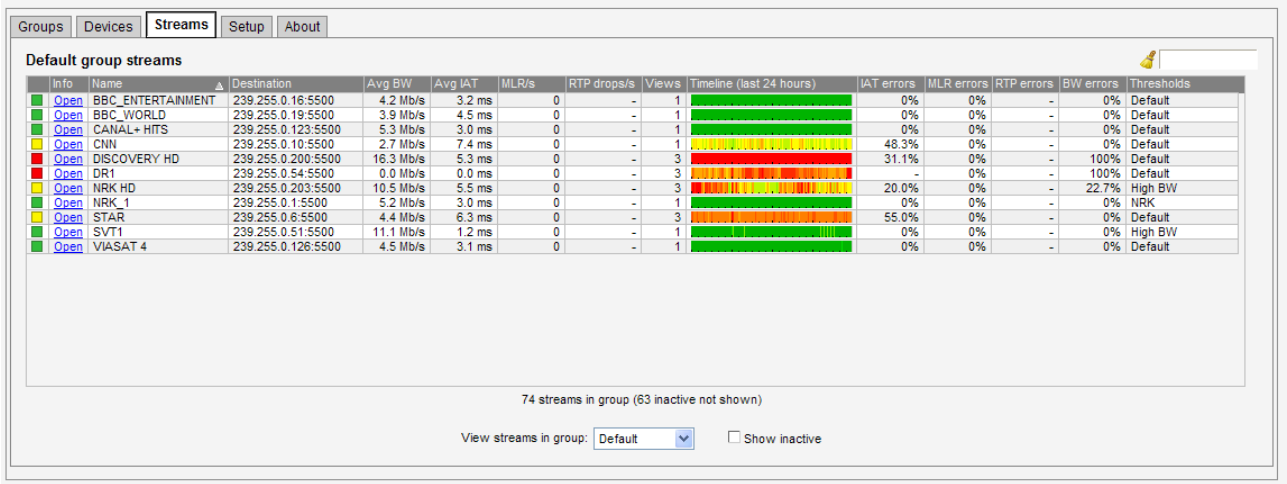
Micro Device Controller

User Manual
2.5.x-x Software Version



	Info	Name	Destination	Avg BW	Avg IAT	MLR/s	RTP drops/s	Views	Timeline (last 24 hours)	IAT errors	MLR errors	RTP errors	BW errors	Thresholds
	Open	BBC_ENTERTAINMENT	239.255.0.16:5500	4.2 Mb/s	3.2 ms	0	-	1		0%	0%	-	0%	Default
	Open	BBC_WORLD	239.255.0.19:5500	3.9 Mb/s	4.5 ms	0	-	1		0%	0%	-	0%	Default
	Open	CANAL+ HITS	239.255.0.123:5500	5.3 Mb/s	3.0 ms	0	-	1		0%	0%	-	0%	Default
	Open	CNN	239.255.0.10:5500	2.7 Mb/s	7.4 ms	0	-	1		48.3%	0%	-	0%	Default
	Open	DISCOVERY HD	239.255.0.200:5500	16.3 Mb/s	5.3 ms	0	-	3		31.1%	0%	-	100%	Default
	Open	DR1	239.255.0.54:5500	0.0 Mb/s	0.0 ms	0	-	3		-	0%	-	100%	Default
	Open	NRK HD	239.255.0.203:5500	10.5 Mb/s	5.5 ms	0	-	3		20.0%	0%	-	22.7%	High BW
	Open	NRK_1	239.255.0.1:5500	5.2 Mb/s	3.0 ms	0	-	1		0%	0%	-	0%	NRK
	Open	STAR	239.255.0.6:5500	4.4 Mb/s	6.3 ms	0	-	3		55.0%	0%	-	0%	Default
	Open	SVT1	239.255.0.51:5500	11.1 Mb/s	1.2 ms	0	-	1		0%	0%	-	0%	High BW
	Open	VIASAT 4	239.255.0.126:5500	4.5 Mb/s	3.1 ms	0	-	1		0%	0%	-	0%	Default

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Sencore is an engineering leader in the development of high-quality signal transmission solutions for the broadcast, cable, satellite, IPTV, and telecommunications markets. The company's world-class portfolio includes video delivery products, system monitoring and analysis solutions, and test and measurement equipment, all designed to support system interoperability and backed by best-in-class customer support. Sencore products meet the rapidly changing needs of modern media by ensuring the efficient delivery of high-quality video from the source to the home. More information about Sencore is available at the company's website, www.sencore.com.

Revision History

Date	Version	Description	Author
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1. INTRODUCTION

1.1. microVB and MDC - Overview

The microVB provides monitoring at the end users' premises. With a size of just 70 x 20 x 130mm it may be put in an envelope and sent to a customer experiencing problems. The low price allows mass deployment, resulting in an outstanding overview of network performance.

The microVB is literally plug and play, and it may be installed by the end-customer. The microVB is simply connected directly up-stream of the set-top box, and it provides measurement data of exactly the same signal that is being received by the set-top box. As it may run off the set-top box' power supply no external power supply is generally needed. The microVB is automatically detected by the centrally located microVB Device Controller server, meaning that no set-up is required by the end-customer.

The microVB Device Controller (MDC) presents measurement data from all microVB devices in the system, the MDC MicroTimeline alarm representation making it possible to get total system status overview at-a-glance. The MDC MicroTimeline represents historical status, typically for the last 24 hours, different colors indicating different levels of error severity during ten-minute intervals.

microVB units are organised into groups, and data from a number of microVBs located in the same region are aggregated, facilitating interpretation of system status.

The patented MediaWindow view makes it possible to analyse IP behaviour over time, packet jitter and packet loss being represented in a single view. Error values are available for read-out, as are measurements of bandwidth and RTP packet loss.

Each microVB will analyse multicasts joined by the down-stream set-top box, and four streams may be analysed in parallel. This makes it possible to monitor the signal currently viewed, in addition to a signal being recorded plus system proprietary streams (e.g. EPG and CA streams).

The OTT module enables monitoring of TCP unicast traffic, typically port 80 media traffic.

The MDC may be integrated into the VideoBridge Controller, enabling control of a complete end-to-end VideoBridge monitoring system via one user interface.

The **Traffic module** option allows the user to view a protocol breakdown of traffic.

The **PFF module** option enables PCAP filtering forwarding, allowing microVB units to send a filtered packet capture to a user-defined IP address for further analysis, e.g. using Wireshark.

Options can be retro-fitted by the customer after purchasing a license.

1.2. Principle of Operation

When a microVB device is powered, it will first of all try to find the IP address of the MDC server, in order to establish communication with the central head-end. There are two different ways for the microVB to locate the MDC server:

Using the MDC IP address or domain name programmed into the microVB device

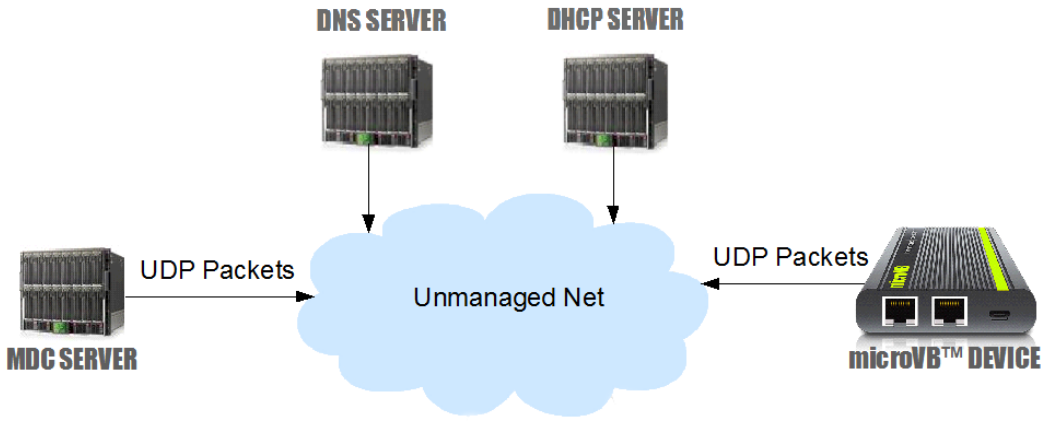
Using a fixed address beacon multicast sent from the MDC server

Establishing Communication Using the MDC Domain Programmed into the microVB

The preferred way of establishing communitaction between microVB devices and the MDC is to program the MDC domain name into the microVBs using the microVB configuration tool 'mdcwrite'. The network must include a DHCP server that gives each microVB its unique IP address and a DNS server that can translate the domain name into an IP address.

Alternatively the MDC IP address can be programmed into the microVB using 'mdcwrite', in which case a DNS server is not necessary to establish communication.

When the microVB reports itself to the MDC, unicast communication in both directions is used.



Establishing Communication Using a Beacon Multicast

If possible the microVB will join the pre-programmed multicast address of the MDC beacon multicast. The beacon multicast contains the MDC server address, the software boot-load address and various control signals. The microVB then starts its reporting to the MDC, allowing the MDC to become aware of the unit and to present it in the MDC devices list. Data from the microVB is sent as UDP unicast.

The beacon signal consists of approximately 100 bytes sent every 20 seconds.

Operation when MDC-microVB Communication is Established

Once contact between the microVB and the MDC has been established, the microVB starts reporting measurement data. The microVB listens to IGMP join messages sent by the downstream set-top box, and it will analyse joined streams. A maximum of four streams are analysed in parallel by the microVB. Measurement data is reported to the MDC, one 1500 byte UDP packet of data being sent every minute.

The MDC checks the software version of the individual microVB devices and will issue upgrade commands if the boot-load software is newer than the microVB software. Note that when unicast mode is used, microVB devices will be upgraded individually, and this may take several hours in a large system (approximately 2 minutes per microVB device).

1.3. Important Notes on Network Configuration

In order for the microVB and microVB Device Controller system to function correctly, the communication between the MDC and individual microVB units must work as intended. Initial configuration of each microVB device relies on one of these two mechanisms:

The microVB unit is pre-programmed with the MDC server domain name or address. The microVB will send its communication parameters to the MDC to enable two-way UDP traffic.

The microVB unit receives the MDC beacon signal, which is sent as a multicast with IP address 233.60.200.250, port number 8888. Network node equipment must therefore be configured to be transparent for the beacon multicast IP address and port number. Note that this applies for transmission from the MDC to the microVB units and not the opposite direction. There is no return traffic from the microVBs to the MDC on this address. The beacon IP address is a GLOP address, meaning that it is allocated for use by VideoBridge, and it should not be used for other purposes than MDC beacon multicast transmission.

The transmission of measurement data from the microVB units to the MDC is performed as UDP unicasts, the IP address being defined by the IPTV system operator. Network node equipment should be transparent to this traffic for the MDC to receive the data.

Beacon Multicast Mode:

The network must be transparent to the MDC beacon multicast with fixed IP address 233.60.200.250, port number 8888, in the direction from MDC to microVB units.

MDC Unicast Mode:

The microVB units have the MDC server address pre-programmed using the microVB configuration tool.

Beacon Multicast and MDC Unicast Mode:

The network must be transparent for UDP unicast traffic from the microVB units to the MDC, the MDC address to be freely defined by the IPTV system operator.

Pff PCAP capture forwarding:

The network must be transparent for EtherIP (Ethernet protocol 97)/IP traffic from the MDC server to the configured destination address.

The operator also selects a multicast address for the software boot-cast that allows microVB units to be firmware updated; the port number must be 8888. This means that the network should be transparent for this traffic in the direction from the MDC to the individual microVB units. Although any multicast address may be used for the boot-cast it is recommended that the VideoBridge reserved GLOP address 233.60.200.251 is used.

1.4. Updated Users' Manuals

Note that current versions of the users' manual can be requested from Sencore. Log-in as end user: **customer** with password: **xmas4u** . Additional technical documentation is also found at the same location.

1.5. About this Users' Manual

This manual describes how to configure and use a microVB/MDC system. Note that basic knowledge about digital television fundamentals and network technology is required to use this equipment.

2. microVB HARDWARE

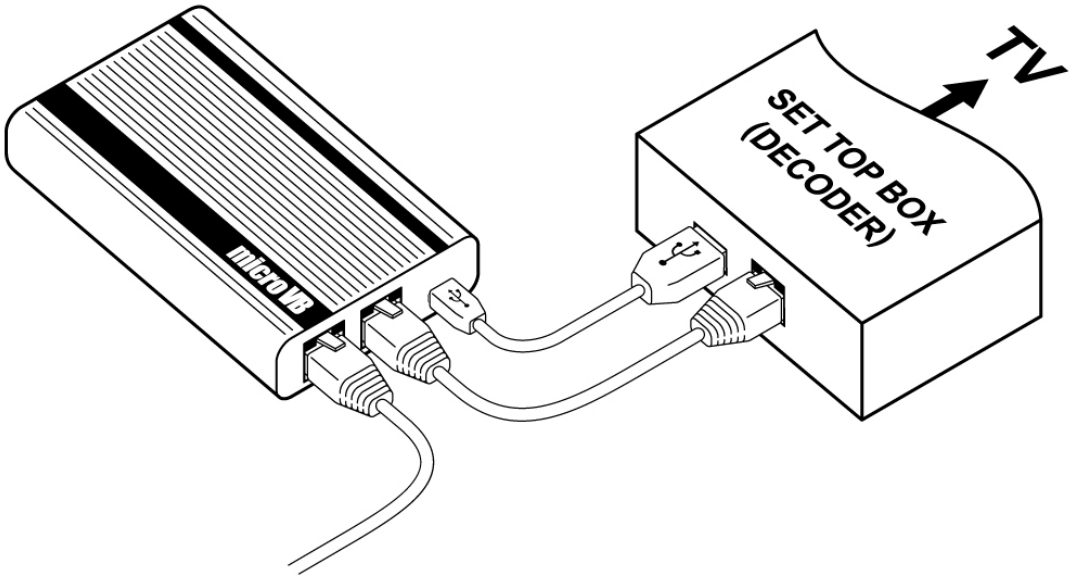
The microVB IPTV analysis unit is a small box for home application. The size of 70mm x 20mm x 130mm allows it to be put in an envelope and mailed to an end customer experiencing problems.

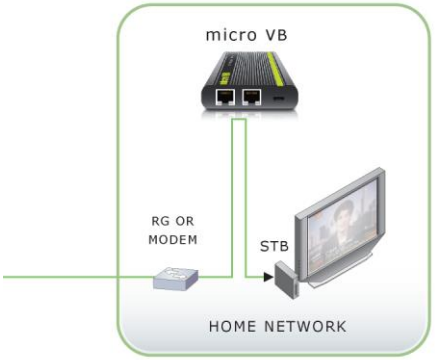
The microVB is powered via a USB port, power may be provided either by the customer's set-top box or by a dedicated USB power supply that may optionally be shipped with the microVB.

The two 100 Base-TX Ethernet connectors are used to connect the microVB in series with the customer's set-top box. The home IPTV input signal should be connected to one of the Ethernet ports and the other Ethernet port should be connected to the set-top box' video/data input.

Located at the opposite side of the unit as the connectors, the microVB is equipped with a green LED that provides power and connection status information. Upon powering the microVB the LED will blink slowly (at slow heartbeat rate). When the MDC beacon signal is detected and connection to the set-top box is verified, the LED will light constantly. The MDC user may issue a command forcing the LED to blink rapidly, thereby verifying that the unit receives the MDC commands.

Note that the microVB must be powered to pass the IPTV signal to the set-top box.


micro VB
SET TOP BOX
(DECODER)
TV


micro VB
RG OR
MODEM
STB
HOME NETWORK

microVB connectors and LED	
Ethernet:	2 x 100 Base-TX Ethernet RJ-45
USB:	USB type B connector (for power), 500mA /2.5 watt required
LED:	Green LED for status information. *Constant light*: connection is established with MDC and media device (e.g. set-top box). *Slow blinking (slow heartbeat rate)*: no established connection with MDC and/or set-top box. *Rapid blinking:* rapid blinking is a response to the 'blink' command issued by the MDC user. The LED will blink rapidly for approximately one minute. Rapid blinking will also occur during firmware loading.

3. MDC SERVER - SYSTEM REQUIREMENTS

3.1. MDC Server - Recommended HW

The Micro Device Controller and the VideoBridge Controller may run on the same server hardware, or they may be installed on separate machines. If these server applications are installed on separate machines they should be able to communicate via a network, but they do not necessarily have to share the same sub-net.

The recommended specification for a server is:

- **Dual quad-core 3.0GHz**
- **8GB RAM**
- **75GB SAS/SATA hard drives or SSD**
- **Gigabit NIC**

This server will run the Micro Device Controller with 1000+ microVB devices or both MDC and VBC with 20 IP-Probes and 100+ microVB devices.

The load on the server will increase for increasing number of devices and the MDC's responsiveness is dependent on server specifications. It may therefore be a good investment to use high performance server hardware in order to handle future system extensions.

Note that it is not recommended to run the MDC on a virtual machine, as this will negatively affect its responsiveness.

3.2. MDC Server Operating System and Browsers

Supported UNIX/Linux platform:

Red Hat Enterprise Linux Server release 5 (32 bit only)
Red Hat Enterprise Linux Server release 6

Supported WEB browsers:

Internet Explorer 7 or newer
Firefox 2.0 or newer

3.2.1. Red Hat Enterprise Linux

Red Hat Enterprise Linux 5 and 6, (RHEL5 and RHEL6) can be downloaded from http://www.redhat.com. This requires a valid *Basic Subscription* which can be purchased at the Red Hat online store. For more information about Red Hat software and installation please refer to http://www.redhat.com/rhel.

3.2.2. Installing Red Hat

When installing RHEL5 for the first time, select the "Web Server" installation option and go with the defaults. A default OS installation should include all components needed by the MDC.

SELinux may be enabled and the firewall may be active, but the following ports need to be open:

Protocol and port	*Description*
WEB **TCP port 8080**	Required. For serving clients.
NTP **TCP port 123**	It is recommended that the server running the MDC software is synchronised against an external NTP server.
UDP port 1239	Traffic from microVB devices to MDC server
UDP port 1240	Traffic from microVB devices to MDC server

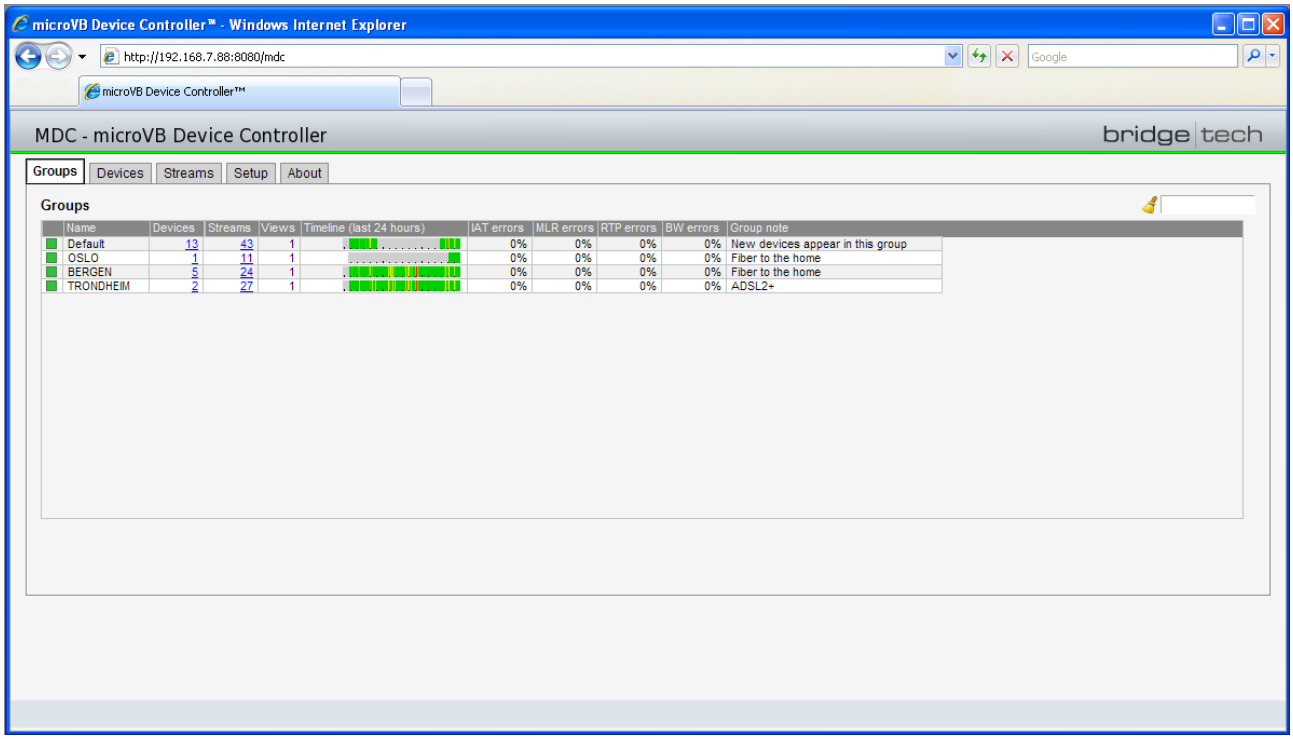
Note that if the MDC and VBC servers run on the same hardware additional ports should be enabled as specified in the VBC users' manual; SELinux should be disabled.

