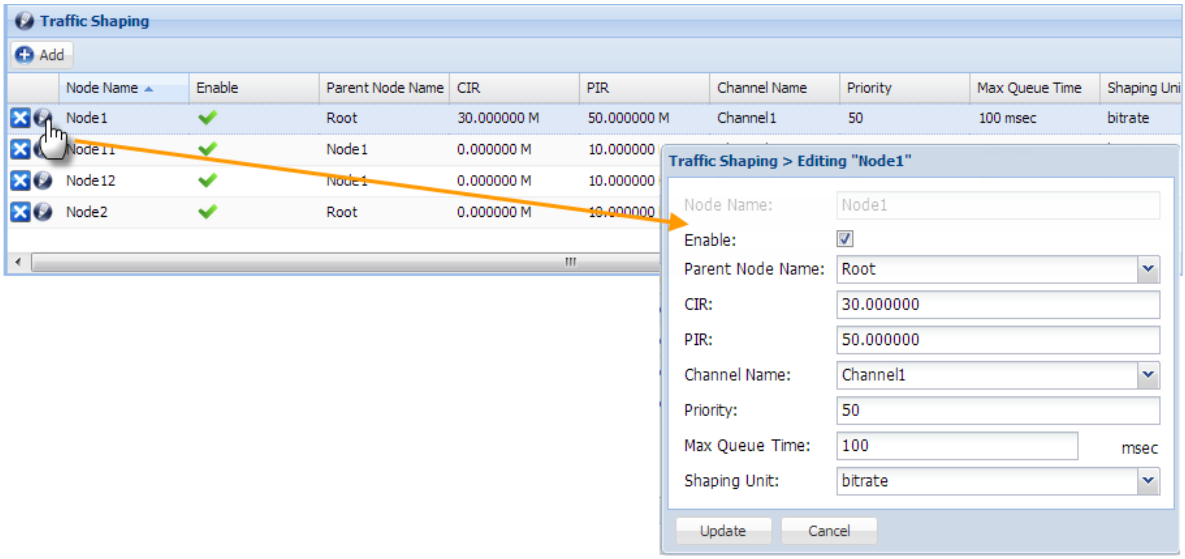
Before configuring the traffic shaping it is strongly advised to make a drawing of the complete shaping tree including traffic classification rules.

The following tree shows an example of different types of incoming IP traffic. In this tree we see that Shaping Node1 and Shaping Node2 directly take in IP traffic from the root node. In Shaping Node1 the data is further distributed over two sub nodes and finally a classification rule captures specific traffic. In Shaping Node2 the traffic is directly captured by a classification rule. Traffic Shaping Node2 will be encapsulated by the TS Encapsulation protocol, refer to following chapter
TS Encapsulation. on page 27



» Scroll down to Traffic shaping (Skip the TS configuration block).

Node1



Parameter	Value	Description
Node Name	Node1	Enter the node name. (By default a unique Node name is proposed)
Enable	✔	Enable the first traffic shaping node.
Parent Node Name	Root	Select one of the available Node names. For the shaping Node1 this is **Root**. Indicating the total incoming traffic.
CIR	30 Mbps	Enter the Committed Information Rate for this traffic shaping node.
PIR	50 Mbps	Enter the Peek Information Rate allowed on this traffic shaping node.
Channel Name	Channel1	Select one of the available channels. The available channels correspond with the channels names defined under **Channels**.
Priority	Keep default value	Use this setting to prioritize the shaped traffic. Value range: 0-99. The lower the value that is entered, the higher the priority!

Parameter	Value	Description
Max Queue Time	Keep default value	This buffer provides the possibility to store an amount of data in a shaping node. When the queue time is exceeded, data will be dropped.
Shaping Unit	Bitrate	Select the shaping unit. • Bitrate: This is commonly used as it guarantees the bitrate that can be received by the terminals. The this advantage of this way of working is that optimal pointing is not encouraged and due to that the available bandwidth is not optimally used. • Symbol rate: This can be used when more than one service provider makes use of the transponder bandwidth. In this case it is possible to divide (shape) the bandwidth amongst the operators as agreed. This way of working encourages the service provider to perform optimal pointing of its terminals. This to obtain an optimal usage of its available bandwidth.

Node 11

» Click **Add;**

» Complete the Pop-Up window.

Parameter	Value	Description
Node Name	Node11	Enter the node name. (By default a unique Node name is proposed, it is recommended to rename this name).
Enable	✔	Enable the shaping node.
Parent Node Name	Node1	Select one of the available Node names. For the shaping Node1 this is **Root**. Indicating the total incoming traffic.
CIR	30 Mbps	Enter the Committed Information Rate for this traffic shaping node.
PIR	50 Mbps	Enter the Peek Information Rate allowed on this traffic shaping node.
Channel Name	Channel1	Select one of the available channels. In this case we want to insert the traffic on the TS Encapsulator 1 (BBF Encapsulator) The available channels correspond with the channels names defined under **Channels**.
Priority	Keep default value	Use this setting to prioritize the shaped traffic. Value range: 0-99. The lower the value that is entered, the higher the priority!
Max Queue Time	Keep default value	This buffer provides the possibility to store an amount of data in a shaping node. When the queue time is exceeded, data will be dropped.
Shaping Unit	Bitrate	Select the shaping unit. • Bitrate: This is commonly used as it guarantees the bitrate that can be received by the terminals. The this advantage of this way of working is that optimal pointing is not encouraged and due to that the available bandwidth is not optimally used. • Symbol rate: This can be used when more than one service provider makes use of the

Parameter	Value	Description
		transponder bandwidth. In this case it is possible to divide (shape) the bandwidth amongst the operators as agreed. This way of working encourages the service provider to perform optimal pointing of its terminals. This to obtain an optimal usage of its available bandwidth.

Node12

» Click **Add**;

» Complete the Pop-Up window.

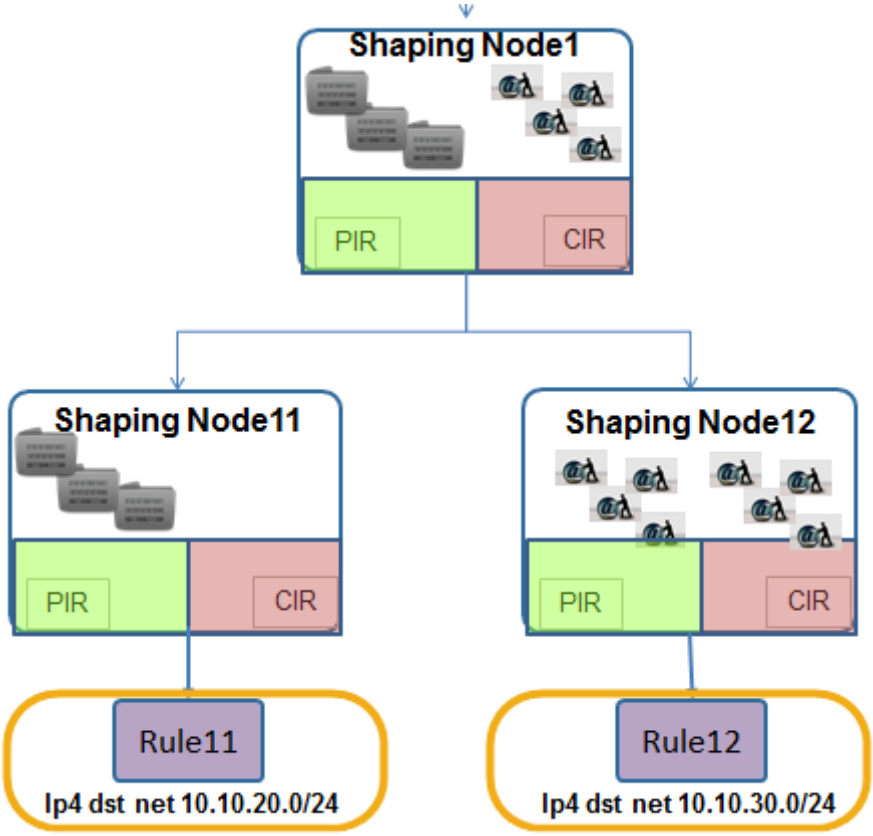
Parameter	Value	Description
Node Name	Node12	Enter the node name. (By default a unique Node name is proposed, it is recommended to rename this name).
Enable		Enable the shaping node.
Parent Node Name	Node1	Select one of the available Node names.  For the shaping Node1 this is **Root**. Indicating the total incoming traffic.
CIR	30 Mbps	Enter the Committed Information Rate for this traffic shaping node.
PIR	50 Mbps	Enter the Peek Information Rate allowed on this traffic shaping node.
Channel Name	Channel1	Select one of the available channels. In this case we want to insert the traffic on the TS Encapsulator 1 (BBF Encapsulator) The available channels correspond with the channels names defined under **Channels**.
Priority	Keep default value	Use this setting to prioritize the shaped traffic. Value range: 0-99. The lower the value that is entered, the higher the priority!
Max Queue Time	Keep default value	This buffer provides the possibility to store an amount of data in a shaping node. When the queue time is exceeded, data will be dropped.
Shaping Unit	Bitrate	Select the shaping unit. • Bitrate: This is commonly used as it guarantees the bitrate that can be received by the terminals. The this advantage of this way of working is that optimal pointing is not encouraged and due to that the available bandwidth is not optimally used. • Symbol rate: This can be used when more than one service provider makes use of the

Parameter	Value	Description
		transponder bandwidth. In this case it is possible to divide (shape) the bandwidth amongst the operators as agreed. This way of working encourages the service provider to perform optimal pointing of its terminals. This to obtain an optimal usage of its available bandwidth.

Configure the Traffic Classification Rules

Use the traffic classification rules to capture specific traffic.

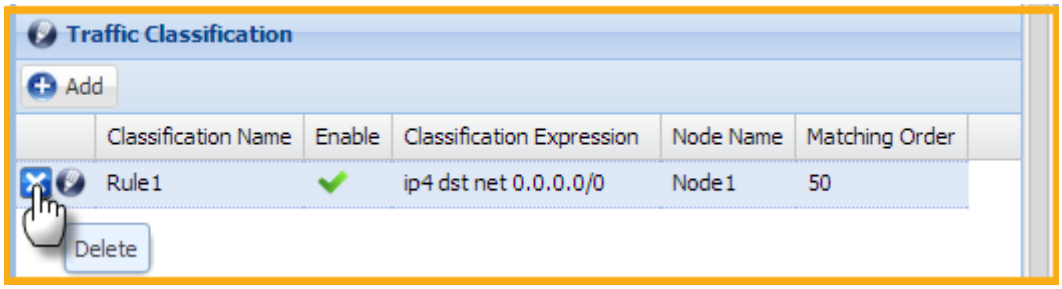
Please refer to *Appendix A - Classification Expressions on page 67* to get an overview on the available expressions.



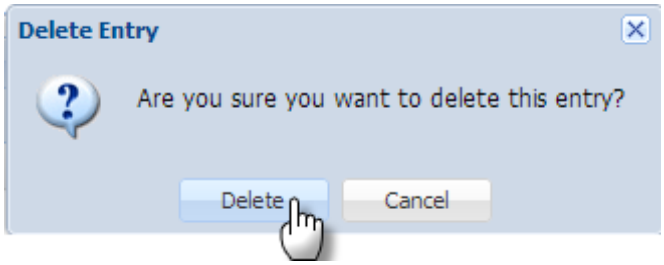
Note that it is not possible to link classification rules to a shaping node that has child nodes. Therefore, when creating child nodes for Shaping Node1, it is needed to either disable or remove the existing Rule1.

Delete Rule1

» Delete Rule1

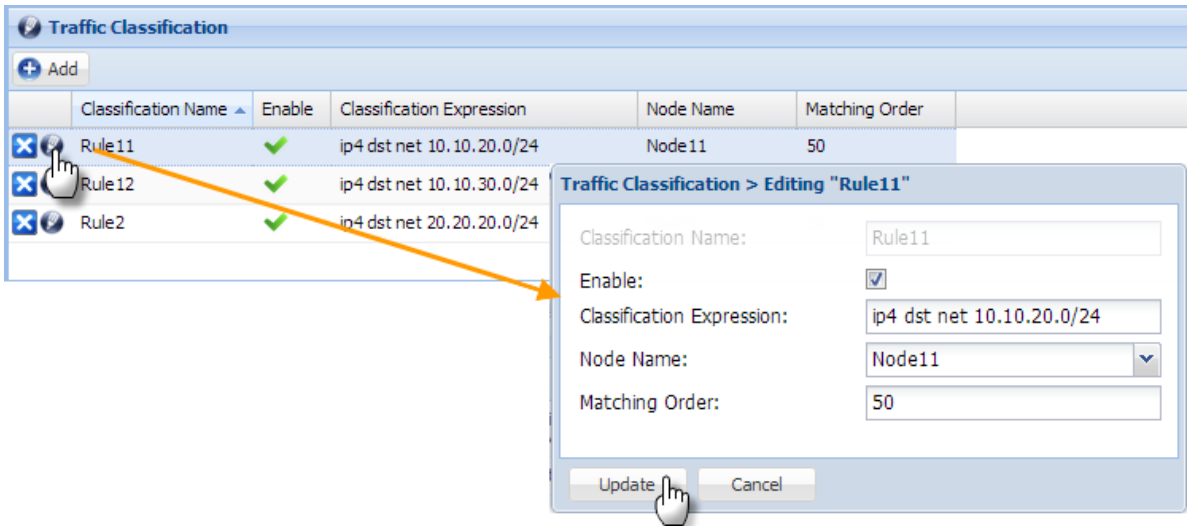


» Click **Delete** to confirm.



