



## **VB440 Studio Probe**

### **User's Manual**

Applies to software release v6.0

November 2020

Current documents are always found in the log-in area of the **[www.bridgetech.tv](http://www.bridgetech.tv)** site.  
Refer to section 1.2 of this document for more information.

VB440 Studio Probe User's Manual  
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# 1 Introduction

## 1.1 About the VB440 Studio Probe

The VB440 Studio Probe performs monitoring and analytics in real-time for high bitrate streams typically seen in studios. It supports RTP streams carrying SMPTE 2022-6 and 2110 streams, optionally protected by SMPTE 2022-7.

The VB440 Studio Probe enables operators to inspect the individual streams and to verify that they are compliant.

The VB440 Studio Probe comes with dual 100Gbps network ports, making it a future proof solution. Each VB440 Studio Probe runs an HTTP server with the client as a web browser, so there is no need to install custom software on computers needing access to the measurement data.

## 1.2 How to Use This Manual

This User's Manual is valid for software version 6.0 of the VB440 Studio Probe.

Throughout this manual the term stream is often used rather than unicast or multicast. One stream may consist of one or more services, and refers to one IP uni- or multicast.

Chapter 2 **SAFETY** lists safety precautions, and this chapter should be read prior to equipment installation.

Chapter 3 **Installation and initial setup** explains how to install the equipment and also how to perform the necessary initial configuration of the VB440 Studio Probe management IP address. A step-by-step quick installation guide is found in section 3.2.

Chapter 4 **The VB440 Graphical User Interface** describes the graphical user interface (GUI) as seen when pointing a web browser to the VB440 Studio Probe's IP address.

5.1.2 **Data — OS Update** explains how to upgrade the software on the VB440 Studio Probe.

Note that current version of the User's Manual can be found on the <https://www.bridgetech.tv/> website. Log in as end user: **customer** with password: **xmas4u**. Additional technical documentation is also found at the same location.



## 2 SAFETY

**Read the installation instructions before connecting the chassis unit to the power source. Do not install the chassis unit with power on.**

**The chassis or the portable unit is intended for installation in restricted access areas. A restricted access area can be accessed only through the use of a special tool, lock and key, or other means of security.**

**Blank face plates and cover panels serve three important functions: they prevent exposure to hazardous voltages and currents inside the chassis, they provide electromagnetic interference shielding and they direct the flow of cooling air through the chassis. Do not operate the chassis unit unless all modules, face plates, front covers and rear covers are in place.**

**Only trained and qualified personnel should be allowed to install, replace or service this equipment.**

**This equipment must be installed and maintained by service personnel as defined by AS/NZS 3260. Incorrectly connecting this equipment to a general-purpose outlet could be hazardous.**

**If SFP modules are used ensure proper precautions are taken to protect eyes against harmful infrared radiation. Do not look straight into the SFP module or fibers connected to the SFP module. The SFP modules employed are certified in Laser Class 1.**

**Ultimate disposal of this product should be handled according to all national laws and regulations.**

**To prevent the system from overheating, do not operate it in an area that exceeds the maximum ambient temperature of 45 degrees Celsius.**

**Do not work on the system or connect or disconnect cables during periods of lightning activity.**



## 3 Installation and initial setup

### 3.1 Prerequisite

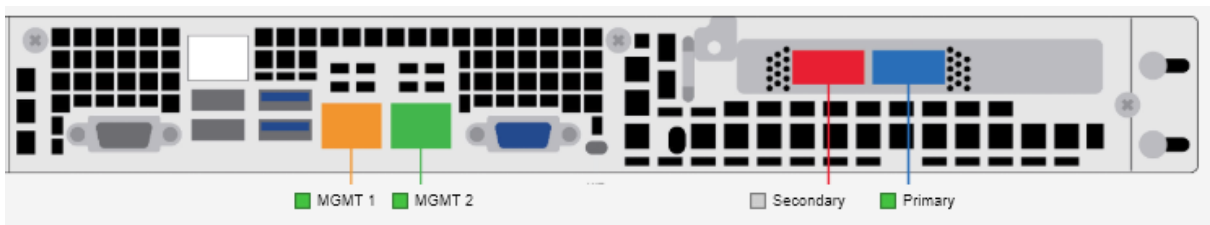
To connect the appliance you need the following:

- Two power cables for the redundant PSU
- 1 or 2 RJ45 1 Gbps Ethernet ports for management
- QSFP28 connectors for the data ports, or a QSFP cage + supported SFP module

Supported QSFP28 protocols:

- 100GBASE-CR4
- 100GBASE-KR4
- 100GBASE-SR4
- 56GBASE-R4
- 50G Ethernet Consortium
- 40GBASE-CR4
- 40GBASE-SR4
- 40GBASE-LR4
- 40GBASE-ER4
- 25GBASE-CR/CR-S
- 25GBASE-SR
- 25GBASE-LR
- 25G Ethernet Consortium
- 10GBASE-SR
- 10GBASE-LR
- 10GBASE-ER
- 10GBASE-CX4
- SGMII
- 1000BASE-X

### 3.2 Quick Installation Guide



Connect one or both of the management cables. Please note that with the default configuration MGMT 1 (Orange) is configured with a static IP, and MGMT 2 (Green) is configured using DHCP. If you choose to use the static port, the pre-configured address will be 10.0.20.101/16.

The server also has an IPMI port that can be connected if wanted. It is configured to use DHCP and the username and password is ADMIN / ADMIN.



Insert the QSFPs into the Primary (Blue) and Secondary (Red) ports, choosing a supported QSFP-type from the list above.

You can then connect the two power cables and power the server on.

### 3.3 Accessing the User Interface

Once the server has been connected to the network, you can use a browser to connect to the user interface.

Please note that, for optimum results, Chrome is recommended to manage the VB440.

To connect to the VB440, you will either have to have mDNS and IPv6 working (typically only on Mac OS) or know the IP. If you have connected to the static management port, the default address should be 10.0.20.101. Your machine will have to be on the same network in order to reach it through that address. If you have connected it to the DHCP management port, you will either have to get the IP from your DHCP server, or from the printout in the console.

```
VB440 Probe - CentOS Linux 7 (Core)
Kernel 3.10.0-862.2.3.el7.x86_64 on an x86_64

  MGMT1: 10.0.20.101 fe80::3bd6:d3ca:3f5e:217f
  MGMT2: 10.0.20.62 fe80::8d3e:452d:3d57:32ae
  Primary: 10.100.1.91 fe80::d8a5:547e:cbc3:50f
  Secondary:

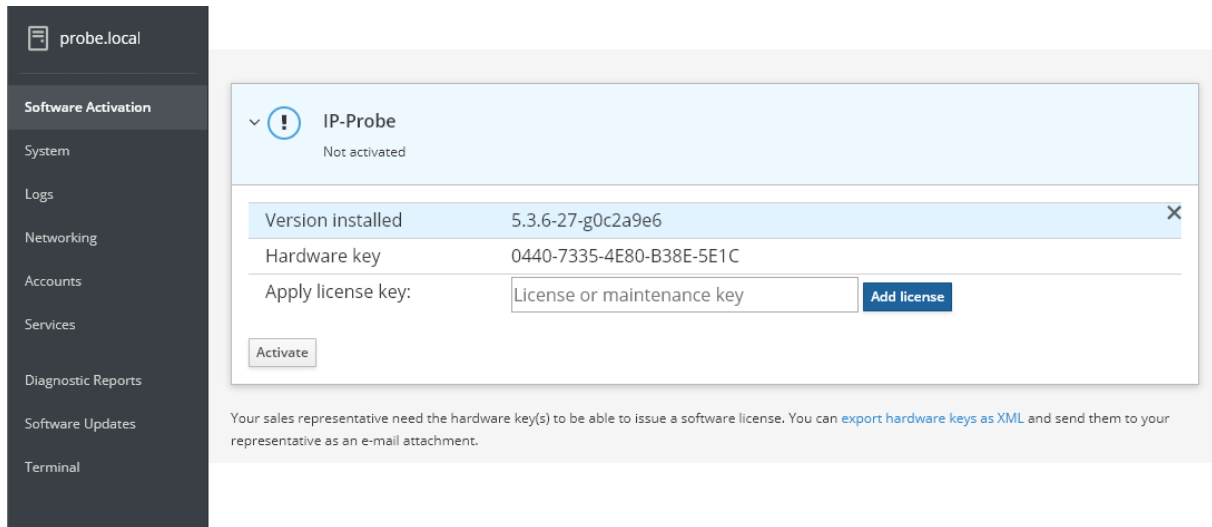
probe login:
```

Depending on if the product is enabled and is properly licensed you either get the enable / license UI or the main UI up.

If you get a HTTPS certificate warning, just accept it.

If you get a login page as seen above, the product has not yet been activated. If you do not get a login page, go straight to section 3.4

Log in using the username **root** and the password **elvis**.

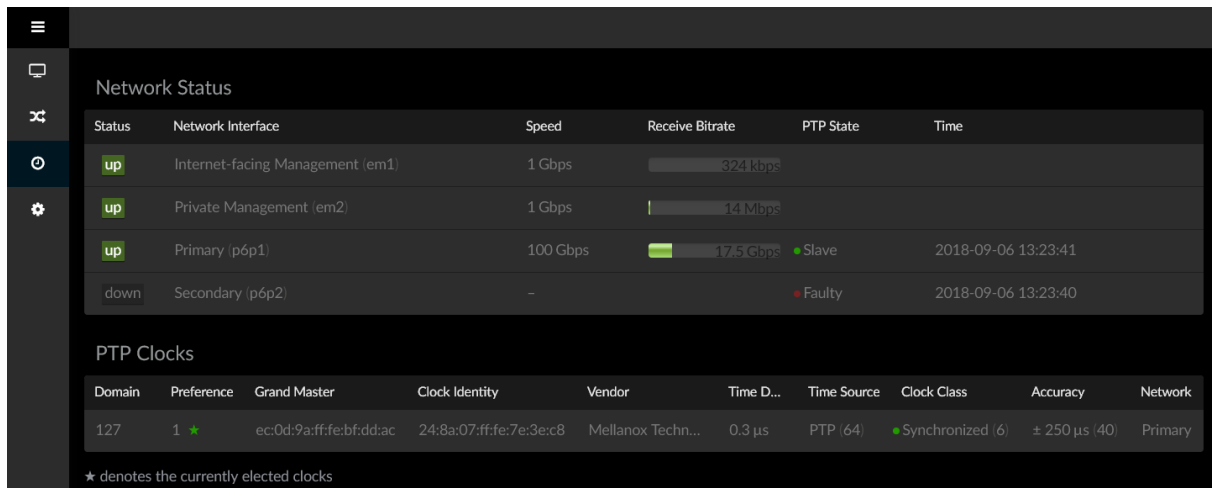


On the **Software activation** screen, expand the IP-Probe menu and input both the software license, and the software maintenance license, pressing **Add license** after each license. When all the licenses have been accepted, press the **Activate** button. You can now access the regular probe UI by going straight to the IP again.