4. MDC SOFTWARE INSTALLATION

The software is installed by following these steps:

Obtain the latest version of the MDC software, e.g. btech_mdc_0.9.1.zip
Copy the compressed archive to the server
Log in as root
Unzip the archive: *unzip btech_mdc_0.9.1.zip*
A directory named like the compressed archive will be generated, e.g. btech_mdc_0.9.1
Enter this directory: *cd btech_mdc_0.9.1*
Start the installer (as root): *./install*

The MDC server should now be up and running and is accessed by pointing a browser at the MDC server IP address, port 8080.



After the non-licenced MDC software is installed, it will support four microVB units. To obtain a license, the **Hardware key** displayed in the **About** page should be given to your VBC reseller who will return a **Product License Key** which is submitted from the same page.

The MDC may be added to the VBC configuration (software version 4.7 or later) as a device by following these steps:

Log in as user *admin*
If a new site should be created, click **Site setup** and add a dedicated MDC site
Click **Equipment** and add a new logical device of type *Micro Device Controller* (selected from the drop-down menu). Assign parameters to the new MDC device.

The MDC will now appear as a device in the VBC user interface. The regular MDC GUI is accessed by clicking the device name in the equipment list.

5. QUICK START GUIDE

5.1. Quick Start Step-By-Step

1. Make sure communication between the MDC and microVB devices can be established, i.e. ensure that the network is transparent for one-way UDP traffic from microVB devices (STB IP addresses) to the MDC server and:

1. Ensure the network is transparent for the MDC beacon signal sent as a multicast with IP address 233.60.200.250, port 8888 **OR**
2. Ensure that the microVB devices are pre-programmed with the MDC server IP address.

2. Install MDC software and verify that the GUI launches correctly.
3. Define multicast ranges to be monitored by the microVB units (**Setup - Beacon**).
4. Specify MDC server address and bootcast parameters (**Setup - Beacon**).
5. Define groups (**Setup - Groups**).
6. Verify microVB detection (**Setup - All Devices**).
7. Assign microVBs to customer IDs and groups (**Setup - All Devices**).
8. Watch for new streams (**Setup - All streams**), assign names to multicasts (and possibly unicasts).
9. Define alarm thresholds (**Setup - Thresholds**).
10. Assign alarm threshold templates to streams - individual thresholds for each group (**Setup - Group Streams**).
11. Monitor groups and streams (**Groups**, **Streams**, **Devices**).
12. If relevant: add MDC to VBC equipment configuration.
13. If relevant: select 'Report to VBC' for some or all streams (**Setup - All streams**).

5.2. Troubleshooting

A new microVB unit does not appear in the MDC devices list.

Check that the customer has connected the unit and has been watching TV.

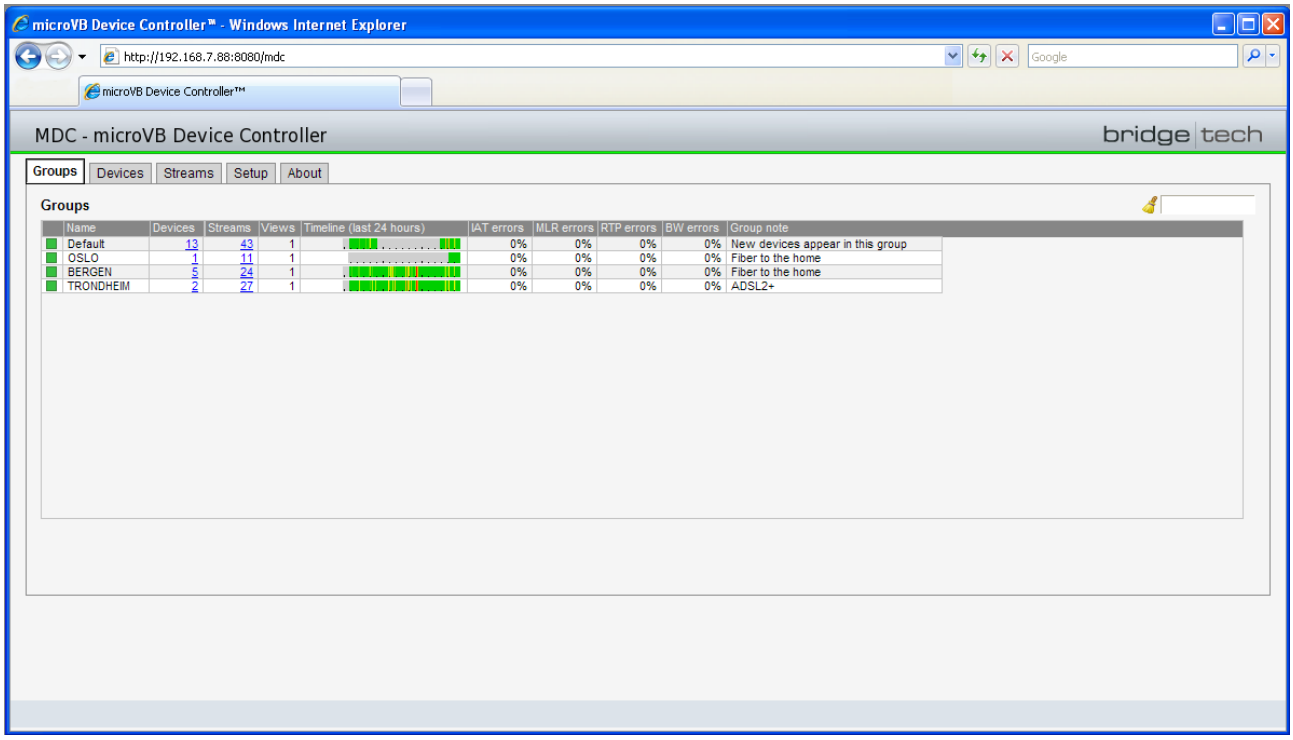
Check the microVB LED status. No LED light means that the microVB is not powered. Slow blinking indicates one or more of the following :

- that one or both Ethernet ports are without link (e.g. set-top box switched off)
- that the beacon multicast is not received by the microVB
- that DHCP ACK or OFFER is not seen

- that no unicast packets are sent from the STB to outside subnet

Check that the microVB device receives the beacon multicast by issuing a 'Blink device LED' command. If the microVB LED is constantly lit the unit appears to be OK, and there is probably a problem with network settings, resulting in microVB unicasts not reaching the MDC. Check that the correct IP address and port has been defined for the MDC server.

The MDC software comes with two simple application tools that may aid in troubleshooting: **mdcsniffer** and **mdcsend**. **mdcsniffer** is a packet sniffer that displays traffic related to microVB - MDC communication. **mdcsend** will mimic a microVB and send a dummy measurement packet to the MDC. These applications may typically be installed on a lap-top running Linux, and a field engineer may easily check if required communication between MDC and microVB may be established. Refer to Appendix II for a description of these applications.



6. THE MDC GRAPHICAL USER INTERFACE

The microVB Device Controller web interface is reached by pointing a web browser towards the IP-address of the MDC as shown in the screen shot above (the IP address and port number in the screen dump above is 192.168.7.88:8080).

The following WEB-browsers are supported:

Internet Explorer 7.0 or higher
Firefox 2.0 or higher

Note that different web browsers behave differently with respect to memory leaking, and if the MDC GUI should be available at all times the browser must be selected carefully. Memory leak

manifests itself as the browser responding more and more slowly, and this is corrected by closing down the application and restarting.

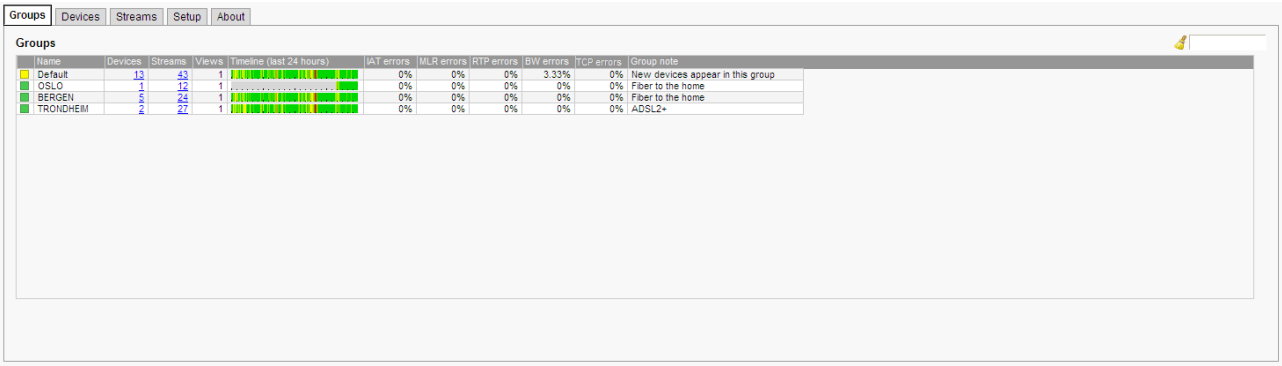
The MDC user interface is easy and intuitive to use. Navigate by clicking the tabs just below the MDC logo. A few of the pages have their own tabs for accessing nested pages.

The WEB interface has been designed to be resizeable in both vertical and horizontal directions with a minimum screen resolution of 1024x768 pixels.

Tool-tip is available for most buttons and labels. To access tool-tip information simply let the mouse pointer hover over a button or a label for a second or two.

Search functionality is available for many views displaying lists. The search field in the upper right corner of the views allows the user to type a text string; the list is updated to display only list entries matching the specified text.

In this manual the term stream is generally used instead of the terms multicast and unicast.



6.1. Groups

The **Groups** view displays overall status for all defined groups of microVB units. The MicroTimeline bars will reflect errors detected during the last 24 hours for all streams and devices, allowing the user to spot irregularities in the complete microVB system at-a-glance.

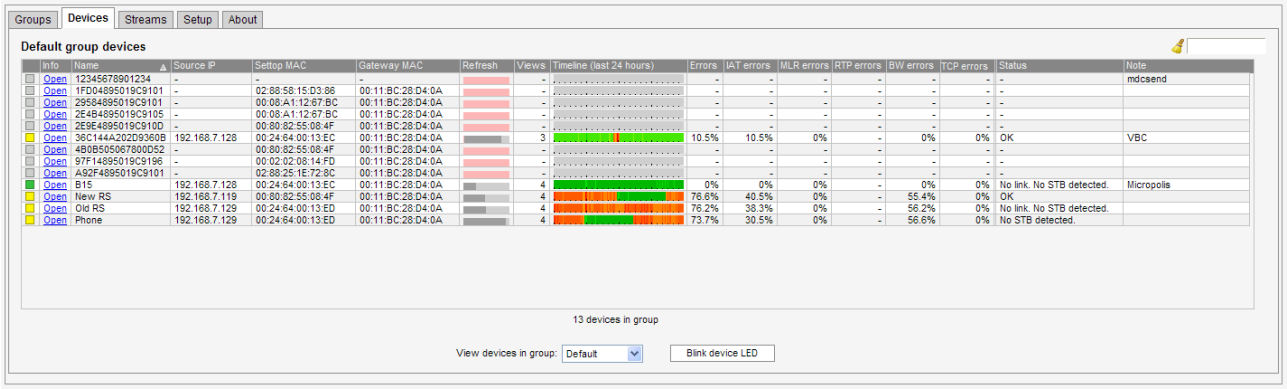
The search field in the upper right corner of the view allows the user to type a text string; the group list is updated to display only groups matching the specified text.

Note that the error figures refer to the last one-minute measurement period.

Groups	
(Bulb):	A bulb indicating the current group status. Green: OK Yellow: IAT and/or BW error Orange: MLR error or RTP drop Red: 100% error, i.e. all seconds within monitoring period are impaired Grey: no measurements
Name:	The group name defined by the user in the **Setup - Groups** view
Devices:	The number of microVB devices associated with the group. Click the link to open

	the **Devices** view with the corresponding group selected.
Streams:	The number of streams that are currently measured or have been measured by microVBs associated with the group. Click the link to open the **Streams** view with the corresponding group selected.
Views:	The total number of multicasts that have been joined by microVB units within the group
Timeline (last 24 hours):	The MDC MicroTimeline displays aggregated status for all streams and all microVBs associated with the group over a time period of 24 hours. Refer to Appendix I for a description of the MDC MicroTimeline.
IAT errors:	Inter-packet arrival time errors (packet jitter) displayed as the percentage of error seconds compared to the total monitoring time during the last monitoring period (generally one minute per stream and per microVB). IAT error seconds are counted when an IAT measurement exceeds the IAT threshold associated with the monitored stream.
MLR errors:	Packet loss displayed as the percentage of error seconds compared to the total monitoring time during the last monitoring period (generally one minute per stream and per microVB). MLR error seconds are counted when the number of packet losses per second exceeds the MLR threshold associated with the monitored stream.
RTP errors:	RTP packet drops displayed as the percentage of error seconds compared to the total monitoring time during the last monitoring period (generally one minute per stream and per microVB). RTP error seconds are counted when the number of packet losses per second exceeds the RTP threshold associated with the monitored stream.
BW errors:	Bandwidth (bitrate) errors displayed as the percentage of error seconds compared to the total monitoring time during the last monitoring period (generally one minute per stream and per microVB). BW error seconds are counted when the stream bandwidth exceeds the maximum bitrate threshold or goes below the minimum bitrate threshold associated with the stream.
TCP errors:	TCP errors displayed as the percentage of error seconds compared to the total monitoring time during the last monitoring period (generally one minute per stream and per microVB). TCP error seconds are counted when any TCP packet loss or TCP packet out-of-order is detected, based on TCP packet sequence number.
Group note:	A group note defined by the user in the **Setup - Groups** view

6.2. Devices



Info	Name	Source IP	Settop MAC	Gateway MAC	Refresh	Views	Timeline (last 24 hours)	Errors	IAT errors	MLR errors	RTP errors	BW errors	TCP errors	Status	Note
Open	12345678901234	-	-	-		-		-	-	-	-	-	-	-	mdcsend
Open	1FD04895019C9101	-	02:88:58:15:D3:86	00:11:BC:28:D4:0A		-		-	-	-	-	-	-	-	
Open	29584895019C9101	-	00:08:A1:12:67:BC	00:11:BC:28:D4:0A		-		-	-	-	-	-	-	-	
Open	2E4B4895019C9105	-	00:08:A1:12:67:BC	00:11:BC:28:D4:0A		-		-	-	-	-	-	-	-	
Open	2E9E4895019C910D	-	00:80:82:55:08:4F	00:11:BC:28:D4:0A		-		-	-	-	-	-	-	-	
Open	38C144A202D9360B	192.168.7.128	00:24:64:00:13:EC	00:11:BC:28:D4:0A		3		10.5%	10.5%	0%	-	0%	0%	OK	VBC
Open	4B0B505067600D52	-	00:80:82:55:08:4F	00:11:BC:28:D4:0A		-		-	-	-	-	-	-	-	
Open	97F14895019C9196	-	00:02:02:08:14:FD	00:11:BC:28:D4:0A		-		-	-	-	-	-	-	-	
Open	A92F4895019C9101	-	02:88:25:1E:72:8C	00:11:BC:28:D4:0A		-		-	-	-	-	-	-	-	
Open	B15	192.168.7.128	00:24:64:00:13:EC	00:11:BC:28:D4:0A		4		0%	0%	0%	-	0%	0%	No link. No STB detected.	Micropolis
Open	New RS	192.168.7.119	00:80:82:55:08:4F	00:11:BC:28:D4:0A		4		76.6%	40.5%	0%	-	55.4%	0%	OK	
Open	Old RS	192.168.7.129	00:24:64:00:13:ED	00:11:BC:28:D4:0A		4		76.2%	38.3%	0%	-	56.2%	0%	No link. No STB detected.	
Open	Phone	192.168.7.129	00:24:64:00:13:ED	00:11:BC:28:D4:0A		4		73.7%	30.5%	0%	-	56.6%	0%	No STB detected.	

The **Devices** view presents a list of microVB devices detected by the MDC.

The drop-down menu under the device list allows selection of a microVB group, typically a geographical region, and only devices associated with the selected group will be displayed.

The **Blink device LED** button allows the user to identify a microVB device in the list. When highlighting the microVB and clicking the **Blink device LED** button a command is transmitted to the microVB instructing the unit's green LED to blink rapidly. The next data transmission from the microVB to the MDC will include the status message 'Led blinking.', and the *Last status* field of the device will display this message. The bulb leftmost in the device list will also start blinking. The **Blink device LED** functionality also allows the user to ensure correct link between a specific customer and a microVB device/set-top MAC address by letting the customer verify that his device's LED is actually blinking when a blink command is issued from the MDC. The microVB unit must be powered in order for this functionality to work.

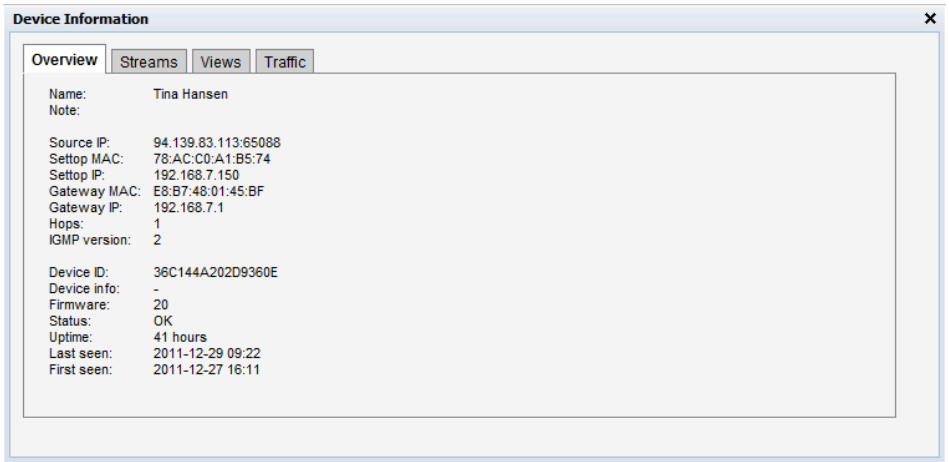
The search field in the upper right corner of the view allows the user to type a text string; the device list is updated to display only devices matching the specified text.

Note that the error figures refer to the last one-minute measurement period.