Create Rule11

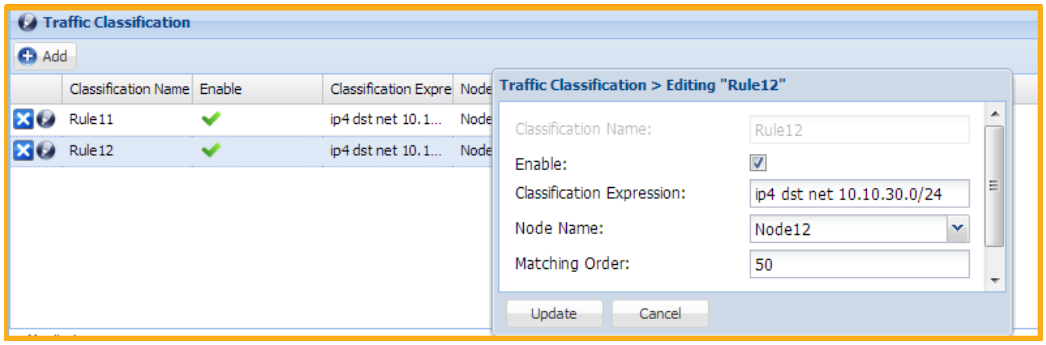
» Click **Add** and fill out the settings in the Pop-Up window.



Parameter	Value	Description
Traffic Classification		
Classification Name	Rule11	Insert a logical Classification Name.
Enable		Activate the classification rule.
Classification Expression	• ip4 dst net 10.10.20.0/24 (Layer 3 Forwarding Mode)	Enter a detailed classification expression when needed.  Make sure that the syntax of the classification expression is correct! We refer to *Appendix A - Classification Expressions on page 67* to have an overview on the possible expressions. Other examples are: • Filter out all icmp traffic with a rule like this: (ip4 dst net xxx) and (icmp type echo-request) • Give priority to same traffic for one specific host: ip4 dst host 10.10.20.5
Shaping Node Name	Node11	Select one of the available shaping node names. In this case select Node11 to link this rule. (The Node names are defined under **Traffic Shaping**.)
Use Matching Order	Keep default value	This parameter is only changed in case of conflicting rules. The lower the value that is entered, the higher the priority!

Create Rule12

» Click Add and fill out the settings in the Pop-Up window.

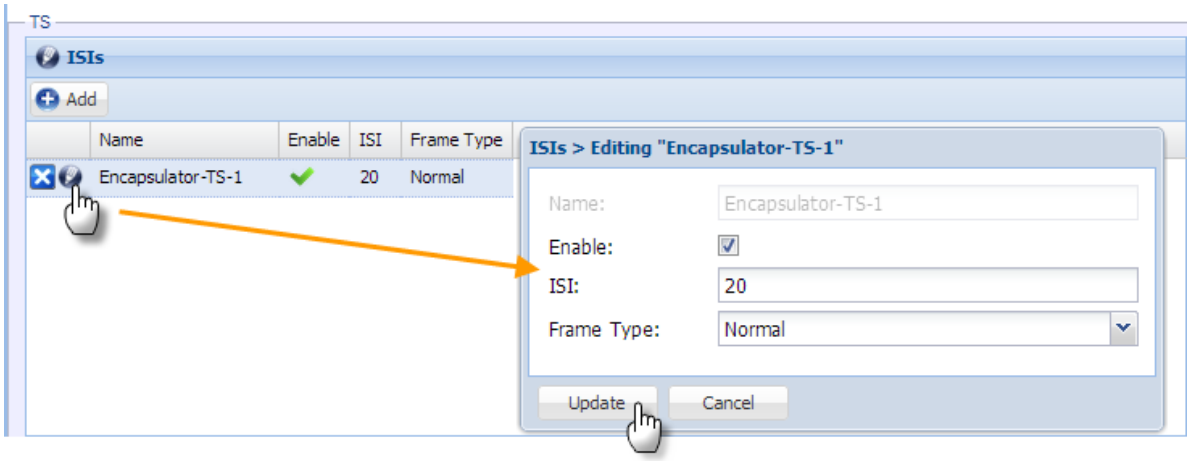


Parameter	Value	Description
Traffic Classification		
Classification Name	Rule12	Insert a logical Classification Name.
Enable	✔	Activate the classification rule.
Classification Expression	• ip4 dst net 0.0.0.0/0 (Layer 3 Forwarding Mode) • all (Layer 2 Forwarding Mode)	Enter a detailed classification expression when needed. Make sure that the syntax of the classification expression is correct! We refer to *Appendix A - Classification Expressions on page 67* to have an overview on the possible expressions. Other examples are: • Filter out all icmp traffic with a rule like this: (ip4 dst net xxx) and (icmp type echo-request) • Give priority to same traffic for one specific host: ip4 dst host 10.10.20.5
Shaping Node Name	Node12	Select one of the available shaping node names. In this case select Node12 to link this rule. (The Node names are defined under **Traffic Shaping**.)
Use Matching Order	Keep default value	This parameter is only changed in case of conflicting rules. The lower the value that is entered, the higher the priority!

4.3.1.2 TS Encapsulation

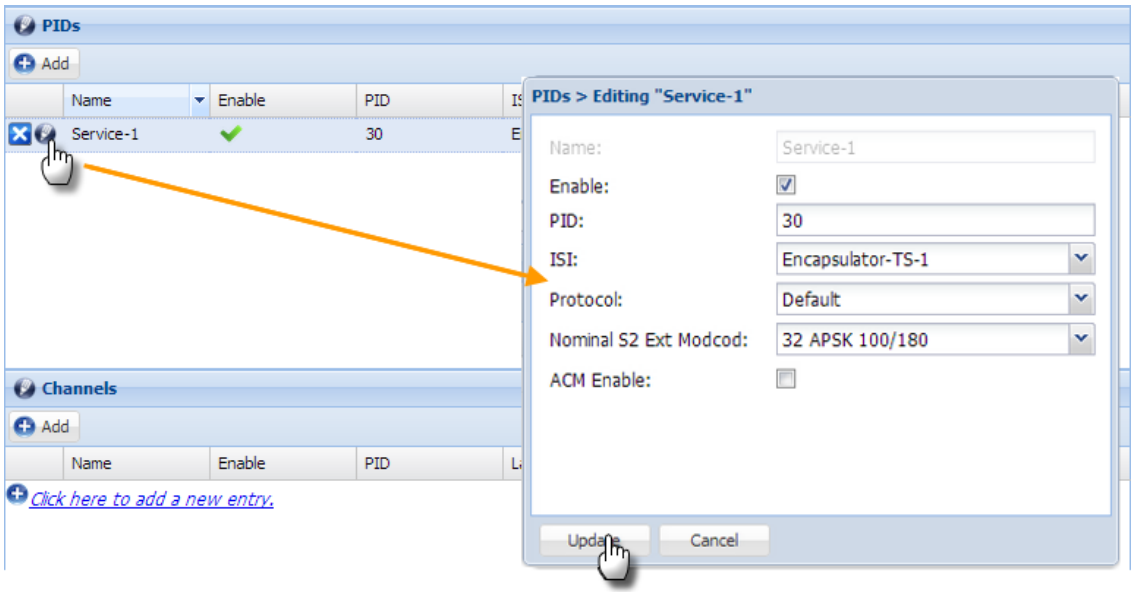
Configure a TS Encapsulator (ISI)

» In the Encapsulation Block scroll to TS Encapsulation.



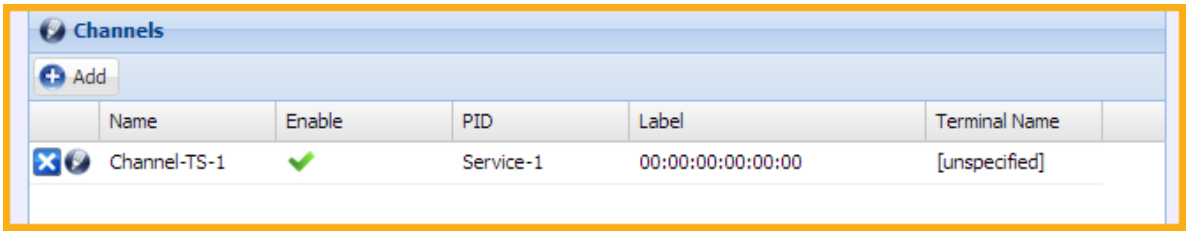
Parameter	Value	Description
Encapsulators		
Name	Encapsulator-TS-1	Enter a logical unique name. Note: A unique name is proposed by the device.
Enable	✔	Enable the encapsulator.
ISI	20	Insert the Input Stream Identifier.
Frame Size	Normal	Normal frames = 64800 bits Short frames = 16200 bits At data rates under 4Mbps we recommend to use short frames. This to increase the BBF filling level.

Configure the PIDs



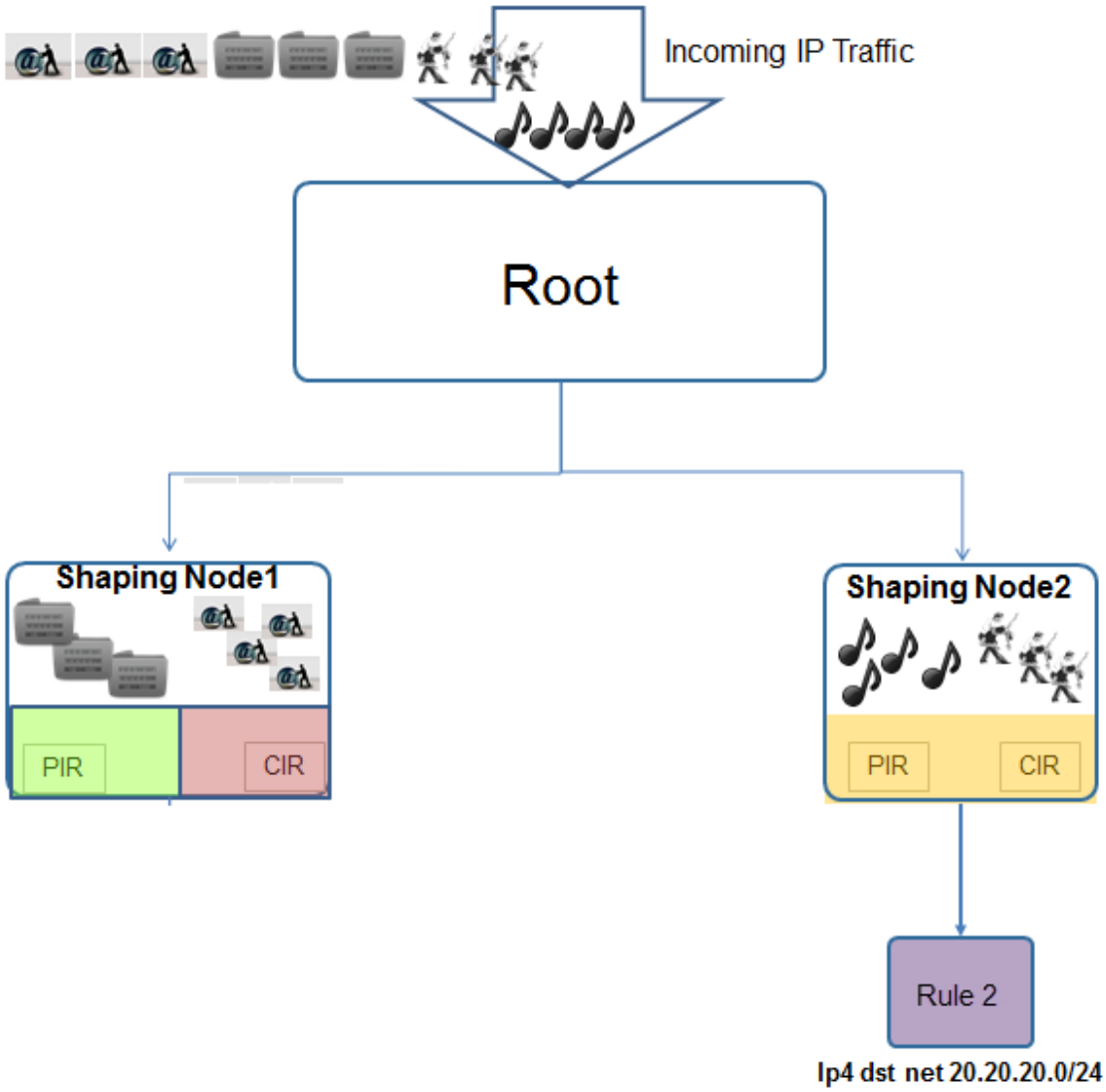
Parameter	Value	Description
PIDs		
Name	Service-1	Enter a logical unique name. Note: A unique name is proposed by the device.
Enable	✔	Enable the creation of PIDs. This adds a Program Identifier to the transport stream packet that is being created. This is needed by the receiver, to filter out this specific program.
PID	30	Enter the Program Identifier number. This number is added to the header transport stream. It will be used by the decapsulator on the receiver site.
ISI	Encapsulator-TS-1	Select one of the available ISI names. The available names are defined under **ISIs**.
Protocol	Default	Here you have the possibility to overrule the default protocol that has been selected under the general encapsulation settings. Refer to *Configure the General Stream Encapsulation Settings. on page 34*
Nominal DVB-S2 ModCod	32APSK 100/180	Select the ModCod to be used (overruled when ACM is enabled).(overruled when ACM is enabled).
ACM Enable	✘	This configuration guideline does not cover ACM.