To get back into the system admin dashboard, go to <http://IP/admin/>.

### 3.4 Graphical User Interface

The default GUI should look similar to the following picture. For more information, refer to chapter 4.



### 3.5 Configuring Ethernet settings

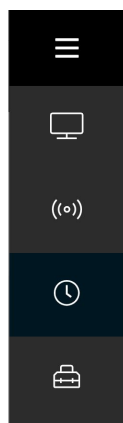
The VB440 comes with built in support for editing the network interface settings. To access the system admin interface, point your browser to <http://IP/admin/> and log in using the default system username **root** and the password **elvis**.

This is described in more detail in the **System Administration** part of the manual.



## 4 The VB440 Graphical User Interface

### Navigation Menu



The navigation menu is located in the top left corner and can be made visible or hidden by clicking the navigation menu button. The navigation menu is marked with three horizontal lines, and is accessible from any page.

The navigation menu consists of four different icons that will help you navigate to the preferred view. The icon shaped like a tv screen leads to the *Services View*. Next there is a signal symbol that takes you to the *Flow View*. The clock indicates the *Status View*. Note that Status view also is the landing page when you first open the probe in a browser. The last symbol illustrates a tool box which opens the Expert view.

### Status View

Displays a generalized overview of the probe, divided into four sections:

- Network Status
- PTP Clocks
- Video Engine Statistics
- Video Streaming Statistics

Note that the page uses responsive design. If the viewport is small, some of the sections seen in the screenshots below will not be visible.

### Network Status

Network Status							
Status	Network Interface	Speed	Receive Bitrate	Neighbor Name	Neighbor Port	PTP State	Time
up	System em1 (em1)	1 Gbps	1 Mbps	Machineroom_Storage	G11/0/12		Details >
down	em2	–					
up	System p6p1 (p6p1)	100 Gbps	15.68 Gbps	Studio-1	Eth1/19	Slave	2020-10-22 11:49:05 Details >
up	System p6p2 (p6p2)	100 Gbps	9.17 Gbps	Studio-2	Eth1/21	Slave	2020-10-22 11:49:05 Details >



*Network Status* shows a quick presentation of key information about each network interface on the probe. The different sections are elaborated in the following table.

<b>Status</b>	Indicates if the network interface is connected.
<b>Network interface</b>	The name of the network interface.
<b>Speed</b>	Physical link speed if the network interface is connected.
<b>Receive Bitrate</b>	The traffic received on the interface measured per second. The bar represents the amount of network traffic compared to the theoretical max based on link speed.
<b>Neighbor Name</b>	Shows the name of the neighboring device retrieved through Link Layer Discovery Protocol (LLDP), if available.
<b>Neighbor Port</b>	Displays the name of the port of the neighboring device if it is reported by LLDP.
<b>PTP State</b>	Shows the current state of the PTP clock on this interface, one of: <ul style="list-style-type: none"><li>• Slave – PTP clock is slaved and synchronized</li><li>• Uncalibrated – PTP clock is slaved, but not synchronized</li><li>• Listening – Listening for eligible PTP master clocks</li><li>• Faulty – Failed to synchronize local PTP clock against master clock</li><li>• Disabled – PTP synchronization on this interface has been disabled manually in Expert View Setup. When disabled, the PTP clock will be synchronized against the less accurate system clock internal to the probe. The system clock might be free-running, or synchronized to NTP servers or a PTP clock on another interface.</li></ul>
<b>Time</b>	Shows the current date and time of the PTP clock on this interface.

For more detailed information, click the **Details** button to the right and a drop-down menu will appear as shown in the screenshot below.



up

Primary (p6p1)

100 Gbps

16.32 Gbps

● Slave

2020-09-21 10:24:58

Details

Operational Status

Troubleshooting Info

Auto Negotiation

FEC

Loopback Mode

Physical state

Speed

State

Width

Height Eye Opening [mV]

Phase Eye Opening [psec]

Physical Grade

No issue was observed.

ON

Standard RS-FEC - RS(528,514)

No Loopback

LinkUp

100GbE

Active

4x

278, 276, 412, 372

17, 21, 18, 16

23171, 17807, 26447, 19878

Supported Capabilities

Enabled Link Speed

Supported Cable Speed

FEC Capability 100GbE

FEC Capability 10GbE

FEC Capability 25GbE

FEC Capability 40GbE

FEC Capability 50GbE

100G, 50G, 40G, 25G, 10G, 1G

100G, 50G, 40G, 25G, 10G, 1G

No-FEC, RS-FEC(528,514)

No-FEC, FireCode FEC

No-FEC, FireCode FEC, RS-FEC(528,514)

No-FEC, FireCode FEC

No-FEC, FireCode FEC, RS-FEC(528,514)

Neighbor Information (LLDP)

Port Description

Port Name

Remote Description

Remote Management IP

Remote Name

vb440demo

Eth1/9

MSN2100,Onyx,SWv3.9.1014

10.254.0.10

sn2100-c-starboard

Module Information

Attenuation (5g,7g,12g) [dB]

Bias Current [mA]

CDR RX

CDR TX

Cable Technology

Cable Type

Compliance

Digital Diagnostic Monitoring

FW Version

Identifier

LOS Alarm

OUI

Power Class

Rev

Rx Power Current [dBm]

Temperature [C]

Transfer Distance [m]

Tx Power Current [dBm]

Vendor Name

Vendor Part Number

Vendor Serial Number

Voltage [mV]

Wavelength [nm]

10,0,0

N/A

OFF,OFF,OFF,OFF

OFF,OFF,OFF,OFF

Copper cable unequalized

Passive copper cable

100GBASE-CR4 or 25GBASE-CR CA-L

No

N/A

QSFP28

N/A

Mellanox

1.5 W max

A

N/A

N/A

10

N/A

Fiberstore

Q28-AO10

H0812300338-1

N/A

N/A

In this detailed view you see information regarding the Transceiver and extended LLDP information.

LLDP (Link Layer discovery protocol) is used by devices to advertise their identity to other devices connected to the same network, also called neighbors. The devices identify themselves by periodically sending out packets to its neighbouring devices. The packets typically contain information such as, port name, capabilities, IP management addresses etc. The Information gathered with the help of LLDP can be useful for troubleshooting configuration problems within the network, or locate connected devices.

## PTP Clocks

PTP Clocks								
Domain	Preference	Grand Master	Clock Identity	Vendor	Time D...	Time Source	Clock Class	Network
127	1 ★	00:09:0d:ff:fe:00:df:20	24:8a:07:ff:fe:7e:3e:c8	Mellanox Techn...	0.2 μs	GPS (32)	● Synchronized (6)	Primary

This section gives an overview of all PTP clocks that announce themselves on the network.

The Precision Time Protocol (PTP) is used to precisely synchronize all clocks in a computer network. Time is exchanged between the master and slave clocks, with intermediate transparent- or boundary clocks which maintain the timing accuracy.



For more information see the section about configuring PTP and BMCA in the appendix.

<b>Domain</b>	Which domain the clock belongs to.
<b>Preference</b>	Indicates in what order the BMCA would select the clock.
<b>Grand Master</b>	The grandmaster identity for this clock.
<b>Clock Identity</b>	The identity of the clock.
<b>Vendor</b>	The vendor of the clocks. This is deduced using the IEEE Organizationally Unique Identifier (OUI) database.
<b>Time Delta</b>	The time delta between the timestamp in the announce messages and the PTP clock on the interface, at the time of reception.
<b>Time Source</b>	The timing source for this clock.
<b>Priority1</b>	The Priority1 value for this clock. (BMCA 1st criteria.)
<b>Clock Class</b>	Indicates to which class the clock belongs to. (BMCA 2nd criteria.)
<b>Accuracy</b>	The announced accuracy. (BMCA 3rd criteria.)
<b>Priority2</b>	The Priority2 value for this clock. (BMCA 4th criteria.)
<b>Network</b>	Which network interface received announce messages from this clock.

## Video Engine Statistics

Video Engine Statistics <small>BETA</small>					
Engine	Video Stream	Video Format	Bitrate	Throughput	Delay
1	Matrox 4 Video@Primary	1920x1080p50	6 Mbps	191 fps	5 ms

Video engine statistics gives you an overview of active engines. The following information relevant to Video Engine Statistics is displayed in the table below.

<b>Engine</b>	The video engine number.
<b>Video Stream</b>	Specifies the name of the active video flow.
<b>Video Format</b>	Specifies the video resolution, scan format and frame rate of the active video flow.
<b>Bitrate</b>	The bitrate of traffic going out of the video engine.



<b>Throughput</b>	The throughput speed of the video engine with this current load, measured as number of frames per second.
<b>Delay</b>	Maximum processing delay per video frame.

## Video Streaming Statistics

Video Streaming Statistics <small>BETA</small>						
Address	Browser	OS	Bitrate	Queue Len	RTT	
172.20.1.204	Chrome 86.0.4240.111	Mac OS 10.15.6	0 Mbps	0 ms	0 ms	Details >
192.168.50.60	Chrome 86.0.4240.183	Windows 10	0 Mbps	1 ms	15 ms	Details >

*Video streaming statistics* point to which devices are playing the Video flow. Information related to Video Streaming Statistics is elaborated in the following table.

<b>Address</b>	The IP address of the client.
<b>Browser</b>	The type of browser used by the client.
<b>OS</b>	The operating system of the client.
<b>Bitrate</b>	Described in detail on the next page.
<b>Queue Len</b>	
<b>RTT</b>	

To view the client performance graphs, RTT (Round-trip Time), Transmit rate, Transmit queue length and retransmission of packets click the **Details>** button to the right.