(Group name) group devices	
Info:	When the **Open** link is clicked the **Device Information** pop-up view will be displayed. This view displays detailed information about the selected microVB unit and streams monitored by it.
Name:	The device name as specified by the user
Source IP:	The source IP address as seen by the MDC
Settop MAC:	The MAC address of the set-top box
Gateway MAC:	The MAC address of the gateway used by the set-top box
Refresh:	When the dark grey refresh bar reaches its maximum length an IP packet containing measurement data is sent from the microVB to the MDC. A red refresh bar indicates that there is no contact between the microVB and the MDC.
Views:	The number of streams monitored by the microVB
Timeline (last 24 hours):	The MDC MicroTimeline displays aggregated status for all streams monitored by the microVB over a time period of 24 hours. Refer to Appendix I for a description of the MDC MicroTimeline.
Errors:	The amount of errors displayed as the percentage of error seconds compared to the total monitoring time during the last monitoring period (generally one minute per stream). Seconds affected by IAT, MLR, RTP and BW errors are counted. Note that the 'Errors' figure is not necessarily the sum of IAT, MLR, RTP and BW error figures, as one monitoring second may be affected by more than one type of error.
IAT errors:	Inter-packet arrival time errors displayed as the percentage of error seconds compared to the total monitoring time during the last monitoring period (generally one minute per stream). IAT error seconds are counted when an IAT measurement exceeds the IAT threshold associated with the monitored stream.
MLR errors:	Packet loss errors displayed as the percentage of error seconds compared to the total monitoring time during the last monitoring period (generally one minute per stream). MLR error seconds are counted when the number of packet losses per second exceeds the MLR threshold associated with the monitored stream.
RTP errors:	RTP packet drop displayed as the percentage of error seconds compared to the total monitoring time during the last monitoring period (generally one minute per stream and per microVB). RTP error seconds are counted when the number of packet losses per second exceeds the RTP threshold associated with the monitored

	stream.
BW errors:	Bandwidth (bitrate) errors displayed as the percentage of error seconds compared to the total monitoring time during the last monitoring period (generally one minute per stream). BW error seconds are counted when the stream bandwidth exceeds the maximum bitrate threshold or goes below the minimum bitrate threshold associated with the stream.
TCP errors:	TCP errors displayed as the percentage of error seconds compared to the total monitoring time during the last monitoring period (generally one minute per stream and per microVB). TCP error seconds are counted when any TCP packet loss or TCP packet out-of-order is detected, based on TCP packet sequence number.
Status:	The last microVB device status received by the MDC. *OK*: the microVB operates normally *LED blinking*: the microVB LED is blinking rapidly as a response to the MDC 'Blink device LED' command. *Bad FLASH*: the microVB flash cannot be programmed; the unit will reboot and retry. *Bad IMAGE*: the bootcast image received contained errors. *No Beacon*: the microVB is unable to detect the MDC beacon. *Streams > 4*: the downstream set-top box has joined more than four whitelist streams. *No link*: there is no Ethernet link between the set-top box and the microVB unit. *No STB detected*: no join messages are detected. Note that some of these messages are informational only, and they do not necessarily indicate that the system is not operating correctly. As an example the status message *No STB detected* may indicate that the set-top box is switched off.
Note:	The customer note defined by the user in the **Setup - All devices** view

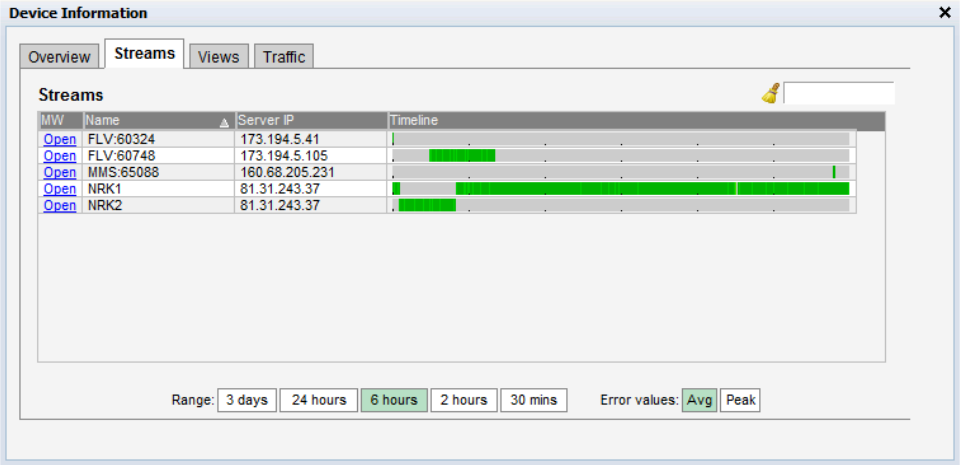
6.2.1. Device Information - Overview



The **Device Information - Details** view displays information about a microVB device.

	Details
Name:	The device name (customer ID) defined by the user in the **Setup - All devices** view
Note:	The customer note defined by the user in the **Setup - All devices** view
Source IP:	The source IP address as seen by the MDC
Settop MAC:	The MAC address of the set-top box
Gateway MAC:	The MAC address of the gateway used by the set-top box
Gateway IP:	The IP address of the gateway used by the set-top box
Hops:	The number of network hops from microVB/STB to MDC server
IGMP version:	The IGMP version used
Device ID:	A hardware device ID unique for each microVB
Device info:	Device information – for future use.
Firmware:	The firmware version currently run by the microVB. If this is older than the current bootload software the MDC will issue a command instructing the microVB device to perform a firmware upgrade.
Status:	The last microbe device status received by the MDC. The status message is displayed on the form <status>: <mode > where mode is UC (unicast) or MC (multicast). *OK*: the microVB operates normally *LED blinking*: the microVB LED is blinking rapidly as a response to the MDC 'Blink device LED' command. *Bad FLASH*: the microVB flash cannot be programmed; the unit will reboot and retry. *Bad IMAGE*: the bootcast image received contained errors. *No beacon*: the microVB is unable to detect the MDC beacon. Note that when the system operates in unicast mode, this message will not be displayed. *No config*: No configuration has been received, neither via multicast nor unicast *Streams > 4*: the downstream set-top box has joined more than four whitelist streams. *No link*: there is no Ethernet link between the set-top box and the microVB unit. *No STB detected*: no packets sent from STB are detected.
Uptime:	The time the microVB has been powered
Last seen:	The time of the latest microVB report or 'heartbeat' signal
First seen:	The time the microVB was first detected by the MDC

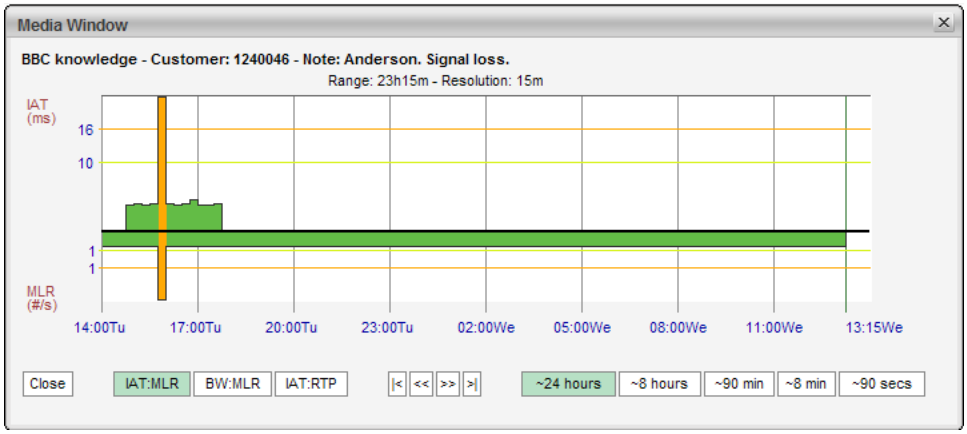
6.2.2. Device Information - Streams



The **Device Information** views are accessed by clicking the *Open* link of a microVB in the **Devices** view. The **Device Information - Streams** view lists the streams monitored by one microVB and displays the MDC MicroTimelines for these streams. The user selects the MicroTimeline time window by clicking one of the *Range* buttons. *Error* buttons allow selection of which error should be indicated in the MicroTimeline. By default all errors are represented, however the cause of an error indication may be further investigated by selecting individual error displaying. Errors selectable are **IAT** (packet jitter) errors, **MLR** (packet loss) errors, **RTP** (RTP packet loss) errors and **BW** (bandwidth) errors. The user selects whether the MicroTimeline should display peak or average measurements (refer to Appendix I for more information).

Streams	
MW:	The **MediaWindow** view of the stream is accessed by clicking the *Open* link
Name:	The stream name, as defined by the user in the **Setup - All Streams** view or derived from SDT analysis. Unicasts will appear on the form stream *type: stream identifier*, where stream types are: *Data* - Unknown type *FLV* - Flash video *HLS* - HTTP Live Streaming *MP4* - Miscellaneous, including SmoothStream *MMS* - Microsoft Media Server
Server IP:	The IP address of the stream server
Timeline:	The MDC MicroTimeline displays aggregated stream status for all streams monitored by the microVB over a selectable time period. Refer to Appendix I for a description of the MDC MicroTimeline.

MediaWindow - IAT:MLR



The **MW** Media Window view provides an at-a-glance status for each of the streams being monitored. From the graphs it is easy to see the jitter characteristics of the signal and if there is packet loss or CC errors present in the signal.

The measurements are always aggregated over a time interval – typically one second. The IAT(max) is the maximum time measured between two neighbouring IP frames within the measurement time interval (the peak packet inter-arrival time). IAT is expressed in milliseconds.

The MLR is the peak estimated number of lost MPEG-2 Transport Stream packets inside any second within the actual time period. The number of lost TS packets is derived from the continuity counters inside the TS packet headers.

A common scenario is to have 7 TS packets per UDP frame. Losing an IP packet will therefore usually result in an MLR of 7 (not always the case because some TS packets such as null packets or PCR packets do not carry a valid CC field).

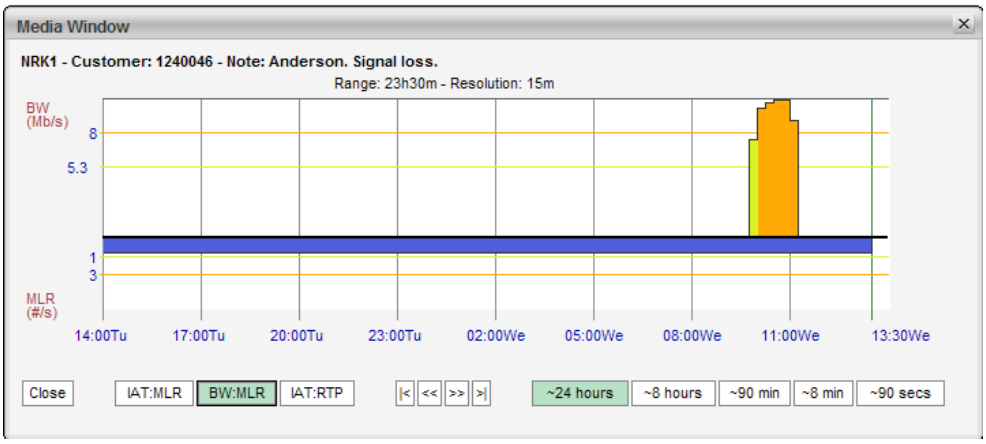
The VideoBridge patented **Media Window** presents both jitter and packet loss measurements in one graph, with jitter (IAT) values growing upwards (+ve Y) and packet loss (MLR) growing downwards (-ve Y). Each sample along the x-axis corresponds to a measurement time-interval that depends on the range of the graph selected.

Tool-tip provides the exact jitter (IAT) and packet loss (MLR) values for a selected bar in a selected graph, the denotation is IAT : MLR.

Orange color is used to indicate error while yellow indicates warning. The error and warning thresholds are allocated to each stream/group in the **Setup - Group Streams** view.

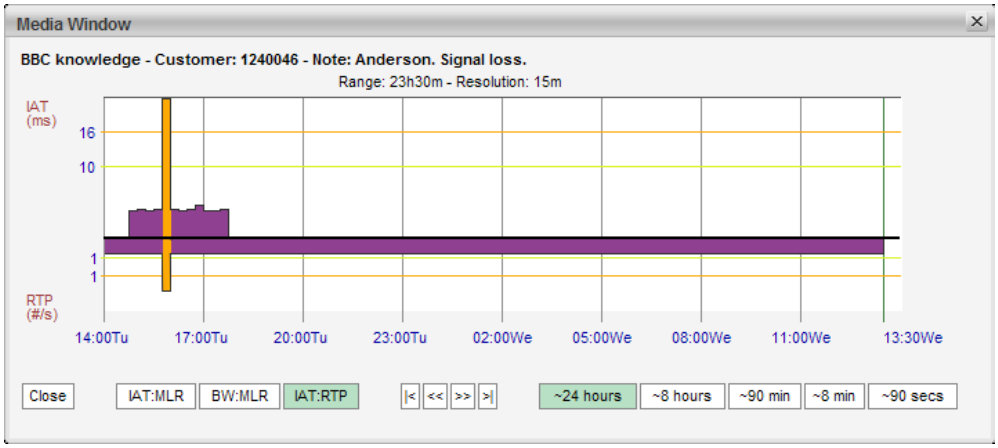
The time window buttons allow selection of x-axis resolution in the graphs, and by using the arrow buttons it is possible to move the timeline to view an error incident more accurately.

MediaWindow - BW:MLR

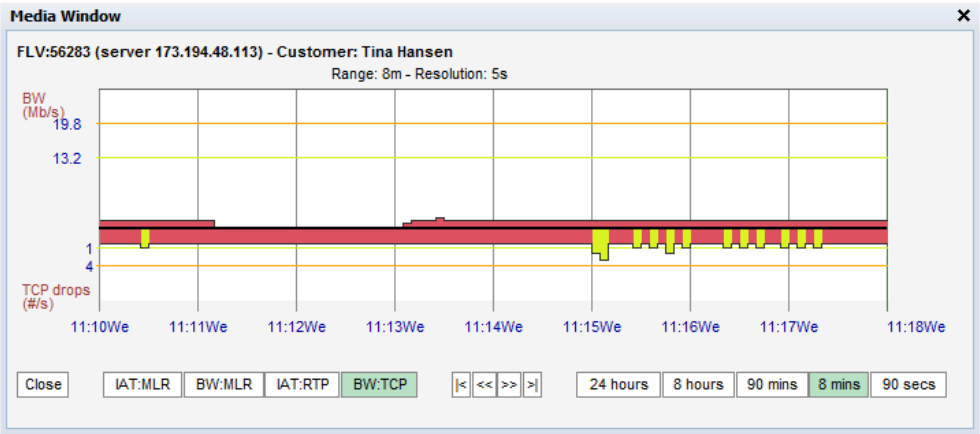


By clicking the **BW:MLR** button the graph displays the peak bandwidth as a function of time. The negative part of the composite graphs is still the packet loss (i.e. the MLR).

MediaWindow - IAT:RTP



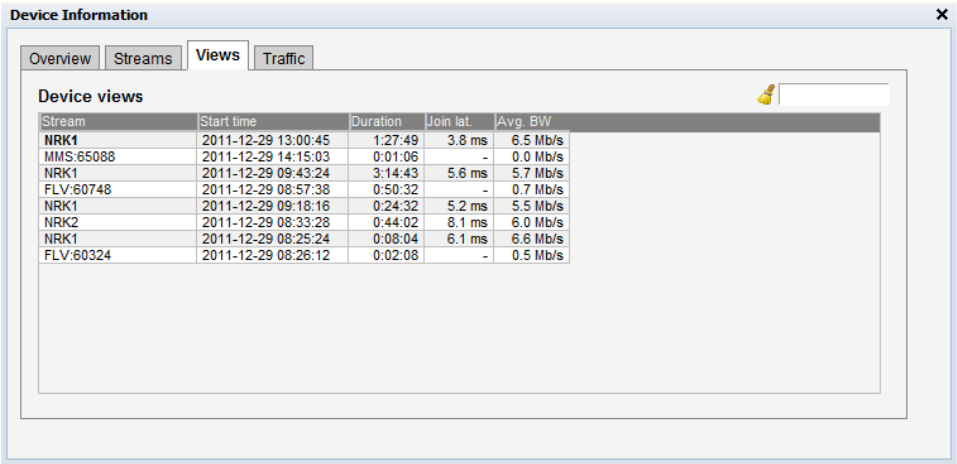
By clicking the **IAT:RTP** button the graph displays the packet jitter as a function of time. The negative part of the composite graphs displays the RTP packet loss. If the monitored stream is not RTP encapsulated there will never be any indication of packet loss in the graph.



MediaWindow – BW:TCP

By clicking the **BW:TCP** button the graph displays the bandwidth as a function of time. The negative part of the composite graphs displays the TCP packet loss. If the monitored stream is not TCP encapsulated there will never be any indication of packet loss in the graph.

6.2.3. Device Information - Views



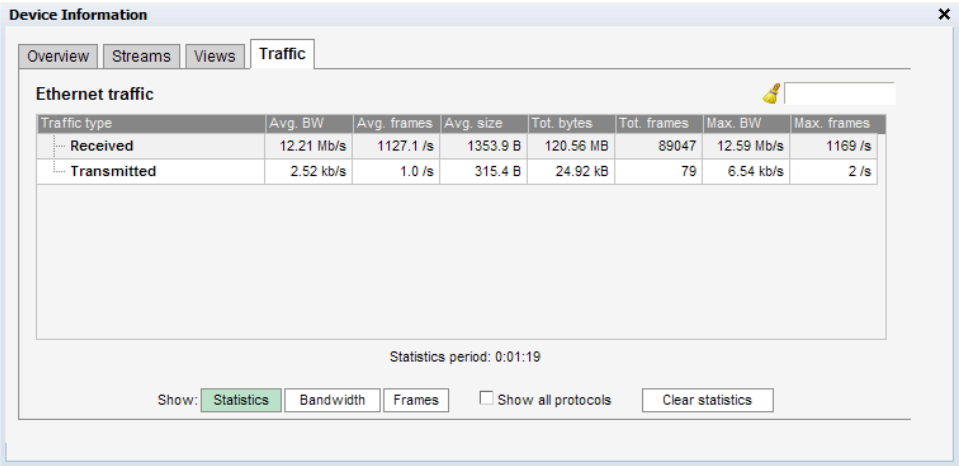
Stream	Start time	Duration	Join lat.	Avg. BW
NRK1	2011-12-29 13:00:45	1:27:49	3.8 ms	6.5 Mb/s
MMS:65088	2011-12-29 14:15:03	0:01:06	-	0.0 Mb/s
NRK1	2011-12-29 09:43:24	3:14:43	5.6 ms	5.7 Mb/s
FLV:60748	2011-12-29 08:57:38	0:50:32	-	0.7 Mb/s
NRK1	2011-12-29 09:18:16	0:24:32	5.2 ms	5.5 Mb/s
NRK2	2011-12-29 08:33:28	0:44:02	8.1 ms	6.0 Mb/s
NRK1	2011-12-29 08:25:24	0:08:04	6.1 ms	6.6 Mb/s
FLV:60324	2011-12-29 08:26:12	0:02:08	-	0.5 Mb/s

The **Views** view displays a list of join events with associated join latencies.

Views	
Stream:	The stream name, as defined by the user in the **Setup - All Streams** view or derived from SDT analysis. Unicasts will appear on the form strea, *type: stream identifier*, where stream types are: *Data* - Unknown type *FLV* - Flash video *HLS* - HTTP Live Streaming *MP4* - Miscellaneous, including SmoothStream

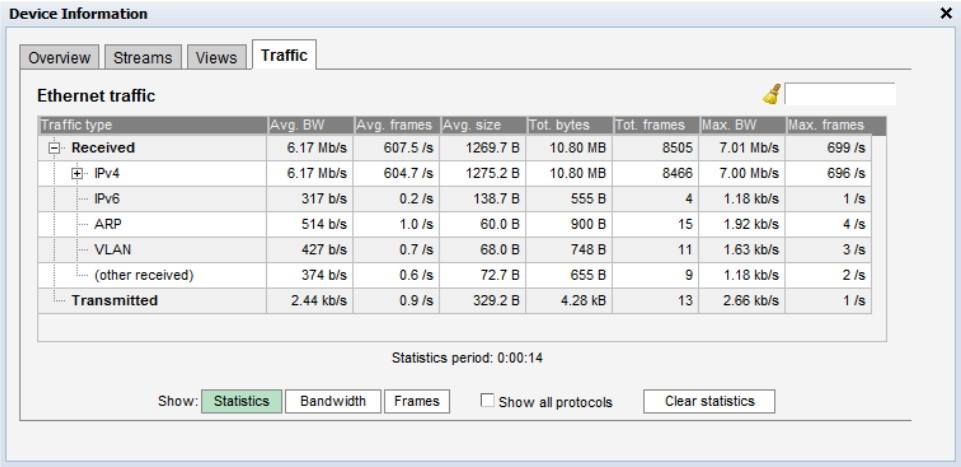
	MMS - Microsoft Media Server
Start time:	The time the join request was detected
Duration:	The time the stream has been joined
Join lat.:	The join latency is measured as the time from a join request was sent by the set-top box until the first packet of the stream is received.
Avg. BW:	The average stream bandwidth measured over the total monitored time. Note that for variable bandwidth signals the average bandwidth value is an indication only.

6.2.4. Device Information - Traffic



Basic MDC

The **Traffic** view of an MDC that is not licensed with the *Traffic module option* will display the total bitrate received and transmitted by the microVB device.