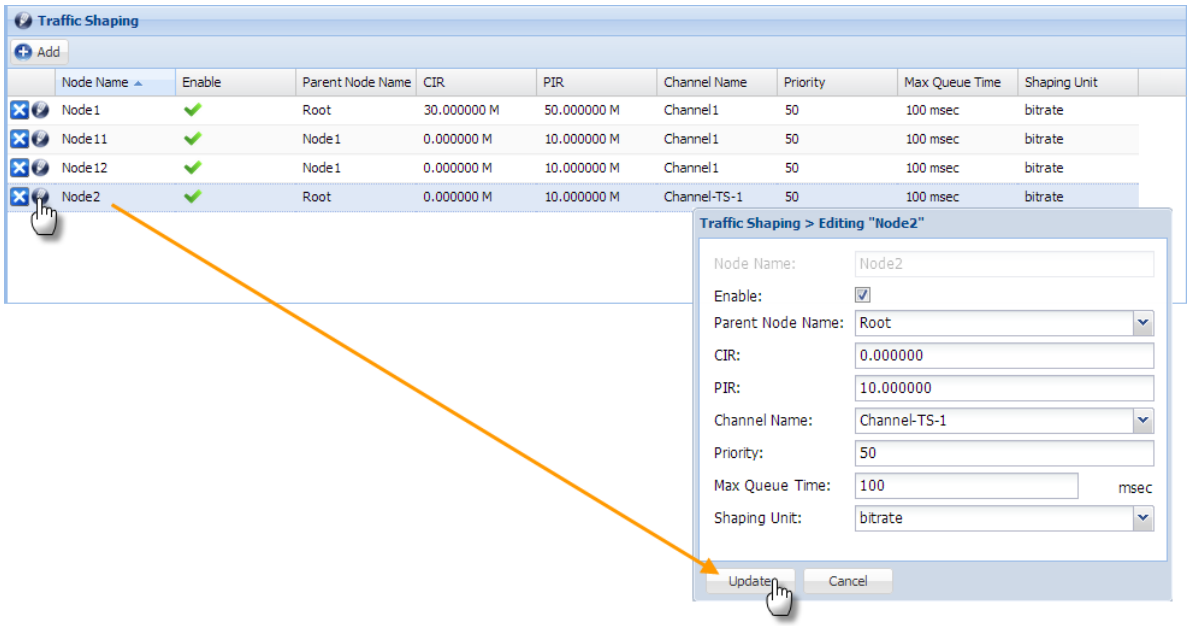
Configure the Channels



Parameter	Value	Description
Channels		
Name	Channel-TS-1	Enter a logical unique name. Note: A unique name is proposed by the device.
Enable	✔	Enable the channel. When enabled the "TS packets" can be transported logical pipe towards the receiver.
PID	Service-1	Select one of the available PID names. The available names are defined under **PIDs**.Ch
Label	00:00:00:00:00:00	Use a label when you want to address a specific receiver. For MPE a label is required!
Terminal Name	<unspecified>	Used when ACM is enabled. This configuration guideline does not cover ACM.

Configure the Traffic Shaping

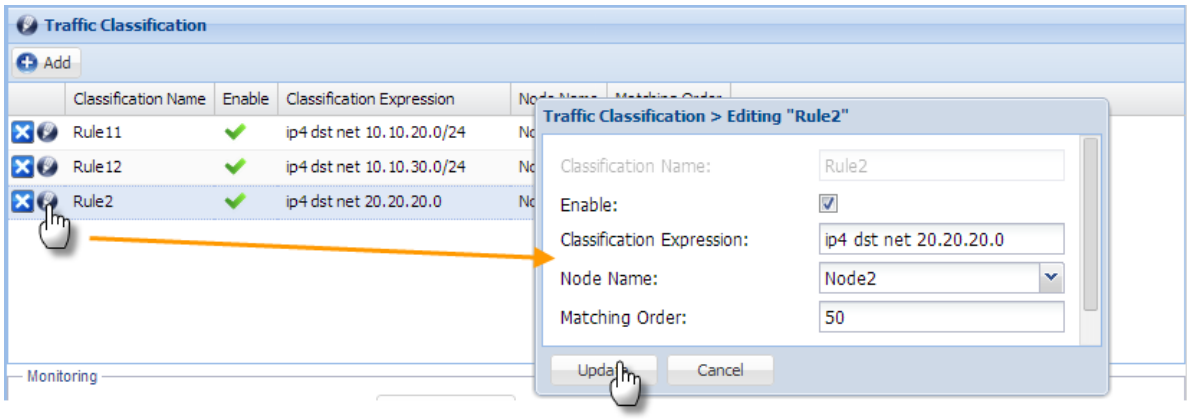




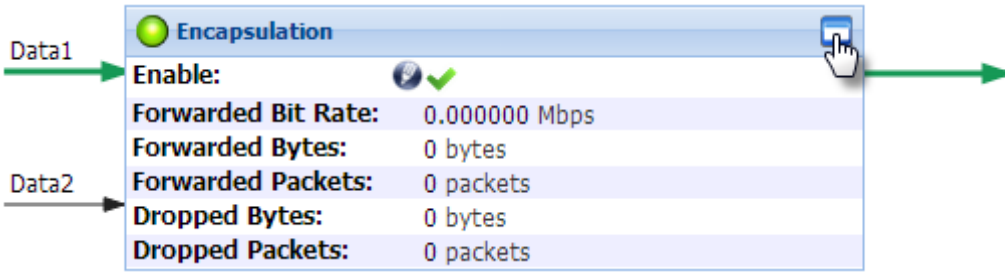
Parameter	Value	Description
Node Name	Node2	Enter the node name. (By default a unique Node name is proposed, it is recommended to rename this name).
Enable	✔	Enable this traffic shaping node.
Parent Node Name	Root	Select one of the available Node names. For the shaping Node2 this is **Root**, Indicating the total incoming traffic.
CIR	0 Mbps	Enter the Committed Information Rate for this traffic shaping node.
PIR	50 Mbps	Enter the Peek Information Rate allowed on this traffic shaping node.
Channel Name	Channel-TS-1	Select one of the available channels. The available channels correspond with the channels names defined under **Channels**.
Priority	Keep default value	Use this setting to prioritize the shaped traffic. Value range: 0-99. The lower the value that is entered, the higher the priority!
Max Queue Time	Keep default value	This buffer provides the possibility to store an amount of data in a shaping node.

		When the queue time is exceeded, data will be dropped.
Shaping Unit	Bitrate	Select the shaping unit. • Bitrate: This is commonly used as it guarantees the bitrate that can be received by the terminals. The this advantage of this way of working is that optimal pointing is not encouraged and due to that the available bandwidth is not optimally used; • Symbol rate: This can be used when more than one service provider makes use of the transponder bandwidth. In this case it is possible to divide (shape) the bandwidth amongst the operators as agreed. This way of working encourages the service provider to perform optimal pointing of its terminals. This to obtain an optimal usage of its available bandwidth.

Configure the Traffic Classification Rules



Parameter	Value	Description
Traffic Classification		
Classification Name	Rule2	Insert a logical Classification Name.
Enable	✔	Activate the classification rule.
Classification Expression	• ip4 dst net 20.20.20.0/0 (Layer 3 Forwarding Mode)	Enter a detailed classification expression when needed. ⚠ Make sure that the syntax of the classification expression is correct! We refer to Appendix Classification Rules to have an overview on the possible expressions. Other examples are: • Filter out all icmp traffic with a rule like this: (ip4 dst net xxx) and (icmp type echo-request) • Give priority to same traffic for one specific host: ip4 dst host 10.10.20.5ip4 dst host 10.10.20.5
Shaping Node Name	Node2	Select one of the available shaping node names. (The Node names are defined under **Traffic Shaping**.)
Use Matching Order	Keep default value	This parameter is only changed in case of conflicting rules. The lower the value that is entered, the higher the priority!

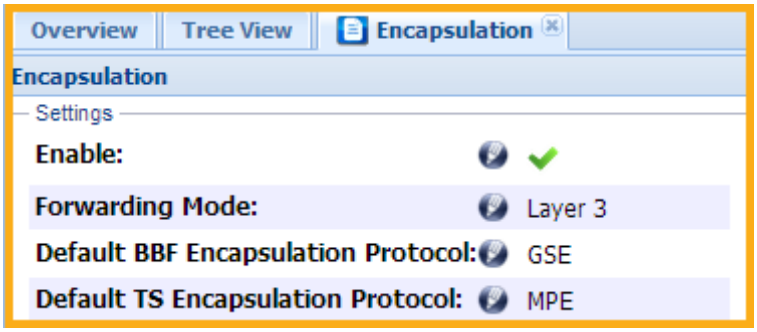


» In the Overview tab, click on the top right icon of the Encapsulation block.

Configuration of the Encapsulation functional block can be split up into the following parts.

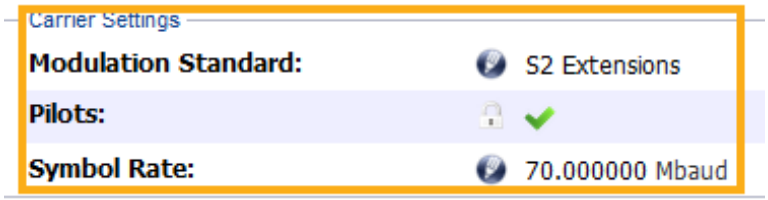
1. Enable Stream Encapsulation settings, select the forwarding mode (L2, L3), select BBF encapsulation protocol, select TS encapsulation protocol;
2. Configure the Carrier Settings;
3. Configure the BBF Encapsulation Protocol;
   - Configuration of the ISIs
   - Configuration of the Channels
4. Configure the TS Encapsulation Protocol;
   - Configuration of the ISIs
   - Configuration of the PIDs
   - Configuration of the Channels
5. Configure the Traffic Shaping;
6. Configure the Traffic Classification.

4.3.2 Configure the Stream Encapsulation Settings



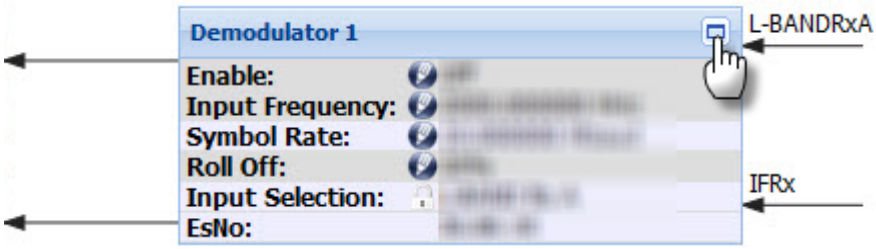
Parameter	Value	Description
Settings		
Enable		Activate stream encapsulation
Forwarding Mode	Layer 3	Select the required forwarding mode. Through this selection, the device either acts as Layer 3 IP Router or as Layer 2 Ethernet Bridge.
Default BBF Encapsulation Protocol	GSE	This encapsulator inserts IP packets directly into BBFs. This is the most efficient way of encapsulating IP packets. This because it generates the least overhead in comparison with the TS encapsulation protocols. There are two possible Encapsulation protocols available: • GSE (Generic Stream Encapsulation), this is a protocol that is compliant with the DVB-S2 standard. (it generates the least overhead in comparison with XPE); • XPE (Extended Performance Encapsulation) is a Newtec Proprietary protocol. (Use this protocol between Newtec equipment. It is implemented to be backward compatible with elevation devices such as EL470, EL478, EL978 and other Newtec devices supporting XPE.).
Default TS Encapsulation Protocol	MPE	This encapsulator first maps IP packets into TS packets (TS packets are used as containers) and this way it generates a set of TS packets. It must be clear that it is not a valid MPEG transport stream that can be used outside of the encapsulation. There are two possible Encapsulation protocols available: • ULE (Unidirectional Lightweight Encapsulation), is more efficient than MPE; • MPE (Multi-Protocol Encapsulation) is less efficient than ULE because it uses more overhead. Use this in case the receiver only supports this protocol.

4.3.3 Configure the Carrier Settings

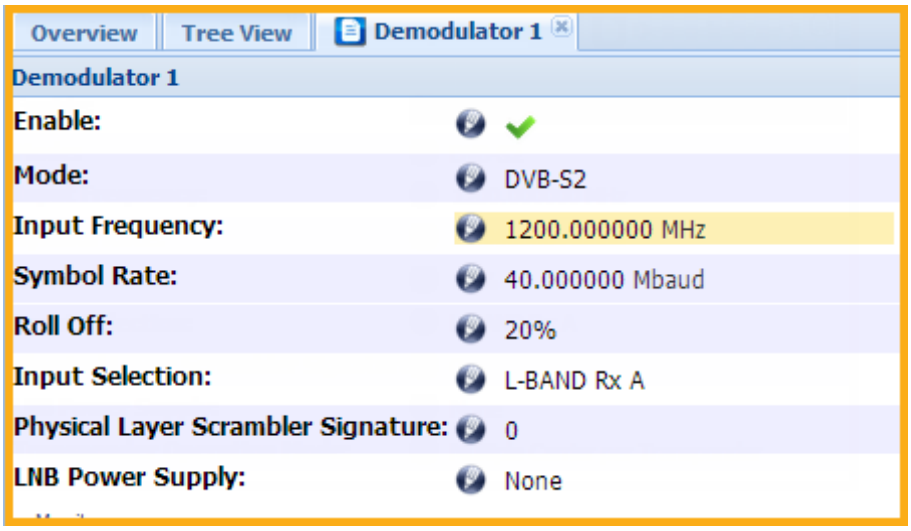


Parameter	Value	Description
Carrier Settings		
Modulation Standard	S2 Extensions	Select the modulation standard as defined by the system setup requirements. (DVB-S2 or S2 Extensions)
Pilots	✔	Activate the use of pilots. Pilots reduce the influence of phase noise in the system. • Use pilots for multi stream; • Use pilots to increase the reliability of the receiver synchronization. (Increasing the performance and robustness of the demodulator.) In case of S2-Extensions, pilots are mandatory and therefore enabled by default.
Symbol Rate	70 Mbaud	Enter the Symbol Rate according to the system setup requirements.

4.4 Configure the Demodulator Settings



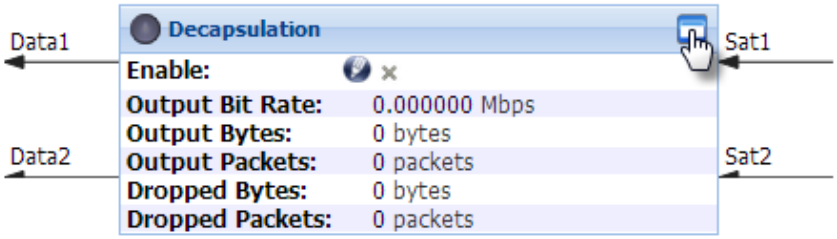
- In the Overview tab, click on the top right icon to open the Demodulator functional block.