The detailed view is divided into four sections, listed in the table below.

<b>RTT</b>	<p>Round Trip Time measures the length of time it takes to transmit data to the client <i>and</i> receive acknowledgement for that data from the client. The one-way delay (network latency from server to client) is given approximately by <math>RTT/2</math>.</p> <p>This value tells something about latency added due to network propagation delay and other delays. Lower values are better. Optimal value is <math>physical\ distance \times speed\ of\ light \times 2</math>.</p>
<b>Transmit Rate</b>	<p>Number of bits per second transmitted to and acknowledged by the client. This is the network bandwidth consumed by this client.</p>
<b>Transmit Queue Length</b>	<p>Maximum length of time packets heading towards the client were queued (held back) by the server due to network congestion between server and client, as to avoid stressing the network. Will</p>



	<p>oscillate at or around zero when available bandwidth exceeds requested bandwidth, or grow above zero otherwise.</p> <p>This value tells something about latency added due to unfavourable network conditions between server and client. Lower values are better.</p>
<b>Retransmission</b>	<p>Number of packets retransmitted.</p> <p>Values above zero indicate network problems between server and client, possibly due to poor signal reception or network congestion. Lower values are better.</p>

Each flow is marked with a colour and displayed as a graph. By default all flows are turned on. The flows can be made visible or hidden by clicking on the name of the flow, at the bottom of this view.



## Flow View

To access the flow view, click the button with the signal symbol, a list containing all monitored flows will be displayed as shown in the screenshot below.

Search...			Show Unmonitored		
	Matrox 2 Video@Primary	● 12 days	ST 2110-20 Video	1920x1080p50	239.0.20.3:50020
	Matrox 2 Audio@Primary	● 12 days	ST 2110-30 Audio	2ch 48 kHz	239.0.30.3:50030
	Matrox 2 Audio@Secondary	● 12 days	ST 2110-30 Audio	2ch 48 kHz	239.0.30.4:50030
	Matrox 2 Video@Secondary	● 12 days	ST 2110-20 Video	1920x1080p50	239.0.20.4:50020
	Matrox 4 Video@Primary	● 12 days	ST 2110-20 Video	1920x1080p50	239.0.20.8:50020
	Matrox 4 Audio@Primary	● 12 days	ST 2110-30 Audio	2ch 48 kHz	239.0.30.8:50030
	Aja@Primary	● 12 days	ST 2022-6 SDI/IP	1920x1080p59.94	239.0.20.9:50020
	Matrox 4 Video@Secondary	● 12 days	ST 2110-20 Video	1920x1080p50	239.0.20.7:50020
	Matrox 4 Audio@Secondary	● 12 days	ST 2110-30 Audio	2ch 48 kHz	239.0.30.7:50030
	Matrox 4 Anc@Primary	● 12 days	ST 2110-40 Anc.		239.0.40.7:50040
	Matrox 4 Anc@Secondary	● 12 days	ST 2110-40 Anc.		239.0.40.8:50040
	Showman Audio@Primary	● 12 days	ST 2110-30 Audio	2ch 48 kHz	239.0.30.25:50030
	Showman Video 2@Primary	● 12 days	ST 2110-20 Video	1280x720p50	239.0.20.47:50020
	Showman PGM@Primary	● 11 days	ST 2110-20 Video	1920x1080i50	239.0.20.27:50020
	Showman Video 1@Primary	● 12 days	ST 2110-20 Video	1920x1080i50	239.0.20.31:50020
	MRD7000 video	● 2 days	ST 2110-20 Video	1920x1080PsF	239.192.0.200:10000
	MRD7000 Anc	● Loss Of Signal	ST 2110-40 Anc.		239.192.0.202:10000
(( )) 30 Streams    17 Monitored    15 Video    10 Audio    5 Ancillary					

To easily locate a specific flow, use the search box in the top left corner.

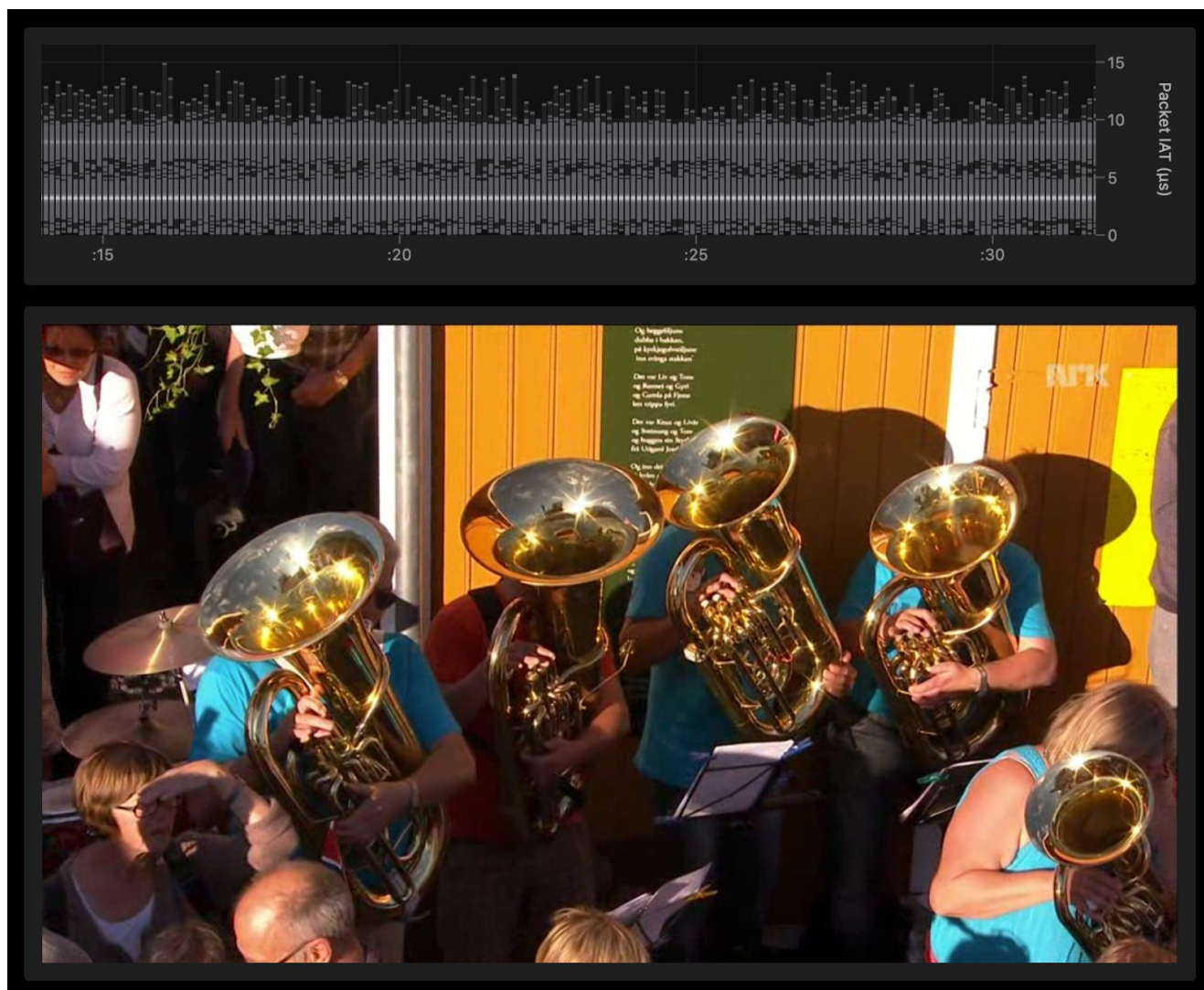
The icons to the left illustrate the type of flow you are looking at. The video camera indicates a video flow, the headphones Audio and the speech bubble Ancillary. Each line consists of



an icon, the flow name, how long the signal has persisted, the transport stream standard, metadata (resolution, number of channels, etc) and IP-address.

At the bottom part of the page you see the total number of configured flows, flows monitored and the composition of Video, Audio and Anc flows. To include all configured flows click on the button **Show Unmonitored** in the upper right corner.

If you click on one of the flows a new window will open and display an IAT graph for that flow, as shown below.





## Naming and configuration of flows

Each service consists of a bundle of flows. For the VB440 to recognize which flows belong together, the flows need to be configured correctly.

Go to Expert View (displayed as a toolbox in the navigation menu), select the Multicast tab, then the Streams tab and add a new flow or click *Edit* on the preferred flow. This will open the edit multicast view where the user can define the following parameters.

Property	Value	Description
Name	Camera 3 Audio@Amber	Identifier for referring to this stream
Group Names	Camera 3	Groups that this stream belongs to
Address	239.0.30.40	Multicast/unicast address
Port	50030	Multicast/unicast port
Ethernet thresholds	Default	Defined in Multicasts/Ethernet thresh.
VBC thresholds	Default	Defined in Setup/VBC thresh
Join stream	<input checked="" type="checkbox"/>	Check to monitor stream
Join interface	p6p2 - System p6p2	On which interface to monitor stream
Page	Page 4	On which page to display stream