Traffic type	Avg. BW	Avg. frames	Avg. size	Tot. bytes	Tot. frames	Max. BW	Max. frames
Received	6.17 Mb/s	607.5 /s	1269.7 B	10.80 MB	8505	7.01 Mb/s	699 /s
IPv4	6.17 Mb/s	604.7 /s	1275.2 B	10.80 MB	8466	7.00 Mb/s	696 /s
IPv6	317 b/s	0.2 /s	138.7 B	555 B	4	1.18 kb/s	1 /s
ARP	514 b/s	1.0 /s	60.0 B	900 B	15	1.92 kb/s	4 /s
VLAN	427 b/s	0.7 /s	68.0 B	748 B	11	1.63 kb/s	3 /s
(other received)	374 b/s	0.6 /s	72.7 B	655 B	9	1.18 kb/s	2 /s
Transmitted	2.44 kb/s	0.9 /s	329.2 B	4.28 kB	13	2.66 kb/s	1 /s

MDC with Traffic Module Option

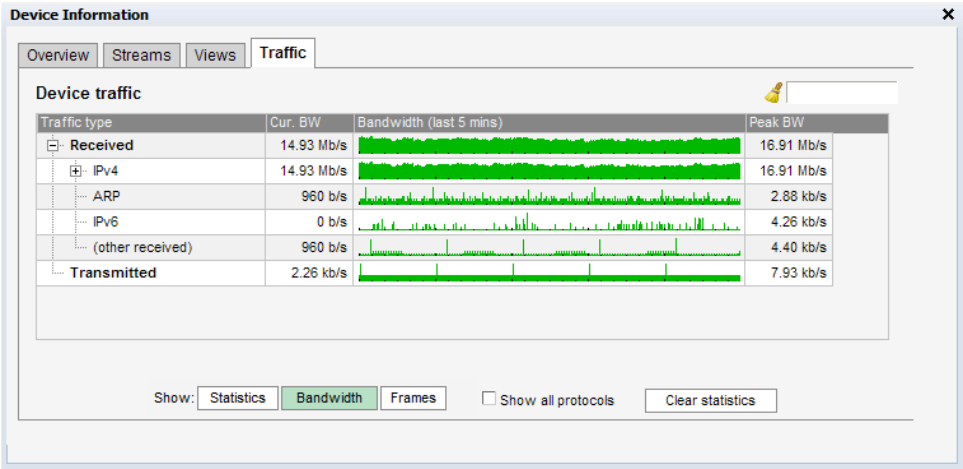
The **Device traffic statistics** view of an MDC that is licensed with the *Traffic module option* will display the total bitrate received by the microVB device and the total bitrate transmitted by the microVB. In addition to these measurements the traffic protocol breakdown can be viewed by expanding the traffic tree. This is done by clicking the + icons in the tree. By default only protocols for which traffic has been detected are displayed; to display all supported protocols mark the 'Show all protocols' check-box.

Clicking the **Clear statistics** button will reset all accumulated statistics.

All current values displayed in the different **Traffic** views are measured over periods of one second. All average values displayed are calculated from the time the view was entered or cleared. A *Statistics period* field shows for how long measurement values have been averaged. If the view is closed and re-opened within a time period of approximately one minute, the measurement and averaging period will resume. The maximum/peak values are maximum values measured during the *Statistics period*.

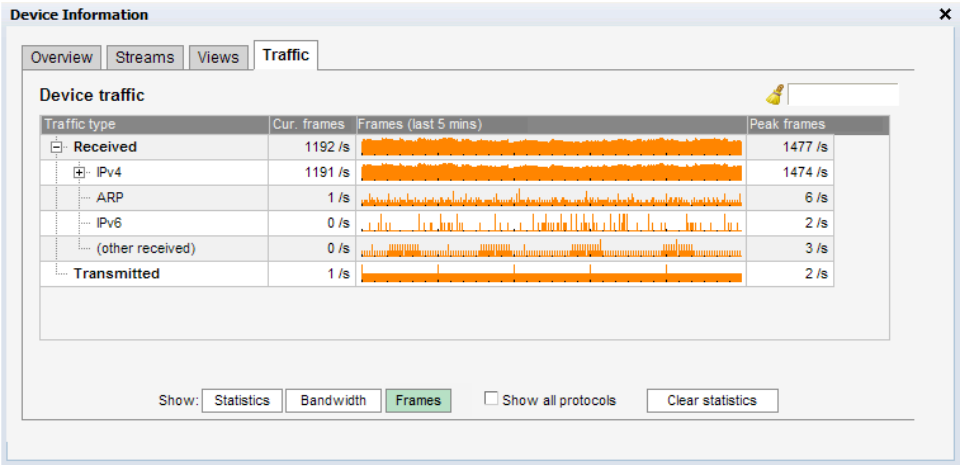
Device traffic - Statistics	
Traffic type:	The traffic tree displays detected traffic as a protocol breakdown. Supported protocols are: • IPv4: Internet Protocol version 4 • IPv6: Internet Protocol version 6 • UDP: User Datagram Protocol • TCP: Transmission Control Protocol • MPEG multicast • MPEG unicast • FEC: Forward Error Correction CoP #3 • Mediaroom: Microsoft Mediaroom server and client • DHCP: Dynamic Host Configuration Protocol • NTP: Network Time Protocol • SNMP: Simple Network Management Protocol • Teredo: Teredo protocol as specified by RFC4380 • IPv6 encapsulation: (proto-41) • HTTP: Hyper-Text Transfer Protocol (Video, Images, Text, other) • RTSP: Real Time Streaming Protocol • IGMP: Internet Group Management Protocol • ICMP: Internet Control Message Protocol • PIM: Protocol Independent Multicast • ARP: Address Resolution Protocol • VLAN: Virtual Local Area Network • STP: Spanning Tree Protocol • Device: microVB measurement traffic - generally not relevant for MDC • Beacon: the MDC beacon traffic
Avg. BW:	The average bandwidth (in Mbit/s)
Avg. packets:	The average packet rate (in packets per second)
Avg. size:	The average packet size (in bytes)
Tot. bytes:	The total number of bytes detected
Tot. packets:	The total number of packets detected
Max. BW:	The maximum bandwidth (in Mbit/s) measured over a period of one second
Max. packets:	The maximum packet rate (in packets per second) measured over a period of one second

To view traffic bandwidths as a function of time click the **Bandwidth** button. This will open the **Device traffic bandwidth** view.



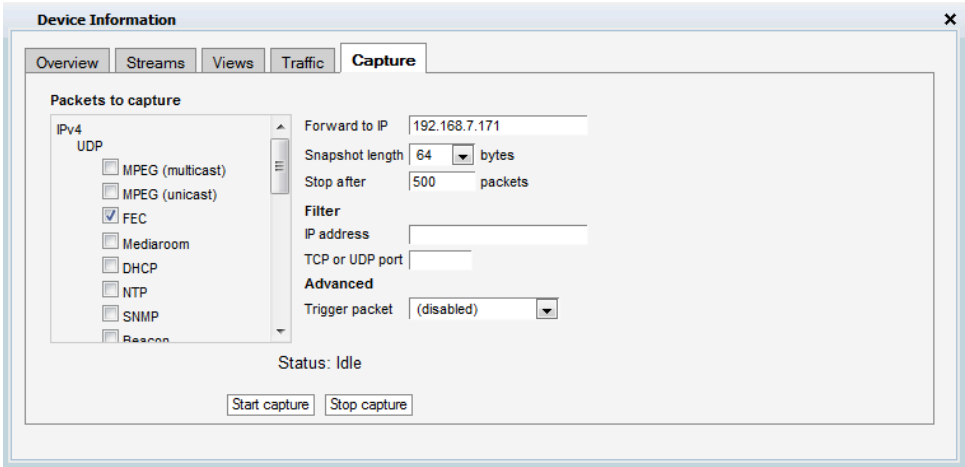
Device traffic - Bandwidth	
Traffic type:	The traffic tree displays detected traffic as a protocol breakdown.
Cur. BW:	The current traffic bandwidth (in Mbit/s)
Bandwidth (last 5 mins):	The bandwidth graph displays traffic bandwidth as a function of time, covering the last five minutes.
Peak BW:	The maximum bandwidth (in Mbit/s), i.e. the highest value of the graph

To view packet traffic as a function of time click the **Packets** button. This will open the **Device traffic packets** view.



Device traffic - Bandwidth	
Traffic type:	The traffic tree displays detected traffic as a protocol breakdown.
Cur. packets:	The current packet rate (in packets per second)
Packets (last 5 mins):	The packet rate graph displays traffic as a function of time, covering the last five minutes.
Peak packets:	The maximum packet rate (in packets per second), i.e. the highest value of the graph

6.2.5. Device Information - Capture (Pff PCAP Filter Forwarding Option)



The Pff PCAP filter forwarding option allows microVB units to send a filtered packet capture to a user-defined IP address for further analysis, e.g. using Wireshark or an offline tool. This can be very useful to check traffic at a microVB location in more detail than the microVB traffic views will provide. A user-specified number of bytes of each packet for one or more selected protocols

will be encrypted and sent to the MDC server. The MDC will de-encrypt the packet information and send it EtherIP encapsulated (IP protocol 97) to a user-defined IP address.

The Pff PCAP mechanisms are explained in more detail in Appendix IV. An application example using Wireshark for packet analysis is also presented in this appendix.

Note that the user should consider return-traffic bandwidth limitations when configuring microVB PCAP parameters. Often only packet headers are required to gain insight into traffic issues, reducing the capture bandwidth necessary compared to full packet capture.

Also note that the network must be transparent for UDP traffic on port 1240 from the microVB to the MDC server address.

To verify that Pff traffic reaches the MDC server and the final destination IP address the Linux command 'tcpdump' can be useful.

On the MDC server you can use the following command to check that capture packets are making it back to MDC from the microVB:

tcpdump udp port 1240

On the capture destination computer ('Forward to IP' address in the capture setup) you can use the following command to check if forwarded packets are arriving ok:

tcpdump ip proto 97

The following capture parameters are defined by the user:

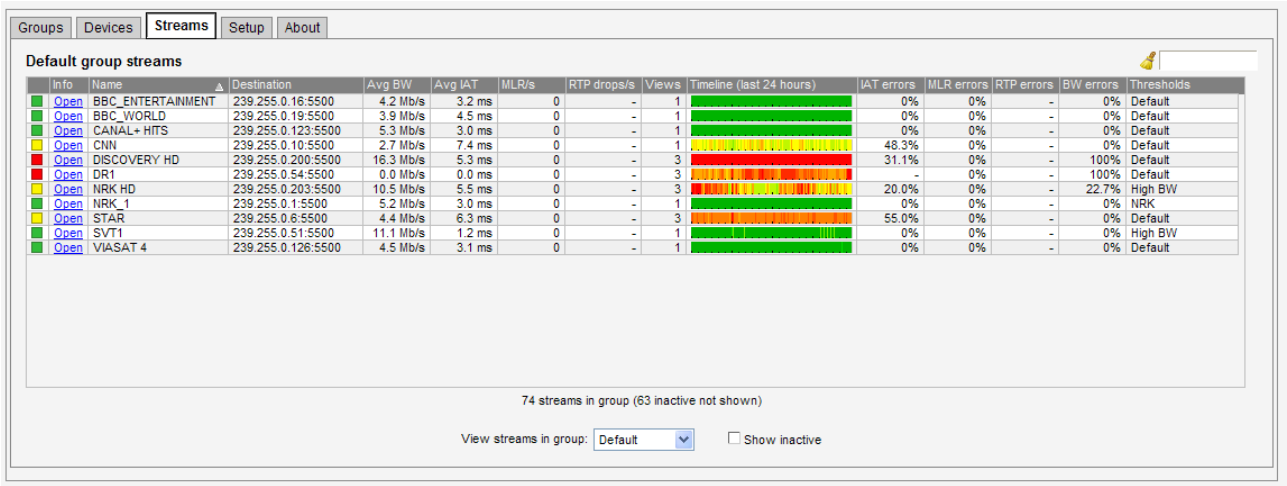
Packets to capture	
IPv4/UDP/MPEG (multicast):	IPv4/UDP/MPEG transport stream multicast traffic
IPv4/UDP/MPEG (unicast):	IPv4/UDP/MPEG transport stream unicast traffic
IPv4/UDP/FEC:	IPv4/UDP/FEC traffic (Forward Error Correction, CoP3)
IPv4/UDP/ Mediaroom:	IPv4/UDP/Mediaroom traffic
IPv4/UDP/DHCP:	IPv4/UDP/DHCP traffic (Dynamic Host Configuration Protocol, port 67 and 68)
IPv4/UDP/NTP:	IPv4/UDP/NTP traffic (Network Time Protocol, port 123)
IPv4/UDP/SNMP:	IPv4/UDP/SNMP traffic (Simple Network Traffic Protocol, port 161 and 162)
IPv4/UDP/Beacon:	IPv4/UDP/Beacon traffic
IPv4/UDP/Teredo:	IPv4/UDP/Teredo traffic (Teredo IPv6 encapsulation)
IPv4/UDP/DNS:	IPv4/UDP/DNS traffic (Domain Name System, port 53)
IPv4/other UDP:	IPv4/UDP traffic that does not match any of the protocols mentioned above
IPv4/TCP/RTSP:	IPv4/TCP/RTSP traffic (Real-Time Streaming Protocol, port 554)
IPv4/otherTCP:	IPv4/TCP traffic that is not RTSP
IPv4/IGMP:	IPv4/IGMP traffic (Internet Group Management Protocol)
IPv4/ICMP:	IPv4/ICMP traffic (Internet Control Message Protocol)
IPv4/PIM:	IPv4/PIM traffic (Protocol Independent Multicast, port 153)
IPv4/ IPv6 encapsulation:	IPv6 traffic encapsulated in IPv4.
Other IPv4:	Any IPv4 that does not fit any of the protocols mentioned above
IPv6:	IPv6 traffic
ARP:	ARP traffic (Address Resolution Protocol)
VLAN:	VLAN tagged traffic (Virtual LAN)
STP:	STP traffic (Spanning Tree Protocol)
Other received:	Traffic that does not fit any of the protocols mentioned above

Destination address and capture size	
Forward to IP:	The destination address
Snapshot length:	Maximum number of bytes to capture from each packet
Stop after:	Capturing will stop automatically after this many packets

	Filter:
IP address:	If an IP address is specified only selected traffic to or from this address is captured.
TCP or UDP port:	If a port number is specified only selected traffic to this port number is captured.

	Advanced:
Trigger packet:	The drop-down menu allows selection of a packet type that will trigger the capture. Capturing will start when a packet of the selected protocol is detected.

6.3. Streams



Info	Name	Destination	Avg BW	Avg IAT	MLR/s	RTP drops/s	Views	Timeline (last 24 hours)	IAT errors	MLR errors	RTP errors	BW errors	Thresholds
Open	BBC_ENTERTAINMENT	239.255.0.16:5500	4.2 Mb/s	3.2 ms	0	-	1		0%	0%	-	0%	Default
Open	BBC_WORLD	239.255.0.19:5500	3.9 Mb/s	4.5 ms	0	-	1		0%	0%	-	0%	Default
Open	CANAL+ HITS	239.255.0.123:5500	5.3 Mb/s	3.0 ms	0	-	1		0%	0%	-	0%	Default
Open	CNN	239.255.0.10:5500	2.7 Mb/s	7.4 ms	0	-	1		48.3%	0%	-	0%	Default
Open	DISCOVERY HD	239.255.0.200:5500	16.3 Mb/s	5.3 ms	0	-	3		31.1%	0%	-	100%	Default
Open	DR1	239.255.0.54:5500	0.0 Mb/s	0.0 ms	0	-	3		-	0%	-	100%	Default
Open	NRK HD	239.255.0.203:5500	10.5 Mb/s	5.5 ms	0	-	3		20.0%	0%	-	22.7%	High BW
Open	NRK_1	239.255.0.1:5500	5.2 Mb/s	3.0 ms	0	-	1		0%	0%	-	0%	NRK
Open	STAR	239.255.0.6:5500	4.4 Mb/s	6.3 ms	0	-	3		55.0%	0%	-	0%	Default
Open	SVT1	239.255.0.51:5500	11.1 Mb/s	1.2 ms	0	-	1		0%	0%	-	0%	High BW
Open	VIASAT 4	239.255.0.126:5500	4.5 Mb/s	3.1 ms	0	-	1		0%	0%	-	0%	Default

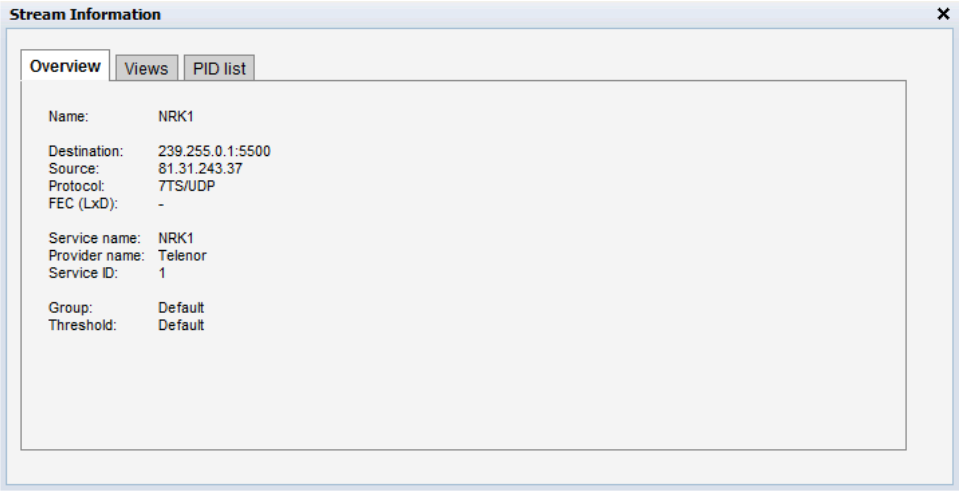
The **Streams** view presents an overview of monitored streams/multicasts in the selected group. The drop-down menu under the stream list allows selection of a microVB group, typically a geographical region, and only streams monitored by one or more microVBs in the selected group will be displayed.

The search field in the upper right corner of the view allows the user to type a text string; the stream list is updated to display only streams matching the specified text.

A drop-down menu allows group selection. By default only active streams monitored by devices within the selected group will be displayed, i.e. streams that have been monitored during the last 24 hour period.

Note that the error figures refer to the last one-minute measurement period.

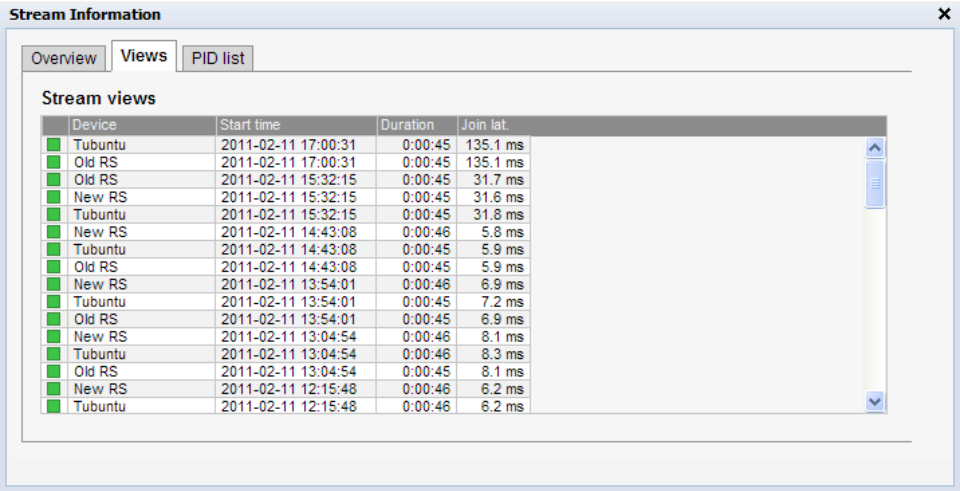
(Group name) group streams	
(Bulb):	A bulb indicating the current stream status, as measured by devices in the selected stream group. Color indications are: Green: status OK (0% errors) Yellow: either IAT or bandwidth errors Orange: packet loss, either MLR or RTP errors Red: 100% errors
Info:	Click the info link to open a stream's **Stream information** pop-up view.
Name:	The stream name defined by the user in the **Setup - All streams** view
Destination:	The multicast destination IP address
Source:	The multicast source IP address
Avg BW:	The average stream bitrate during the last minute
Avg IAT:	The average inter-packet arrival time (packet jitter) during the last minute
MLR/s:	The average packet loss per second during the last minute
RTP drops/s:	The average RTP packet loss ratio per second during the last minute
Avg join:	The average join latency for the stream, measured as the time from join request to the arrival of the first packet of the stream
Views:	The number of microVB units that have monitored the stream during the last minute
Timeline (last 24 hours):	The MDC MicroTimeline displays aggregated stream status for all microVBs associated with the group over a time period of 24 hours. Refer to Appendix I for a description of the MDC MicroTimeline.
IAT errors:	Inter-packet arrival time errors displayed as the percentage of error seconds compared to the total stream monitoring time during the last minute. IAT error seconds are counted when an IAT measurement exceeds the IAT threshold associated with the monitored stream.
MLR errors:	Packet loss errors displayed as the percentage of error seconds compared to the total stream monitoring time during the last minute. MLR error seconds are counted when the number of packet losses per second exceeds the MLR threshold associated with the monitored stream.
RTP errors:	RTP packet drops displayed as the percentage of error seconds compared to the total monitoring time during the last monitoring period (generally one minute per stream and per microVB). RTP error seconds are counted when the number of packet losses per second exceeds the RTP threshold associated with the monitored stream.
BW errors:	Bandwidth (bitrate) errors displayed as the percentage of error seconds compared to the total stream monitoring time during the last minute. BW error seconds are counted when the stream bandwidth exceeds the maximum bitrate threshold or goes below the minimum bitrate threshold associated with the stream.
Thresholds:	The name of the threshold template associated with the stream in the **Setup - Group Streams** view



Stream Information - Overview

The **Stream Information Overview** view displays overview information about the selected stream.