Parameter	Value	Description
Demodulator		
Enable	✔	Activate the demodulator.
Mode	DVB-S2	Select the modulation mode that is used by the sending site (MDM6000 on the remote site). Note: When the selection does not match, the incoming BBFs are not recognized.
Input Frequency	1200MHz	Set the input frequency according to the output frequency of the sending site (MDM6000 on the remote site).
Symbol Rate	40Mbaud	Enter the symbol rate according to the system setup specifications.
Roll Off	15%	Select the appropriate roll off factor, according to the requirements of the system setup.
Input Selection	L-Band Rx A	Indicates on what Rx interface the RF is received. This is done automatically based on the input frequency.
Physical Layer Scrambler Signature	0	
LNB Power Supply	None	When an LNB is used it is possible to select the corresponding power supply
Transponder Operation Mode	Automatic	• The multi carrier per transponder configuration is to be used in case the transponder is operated in multiple carriers per traveling wave tube (TWTA) on the satellite;

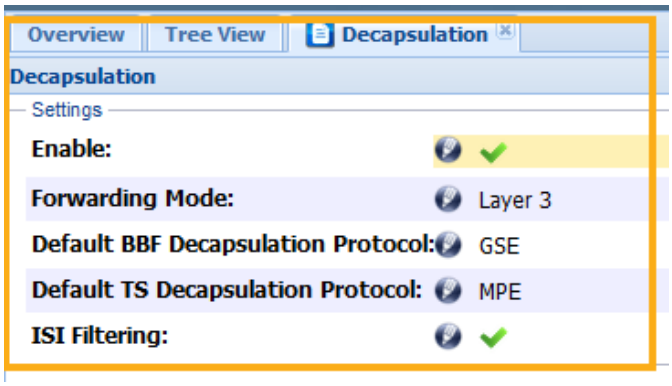
Parameter	Value	Description
		• The single carrier per transponder configuration in linear mode configuration assumes that the transponder has sufficient backoff to be considered in linear mode with a single carrier and that the operation is clearly within the linear region of the transponder; • In the case the satellite channel is operated in a single carrier per transponder mode in the non-linear amplification region of the transponder.

4.5 Configure Decapsulation



» Click on the top right icon to open the Decapsulation functional block.

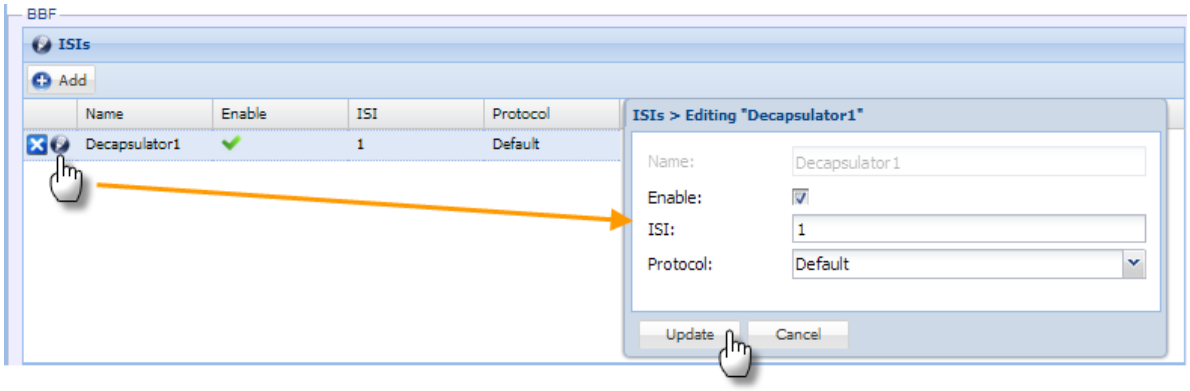
4.5.1 Enable Decapsulation and ISI Filtering



Parameter	Value	Description
Enable	✔	Enable the decapsulator to start decapsulating the incoming BBF's.
Forwarding Mode	Layer 3	This is the same setting as in the Encapsulator.
Default BBF Decapsulation Protocol	GSE	Select the default decapsulation protocol that is mainly used to decapsulate the incoming BBFs. • GSE • XPE
Default TS Decapsulation Protocol	MPE	Select the default decapsulation protocol that is mainly used to decapsulated the incoming "TS packets". • MPE • ULE
ISI Filtering	✔	Enable ISI filtering. When this is not enabled no filtering is performed and the decapsulation cannot take place!

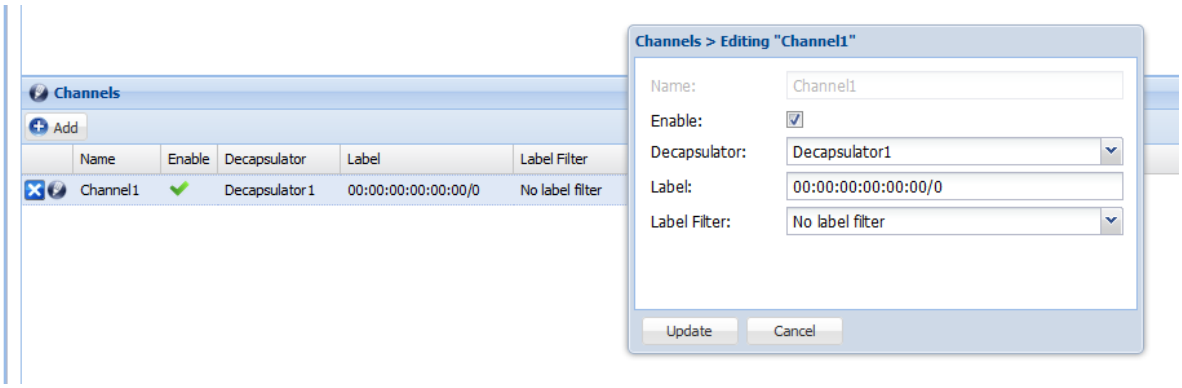
4.5.2 Configure the BBF Decapsulator

4.5.2.1 Configure the BBF Decapsulation ISIs



Parameter	Value	Description
ISIs		
Name	Decapsulator1	Displays the name of the decapsulator
Enable	✔	Activate the decapsulation of the ISI.
ISI	1	Enter the ISI value that you want to filter out. This must correspond to the ISI value defined on the sending site. (In this case on the remote site).
Protocol	Default	Here you have the possibility to overrule the default protocol that has been selected under the general decapsulation settings. Refer to *Enable Decapsulation and ISI Filtering on page 39*

4.5.2.2 Configure the Decapsulation Channels



Parameter	Value	Description
Channels		
Name	Channel1	Indicate the channel that you want to decapsulate. Verify the used channel name on the sending site.
Enable	✔	Activate the decapsulation of the channel.
Decapsulator	Decapsulator1	Select the decapsulator name.
Label		For more information on the use of the label and label filter please refer to the user manual. The user manual can be found on CD-ROM that is delivered together with the device.
Label filter		

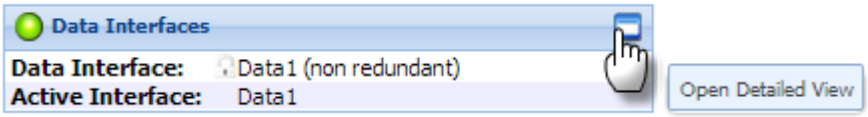
5 Configure the Remote Site

The configuration of the Remote site can be split up into the following steps.

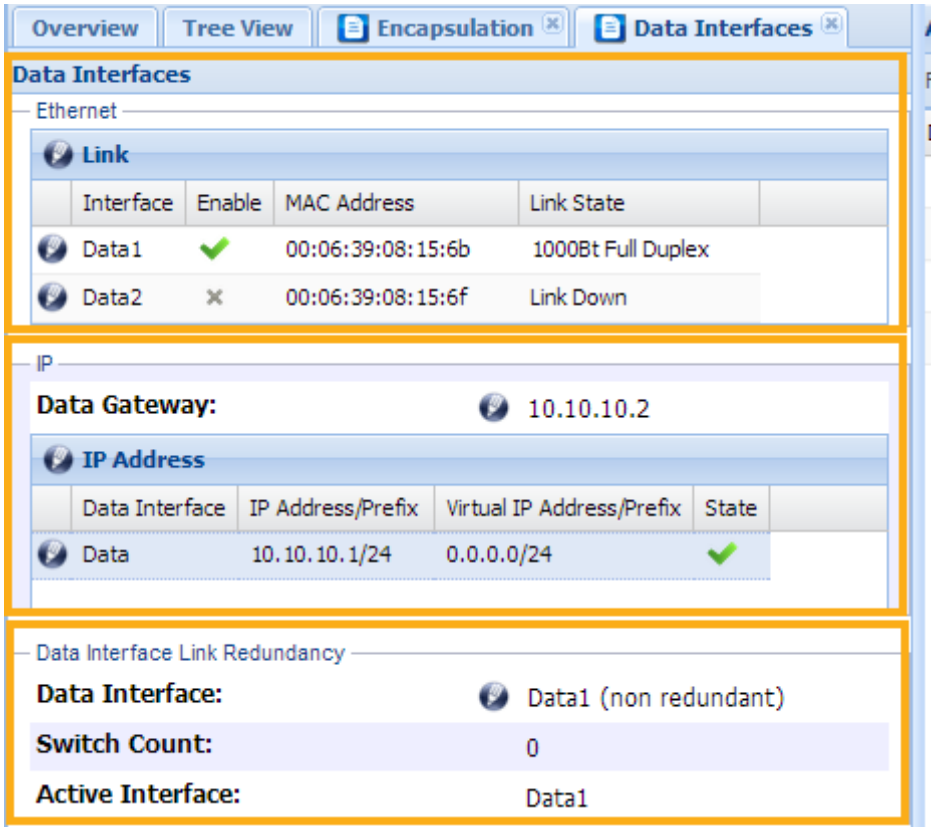
- Configure the Data interface;
- Configure the Modulator;
- Configure the Encapsulation;
- Configure the Demodulator;
- Configure the Decapsulation;

5.1 Configure the Data Interfaces

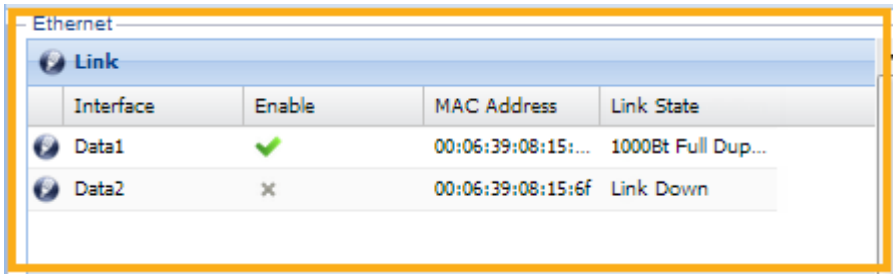
Log in as operator, please refer to chapter *Log in as Operator. on page 4*



» In the Overview tab, click on the top right icon to open the Data Interfaces functional block. Configuration of the Ethernet and IP Connectivity is split up into three parts as shown in the following figure.

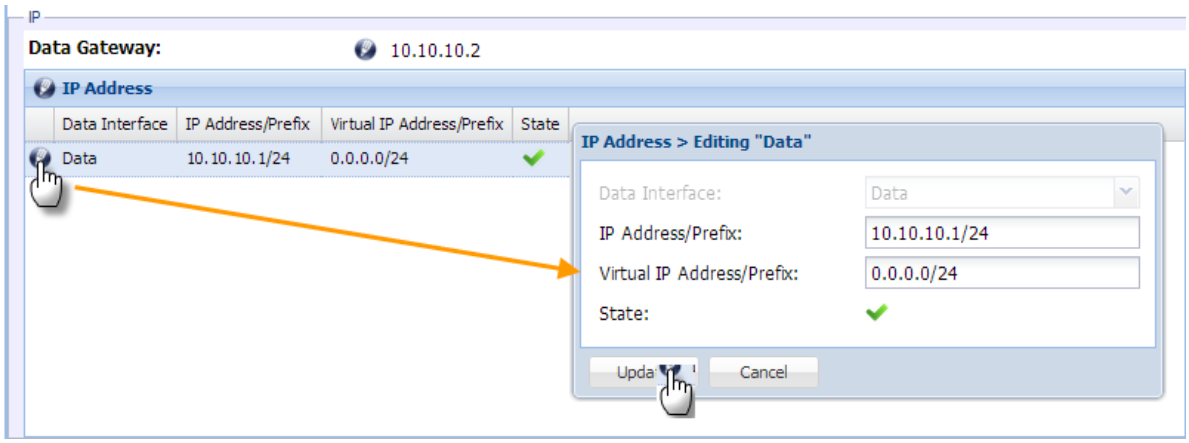


5.1.1 Enable the Ethernet Ports



Parameter	Value	Description
Ethernet Link		
Data1	✔	Enable Data1; to make a connection between the Backbone Provider and the MDM6000.
Data2	✘	Disable Data2; in this example it is not foreseen to setup link redundancy between the Backbone provider and the MDM6000.

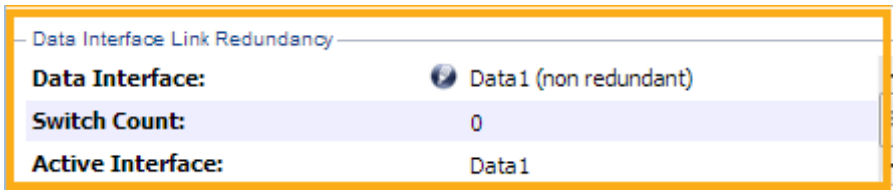
5.1.2 Configure the IP Addresses and its Prefixes



Make sure that the IP Addresses between the different devices belong to the same IP range.

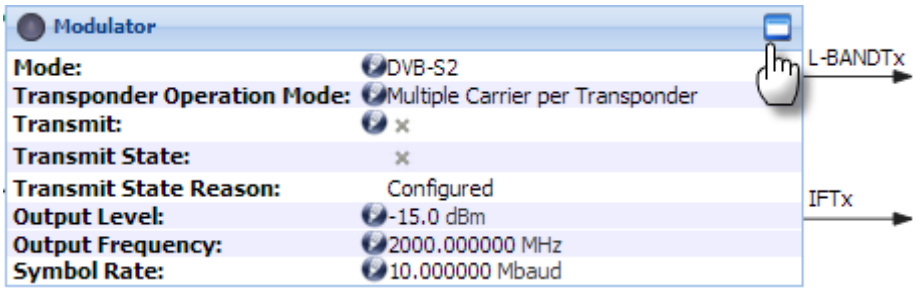
Parameter	Value	Description
IP Address		
Data Gateway	10.10.10.2	
Data	10.10.10.1/24	Configure the IP Address and its prefix (Net Mask) of Data1. Data coming from the customer equipment is received on this interface.