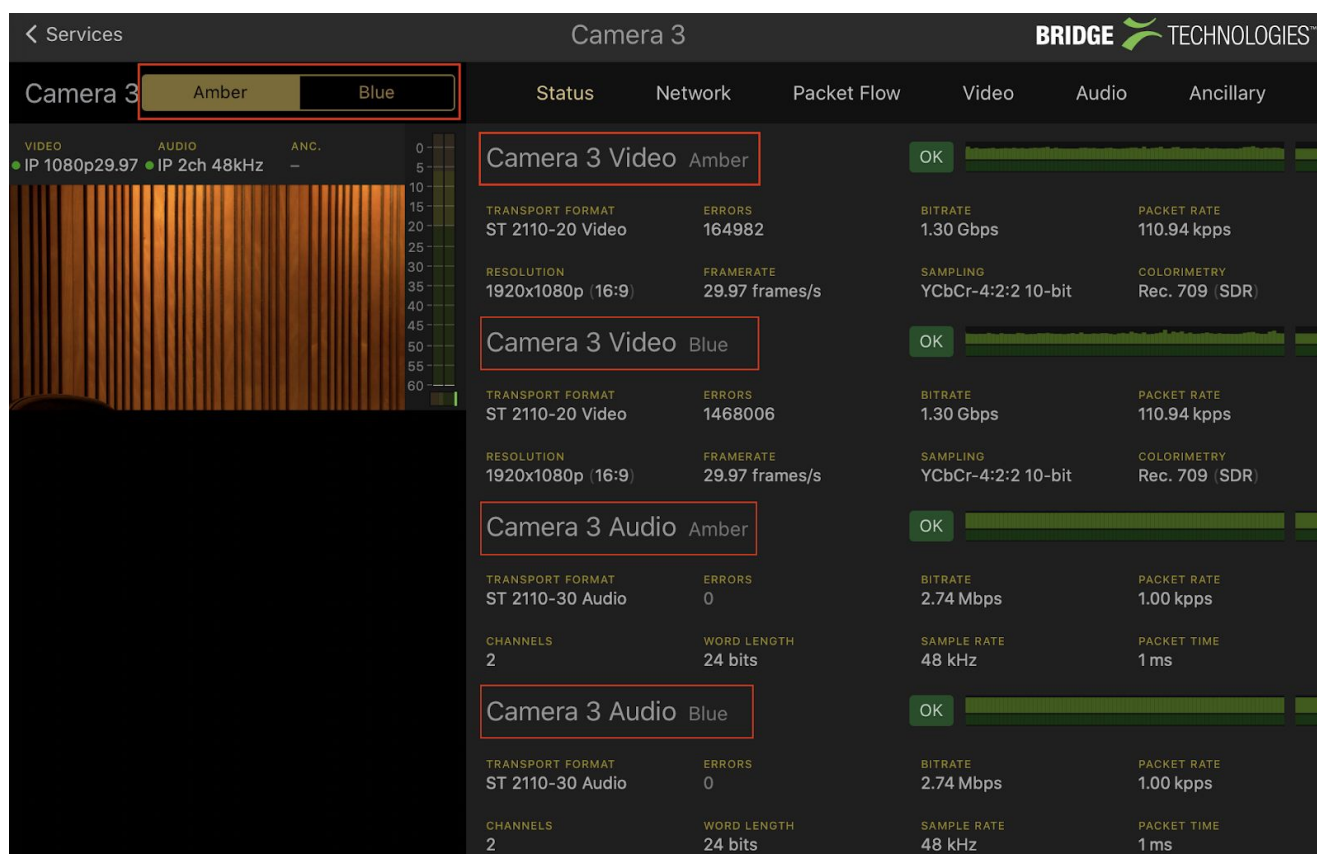
In the name section you can provide both a flow name and a class label. A class will in this context be used as a label to show which network you are receiving the stream from. Typically used labels are *Primary* and *Secondary* or *Amber* and *Blue*. The flow class is added as a part of the flow name by separating the flow name and class with the character '@'. In order to join more than one class of flows and create two identical parallel services, it's important to be careful to not mix capitalization between the different class labels. The Group Name also needs to be identical for all flows belonging to the specific group.

For example, in the screenshot above the video flow is labeled with the class name *Amber* and assigned to the group "Camera 3". For the remaining flows to be configured correctly, the flows should then be named "Camera 3 Video@Amber", "Camera 3 Anc@Amber" and belong to the same *Group Name* ("Camera 3"). To add a second class, use the flow names and *Group Name* together with a new class label. A completed configuration may look like the image below.



Camera 3 Anc@Amber
Camera 3 Anc@Blue
Camera 3 Audio@Amber
Camera 3 Audio@Blue
Camera 3 Video@Amber
Camera 3 Video@Blue
Camera 4 Anc@Amber
Camera 4 Anc@Blue
Camera 4 Audio@Amber
Camera 4 Audio@Blue
Camera 4 Video@Amber
Camera 4 Video@Blue
Camera 5 Anc@Amber
Camera 5 Anc@Blue
Camera 5 Audio@Amber
Camera 5 Audio@Blue
Camera 5 Video@Amber
Camera 5 Video@Blue

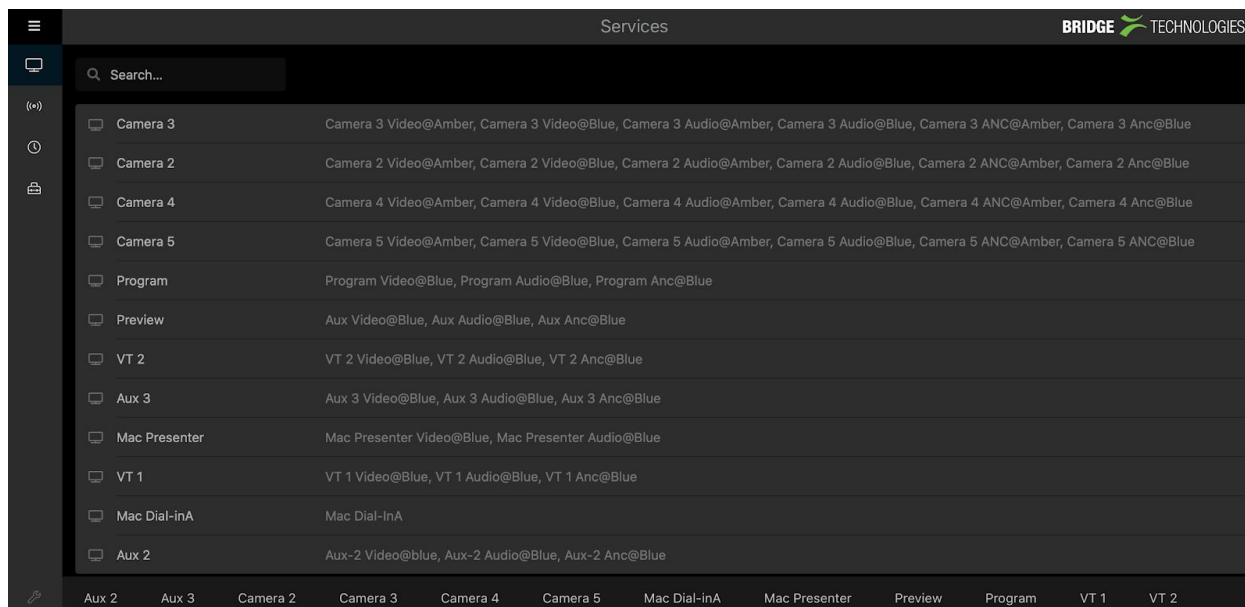
If the flows are configured correctly, they should be displayed as shown below in the screenshot of the status view.





## Service view

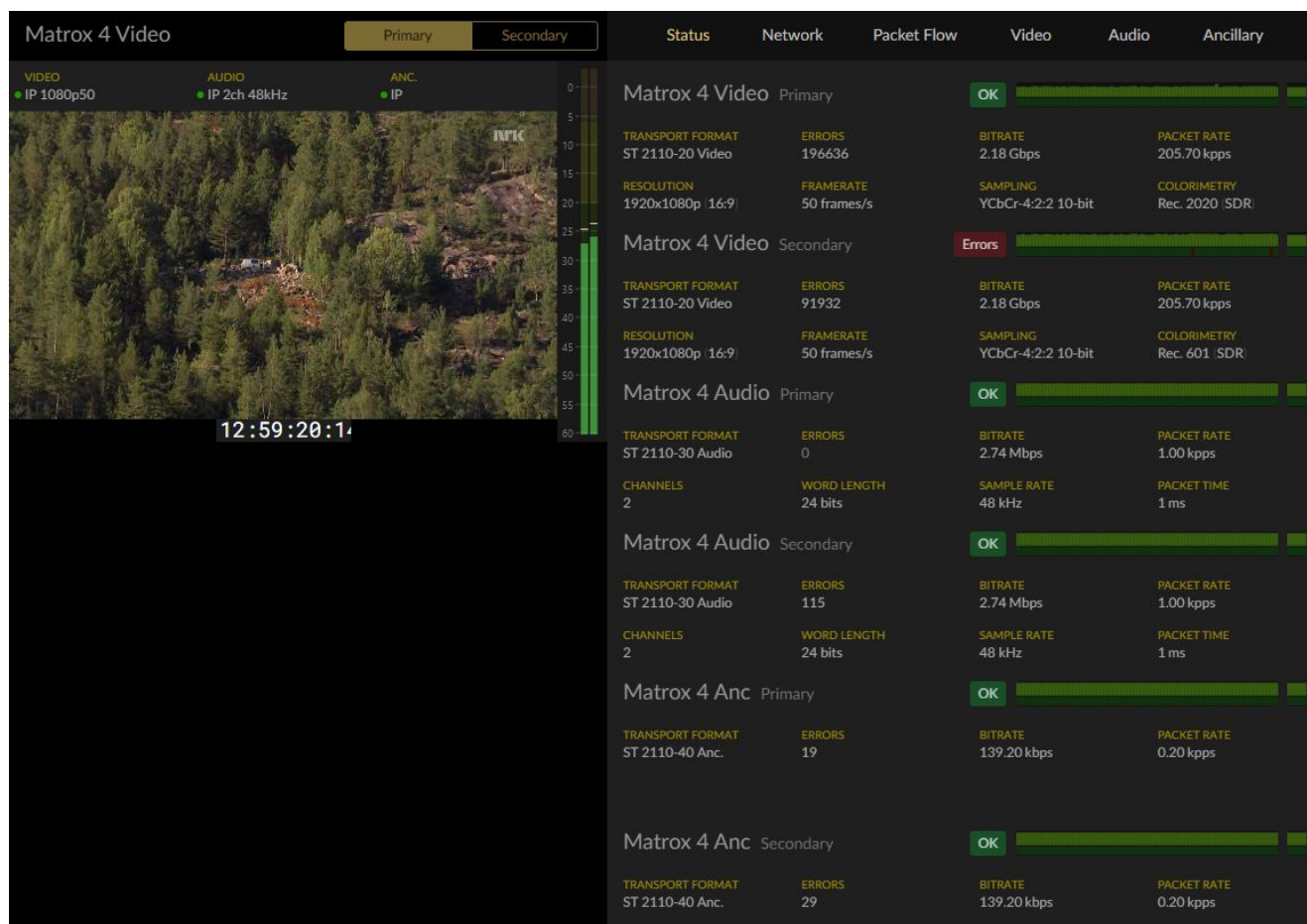
To access the service view, click the button displayed as a TV screen in the navigation menu.