Overview	
Name:	The stream name as defined by the user
Destination:	The IP destination address
Source:	The IP source address
Protocol:	The Transport Stream mapping scheme
FEC (LxD):	CoP #3 Forward Error Correction mode (FEC matrix dimension)
Service name:	The service name, as signalled in SDT
Provider name:	The provider name, as signalled in NIT
Service ID:	The service ID, as signalled in PAT
Group:	The selected MDC group
Threshold:	The alarm threshold associated with the stream by the user

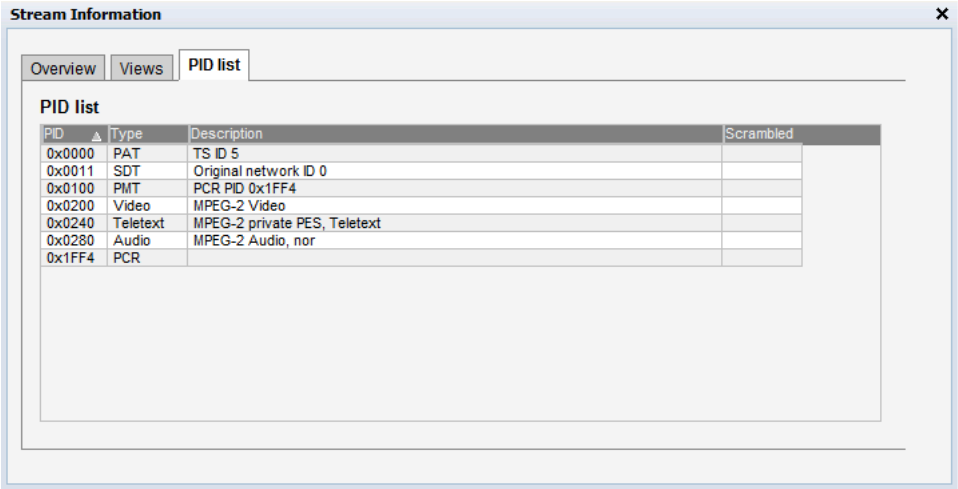


	Device	Start time	Duration	Join lat.
	Tubuntu	2011-02-11 17:00:31	0:00:45	135.1 ms
	Old RS	2011-02-11 17:00:31	0:00:45	135.1 ms
	Old RS	2011-02-11 15:32:15	0:00:45	31.7 ms
	New RS	2011-02-11 15:32:15	0:00:45	31.6 ms
	Tubuntu	2011-02-11 15:32:15	0:00:45	31.8 ms
	New RS	2011-02-11 14:43:08	0:00:46	5.8 ms
	Tubuntu	2011-02-11 14:43:08	0:00:45	5.9 ms
	Old RS	2011-02-11 14:43:08	0:00:45	5.9 ms
	New RS	2011-02-11 13:54:01	0:00:46	6.9 ms
	Tubuntu	2011-02-11 13:54:01	0:00:45	7.2 ms
	Old RS	2011-02-11 13:54:01	0:00:45	6.9 ms
	New RS	2011-02-11 13:04:54	0:00:46	8.1 ms
	Tubuntu	2011-02-11 13:04:54	0:00:46	8.3 ms
	Old RS	2011-02-11 13:04:54	0:00:45	8.1 ms
	New RS	2011-02-11 12:15:48	0:00:46	6.2 ms
	Tubuntu	2011-02-11 12:15:48	0:00:46	6.2 ms

Stream Information - Views

The **Stream Information Views** view lists devices that have recently monitored the selected stream.

Views	
(Bulb):	A bulb indicating the stream status for individual device views. Green color represents status OK whereas the colors yellow, orange and red indicate different levels of error severity, red being the most severe.
Device:	The device name
Start time:	The time the join request was detected
Duration:	The time the stream was joined
Join lat.:	The join latency is measured as the time from a join request was sent by the set-top box until the first packet of the stream is received.



Stream Information - PID list

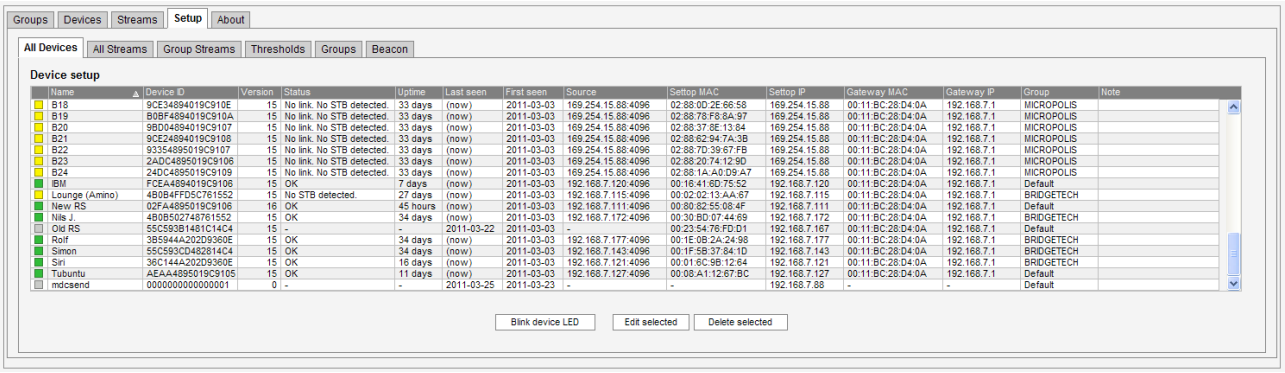
The Stream Information - PID list view displays the PIDs in a stream and associated metadata.

PID list	
PID:	The PID
Type:	The PID type. The following PID types are supported: PAT: Program Allocation Table PMT: Program Map Table CAT: Conditional Access Table NIT: Network Information Table SDT: Service Description Table SDT/BAT: SDT and Bouquet Association Table EIT: Event Information Table RST: Running Status Table TDT/TOT: Time Description Table/Time Offset Table PCR: Program Clock Reference Audio Video DSM-CC: Digital Storage Media - Command and Control Private Teletext Subtitles Other Unknown : The PID is present, however the microVB cannot analyse the contents
Description:	Meta-data contained within the PID
Scrambled:	If the PID is scrambled, this field will be checked.

6.4. Setup

All of the MDC setup is performed via the different **Setup** views, the other views providing monitoring and information only.

6.4.1. Setup - All Devices



	Name	Device ID	Version	Status	Uptime	Last seen	First seen	Source	Settop MAC	Settop IP	Gateway MAC	Gateway IP	Group	Note
	B18	9CE34894019C910E	15	No link. No STB detected.	33 days	(now)	2011-03-03	169.254.15.88:4096	02:88:0D:2E:66:58	169.254.15.88	00:11:BC:28:D4:0A	192.168.7.1	MICROPOLIS	
	B19	B0BF4894019C910A	15	No link. No STB detected.	33 days	(now)	2011-03-03	169.254.15.88:4096	02:88:78:F8:8A:97	169.254.15.88	00:11:BC:28:D4:0A	192.168.7.1	MICROPOLIS	
	B20	9BD04894019C9107	15	No link. No STB detected.	33 days	(now)	2011-03-03	169.254.15.88:4096	02:88:37:8E:13:84	169.254.15.88	00:11:BC:28:D4:0A	192.168.7.1	MICROPOLIS	
	B21	9CE24894019C9108	15	No link. No STB detected.	33 days	(now)	2011-03-03	169.254.15.88:4096	02:88:62:94:7A:3B	169.254.15.88	00:11:BC:28:D4:0A	192.168.7.1	MICROPOLIS	
	B22	9335489501 9C9107	15	No link. No STB detected.	33 days	(now)	2011-03-03	169.254.15.88:4096	02:88:7D:39:67:FB	169.254.15.88	00:11:BC:28:D4:0A	192.168.7.1	MICROPOLIS	
	B23	2ADC4895019C9106	15	No link. No STB detected.	33 days	(now)	2011-03-03	169.254.15.88:4096	02:88:20:74:12:9D	169.254.15.88	00:11:BC:28:D4:0A	192.168.7.1	MICROPOLIS	
	B24	24DC4895019C9109	15	No link. No STB detected.	33 days	(now)	2011-03-03	169.254.15.88:4096	02:88:1A:A0:D9:A7	169.254.15.88	00:11:BC:28:D4:0A	192.168.7.1	MICROPOLIS	
	IBM	FCEA4894019C9106	15	OK	7 days	(now)	2011-03-03	192.168.7.120:4096	00:16:41:6D:75:52	192.168.7.120	00:11:BC:28:D4:0A	192.168.7.1	Default	
	Lounge (Amino)	4B0B4FFD5C761552	15	No STB detected.	27 days	(now)	2011-03-03	192.168.7.115:4096	00:02:02:13:AA:67	192.168.7.115	00:11:BC:28:D4:0A	192.168.7.1	BRIDGETECH	
	New RS	02FA4895019C9106	16	OK	45 hours	(now)	2011-03-03	192.168.7.111:4096	00:80:82:55:08:4F	192.168.7.111	00:11:BC:28:D4:0A	192.168.7.1	Default	
	Nils J.	4B0B502748761552	15	OK	34 days	(now)	2011-03-03	192.168.7.172:4096	00:30:BD:07:44:69	192.168.7.172	00:11:BC:28:D4:0A	192.168.7.1	BRIDGETECH	
	Old RS	55C593B1481C14C4	15	-	-	2011-03-22	2011-03-03	-	00:23:54:76:FD:D1	192.168.7.167	00:11:BC:28:D4:0A	192.168.7.1	Default	
	Rolf	3B5944A202D9360E	15	OK	34 days	(now)	2011-03-03	192.168.7.177:4096	00:1E:0B:2A:24:98	192.168.7.177	00:11:BC:28:D4:0A	192.168.7.1	BRIDGETECH	
	Simon	55C593CD482814C4	15	OK	34 days	(now)	2011-03-03	192.168.7.143:4096	00:1F:5B:37:84:1D	192.168.7.143	00:11:BC:28:D4:0A	192.168.7.1	BRIDGETECH	
	Sri	36C1444A202D9360E	15	OK	16 days	(now)	2011-03-03	192.168.7.121:4096	00:01:6C:9B:12:64	192.168.7.121	00:11:BC:28:D4:0A	192.168.7.1	BRIDGETECH	
	Tubuntu	AEAA4895019C9105	15	OK	11 days	(now)	2011-03-03	192.168.7.127:4096	00:08:A1:12:67:BC	192.168.7.127	00:11:BC:28:D4:0A	192.168.7.1	Default	
	mdcsend	0000000000000001	0	-	-	2011-03-25	2011-03-23	-	-	192.168.7.88	-	-	Default	

The **Setup - All Devices** view lists detected microVB units and their parameters. When a new microVB device is detected by the MDC it will appear in this view, associated by the Default group; *Name* and *Note* fields left blank. To facilitate monitoring and customer support each device should be associated with a group, and a suitable name should be associated with each device/set-top MAC address. Sorting on the *First seen* column will make it easy to spot newly detected devices.

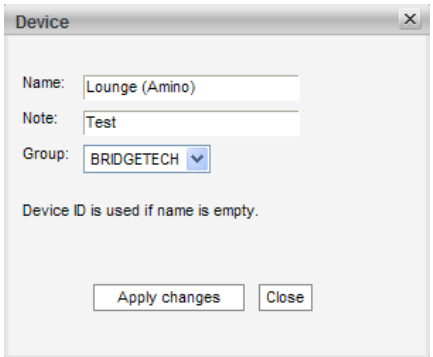
Highlighting a device by clicking the corresponding list entry and clicking **Edit selected** will open the **Device** pop-up menu, allowing group selection and editing of *Name* and *Note* text fields.

Highlighting a device by clicking the corresponding list entry and clicking **Delete selected** will delete the device from the list. This is typically done if a microVB unit is no longer in use.

The **Blink device LED** button allows the user to identify a microVB device in the list. When highlighting the microVB and clicking the **Blink device LED** button a command is transmitted to the microVB instructing the unit to blink its green LED rapidly. The next data transmission from the microVB to the MDC will include the status message 'Led blinking.', and the *Last status* field of the device will display this message. The bulb leftmost in the device list will also start blinking. The **Blink device LED** functionality also allows the user to ensure correct link between a specific customer and a microVB device/set-top MAC address by letting the customer verify that his device's LED is actually blinking when a blink command is issued from the MDC. The microVB unit must be powered in order for this functionality to work.

Clicking the **Blink device LED** button when no device has been selected will result in all devices blinking. This will work even if the list is empty. This feature may be convenient for debugging during the initial installation process.

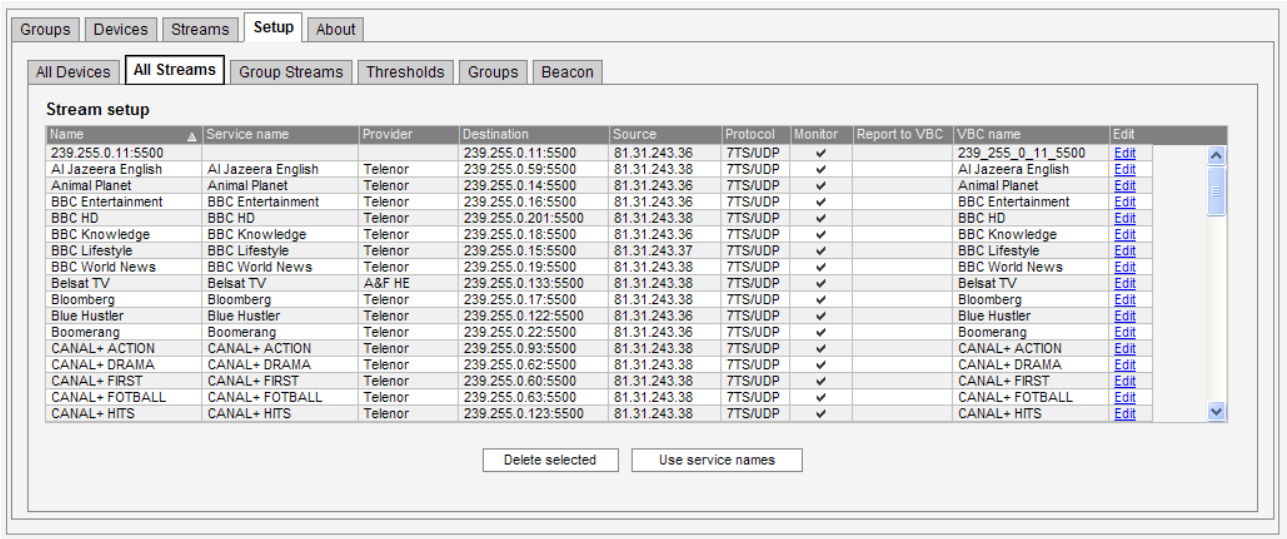
Device Setup	
Name:	The device name as specified by the user in the **Setup - All devices - Edit** view. If no name has been assigned to the device, the device ID will be displayed.
Device ID:	A device ID unique to each microVB. The device ID is associated with device name and note, meaning that a unit that is moved from one monitoring position to another will reappear in the MDC GUI with the same name and note. The bulb associated with the device ID shows the device status (in order of priority): Grey: no contact with the device Red: image or flash error Orange: no beacon or streams>4 Yellow: no link or no set-top box found Green: if none of the above apply
Version:	The current software version of the microVB unit. The version number should match the current MDC bootcast version, if bootcast transmission is activated.
Status:	The latest status reported by the microVB
Uptime:	The time the microVB has been powered
Last seen:	The time of the latest microVB report or 'heartbeat' signal
First seen:	The time the microVB was first detected by the MDC
Source:	The source IP address and port number, as seen by the MDC
Settop MAC:	The MAC address of the set-top box that the microVB is connected to
Settop IP:	The IP address of the set-top box that the microVB is connected to
Gateway MAC:	The MAC address of the gateway of the set-top box that the microVB is connected to
Gateway IP:	The IP address of the gateway of the set-top box that the microVB is connected to
Group:	The group associated with the microVB unit, as selected by the user. Groups defined in the **Setup - Groups** view are available for selection.
Note:	A text field that may be used for an arbitrary purpose, e.g. to indicate errors reported by the customer



The Device pop-up view allows the user to assign name and note text strings to a microVB. The

microVB is also associated with one of the defined groups. The **Apply changes** button must be clicked for changes to take effect.

6.4.2. Setup - All Streams



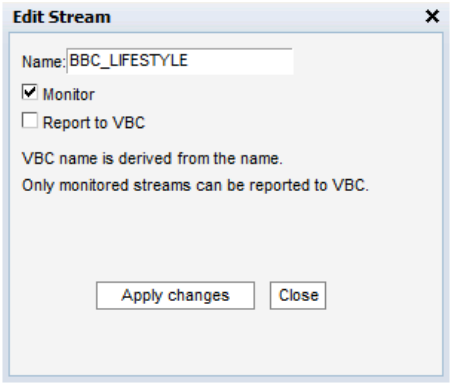
Name	Service name	Provider	Destination	Source	Protocol	Monitor	Report to VBC	VBC name	Edit
239.255.0.11:5500			239.255.0.11:5500	81.31.243.36	7TS/UDP	✓		239_255_0_11_5500	Edit
Al Jazeera English	Al Jazeera English	Telenor	239.255.0.59:5500	81.31.243.38	7TS/UDP	✓		Al Jazeera English	Edit
Animal Planet	Animal Planet	Telenor	239.255.0.14:5500	81.31.243.36	7TS/UDP	✓		Animal Planet	Edit
BBC Entertainment	BBC Entertainment	Telenor	239.255.0.16:5500	81.31.243.36	7TS/UDP	✓		BBC Entertainment	Edit
BBC HD	BBC HD	Telenor	239.255.0.201:5500	81.31.243.38	7TS/UDP	✓		BBC HD	Edit
BBC Knowledge	BBC Knowledge	Telenor	239.255.0.18:5500	81.31.243.36	7TS/UDP	✓		BBC Knowledge	Edit
BBC Lifestyle	BBC Lifestyle	Telenor	239.255.0.15:5500	81.31.243.37	7TS/UDP	✓		BBC Lifestyle	Edit
BBC World News	BBC World News	Telenor	239.255.0.19:5500	81.31.243.38	7TS/UDP	✓		BBC World News	Edit
Belsat TV	Belsat TV	A&F HE	239.255.0.133:5500	81.31.243.38	7TS/UDP	✓		Belsat TV	Edit
Bloomberg	Bloomberg	Telenor	239.255.0.17:5500	81.31.243.38	7TS/UDP	✓		Bloomberg	Edit
Blue Hustler	Blue Hustler	Telenor	239.255.0.122:5500	81.31.243.36	7TS/UDP	✓		Blue Hustler	Edit
Boomerang	Boomerang	Telenor	239.255.0.22:5500	81.31.243.36	7TS/UDP	✓		Boomerang	Edit
CANAL+ ACTION	CANAL+ ACTION	Telenor	239.255.0.93:5500	81.31.243.38	7TS/UDP	✓		CANAL+ ACTION	Edit
CANAL+ DRAMA	CANAL+ DRAMA	Telenor	239.255.0.62:5500	81.31.243.38	7TS/UDP	✓		CANAL+ DRAMA	Edit
CANAL+ FIRST	CANAL+ FIRST	Telenor	239.255.0.60:5500	81.31.243.38	7TS/UDP	✓		CANAL+ FIRST	Edit
CANAL+ FOTBALL	CANAL+ FOTBALL	Telenor	239.255.0.63:5500	81.31.243.38	7TS/UDP	✓		CANAL+ FOTBALL	Edit
CANAL+ HITS	CANAL+ HITS	Telenor	239.255.0.123:5500	81.31.243.38	7TS/UDP	✓		CANAL+ HITS	Edit

When new streams are monitored by a microVB device they will appear in the **Setup - All streams** view with the multicast address as the stream name. By default the new stream will be monitored but measurements will not reported to a VideoBridge Controller, that may be part of the system. By clicking the *Edit* field of the stream the user will access the **Edit Stream** view, allowing the stream name to be edited.