5.1.3 Configure the Data Interface Link Redundancy

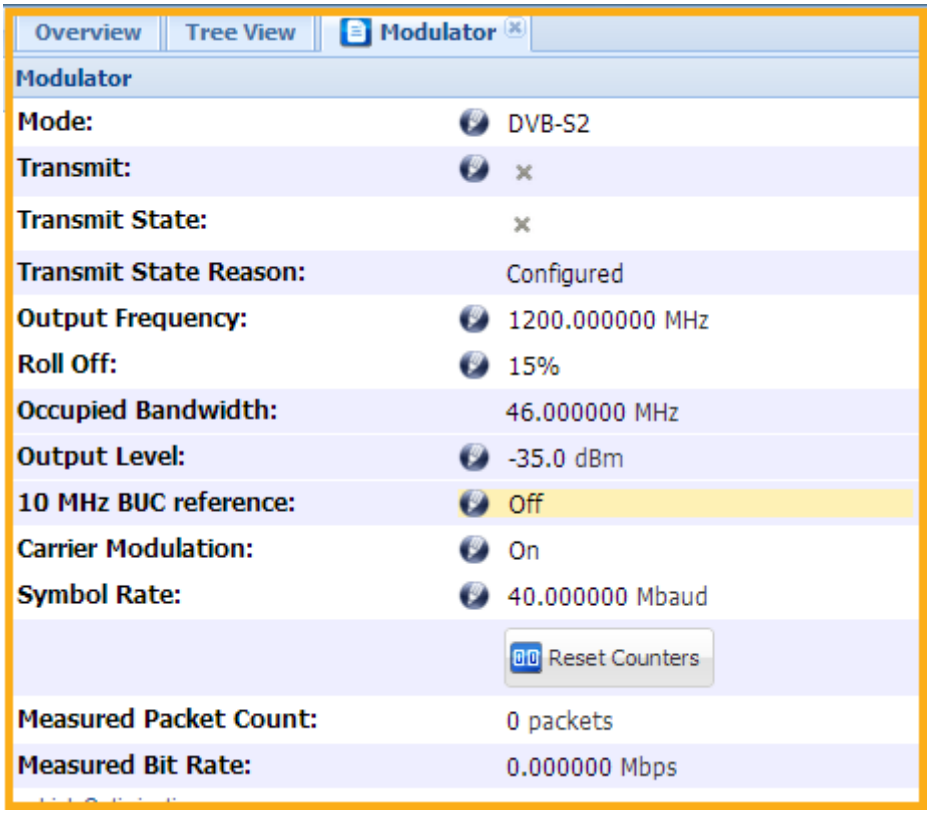


Parameter	Value	Description
Data Interface Link Redundancy		
Data Interface	Data1 (non redundant)	Select Data 1 (non redundant) in this case no bonding (link redundancy) is performed. When link redundancy is required, configure the Data2 interface and select a redundant option from the drop down list.
Switch Count		This counter is only active in case data link redundancy is active. This indicates the amount of switches between Data1 and Data2.
Active Interface	Data1	Indicates which physical Data Interface is active at the moment.

5.2 Configure the Modulator Settings



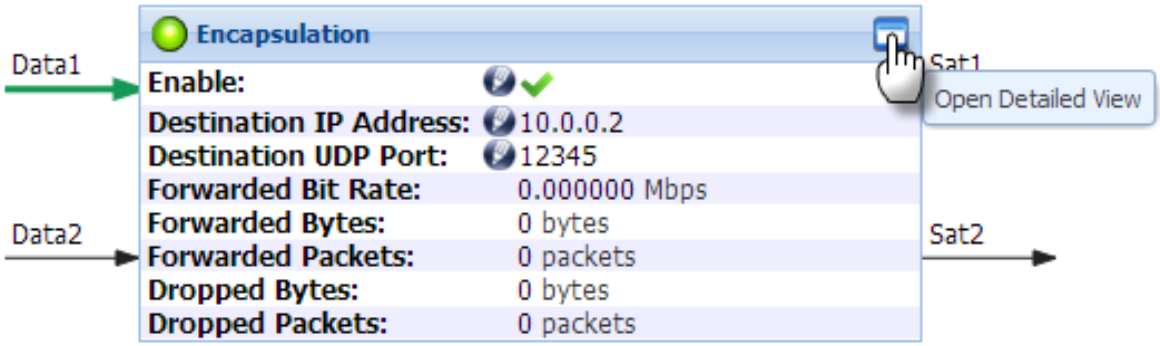
» In the Overview tab, click on the top right icon to open the Modulator functional block.



Parameter	Value	Description
Modulator		
Mode	DVB-S2	Select the modulation mode as defined by the system setup requirements.
Transmit	✗	Activate the transmission over satellite. Wait until the configuration is completed before enabling this parameter.
Output Frequency	1200MHz	Set the output frequency according to the requirements of the system setup.
Roll Off	15%	Select the appropriate roll off factor, according to the requirements of the system setup.
Output Level	-35dBm	Enter the value as defined by the link provider. Please contact your link provider to define the output level.
Clock Output	✗	Enables or disables the transmission of a 10MHz clock signal on the RF output interface. This reference signal can be multiplexed on the L-band output interface.
Carrier Modulation	✓	The modulated RF signal is available on the L-BAND Tx interface.
Symbol Rate	40Mbaud	Enter the available symbol rate.

Only enable Transmit once encapsulation has been configured!

5.3 Configure Encapsulation

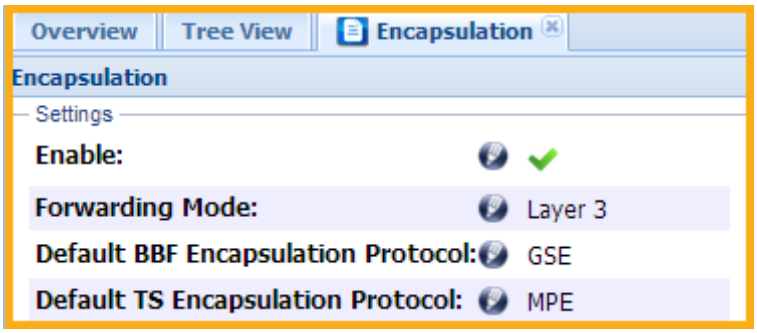


» In the Overview tab, click on the top right icon of the Encapsulation block.

Configuration of the Encapsulation functional block can be split up into the following parts.

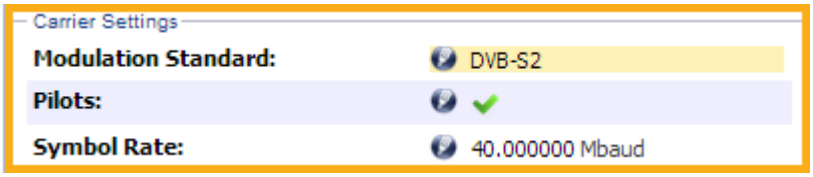
1. Enable Stream Encapsulation settings, select the forwarding mode (L2, L3), select BBF encapsulation protocol, select TS encapsulation protocol;
2. Configure the Carrier Settings;
3. Configure the BBF Encapsulation Protocol;
   - Configuration of the ISIs
   - Configuration of the Channels
4. Configure the TS Encapsulation Protocol;
   - Configuration of the ISIs
   - Configuration of the PIDs
   - Configuration of the Channels
5. Configure the Traffic Shaping;
6. Configure the Traffic Classification.

5.3.1 Configure the General Stream Encapsulation Settings



Parameter	Value	Description
Settings		
Enable		Activate stream encapsulation
Forwarding Mode	• Layer 3	Select the required forwarding mode. Through this selection, the device either acts as Layer 3 IP Router or as Layer 2 Ethernet Bridge.
Default BBF Encapsulation Protocol	• GSE	This encapsulator inserts IP packets directly into BBFs. This is the most efficient way of encapsulating IP packets. Because it generates the least overhead in comparison with the TS encapsulation protocols. There are two possible Encapsulation protocols available: • GSE (Generic Stream Encapsulation), this is a protocol that is compliant with the DVB-S2 standard. (it generates the least overhead); • XPE (Extended Performance Encapsulation) is a Newtec Proprietary protocol. (Use this protocol between Newtec equipment. It is implemented to be backward compatible with elevation devices such as EL470, EL478, EL978 and ...).
Default TS Encapsulation Protocol	• MPE	This encapsulator first maps IP packets to TS packets (TS packets are used as containers) and this way it generates a set of TS packets. It must be clear that it is not a valid MPEG transport stream that can be used outside of the encapsulation. There are two possible Encapsulation protocols available: • ULE (Unidirectional Lightweight Encapsulation), is more efficient than MPE; • MPE (Multi-Protocol Encapsulation) is less efficient than ULE because it uses more overhead. Use this incase the receiver only supports this protocol.

5.3.2 Configure the Carrier Settings



Parameter	Value	Description
Carrier Settings		
Modulation Standard	DVB-S2	Select the modulation standard as defined by the system setup requirements. (DVB-S2 or S2 Extensions)
Pilots	✔	Activate the use of pilots. Pilots reduce the influence of phase noise in the system. • Use pilots for multi stream; • Use pilots to increase the reliability of the receiver synchronization. (Increasing the performance and robustness of the demodulator.) In case of S2-Extensions, pilots are mandatory and therefore enabled by default.
Symbol Rate	40 Mbaud	Enter the Symbol Rate according to the system setup requirements.

5.3.3 Encapsulation

Before the traffic is modulated, the IP traffic is classified, shaped and encapsulated.
There are different encapsulation protocols available that can be split up into two main groups, BBF Encapsulation Protocols and TS Encapsulation Protocols.

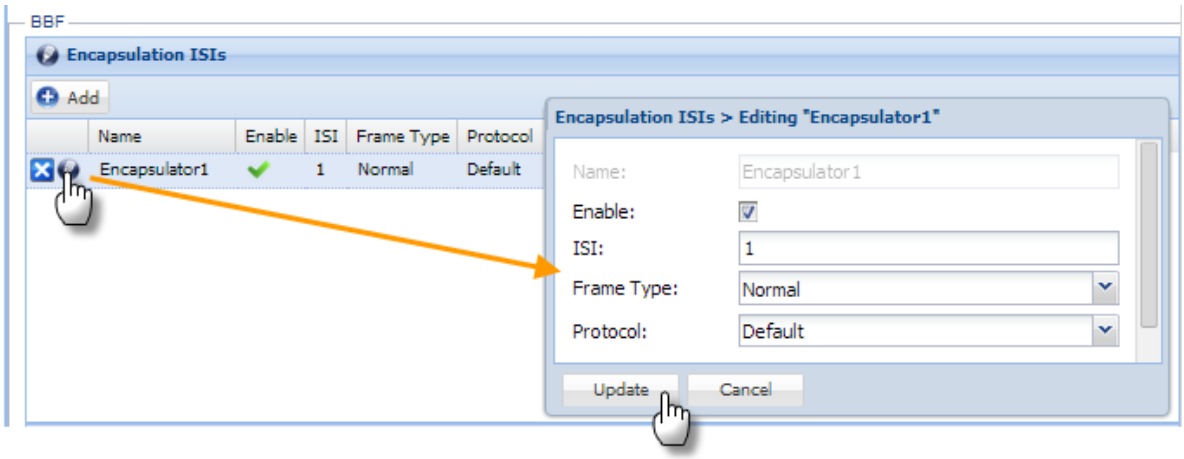
The BBF Encapsulation Protocols directly insert IP packets into BBFs. The following protocols GSE or XPE can be used to do this.

The TS Encapsulation Protocols first maps IP packets to TS packets and then encapsulated into baseband frames.

Depending on the protocol, BBF Encapsulation Protocol or TS Encapsulation Protocol, a different procedure is used.

5.3.3.1 BBF Encapsulation

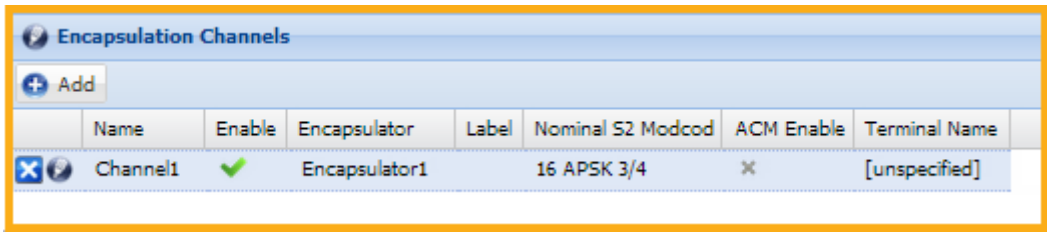
Configure a BBF Encapsulator (ISI)



Parameter	Value	Description
Encapsulators		
Name	Encapsulator1	This is the default name for the first BBF encapsulator. The name is fixed!
Enable	✔	Enable the encapsulator.
ISI	1	Insert the Input Stream Identifier. Note that this is a decimal value.