This view lists all configured services, the different flows associated with each service is displayed on the right side of the service name. To access the detailed service view, click directly on a service from the list, or select a service from the bottom of this view. Note the search box in the top left corner to easily locate the preferred service.



## Status



If you have configured and joined more than one class of flows for a service, you have the option to view both classes, in this view named “Primary” and “Secondary”. Note that the class names are configurable and can be named as preferred. For more information, see section “*Naming and configuration of flows*”.

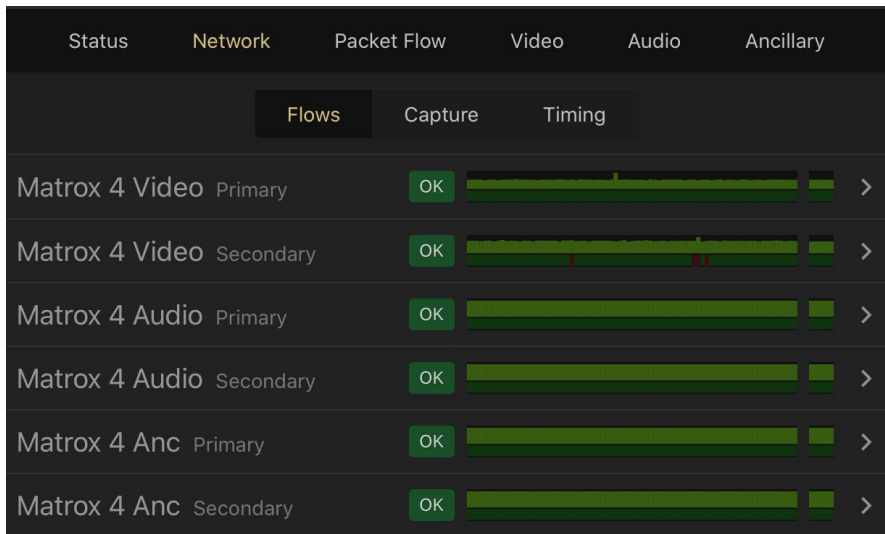
On the right side of the live transmitted video flow you will find the audio bars (if available). To watch the preferred stream, use the buttons at the top left, in this view named “Primary” and “Secondary”. The selected stream will be marked yellow. To the right, each flow is listed with information associated with each flow. Depending on the status of the stream, the green “button” showing **OK** in this view, either shows OK or ERRORS. The media window is showing a combined IAT / packet loss graph.

## Network

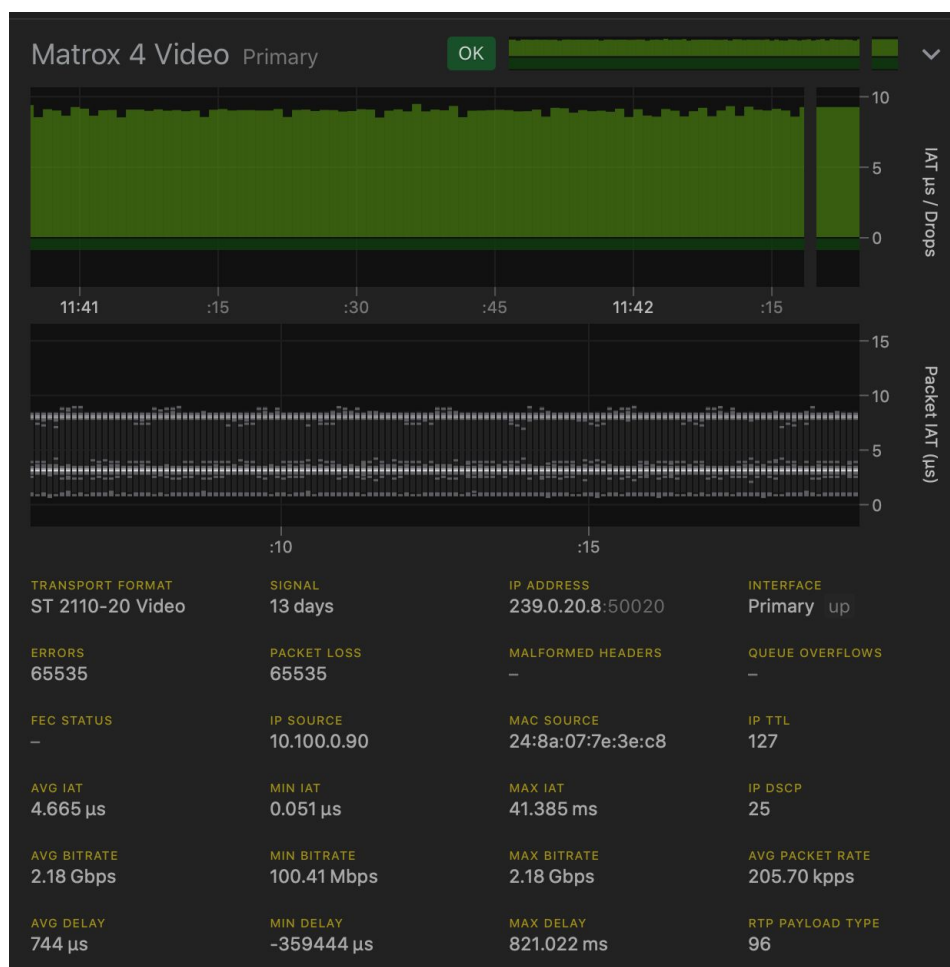
The network view offers three tabs, Flow, Capture and Timing.



## Flows



The flow view is intended to provide more extensive information about each individual flow. Click anywhere on the line to extend the window and see the current status of the selected flow. The new window contains two IAT graphs and detailed measurements as shown in the screenshot below.



## Capture

Used for troubleshooting by capturing packets for analysis.

To capture a packet click on the **Packet capture** button to the left. A drop down menu will appear as shown below.



Packet Capture

Edit

Time Limit (ms)

Video Frame Limit

Packet Limit

10000

0

10000

☒ Capture PTP traffic

☒ Align video captures to start of frame

☐ Rolling capture (Requires Packet Limit)

☐ Only capture errored packets (Packets with Ethernet/IP/UDP errors) Select all on: Amber, Blue

☒ Flow to capture

Bitrate

Packet Rate

Type

Path

☒ Camera 3 Video@Amber

1.30 Gbps

110.94 kpps

Video

Amber

☐ Camera 3 Video@Blue

1.30 Gbps

110.94 kpps

Video

Blue

☒ Camera 3 Audio@Amber

2.74 Mbps

1.00 kpps

Audio

Amber

☐ Camera 3 Audio@Blue

2.74 Mbps

1.00 kpps

Audio

Blue

☒ Camera 3 Anc@Amber

37.44 kbps

0.06 kpps

Anc

Amber

☐ Camera 3 Anc@Blue

37.44 kbps

0.06 kpps

Anc

Blue

New Capture

The selected settings in the view above are the default settings. Adjust the settings to your preference and press “New Capture” when the settings are correct. Please note that Rolling Captures will continuously capture the stream until manually stopped by the user. When it is stopped, it will write out the last packets received up to the packet limit put into the *Packet Limit* field, or the time limit in the *Time Limit* field. This feature is useful for capturing events after-the-fact. Please note that the probe has limited space, so an arbitrarily long buffer can not be used. The following picture shows how the view is during a rolling capture.

Packet Capture						Edit
Capture Time	Status	Packets	Size	Errors		
2020-09-30 16:28:54	Completed	10000 packets	12.6 MB	–	Pcap	Details >
2020-09-30 16:29:35	In Progress	10000 packets	12.6 MB	–	Stop	Details >

In the main view all captures are listed. For a detailed view, click **Details >**. The window will be extended as shown in the screenshot below. To download a complete capture click



**Pcap**, and open the file in Wireshark or similar tool. To delete a capture, click on *Edit* and then *Delete* on the preferred capture.

Packet Capture						Edit
Capture Time	Status	Packets	Size	Errors		
2020-09-22 11:47:46	Completed	10000 packets	12.5 MB	–	Pcap	Details ▾
Flows captured (3)		Packets	Frames	Bytes	Errors	Capture all packets
Matrox 4 Video@Primary		9917	2	13123336	–	No Video Frame Limit
Matrox 4 Audio@Primary		68	0	23256	–	Max 10000 Packets
Matrox 4 Anc@Primary		15	4	1310	–	Max 10000 ms capture time
						No packets dropped by hardware

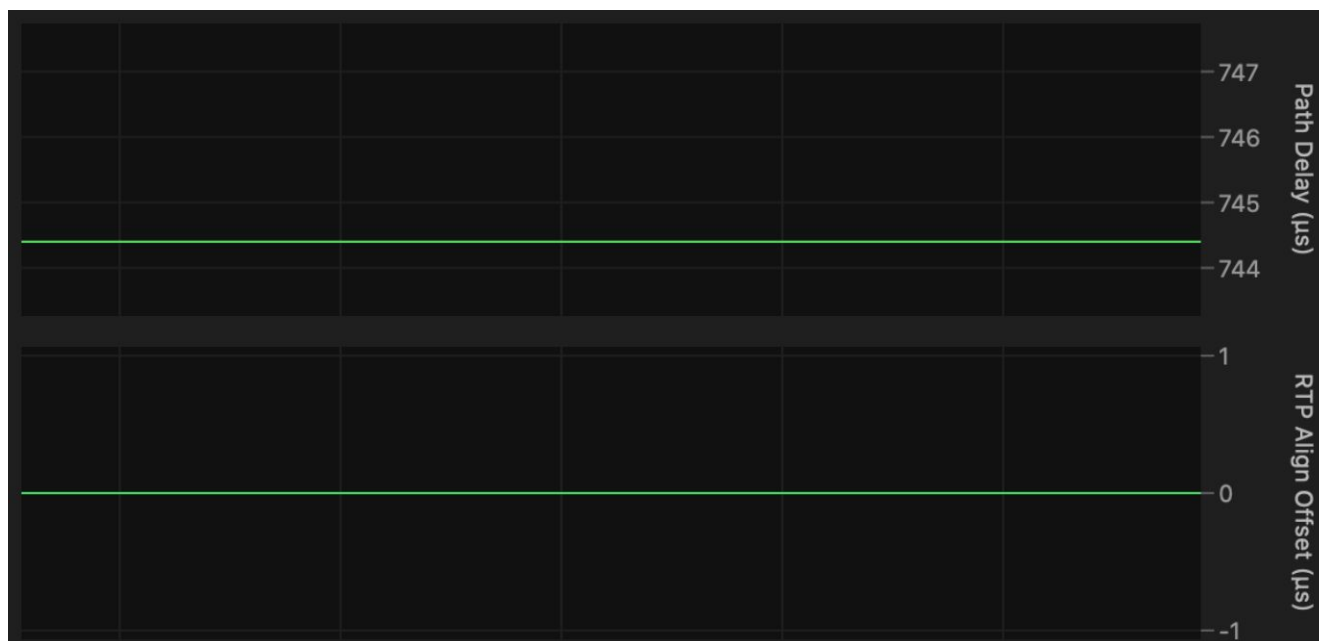
## Timing

The Timing view is sectioned into three categories which all contain trend graphs. Each colored line in the graph represents a flow. By default all flows are turned on. The flows can be made visible or hidden by clicking on the name of the flow, at the bottom of this view. In the top right corner of the view there is an option to change the timeline for the graph, to either 5 minutes or 30 seconds.