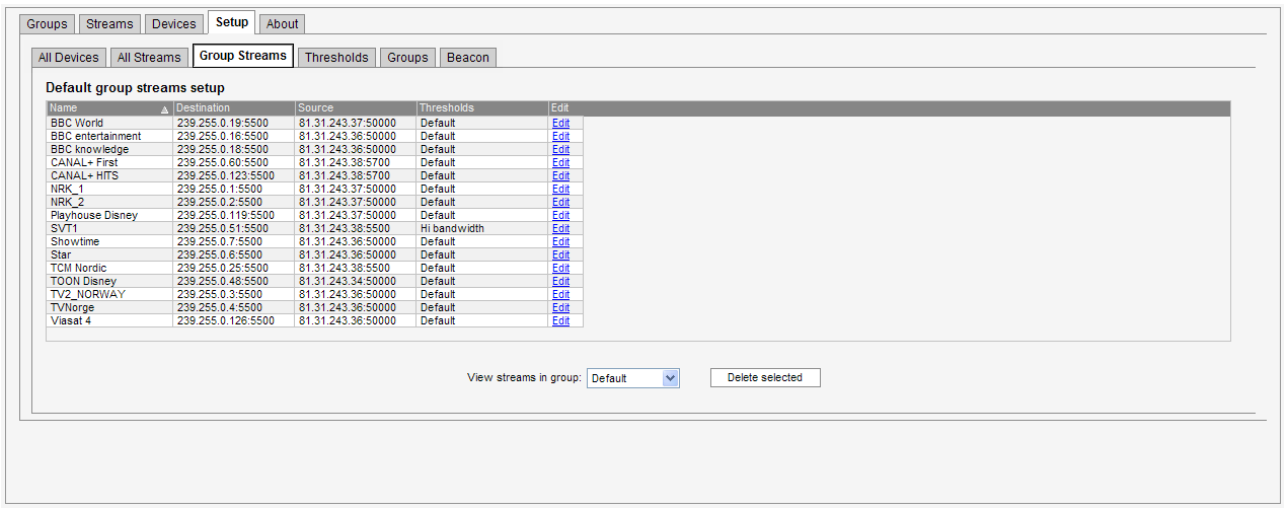
By highlighting a stream and clicking **Delete selected** the stream will be removed from the stream list. Note that the stream will re-appear if it is monitored by a microVB device. To avoid a stream re-appearing it may be removed from the white list, or monitoring of the stream may be de-selected.

Streams	
Name:	The stream name as defined by the user in the **Edit stream** pop-up view. If no name has been specified, the service name derived from SDT will be used or the multicast destination address will appear in this field if no SDT is present in the stream.
Service name:	The service name as derived from the SDT
Provider:	The service provider as derived from SDT
Destination:	The multicast destination address
Source:	The multicast source address
Protocol:	The MPEG into IP mapping scheme
Monitor:	If monitoring of the stream has been selected by the user in the **Edit stream** pop-up view this field will be checked. If the field is not checked the stream will not be monitored by the MDC.

Report to VBC:	If reporting to VBC for this stream has been selected by the user in the **Edit stream** pop-up view, this field will be checked. If the field is not checked microVB measurements for this stream will not be reported to the VBC. Note that only devices in the *Default* group will report to the VideoBridge Controller.
VBC name:	The VBC stream name is derived from the stream name defined by the user for this multicast. The stream will be represented by the VBC name throughout the VBC GUI.
Edit:	Click the Edit link to open the **Edit stream** pop-up view.



The Edit Stream pop-up view allows the user to define a stream name for the multicast. The user also selects whether a stream should be monitored and if measurement data should be reported to a VideoBridge Controller. The **Apply changes** button must be clicked for changes to take effect. If the *Name* field is left blank, the service name derived from SDT will be used. If no SDT is present in the stream, the multicast destination address will be used.



6.4.3. Setup - Group Streams

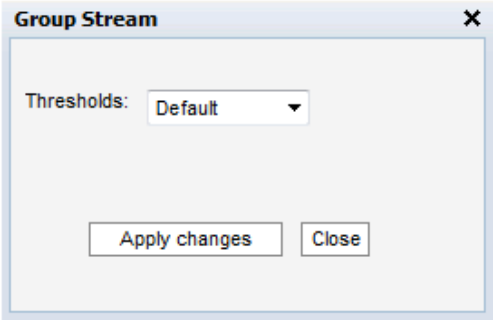
The **Setup - Group Streams** view allows selection of a threshold template to be associated

with each stream for each group. Note that the same stream may have different threshold settings for different groups, in order to cater for required differences due to network topology or last mile transmission technology. As an example it may be required to use different thresholds for areas deploying fibre-to-the-home as opposed to xDSL.

The drop-down menu under the stream list allows selection of a group. By clicking the *Edit* link of a stream a threshold group may be assigned to the selected group/stream combination.

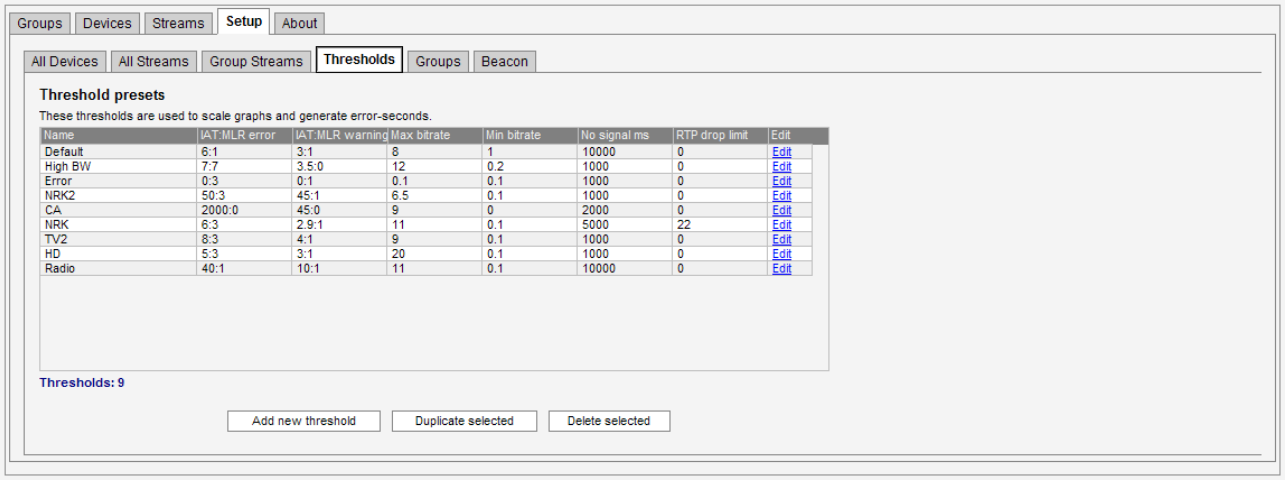
Highlighting a list entry and clicking **Delete selected** will remove a stream from the stream list of the selected group.

(Group name) group streams setup	
Name:	The stream name as defined by the user in the **Setup - All streams** view. If no name has been specified the multicast destination address will appear in this field.
Destination:	The multicast destination address
Source:	The multicast source address
Thresholds:	The thresholds template associated with the stream for the current group, as selected by the user in this view. Note that one stream may be associated with different thresholds for different groups.
Edit:	Click the *Edit* link to select thresholds template for the stream of the current group. Threshold templates defined by the user in the **Setup - Thresholds** view are available for selection. Note that one stream may be associated with different thresholds for different groups.



The **Group Stream** pop-up view allows selection of a threshold template to be associated with each stream for each group. The **Apply changes** button must be clicked for changes to take effect.

6.4.4. Setup - Thresholds



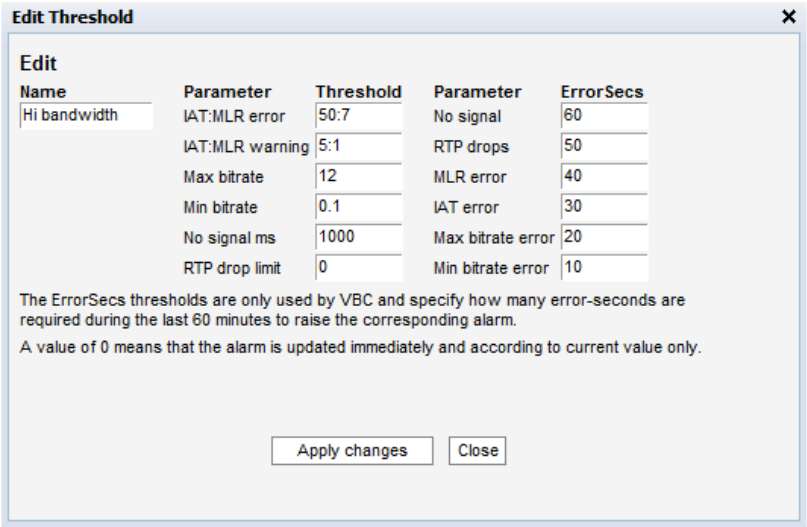
Name	IAT:MLR error	IAT:MLR warning	Max bitrate	Min bitrate	No signal ms	RTP drop limit	Edit
Default	6:1	3:1	8	1	10000	0	Edit
High BW	7:7	3.5:0	12	0.2	1000	0	Edit
Error	0:3	0:1	0.1	0.1	1000	0	Edit
NRK2	50:3	45:1	6.5	0.1	1000	0	Edit
CA	2000:0	45:0	9	0	2000	0	Edit
NRK	6:3	2.9:1	11	0.1	5000	22	Edit
TV2	8:3	4:1	9	0.1	1000	0	Edit
HD	5:3	3:1	20	0.1	1000	0	Edit
Radio	40:1	10:1	11	0.1	10000	0	Edit

Thresholds are used to determine when the microVB should count error seconds. If the defined threshold level is exceeded for a parameter, an error second is counted. Thresholds are also used to scale some graphs, like the MediaWindow graph.

There are two different ways of creating user-defined thresholds. To create a new threshold template from scratch the user should click the **Add new threshold** button. A pop-up window will appear allowing the user to define thresholds. Another way of creating a user-defined threshold template is by highlighting one of the templates already defined and then click the **Duplicate highlighted** button.

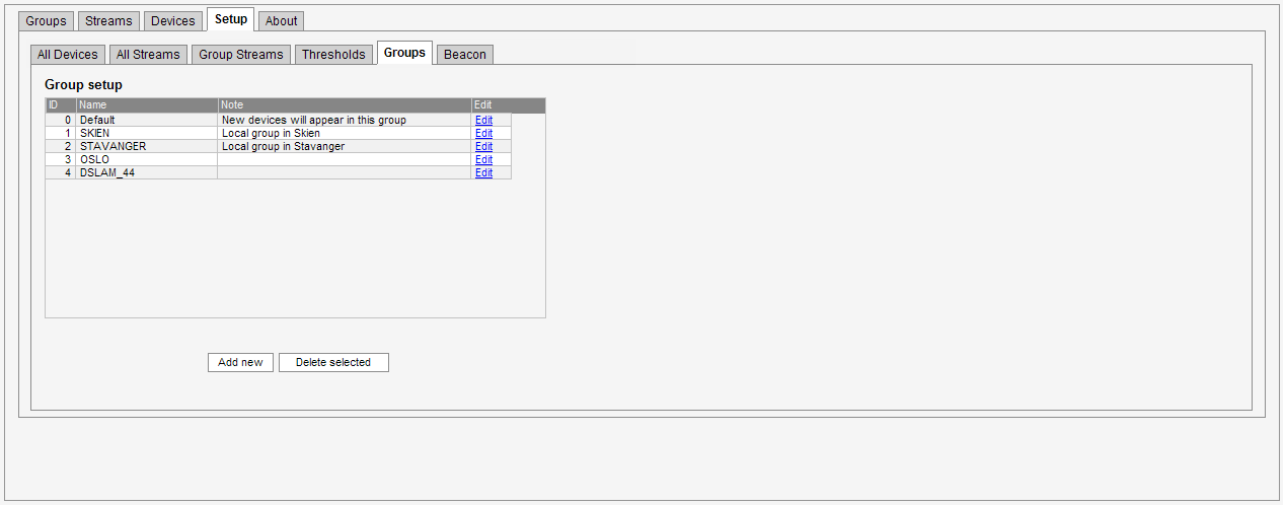
Deleting a threshold template is done by highlighting the template that should be removed and clicking **Delete selected**. If a threshold template currently assigned to a multicast is deleted, the 'Default' template will be assigned to the multicast.

Threshold presets	
Name:	The name of the threshold template
IAT:MLR error:	The error thresholds for inter-packet arrival time and packet loss on the format **IAT error threshold:MLR error threshold**
IAT:MLR warning:	The warning thresholds for inter-packet arrival time and packet loss on the format **IAT warning threshold:MLR warning threshold**
Max bitrate:	The maximum bitrate in Mbit/s. If the bitrate measured over one second exceeds the maximum bitrate threshold that second will be counted as an error second.
Min bitrate:	The minimum bitrate in Mbit/s. If the bitrate measured over one second drops below the minimum bitrate threshold that second will be counted as an error second.
No signal ms:	Number of milliseconds without receiving any signal before 'No signal' error seconds are counted
RTP drop limit:	The RTP packet loss threshold. If the number of RTP drops detected within one second exceeds the RTP drop limit that second will be counted as an error second.
Edit:	Click the Edit link to open the **Edit threshold** pop-up view and edit thresholds.



The error second thresholds on the right hand side of the **Edit Threshold** pop-up view are used by the VideoBridge Controller (VBC) to issue VBC specific alarms. The VBC will raise an alarm when the number of error seconds exceeds the error seconds threshold. If a VBC is not part of the system these settings can be ignored. The **Apply changes** button must be clicked for changes to take effect.

VBC thresholds	
No signal:	The no signal threshold is not used for the microVB and the default value may be left unchanged.
RTP drops:	Number of seconds with RTP packet drops. This will be zero unless the stream is encapsulated in RTP headers
MLR error:	Number of seconds with packet drops in the TS layer (seconds when there is packet loss). This is equal to the number of error seconds with CC errors.
IAT error:	Number of seconds when the delay factor exceeds the IAT threshold
Max bitrate error:	Number of seconds the bitrate can exceed the error-threshold before a VBC alarm is generated
Min bitrate error:	Number of seconds the bitrate can fall below the error-threshold before a VBC alarm is generated



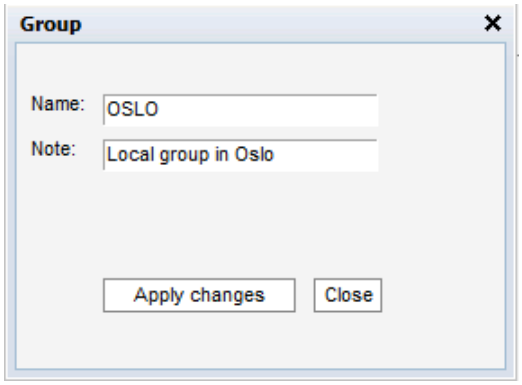
6.4.5. Setup - Groups

The **Setup - Groups** view allows group definition. microVB units are grouped to ease system status monitoring. Typically group names will refer to geographical location.

A new group is created by clicking the **Add new** button and entering a group name and text note in the **Group** pop-up view.

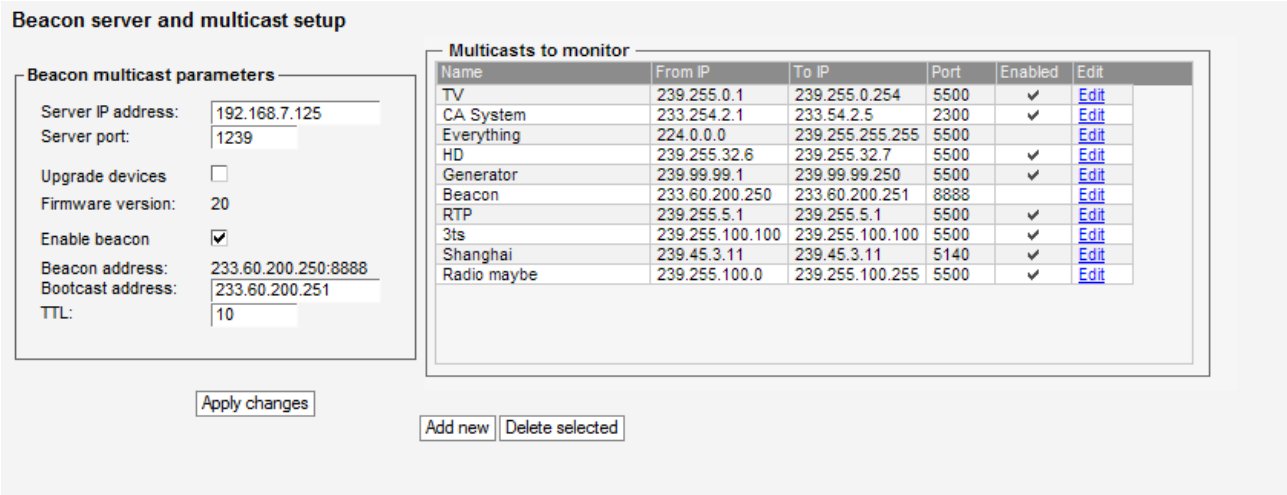
By highlighting a group and clicking the **Delete selected** button a group is removed from the groups list. Devices associated with a group that is deleted are automatically associated with the *Default* group.

	Groups
ID:	The group ID is a number identifying the group and it is automatically assigned to each new group. The group ID is used by the VideoBridge Controller only.
Name:	The group name as specified by the user
Note:	A text string available for group description
Edit:	Click the *Edit* link to open the **Group** pop-up view and edit the parameters specified above.



The **Group** pop-up view allows the user to assign a name and note to a group. The **Apply changes** button must be clicked for changes to take effect.

6.4.6. Setup - Beacon

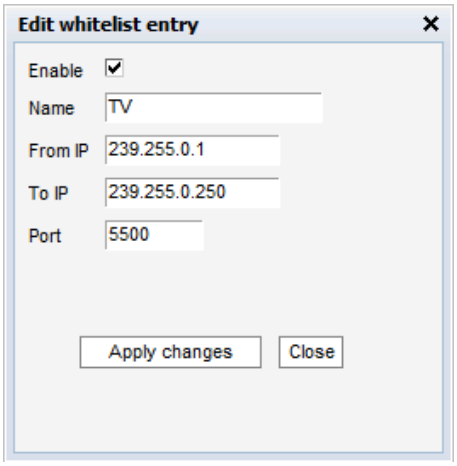


The **Setup - Beacon** view allows the user to set parameters for beacon and bootcast multicasts and to define whitelist multicast ranges. The microVB units will only monitor multicasts with addresses within the defined whitelist multicast ranges.

Beacon multicast parameters	
Server IP address:	The beacon server IP address - to be used by the microVBs when sending measurement data to the MDC
Server port:	The port number to be used by the microVBs to send measurement data to the MDC
Upgrade devices:	Check the **Upgrade devices** check-box to activate transmission of the firmware upgrade bootcast.
Firmware version:	The firmware sent to upgrade microVB devices
Enable beacon:	Check the **Enable beacon** check-box to activate the beacon. The beacon must be activated for the MDC to detect new microVB devices.
Beacon address:	The beacon multicast IP address can be selected from the drop-down menu.
Bootcast address:	The bootcast multicast IP address. The bootcast IP address and port number is signalled in the MDC beacon, thus allowing microVBs to automatically detect and upload new software. The VideoBridge reserved GLOP address 233.60.200.251 is recommended. Note that the bootcast port number must be 8888.
TTL:	The beacon Time To Live figure. TTL should be set sufficiently high to ensure the beacon multicast reaches all microVB units.