Parameter	Value	Description
Frame Size	Normal	Normal frames = 64800 bits Short frames = 16200 bits At data rates under 4Mbps we recommend to use short frames. This to increase the BBF filling level. In case of S2-Extensions, normal frames are mandatory and therefore enabled by default.
Protocol	Default	Here you have the possibility to overrule the default protocol that has been selected under the general encapsulation settings. Refer to *Configure the General Stream Encapsulation Settings. on page 47*

Configure the Channel



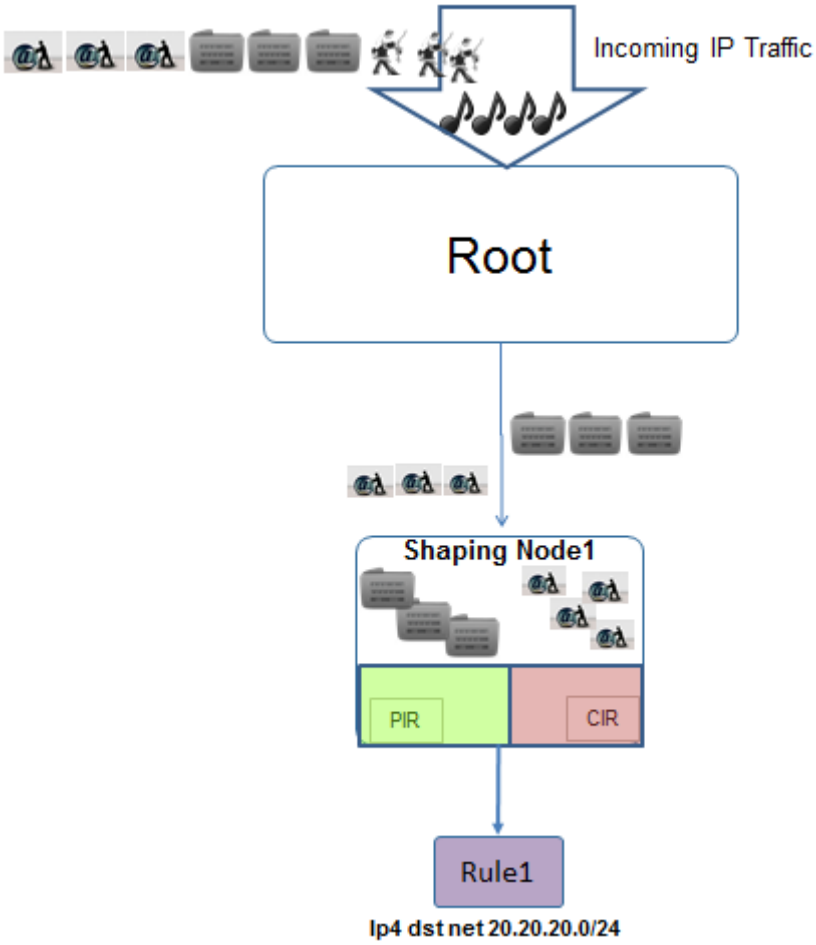
Parameter	Value	Description
Channels		
Name	Channel1	This is the default name for the first BBF channel. Note: The name is fixed and cannot be overruled.
Enable	✔	Activate the channel.
Encapsulator	Encapsulator1	Select the corresponding Encapsulator.
Label		Not used in this example. Use a label when you want to address a specific receiver.
Nominal S2 ModCod	16APSK 3/4	Select the ModCod to be used (overruled when ACM is enabled).
ACM Enable	✖	This configuration guideline does not cover ACM.
Terminal Name	[unspecified]	Used when ACM is enabled. This configuration guideline does not cover ACM.

Configure Traffic Shaping

Traffic shaping is used to do congestion control. Congestion control means defining how much of satellite capacity is distributed amongst the service providers. Furthermore it is possible to configure the quality of service by setting the priority and maximum queue time.

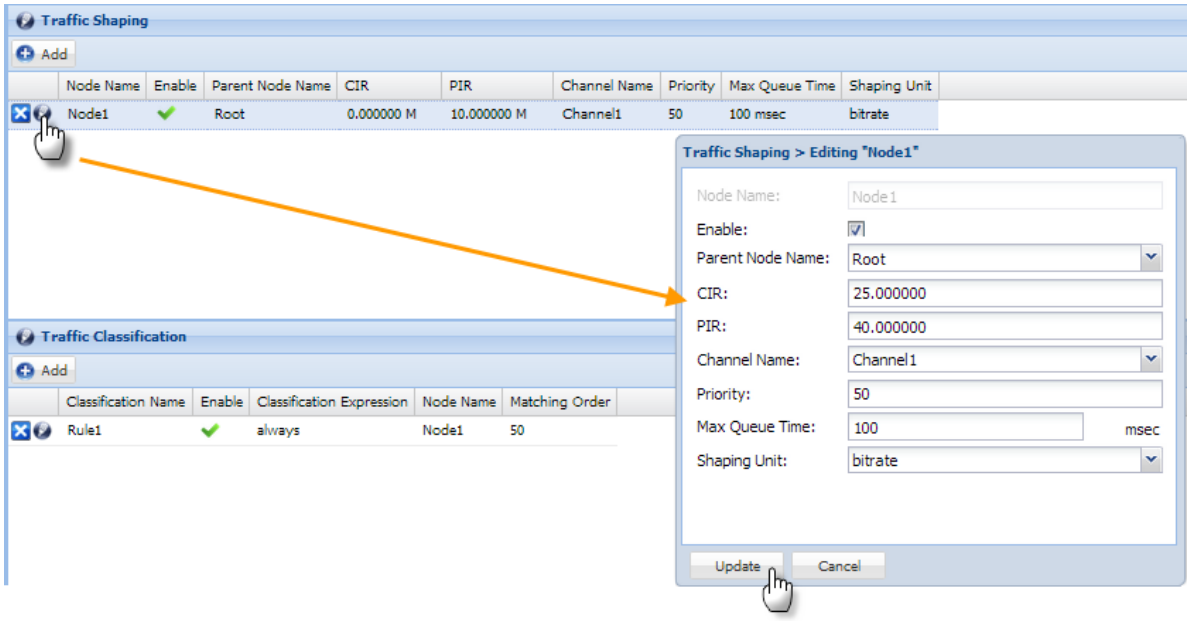
Before configuring the traffic shaping it is strongly advised to make a drawing of the complete shaping tree including traffic classification.

The following tree shows the different types of incoming IP traffic. Shaping Node1 that takes in the traffic.



» Scroll down to Traffic shaping (Skip the TS configuration block).

Node2



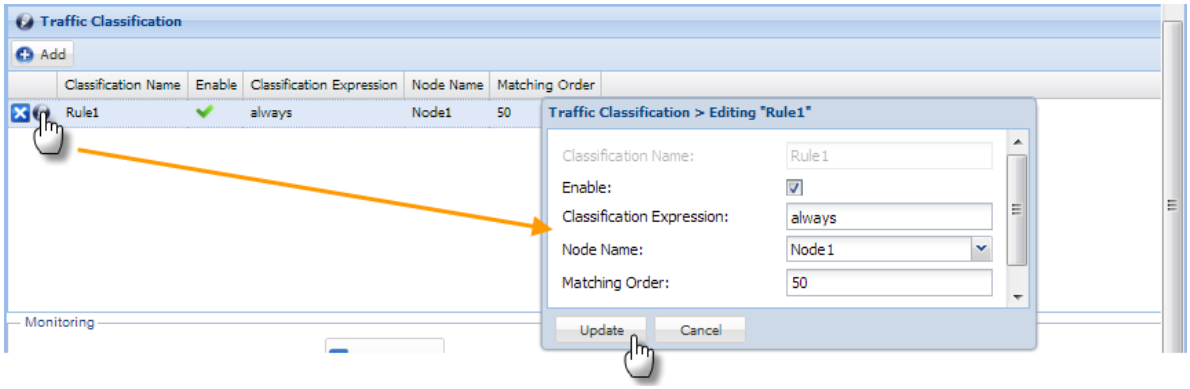
Parameter	Value	Description
Node Name	Node1	Enter the node name. (By default a unique Node name is proposed, it is recommended to rename this name).
Enable	✔	Enable the first traffic shaping node.
Parent Node Name	Root	Select one of the available Node names. For the shaping Node1 this is **Root**. Indicating the total incoming traffic.
CIR	25 Mbps	Enter the Committed Information Rate for this traffic shaping node.
PIR	40 Mbps	Enter the Peek Information Rate allowed on this traffic shaping node.
Channel Name	Channel1	Select one of the available channels. The available channels correspond with the channels names defined under **Channels**.
Priority	Keep default value	Use this setting to prioritize the shaped traffic. Value range: 0-99. The lower the value that is entered, the higher the priority!

Parameter	Value	Description
Max Queue Time	Keep default value	This buffer provides the possibility to store an amount of data in a shaping node. When the queue time is exceeded, data will be dropped.
Shaping Unit	Bitrate	Select the shaping unit. • Bitrate: This is commonly used as it guarantees the bitrate that can be received by the terminals. The this advantage of this way of working is that optimal pointing is not encouraged and due to that the available bandwidth is not optimally used. • Symbol rate: This can be used when more than one service provider makes use of the transponder bandwidth. In this case it is possible to divide (shape) the bandwidth amongst the operators as agreed. This way of working encourages the service provider to perform optimal pointing of its terminals. This to obtain an optimal usage of its available bandwidth.

Configure the Traffic Classification Rules

Use the traffic classification rules to capture specific traffic.

Please refer to *Appendix A - Classification Expressions on page 67*



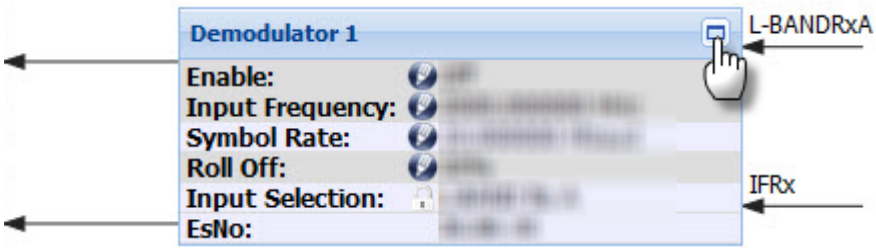
Parameter	Value	Description
Traffic Classification		
Classification Name	Rule1	Insert a logical Classification Name.
Enable	✔	Activate the classification rule.
Classification Expression	always	Enter a detailed classification expression when needed. Make sure that the syntax of the classification expression is correct! We refer to Appendix A on page to have an overview on the possible expressions. Other examples are: • Filter out all icmp traffic with a rule like this: (ip4 dst net xxx) and (icmp type echo-request) • Give priority to same traffic for one specific host: ip4 dst host 10.10.20.5ip4 dst host 10.10.20.5
Shaping Node Name	Node1	Select one of the available shaping node names. In this case select Node1 to link this rule. (The Node names are defined under **Traffic Shaping**.)
Use Matching Order	Keep default value	This parameter is only changed in case of conflicting rules. The lower the value that is entered, the higher the priority!

5.3.3.2 TS Encapsulation

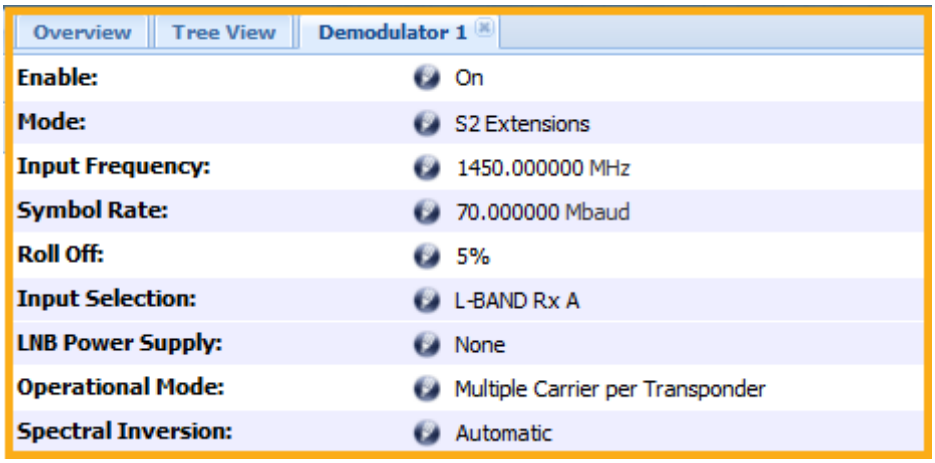
Configure a TS Encapsulator (ISI)

In this system setup it is **not** foreseen to enter a return channel in the TS encapsulation format. Incase it is needed to create a TS Encapsulation please refer to TS Encapsulation.

5.4 Configure the Demodulator

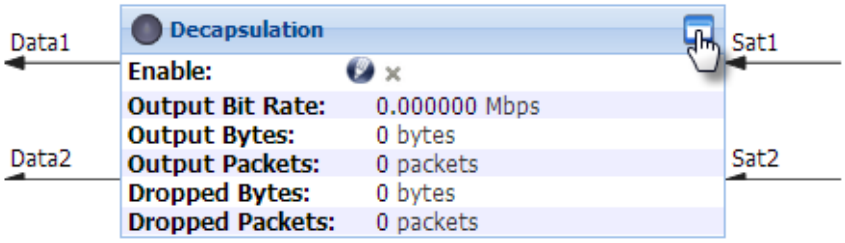


- In the Overview tab, click on the top right icon to open the Demodulator functional block.



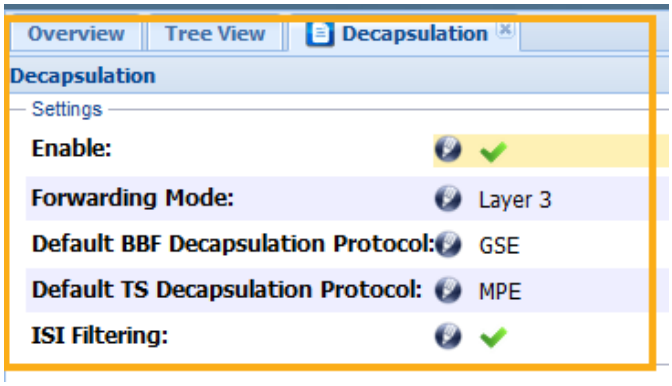
Parameter	Value	Description
Demodulator		
Enable		Activate the demodulator.
Mode	S2 Extensions	Select the modulation mode that is used by the sending site (MDM6000 on the remote site). Note: When the selection does not match, the incoming BBFs are not recognized.
Input Frequency	1450MHz	Set the input frequency according to the output frequency of the sending site (MDM6000 on the remote site).
Symbol Rate	70Mbaud	Enter the symbol rate according to the system setup specifications.
Roll Off	5%	Select the appropriate roll off factor, according to the requirements of the system setup.
Input Selection	L-Band Rx A	Indicates on what Rx interface the RF is received. This is done automatically based on the input frequency.
LNB Power Supply	None	When an LNB is used it is possible to select the corresponding power supply. In this example, this setting is locked as the input frequency is IF.
Transponder Operational Mode	Single Carrier per Transponder	Depends if the transponder is used in linear or non-linear area. A non-linearity compensation is applied when 'single carrier per transponder' is selected.