To understand the Timing view it's helpful to understand the timing model. For more information we suggest reading the “*Timing section*” provided in the appendix.

## Path delay and RTP Align Offset

The first two graphs, both use the packet's RTP timestamp as a reference. The Path Delay Graph shows the time difference between the RTP timestamp and the packet's arrival time. While the RTP Align Offset graph shows the time difference between the RTP timestamp and the Alignment point.



### First Packet Time (FPT) and FPT Margin

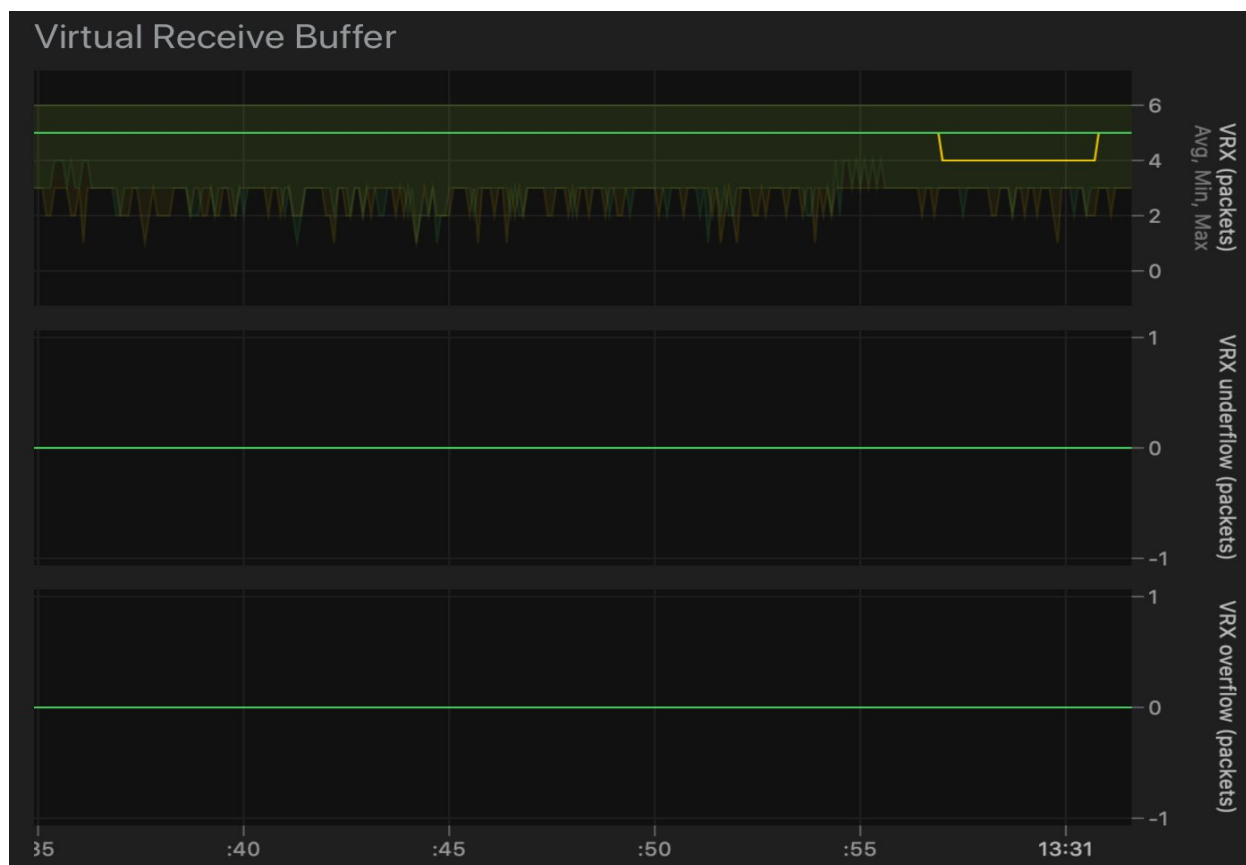


The second two graphs show *First Packet Time* and *FPT Margin*. The *First Packet Time* graph shows the time difference between the packet's timestamp at arrival and the Alignment Point. While the *FPT Margin* graph shows the time difference between the packet's timestamp at arrival and start of packet read.



## Virtual Receive Buffer (VRX)

This section contains three graphs. The VRX graph measures the number of packets present during the steady state window. The next two graphs show if the Virtual receiver buffer underflow or overflow.



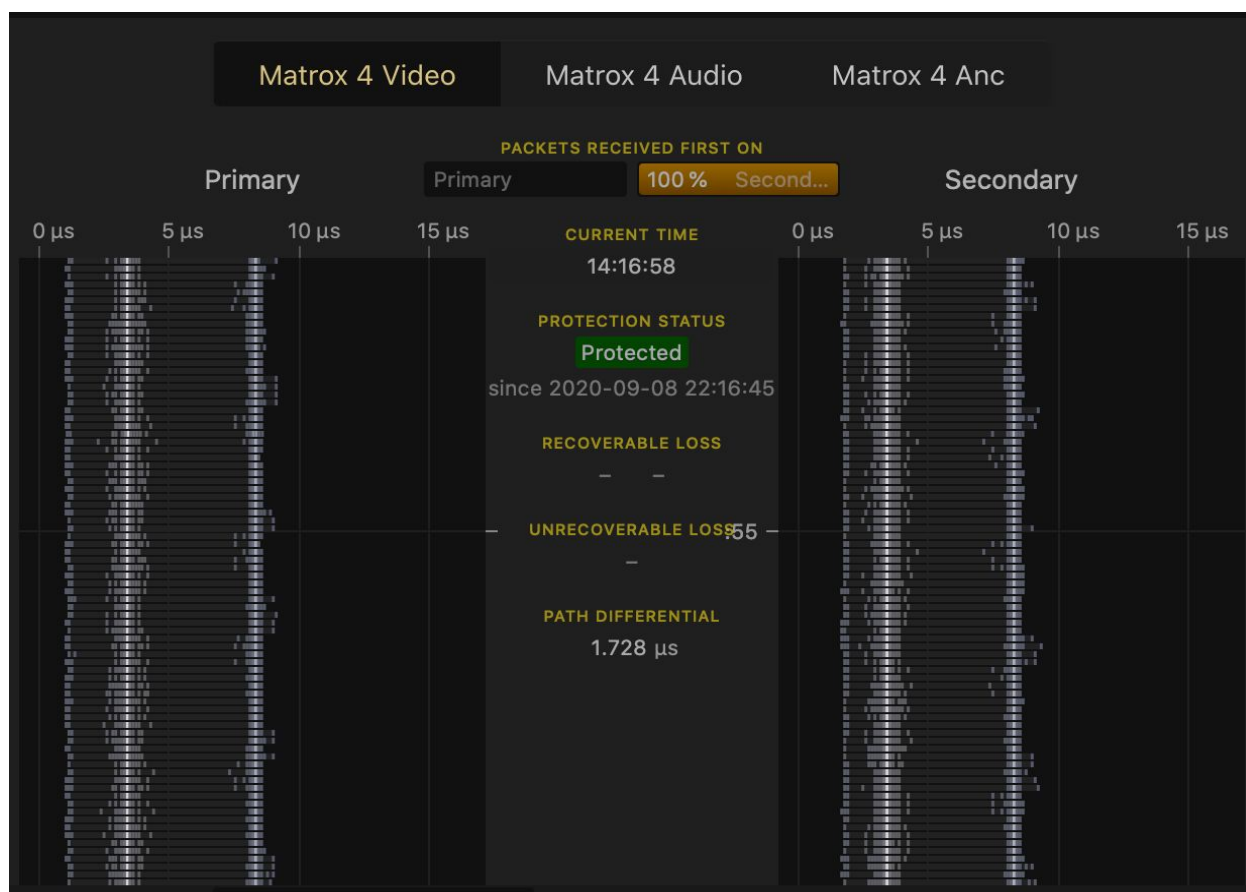
## Network Burstiness (C)

The first graph shows average and maximum packets in real time. The maximum value is pre-defined based on the type of transmitter. The second graph shows the number of packets exceeding the maximum allowed value.



## Packet Flow

Shows IAT and timing for the Video, Audio and Anc flows in different tabs. If the flows are configured to contain more than one class, both flows will be displayed as shown below. In between the primary and secondary flow you can see an illustration of which stream is ahead.