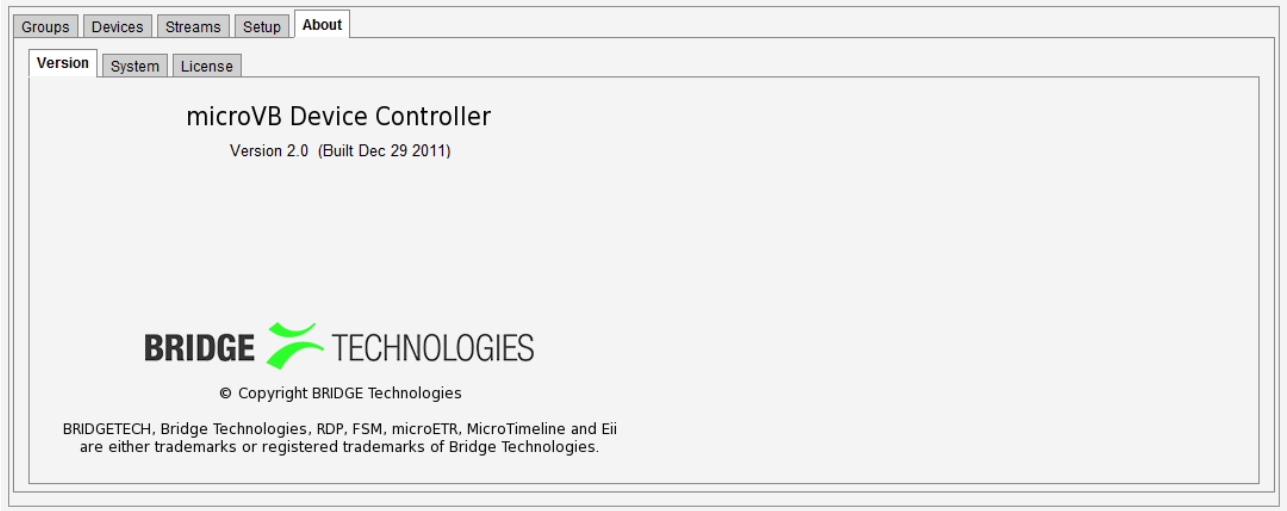
When beacon multicast parameters have been changed the **Apply changes** button must be clicked for the changes to take effect.

A whitelist multicast is added to the list by clicking the **Add new** button and entering multicast parameters. An existing whitelist multicast is deleted by highlighting the multicast and clicking the **Delete selected** button. To edit an existing whitelist multicast click the associated **Edit** link.



Edit whitelist entry	
Enable:	This field must be checked for the microVB to monitor multicasts with addresses within the associated whitelist multicast range.
Name:	The name of the whitelist multicast range
From IP:	The whitelist multicast range start IP address
To IP:	The whitelist multicast range end IP address
Port:	The whitelist multicast range port number

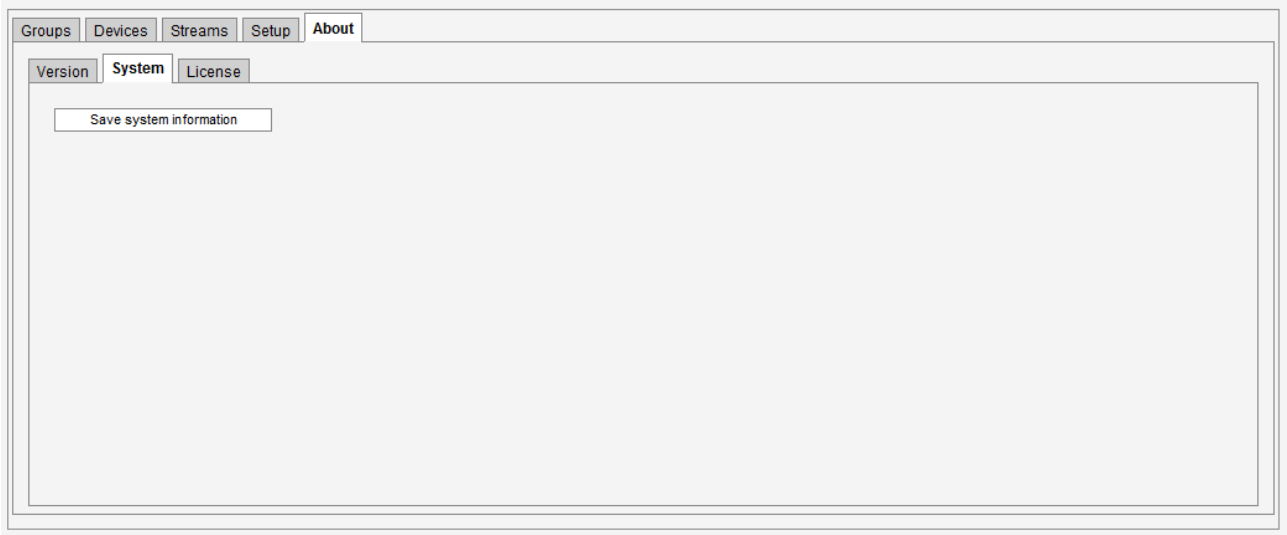
6.5. About



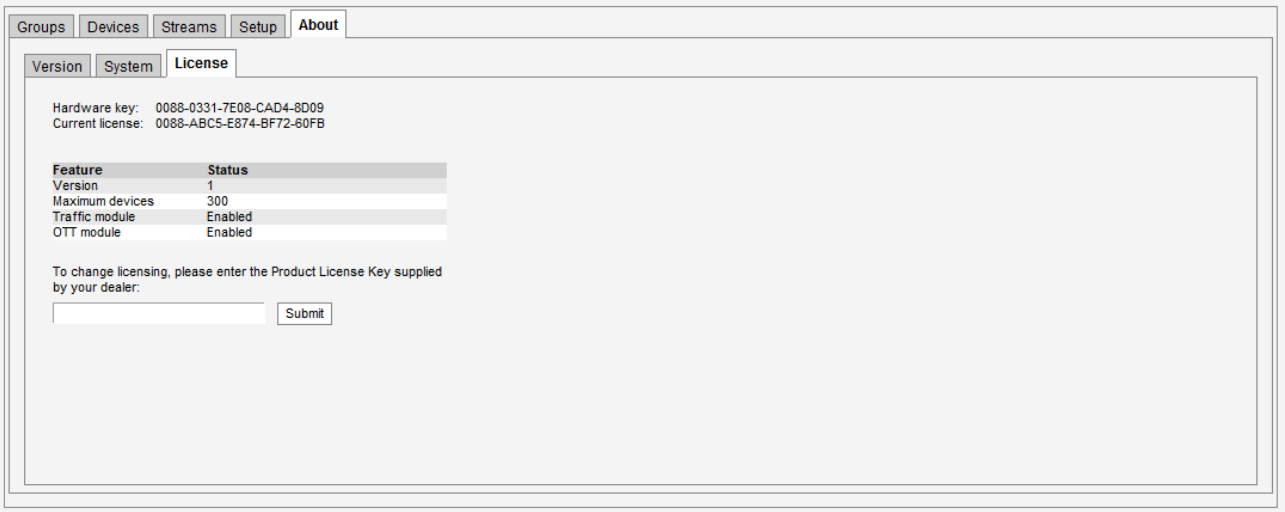
6.5.1. About - Version

The **About - Version** view displays information about the MDC software version.

6.5.2. About - System



When the **Save system information** button is clicked, a text file containing system information is opened in a new window. This file may be useful if MDC problems are experienced and technical support is needed.



6.5.3. About - License

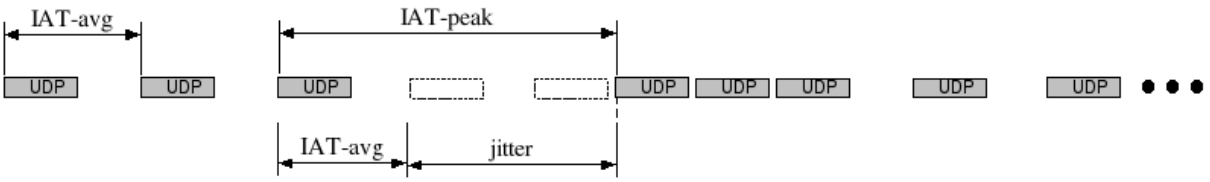
The **About - License** view displays information about the current MDC license.

A basic MDC may be upgraded to include the **Traffic module** option and the **OTT module** option. This can be done on-site by the user when the option has been purchased.

I. Appendix: Measurement Fundamentals

IAT - Inter-Packet Arrival Time

Packet jitter can be detected by checking the spacing between packets. To avoid the need for specifying stream bit-rate, the maximum Inter-packet Arrival Time (IAT) may be used as a measure of packet jitter (and the buffer size needed for signal reception), even if it is strictly the sum of the average IAT and the jitter. The maximum IAT as a measure of jitter is also applicable for variable bitrate streams.

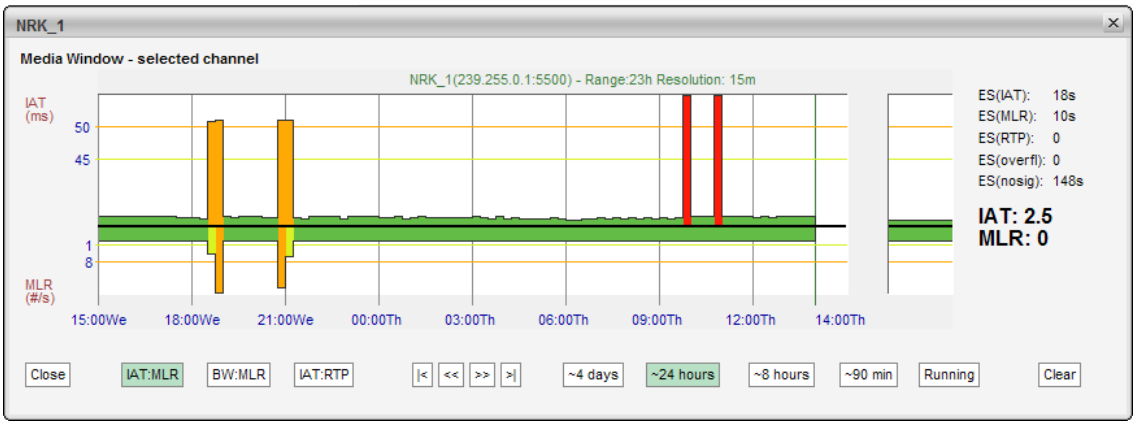


MLR - Packet Loss

Packet loss can be estimated by checking the continuity counters of MPEG transport stream packet headers. Packet loss may be specified as the number of packets lost during a fixed period

of one second - the MPEG Loss Rate (MLR).

MDC MediaWindow



MediaWindow views are used in the VideoBridge probes used for digital television monitoring. The user selects thresholds that define different status levels. These threshold values are selected so that the graph color indications give representative readings for the system and stream monitored. There are four different status colors.

Measurement values lower than the warning threshold will result in a green representation in the graph, a value between warning and error threshold yields yellow, and if the error threshold is exceeded the graph will be orange. 'No signal' is represented by red color. The IAT and MLR warning thresholds are shown as yellow lines with associated magnitude, and the error thresholds are likewise displayed as orange lines.

Data from the last day is stored with a time resolution of one second. The displayed time window is selectable from approximately 90 seconds to 24 hours, and scroll arrows allow high resolution display of any time period within the last day. Tool-tip functionality makes it easy to read the time and measurement values of a specific incident.

II.

III. Appendix: MDC MicroTimelines

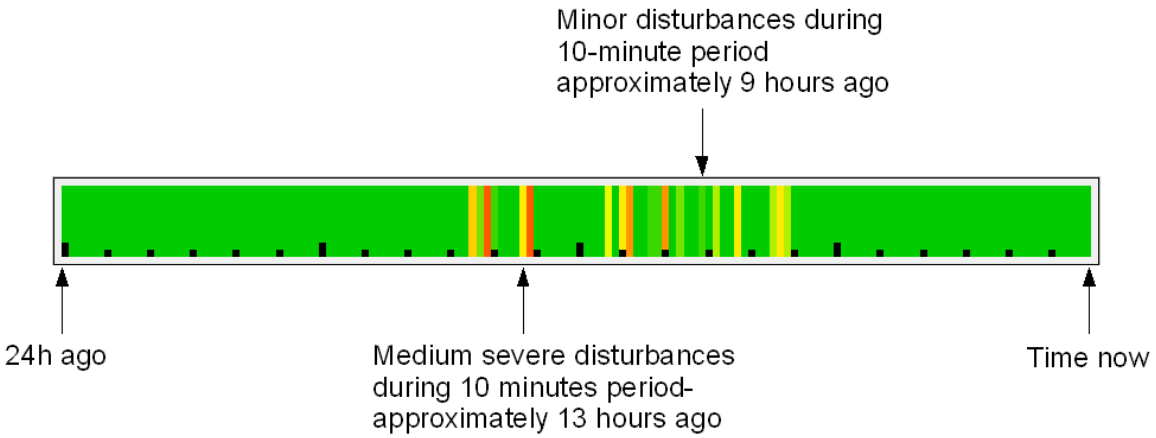
The MDC MicroTimelines in the **Groups**, **Streams** and **Devices** views show how streams and microVB groups have performed over the last 24 hours. The MDC MicroTimelines have a resolution of 10 minutes, and performance during each 10-minute interval is displayed by the use of colors. The status color range varies from green via yellow and orange to red, green indicating status OK whereas red indicates severe error. Periods of time with no measurements are represented by grey.

The MDC MicroTimelines in the views **Groups** and **Streams** generally represent measurements from more than one microVB device, and all error seconds from all relevant

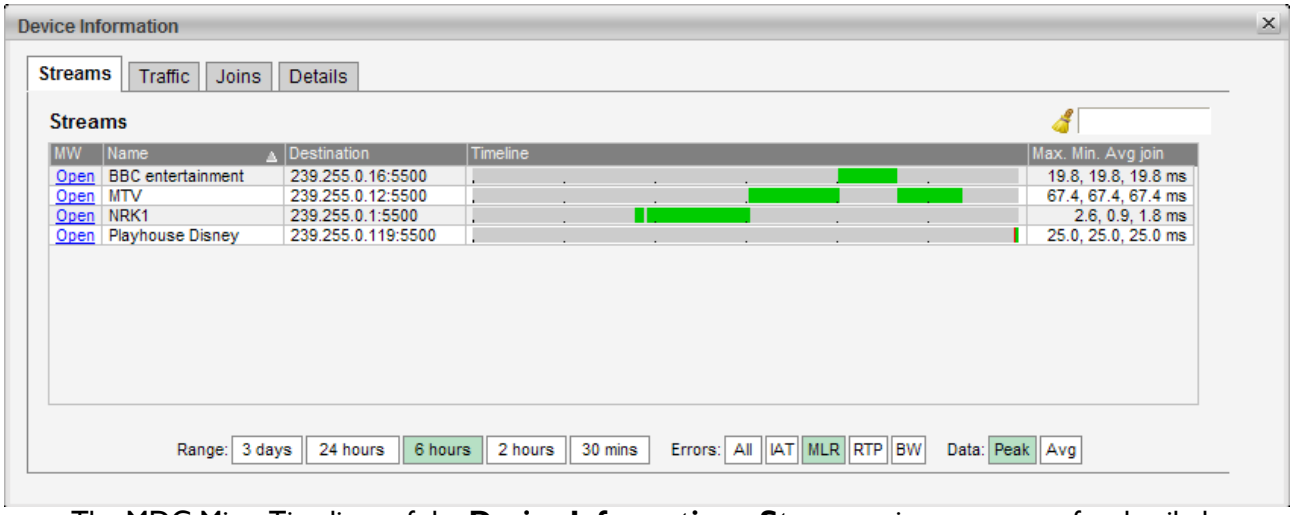
probes are summed and the total number of error seconds compared to the actual total measurement period to determine what color should be displayed for each 10-minute period. This means that the MDC MicroTimeline will present a measurement average for each 10-minute period of the last 24 hours. Note that one second in time affected by more than one type of error will count one error second only.

Black markings in the MDC MicroTimeline indicate time, the spacing being one hour. This is valid for all MDC MicroTimelines.

The MDC MicroTimelines in the **Devices** view represent measurement from single microVB units, but apart from that they are identical to the **Groups** and **Streams** MDC MicroTimelines.



MDC MicroTimeline (Device Information - Streams view)



The MDC MicroTimelines of the **Device Information - Streams** view are meant for detailed examination of stream behaviour as measured by a single microVB device. The principle of presenting the historical signal status by the use of colors is identical to the other MDC MicroTimelines, but in this view the user may select a number of presentation parameters in order to easily pin-point errors: the time window is selectable from 30 minutes to 3 days, the type of error seconds to be represented is selectable and the user selects whether the color

representing a time fraction of the graph should refer to the average status or the peak error level during that time.

The MDC MicroTimeline resolution depends on the time window selected, and the color of each fraction of the graph depends on measurements during that time period. When **Avg** (average) presentation is selected, the number of error seconds counted during a time period is compared to the length of the monitoring period to determine graph status color. When **Peak** presentation is selected, a single error second measured during a graph fraction period will result in the graph color being red for that period. Thus when **Peak** is selected the graph colors will be green (OK) and red (error) only.

In order to determine what error parameter has occured during an MDC MicroTimeline window period, the user may select to view errors due to either packet jitter (**IAT**), packet loss (**MLR**), RTP packet loss (**RTP**) or bandwidth (**BW**). The **Peak** and **Avg** buttons will work as explained above.

For even more detailed error analysis the MediaWindow (MW) view may be opened, allowing precise measurement data to be viewed.

IV. Appendix: mdcsniffer and mdcsend Troubleshooting Tools

The MDC software comes with two simple tools that may aid in troubleshooting: **mdcsniffer** and **mdcsend**. **mdcsniffer** is a packet sniffer that displays traffic related to microVB - MDC communication. **mdcsend** will mimic a microVB and send a dummy measurement packet to the MDC, easily recognisable in the MDC GUI. These applications may typically be installed on a lap-top running Linux, and a field engineer can easily check if required communication between the MDC and a microVB may be established.

mdcsniffer and **mdcsend** are automatically unpacked during the MDC installation process, and they are located in the */opt/mdc* directory. They may simply be copied to a lap-top running Linux to be available for field engineering use. Note that it is necessary to be logged in as the user *root* to run **mdcsniffer**.

mdcsniffer

The **mdcsniffer** may be used anywhere in the signal chain between MDC and the end user - the MDC beacon signal should be transmitted transparently through the system, and if present it will show up in the **mdcsniffer** packet display list. Packets transmitted from microVB units will also be displayed, in addition to IGMP messages. A sample **mdcsniffer** output is shown below. Text typed by the user is highlighted in green. Beacon packets should always be present in the list, provided that the beacon multicast transmission has not been deliberately switched off.

```
[sniff@mds ~]$ ./mdcsniffer
mdcsniffer (compiled Feb  4 2010) -- Copyright Bridge Technologies AS, 2009

Use 'mdcsniffer ?' for help.

NOTE: This tool can only show packets it can see!

TIME       SOURCE IP       DESTINATION IP  PORT  LEN  ! DESCRIPTION
 0:00.072 192.168.7.88    233.60.200.250  8888   76 ! Beacon packet
 0:00.075 192.168.7.30    192.168.7.88    3214  237 ! Device ID 336E4895019C910C, ver 15
 0:02.802 192.168.7.88    233.60.200.250  8888   76 ! Beacon packet
 0:02.804 192.168.7.30    192.168.7.88    3214  237 ! Device ID 336E4895019C910C, ver 15
 0:05.759 192.168.7.30    192.168.7.88    3214 1215 ! Device ID B0BE4894019C9109, ver 15
 0:06.001 192.168.7.88    233.60.200.250  8888   76 ! Beacon packet
 0:06.002 192.168.7.30    192.168.7.88    3214  237 ! Device ID 336E4895019C910C, ver 15
 0:06.988 192.168.7.30    192.168.7.88    3214 1215 ! Device ID 97F14895019C9103, ver 15
 0:08.495 192.168.7.88    233.60.200.250  8888   76 ! Beacon packet
 0:08.496 192.168.7.30    192.168.7.88    3214  237 ! Device ID 336E4895019C910C, ver 15
 0:08.689 192.168.7.30    192.168.7.88    3214 1215 ! Device ID AE704894019C910A, ver 15
 0:10.181 192.168.7.30    192.168.7.88    3214 1215 ! Device ID 252B4895019C910A, ver 15
 0:10.666 192.168.7.30    192.168.7.88    3214 1215 ! Device ID 9052489401 9C9101, ver 15
 0:12.421 192.168.7.88    233.60.200.250  8888  132 ! Beacon packet
 0:12.738 192.168.7.30    192.168.7.88    3214 1215 ! Device ID 2982489501 9C910C, ver 15
 0:12.938 192.168.7.88    233.60.200.250  8888   76 ! Beacon packet
 0:12.939 192.168.7.30    192.168.7.88    3214  237 ! Device ID 336E4895019C910C, ver 15
 0:13.411 192.168.7.30    192.168.7.88    3214 1215 ! Device ID 25C14895019C910D, ver 15
 0:13.831 192.168.7.129   192.168.7.88    3214  123 ! Device ID 55C593B1481C14C4, ver 4
 0:14.389 192.168.7.30    192.168.7.88    3214 1215 ! Device ID A9DD4894019C910D, ver 15
 0:15.133 192.168.7.1     224.0.0.1       -     60 ! IGMP QUERYv2 ALL
 0:15.309 192.168.7.88    233.60.200.250  8888   76 ! Beacon packet
 0:15.310 192.168.7.30    192.168.7.88    3214  237 ! Device ID 336E4895019C910C, ver 15
 0:16.178 192.168.7.30    192.168.7.88    3214 1215 ! Device ID 2DC54895019C9109, ver 15
 0:16.312 192.168.7.125   224.0.0.251     -     60   IGMP REPORT 224.0.0.251
 0:17.668 192.168.7.88    233.60.200.250  8888   76 ! Beacon packet
```

The **mdcsniffer** list consists of the following columns:

mdcsniffer: Packet Parameters Listed	
TIME	The time from the mdcsniffer was started to detection of packet. The format is *minutes : seconds*.
SOURCE MAC	The source MAC address. Only displayed if the *-m* option has been selected (*./mdcsniffer -m*).
DESTINATION MAC	The destination MAC address. Only displayed if the *-m* option has been selected(*./mdcsniffer -m*).
SOURCE IP	The source IP address
DESTINATION IP	The destination IP address
PORT	The destination port number
LEN	The total packet length in bytes
DESCRIPTION	A description of the packet

Typical packet descriptions are:

mdcsniffer: Packet Descriptions	
Beacon packet	Beacon and bootcast packets are listed as beacon packets. Beacon packets should be present at all stages in the network. Beacon and bootcast packets are differentiated by destination IP address.
Device ID <ID>, <firmware version>	Report packets from microVB devices are described with device ID and firmware version. If the PC running **mdcsniffer** is connected as a substitute for an end-user's set-top box, report packets from the up-stream microVB should be present in the list.
IGMP QUERY	IGMP query packets from the up-stream switch should be present at end-users' premises.
IGMP REPORT	microVB devices will join the beacon multicast upon start-up, and they will regularly confirm joining by sending IGMP report packets to the up-stream switch. Join packets are listed as IGMP report packets. If an application like VLC is run on the lap-top, the PC's IGMP messages will also be listed.
IGMP LEAVE	If an application like VLC is run on the lap-top, IGMP leave messages will be present after channel zapping.