5.5 Configure Decapsulation



» Click on the top right icon to open the Decapsulation functional block.

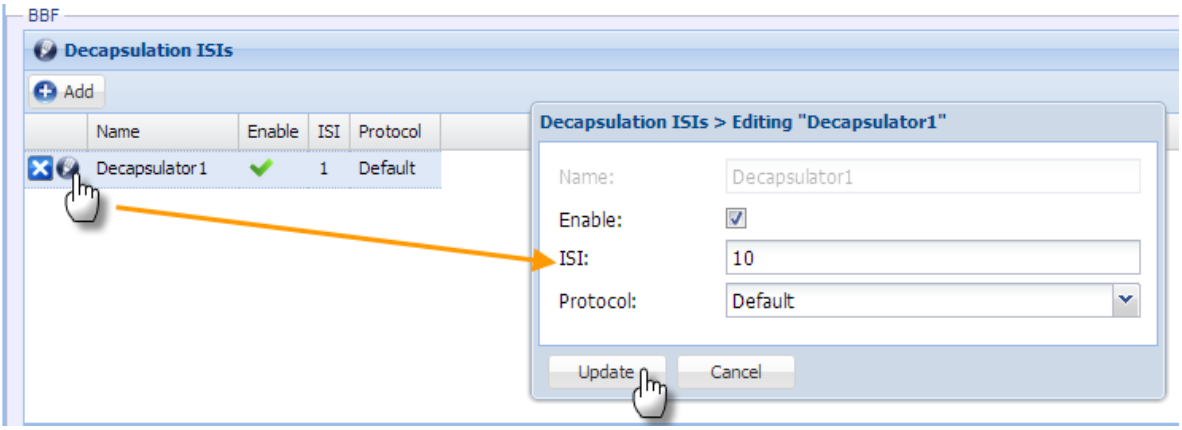
5.5.1 Enable Decapsulation and ISI Filtering



Parameter	Value	Description
Enable	✔	Enable the decapsulator to start decapsulating the incoming BBF's.
Forwarding Mode	• Layer 3	This is the same setting as in the Encapsulator on the sending site.
Default BBF Decapsulation Protocol	• GSE	Select the default decapsulation protocol that is mainly used to decapsulated the incoming BBFs.
Default TS Decapsulation Protocol	• MPE	Select the default decapsulation protocol that is mainly used to decapsulated the incoming "TS packets".
ISI Filtering	✔	Enable ISI filtering. When this is not enabled no filtering is performed and the decapsulation cannot take place!

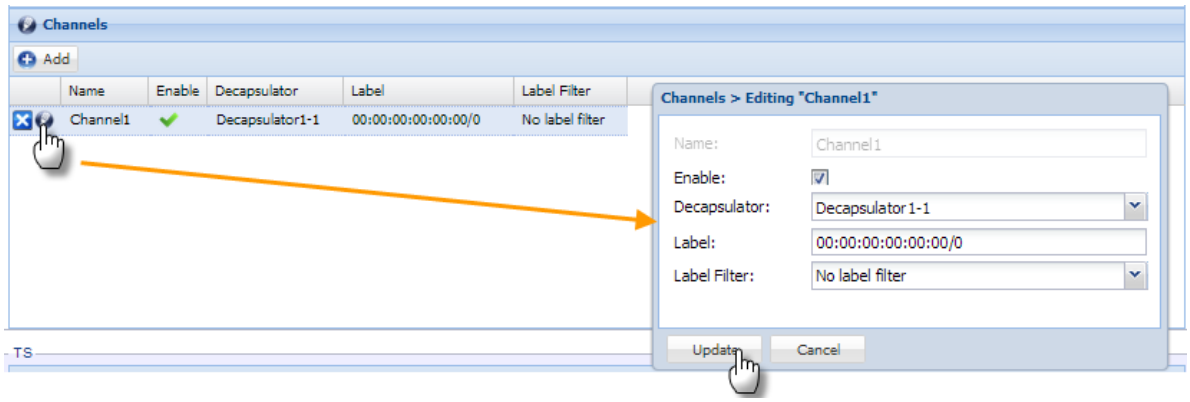
5.5.2 Configure the BBF Decapsulator

5.5.2.1 Configure the Decapsulation ISIs



Parameter	Value	Description
Name	Decapsulator1	This is the default name for the first decapsulator.
Enable	✔	Enable the decapsulator.
ISI	10	Enter the ISI you want to decapsulate. This must correspond with the ISI value that has been configured on the Hub site. Refer to Configure a BBF Encapsulator (ISI).
Protocol	Default	Here you have the possibility to overrule the default protocol that has been selected under the general decapsulation settings. Refer to Enable Decapsulation and ISI Filtering.

5.5.2.2 Configure the Channels

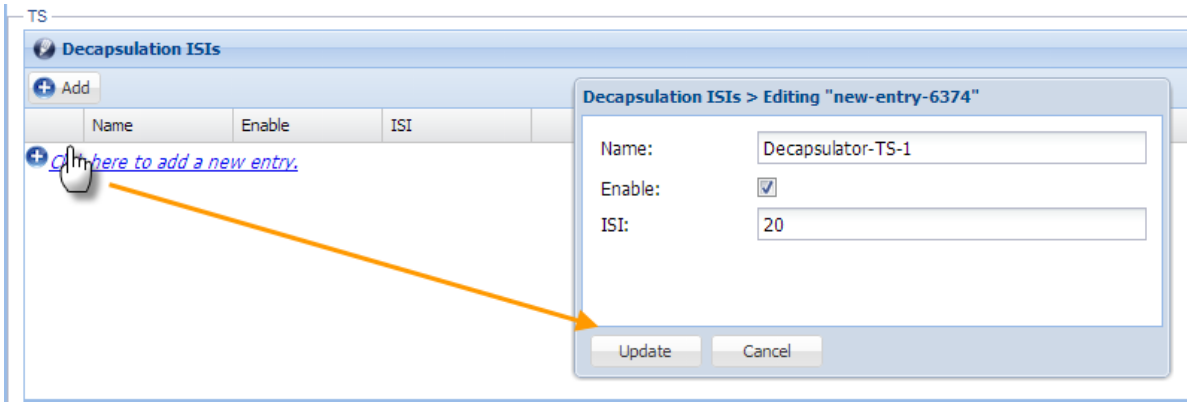


» Click **Add** to add a Channel.

Parameter	Value	Description
Channels		
Name	Channel1	Indicate the channel that you want to decapsulate. Verify the used channel name on the sending site.
Enable	✔	Activate the decapsulation of the channel.
Demod ID	1	This is the default ID.
Label		For more information on the use of the label and label filter please refer to the user manual. The user manual can be found on CD-ROM that is delivered together with the device.
Label filter		

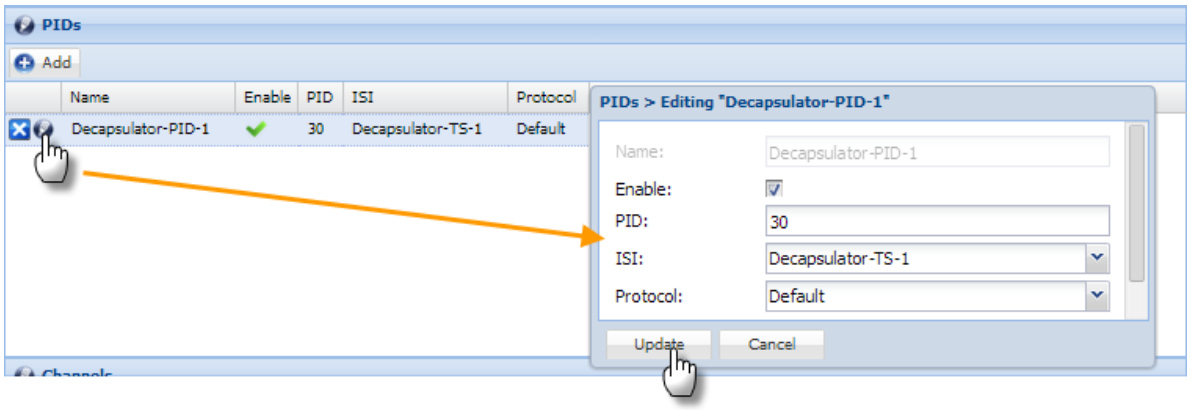
5.5.3 Configure the TS Decapsulator

5.5.3.1 Configure the TS Decapsulation ISIs



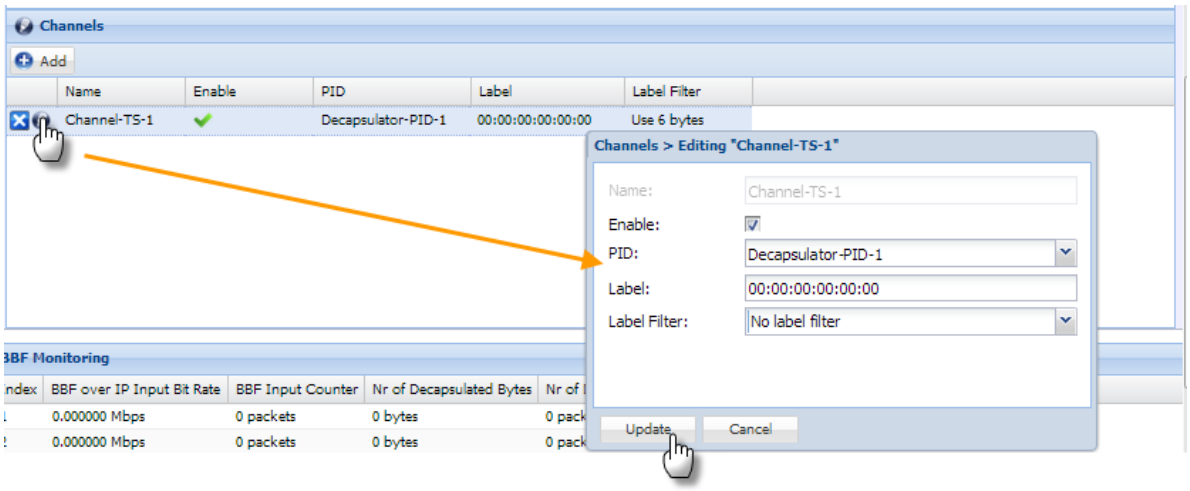
Parameter	Value	Description
Name	Decapsulator-TS-1	Enter a logical name for the first TS decapsulator.
Enable	✔	Enable the decapsulator.
ISI	20	Enter the ISI you want to decapsulate. This must correspond with the ISI value that has been configured on the Hub site. Refer to *Configure a TS Encapsulator (ISI) on page 57*
Demod ID	1	This corresponds with the demod ID of the demodulator of the MDM6000.

5.5.3.2 Configure the PIDs Decapsulation



Parameter	Value	Description
Name	Decapsulator-PID-1	Enter a logical name for the first PIDs decapsulator.
Enable	✔	Enable the PID decapsulator.
PID	30	Enter the PID (Program Identifier) you want to decapsulate. This must correspond with the PID value that has been configured on the Hub site.
ISI	Decapsulator-TS-1	Select one of the available ISI decapsulator names. The PID you want to filter out must exist on this decapsulator.
Protocol	Default	Here you have the possibility to overrule the default protocol that has been selected under the general decapsulation settings. Refer to *Enable Decapsulation and ISI Filtering. on page 60*

5.5.3.3 Configure the Channels

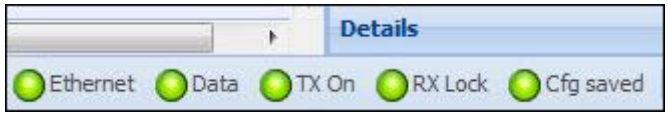


» Click **Add** to add a Channel.

Parameter	Value	Description
Channels		
Name	Channel1-TS-1	Indicate the channel that you want to decapsulate. Verify the used channel name on the sending site.
Enable	✔	Activate the decapsulation of the channel.
PID	Decapsulator-PID-1	Select one of the available PID decapsulators. This to indicate to what decapsulator this channel must be linked.
Label		For more information on the use of the label and label filter please refer to the user manual. The user manual can be found on CD-ROM that is delivered together with the device.
Label filter		

6 Finalize the Setup

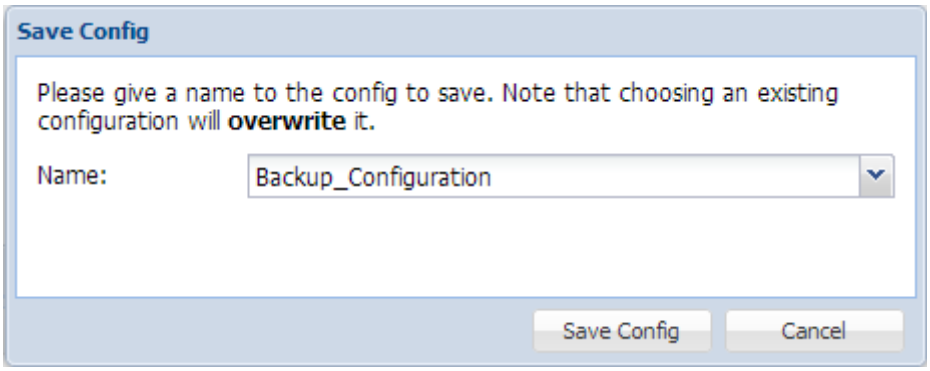
To check if the setup is working properly, you can use the indicators at the bottom right of the GUI. All these indicators should be marked green:



If some indicators are red or not lit, then check if all settings have been applied correctly.

If the 'Cfg saved' indicator is red, then the configuration has not been saved yet. To save the current configuration, do the following tasks:

- * Navigate to the **Tasks Pane** (GUI) to check the available configurations;
- * Click **Device**;
- * Click **Configurations**;
- * Click **Save...**



- * Enter a Name or select a configuration using the drop down list.

Saving the current configuration makes it the default configuration. This does not mean that it becomes the boot configuration.

By default, the selected configuration is overwritten upon saving. Enter a name to save the configuration under a new configuration file.

7 Appendix A - Classification Expressions

Filter all incoming packets based on expressions that match any field of an incoming packet

- * IP addresses, TOS byte, protocol, etc.

Expressions can be ANDed (&&), ORed (||), negated (!), brackets can be used to group different expressions.