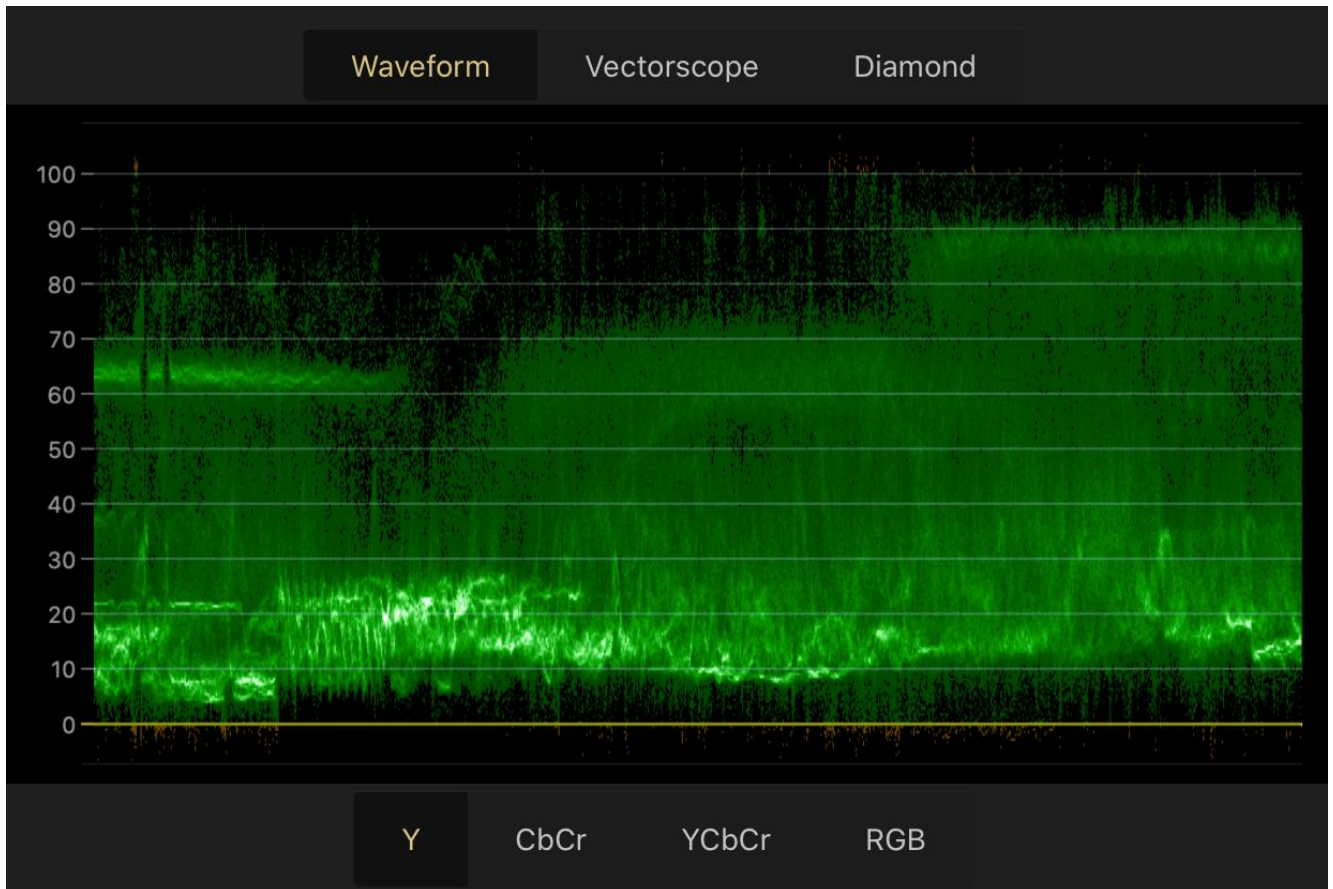


## Video

The Video view shows the colour scope of the video flow, displayed in three different tabs, Waveform, Vectorscope and Diamond.



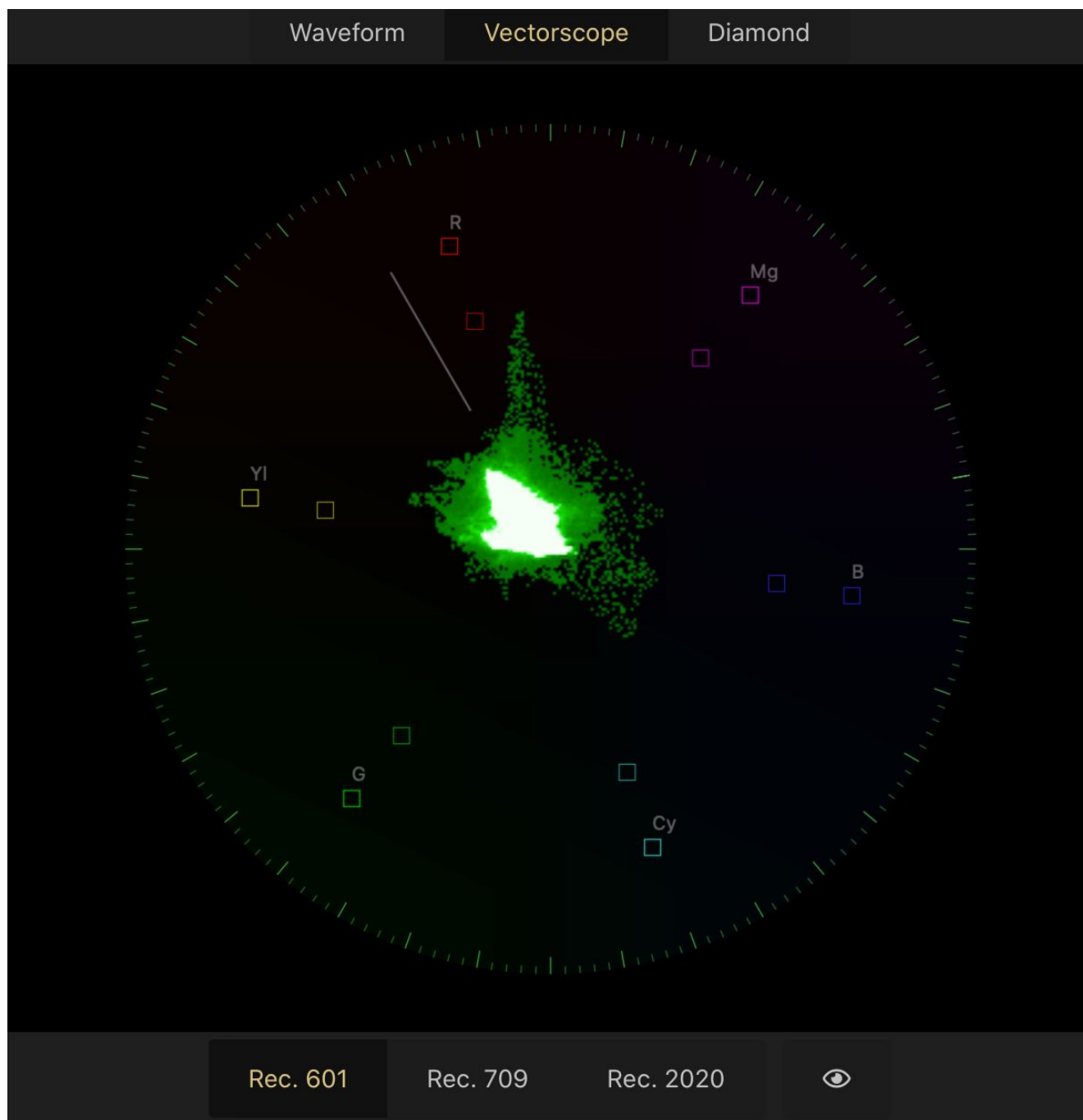
## Waveform



In the waveform scope there are four different displays. Y Displays luminance, CbCr displays color difference, YCbCr combines the first two and RGB shows the red, green, and blue components in the video. The buttons at the bottom of the view makes it easy to select the preferred data.



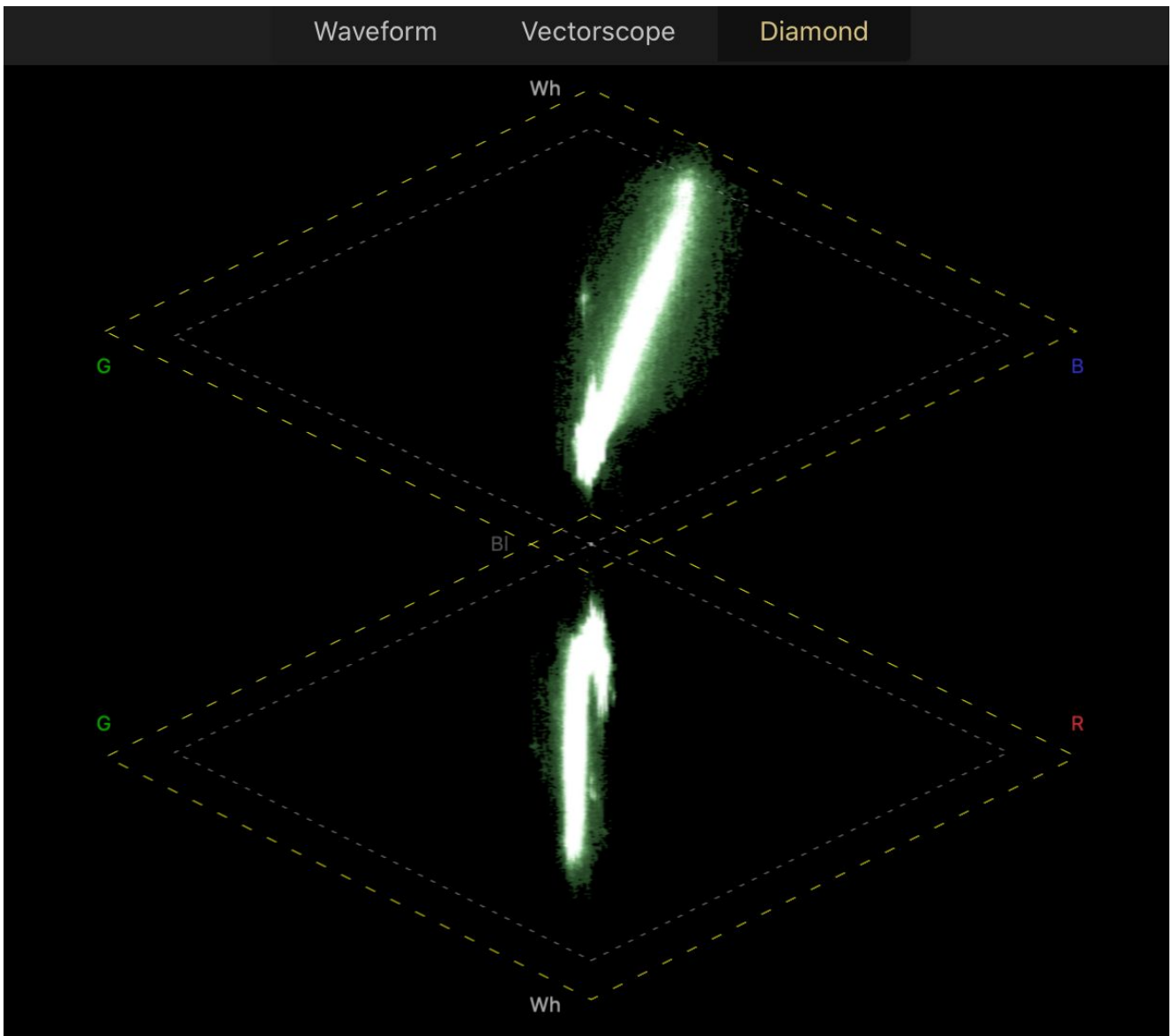
## Vectorscope



To change the colourimetry, use the buttons at the bottom. Changing the colour space in this view, will change the video picture for all clients. To increase the contrast of the vectorscope, press and hold the eye icon.