By typing **mdcsniffer ?** the two application options are displayed:

mdcsniffer -a	All detected packets will be listed
mdcsniffer -m	Source and destination MAC addresses will be listed

mdcsend

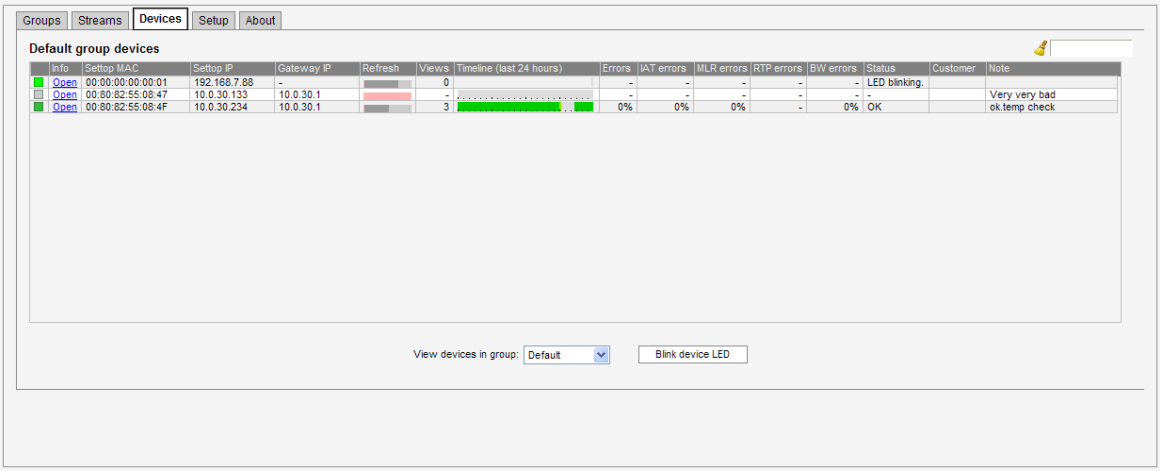
The **mdcsend** application will send a dummy microVB report packet to the MDC when activated. Thus if a lap-top with this application is connected to the network at a customer's home (or at any stage in the network), it is possible to check the network transparency for microVB report packets. The command format is:

mdcsend <IP address> <IP port number>

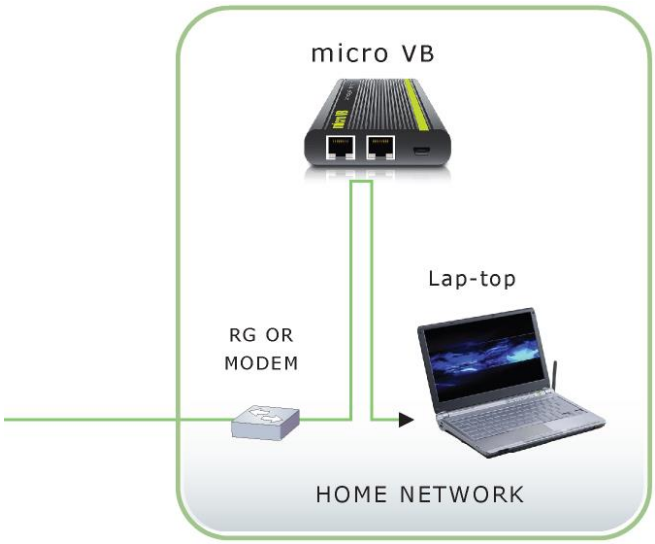
where the MDC server's IP address and port number is specified. A typical **mdcsend** output is shown below. Text typed by the user is highlighted in green.

```
Last login: Tue Feb  9 13:08:41 2010 from 192.168.7.133
[mdcsend@mds ~]$ ./mdcsend 192.168.7.44 1234
Sent device packet to 192.168.7.44:1234
[mdcsend@mds ~]$
```

A device with ID 0000000000000001 should appear in the *Default* group in the MDC GUI. The sent packet will mimic a microVB blinking, to make it easy to recognise the device in the MDC **Devices** view. If column sorting on set-top MAC address is performed, the **mdcsend** dummy device will appear at the top of the device list. Note that the IP address of the PC running the **mdcsend** application will appear in the **Device Information - Details** view rather than the IP address of the set-top box. Also note that if several users run the **mdcsend** application from different PCs, all will appear with the same device ID in the MDC GUI. It is therefore recommended that only one user makes use of the application at any time.



Using mdcsniffer and mdcsend



A typical application for **mdcsniffer** and **mdcsend** is to check signalling in an end-customer's home. By replacing a set-top box with a lap-top with these applications installed, it is possible to examine signals received from the MDC server and also check packets sent by the microVB, as these are sent on both microVB Ethernet ports. The Ethernet cable should be reconnected from set-top box to the lap-top, leaving the set-top box (and thereby microVB) powered on.

It may be a good idea to run an application like VLC on the lap-top, to create regular multicast join/leave IGMP traffic between PC and up-stream switch, to mimic set-top box operation.

In this configuration the following packets should be present to be displayed by mdcsniffer:

- Beacon packets from the MDC server
- Report packets from the microVB
- IGMP query packets from the up-stream switch
- IGMP report packets from the microVB (joining the beacon multicast)
- Any IGMP report and leave packets sent from the PC

When the **mdcsend** application is run, the dummy device should be detected by the MDC server. Note that in some networks it may be necessary to change the PC's IP address and even MAC address, for compatibility with network security settings.

V. Appendix: mdcwrite - microVB Configuration Tool

The microVB configuration tool 'mdcwrite' is used to pre-configure the MDC server domain name in microVB devices to establish communication. For devices running firmware older than 21 it is necessary to upgrade them when programming server domain name.

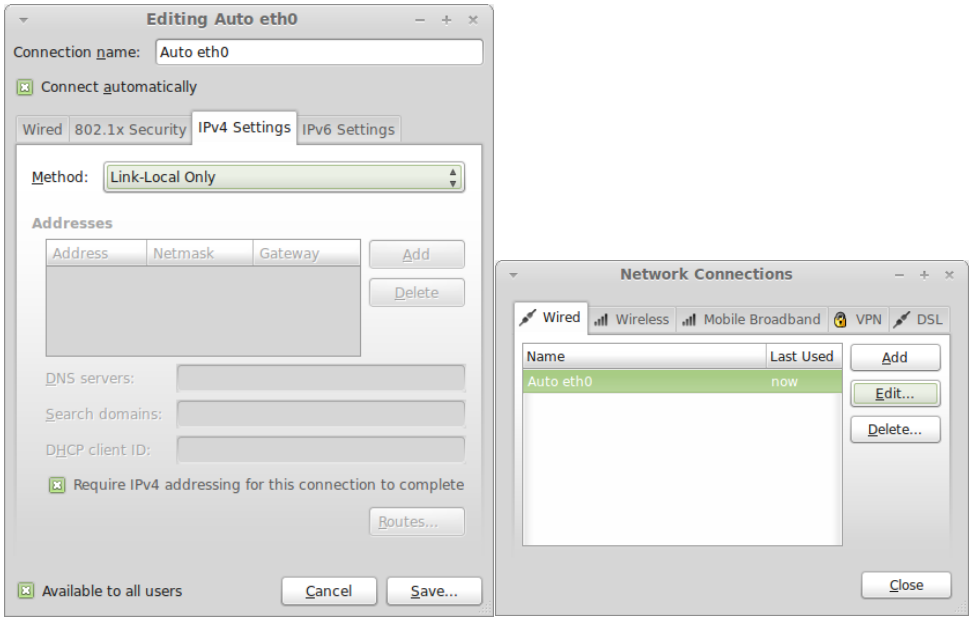
As an alternative to using the flexibility of a server domain name it is possible to program the MDC server IP address into the microVB devices. The IP address of the microVB itself can also be programmed rather than relying on a DHCP server. Note that static parameters will be overwritten if a programmed MDC domain name resolves and/or if a DHCP server is present to allocate an IP address to the microVB.

mdcwrite is an application that will be automatically included when the MDC software is downloaded and installed. Application parameters available are shown below.

```
mdcwrite (compiled Sep 25 2012) -- Copyright Bridge Technologies
AS, 2012

This program will write configuration information into a device.
Double check the configuration printed and then connect one
device at a time.
NOTE: It may be necessary to configure the interface with a
static IP.

Options
  --server-hostname <dns name>
      Hostname of server.

  --firmware <filename>
      Write firmware into device.

  --one
      Exit after programming one device.

Advanced options (for use in special cases)
  --server-ip <ip>
      Initial server to use. --server-hostname will be used
instead if it resolves.

  --device-ip <ip>
  --device-netmask <netmask>
  --device-gateway <ip>
      Initial IP, netmask and gateway for device. All three or
none must be specified.
      Will be overwritten by DHCP.
```

microVB Configuration Example

When configuring microVB devices it is necessary to configure the Linux machine Ethernet port to local link rather than DHCP. An example of how this could look is shown below. When local link has been selected connect to one of the microVB Ethernet ports. Note that the microVB units must be powered.



The example below shows the screen printout when programming two microVB units running firmware version 19 - they are updated to firmware version 20 when the user-defined server domain name 'mdc.example.com' is programmed into the devices. The filename and file location of the new firmware will be as shown in this example, unless they have been altered by the user.

```
thomas@drops ~/code/btech/microvb/mdc/util $ ./mdcwrite --firmware /opt/mdc/firmware.bin --server-hostname mdc.example.com
Firmware loaded (ver 20, type 16, crc 502DDD8B, sz 64664)

PLEASE REVIEW BEFORE CONNECTING DEVICES!
Server hostname : mdc.example.com
Firmware version: 20

Press Ctrl+C to stop.

Device ID 4B0B4659663A1752 (fw 19): uploading...ok. -- DONE! --
Device ID 2F594895019C910A (fw 19): uploading...ok. -- DONE! --
```

VI. Appendix: Pff PCAP Filter Forwarding

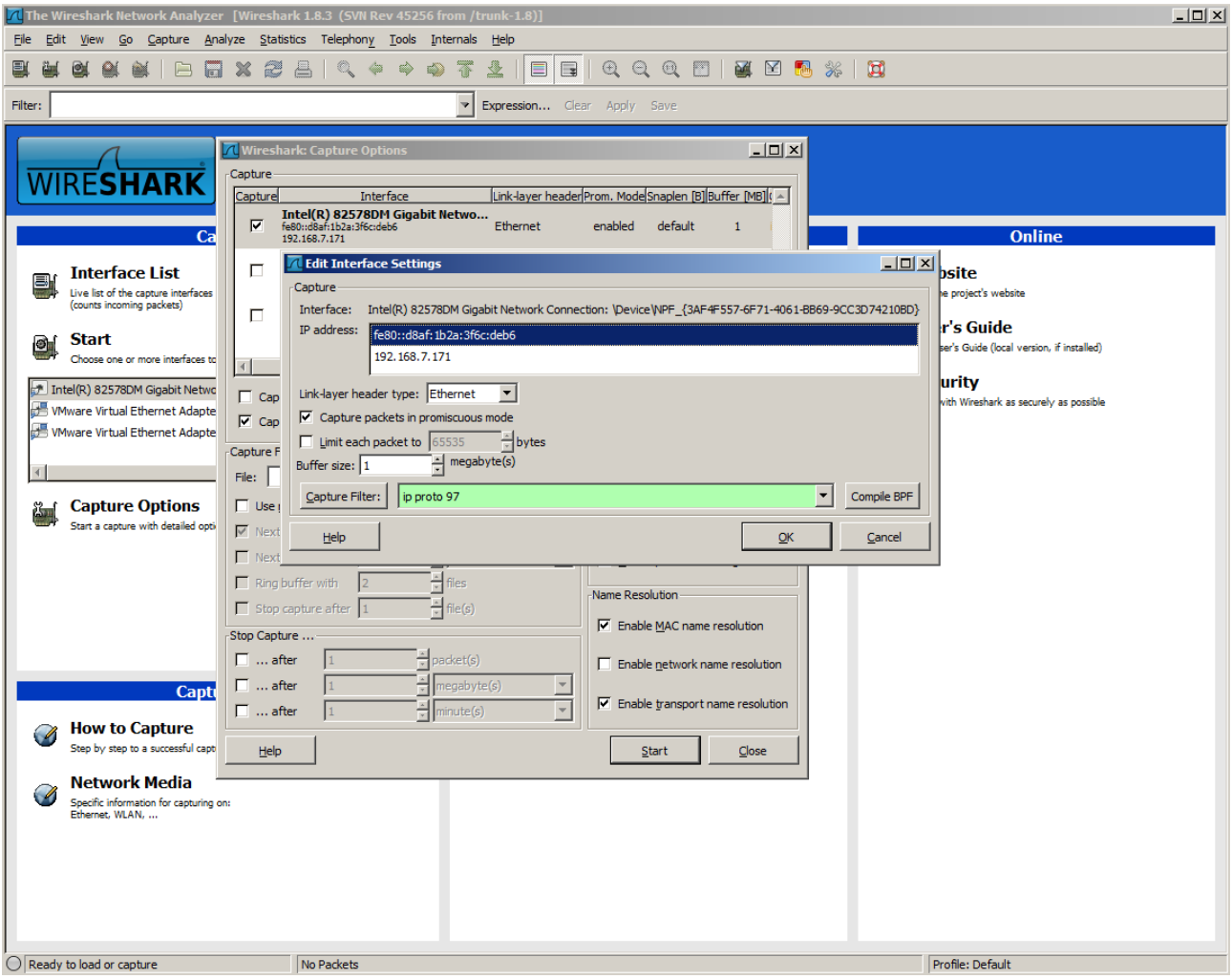
The optional Pff PCAP filter forwarding enables a part of each packet of a specified type to be sent to a user-defined address. This makes it possible to investigate network problems in detail. Generally it is only necessary to forward packet headers, thus reducing the network load added by the PCAP filter forwarding.

The user specifies the size of each packet slice in addition to the number of packets to capture. Packet slices are sent to the MDC server that will in turn re-transmit the capture to the final destination address. Note that the network must be transparent for EtherIP traffic from the

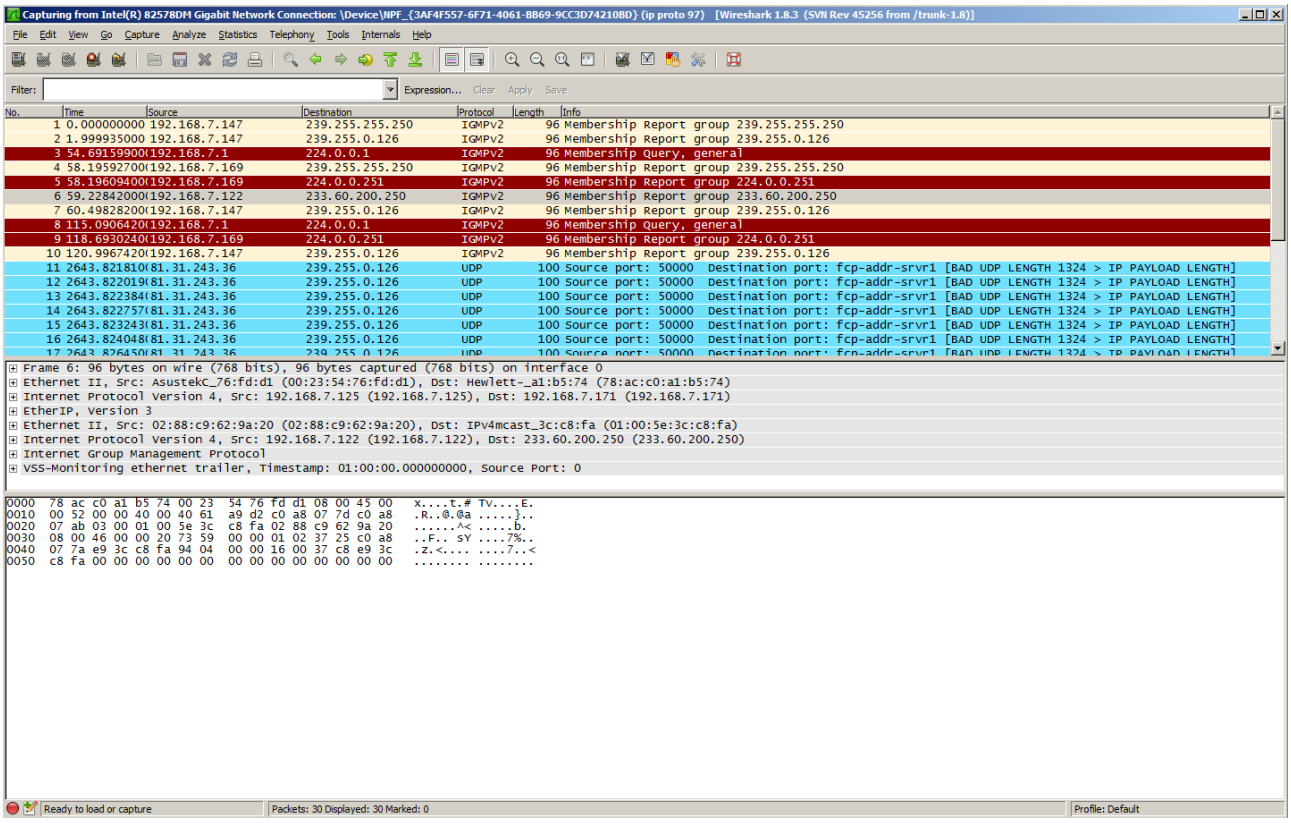
MDC to the destination address for the system to work as intended.

Example Using Wireshark

In order for Wireshark to analyse the PCAP capture it is reommended to filter on EtherIP encapsulation of received packets. This is done by entering the **Capture - Options** view and selecting the interface receiving the microVB PCAP traffic. Double click the interface in the list and define capture filter **ip proto 97** . Start the Wireshark capture, and the microVB capture traffic should appear in the traffic list.



The screenshot below shows the Wireshark capture result when the microVB has been configured to first capture ten IGMP packets and later multicast traffic.



Please refer to Wireshark and general network documentation for details on how to use Wireshark and analyse captures.

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