In later releases a more extended syntax with IPV6/MPLS will become available.

expression=expression and expression expression=expression && expression expression=expression or expression expression=expression || expression expression=not expression expression=!expression	expression=(expression) expression=protocol expression=field value expression=protocol field value expression=always expression=never

ETHERNET ethernet dst ether <mac> ethernet src ether <mac> ethernet unicast ethernet unicast-this-host ethernet unicast-other-host ethernet multicast ethernet broadcast ethernet this-host ethernet protocol <ethertype> ethernet vlan/vlan2/vlan3 <tag> ethernet vlan-priority/vlan-priority2/vlan-priority3 <prio> ethernet vlan-type/vlan-type2/vlan-type3 <ethertype>	ARP arp operation <operation> arp src ether <mac> arp dst ether <mac> arp src host <ip4address> arp src net <ip4address>-<ip4address> arp src net <ip4address> mask <ip4netmask> arp src net <ip4address>/<ip4bits> arp dst host <ip4address> arp dst net <ip4address>-<ip4address> arp dst net <ip4address> mask <ip4netmask> arp dst net <ip4address>/<ip4bits>
IPv4 ip4 tos <tos> ip4 dscp <dscp> ip4 protocol <protocol> ip4 src host <ip4address> ip4 src net <ip4address>-<ip4address> ip4 src net <ip4address> mask <ip4netmask> ip4 src net <ip4address>/<ip4bits> ip4 dst host <ip4address> ip4 dst net <ip4address>-<ip4address> ip4 dst net <ip4address> mask <ip4netmask> ip4 dst net <ip4address>/<ip4bits> ip4 unicast ip4 multicast ip4 broadcast ip4 ah ip4 esp	UDP udp src port <port> udp src port <port>-<port> udp dst port <port> udp dst port <port>-<port> udp rtp-detection <rtpdetect> TCP tcp src port <port> tcp src port <port>-<port> tcp dst port <port> tcp dst port <port>-<port> ICMP4 icmp4 type <icmp4type> icmp4 code <icmp4code>
IGMP igmp type <igmptype> igmp host <ip4address> igmp net <ip4address>-<ip4address> igmp net <ip4address> mask <ip4netmask> igmp net <ip4address>/<ip4bits>	

7.1 Example Expressions

Rule	Expression to be used on the MDM6000
A regular route towards network 192.168.2.0/24.	dst net 192.168.2.0/24
All Ping messages	icmp type echo-request
All encrypted Ipsec packets towards 192.168.2.4	(ip4 esp) and dst host 192.168.2.4
All IPv4 multicast towards udp destination port 6001	(ip4 multicast) and (udp dst port 6001)
Forward Ethernet frames based on vlan tags 300 and 301.	(ethernet vlan 300) and (ethernet vlan 301)

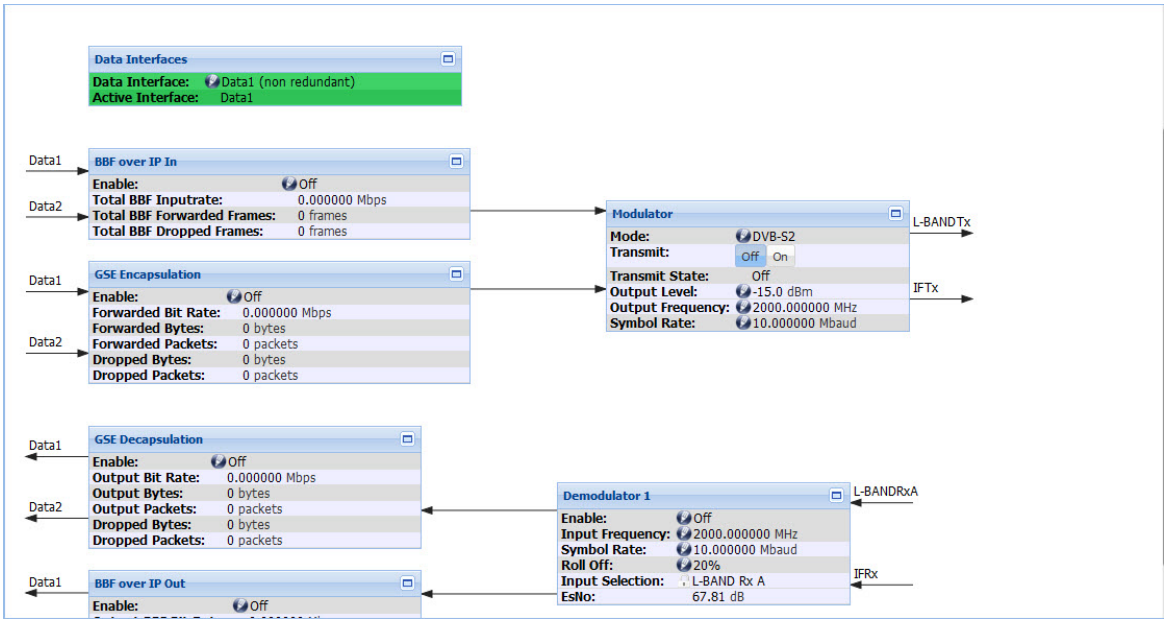
When working in Layer 2 forwarding mode and using Layer 3 only classification rules (e.g. ip4 dst net 0.0.0.0/0), make sure that ARP packets can still cross the link by adding an appropriate classification rule for ARP as well. Alternatively a static configuration of ARP tables in the switches or routers can be defined.

If no valid ARP configuration is provided by the system, no IP packets will be forwarded by the routers.

8 Appendix B: Default Device Configuration

This device is preconfigured, reflecting the following setup:

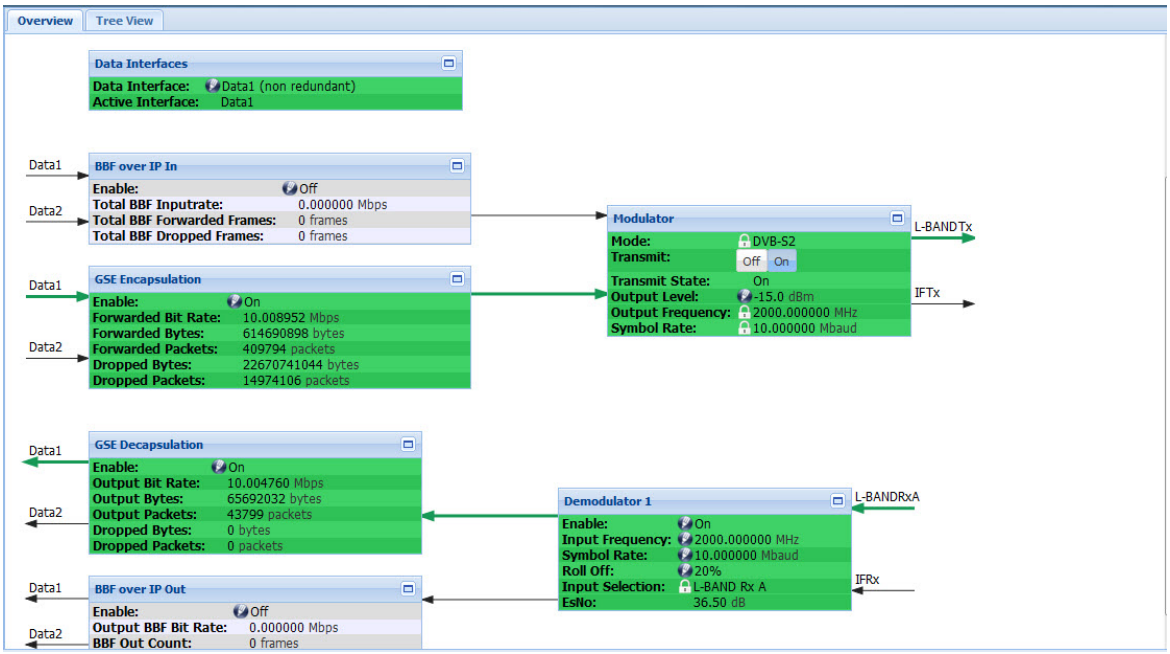
Forward Link	Return Link
• Modulation Standard = DVB-S2 • Symbol Rate = 10Mbaud • Output Frequency = 2000MHz • Output Level = -15dB	• Modulation Standard = DVB-S2 • Symbol Rate = 10Mbaud • Output Frequency = 2000MHz • Output Level = -15dB



From the overview menu it is possible to enable the different blocks (do this both for the HUB site and remote site).

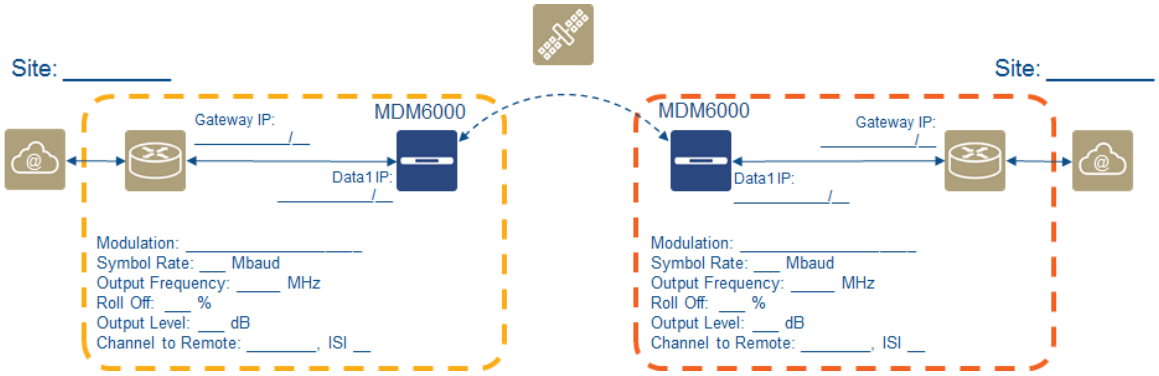
- GSE Encapsulation Enable = On
- Modulator Transmit = On
- Demodulator Enable = On
- GSE Decapsulation = On

Correct cabling between two MDM6000 devices results in the following figure:

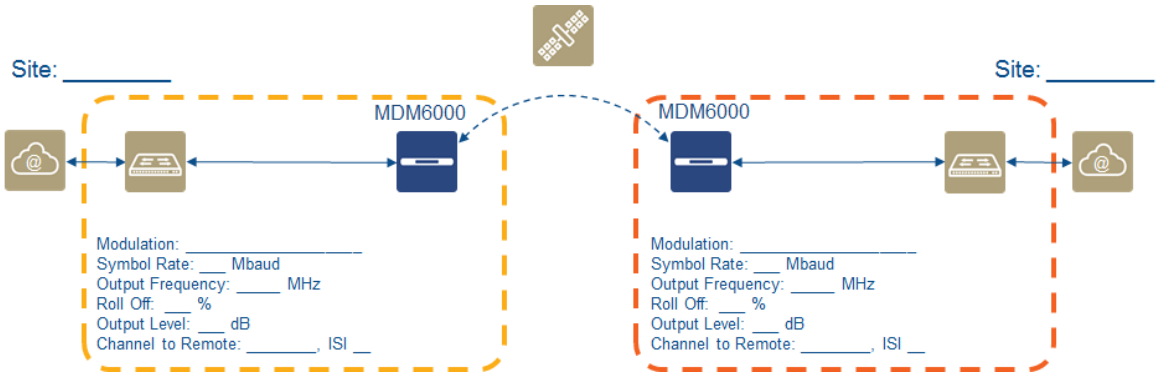

Overview
Tree View
Data Interfaces
Data Interface: Data1 (non redundant)
Active Interface: Data1
Data1
Data2
BBF over IP In
Enable: Off
Total BBF Inputrate: 0.000000 Mbps
Total BBF Forwarded Frames: 0 frames
Total BBF Dropped Frames: 0 frames
Modulator
Mode: DVB-S2
Transmit: Off On
Transmit State: On
Output Level: -15.0 dBm
Output Frequency: 2000.000000 MHz
Symbol Rate: 10.000000 Mbaud
L-BANDTx
IFTx
Data1
Data2
GSE Encapsulation
Enable: On
Forwarded Bit Rate: 10.008952 Mbps
Forwarded Bytes: 614690898 bytes
Forwarded Packets: 409794 packets
Dropped Bytes: 22670741044 bytes
Dropped Packets: 14974106 packets
Data1
Data2
GSE Decapsulation
Enable: On
Output Bit Rate: 10.004760 Mbps
Output Bytes: 65692032 bytes
Output Packets: 43799 packets
Dropped Bytes: 0 bytes
Dropped Packets: 0 packets
Demodulator 1
Enable: On
Input Frequency: 2000.000000 MHz
Symbol Rate: 10.000000 Mbaud
Roll Off: 20%
Input Selection: L-BAND Rx A
EsNo: 36.50 dB
L-BANDRxA
IFRx
Data1
Data2
BBF over IP Out
Enable: Off
Output BBF Bit Rate: 0.000000 Mbps
BBF Out Count: 0 frames

9 Appendix C: Setup Templates

Layer 3 Forwarding Mode



Layer 2 Forwarding Mode



10 Appendix D - Acronyms

Acronym	Definition
ACM	Adaptive Coding Modulation
APSK	Amplitude and Phase Shift Keying
B2B	Business-to-Business
B2C	Business-to-Customer
BUC	Block Up Converter
CD-ROM	Compact Disc Read Only Memory (in computer systems)
CIR	Committed Information Rate
CLI	Command Line Interface
DC	Direct Current
DVB-S2	Digital Video Broadcasting-Second Generation
Es/N0	Energy per Symbol to Noise density
S2 Ext	Extensions
FIFO	First in First Out
GSE	Generic Stream Encapsulation
GUI	Graphical User Interface
ICMP	Internet Control Message Protocol
ID	Identifier
IF	Intermediate Frequency
IGMP	Internet Group Management Protocol
IP	Internet Protocol
ISI	Input Stream Identifier
ISP	Internet Service Provider
L3	Layer 3
LNB	Low Noise Block Converter

MGMT	Management
PC	Personal Computer
PIR	Peak Information Rate
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
RX	Receive
TX	Transmit

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