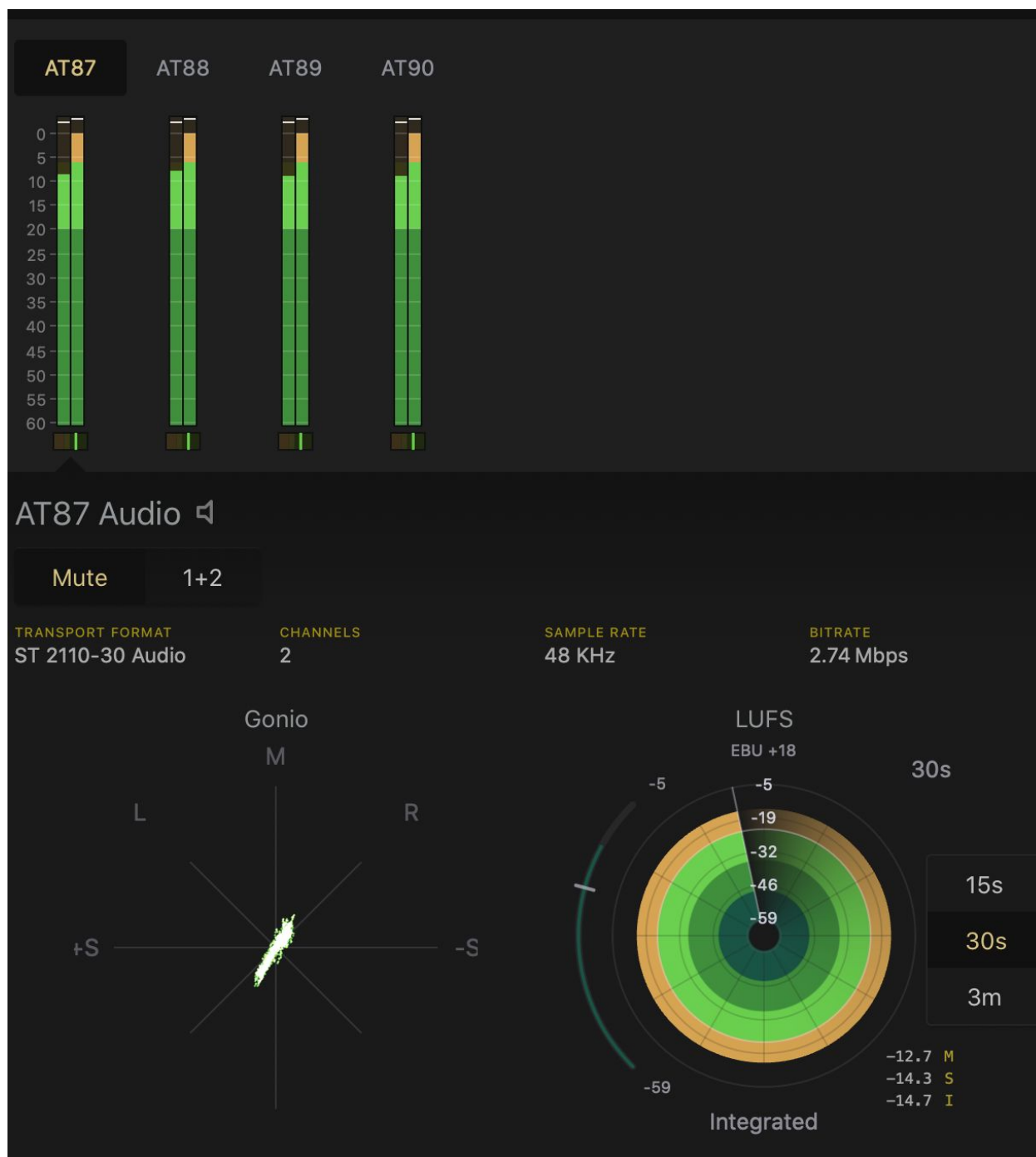
## Diamond



The Diamond scope shows the interaction of RGB and helps identify RGB gamut errors in digital video signals. The blacks are in the middle of the display where the two diamonds join. The whites are at the top of the upper diamond and bottom of the lower. Blue and red is displayed on the right and green on the left. If the image is balanced and is showing a grayscale, most of the trace is centered and forms a vertical line.



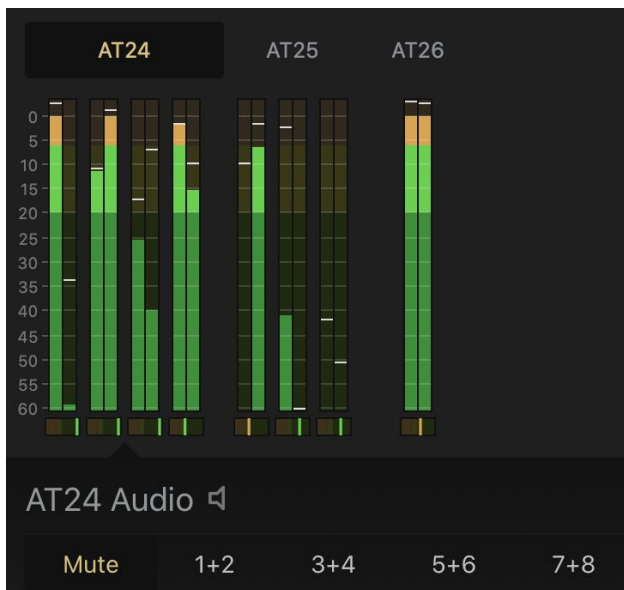
## Audio



The audio view shows the audioflows belonging to the specific service. The audioflows are displayed in three different sections of the view, through RMS meters, Goniometer and a LUFS radar.

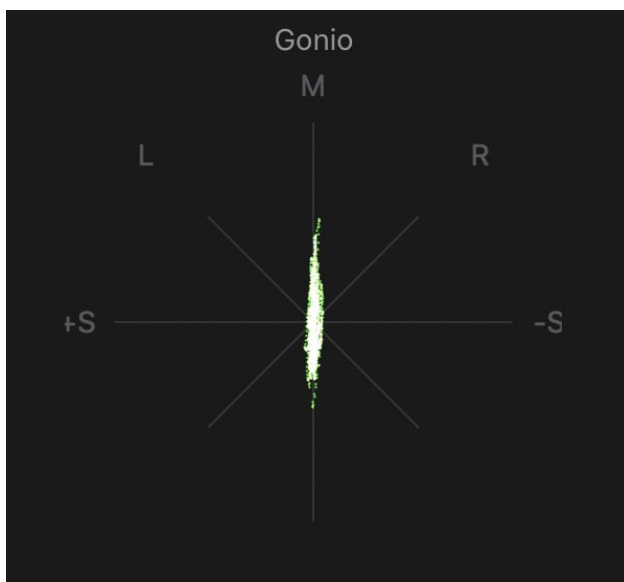


## RMS Meter



In the screenshot above shows three audio flows, to select one, click on the flow name. The first flow (AT24) contains eight audio channels. The audio channel is set to mute by default, to enable audio, click on the preferred channel pair. Underneath each of the paired RMS meters there is a Microphase meter.

## Gonio Meter



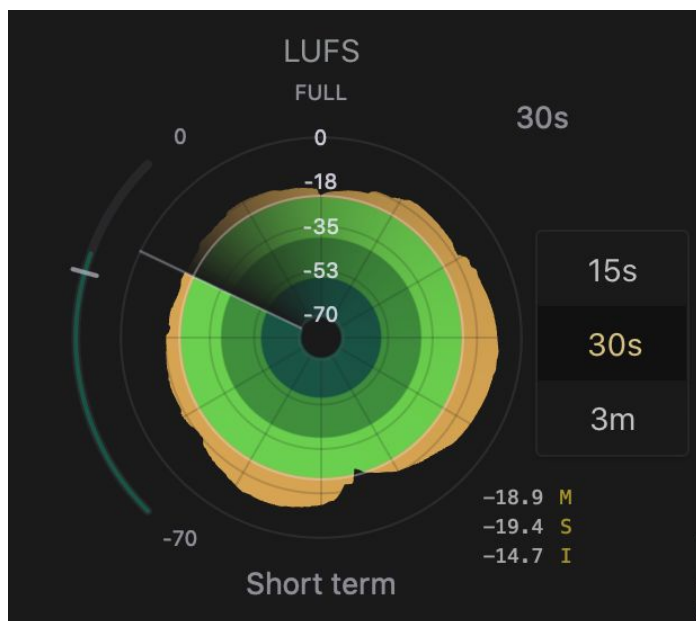
A signal is plotted on each axis. A left-only channel will run a line from top left to the bottom right on the L axis, and a right only channel will make the equivalent line on the R axis. A mono signal will form a straight line in the M axis or be slightly angled according to balance. A stereo signal on the other hand is not symmetrical and will form a jittery cloud. If one of



the channels is phase inverted it will result in a horizontal line or for mono the plotted line will reduce close to silence.

## LUFS

Loudness Units Full Scale or LUFS, is an average calculation of sound over time and follows the EBU R128 recommendation.

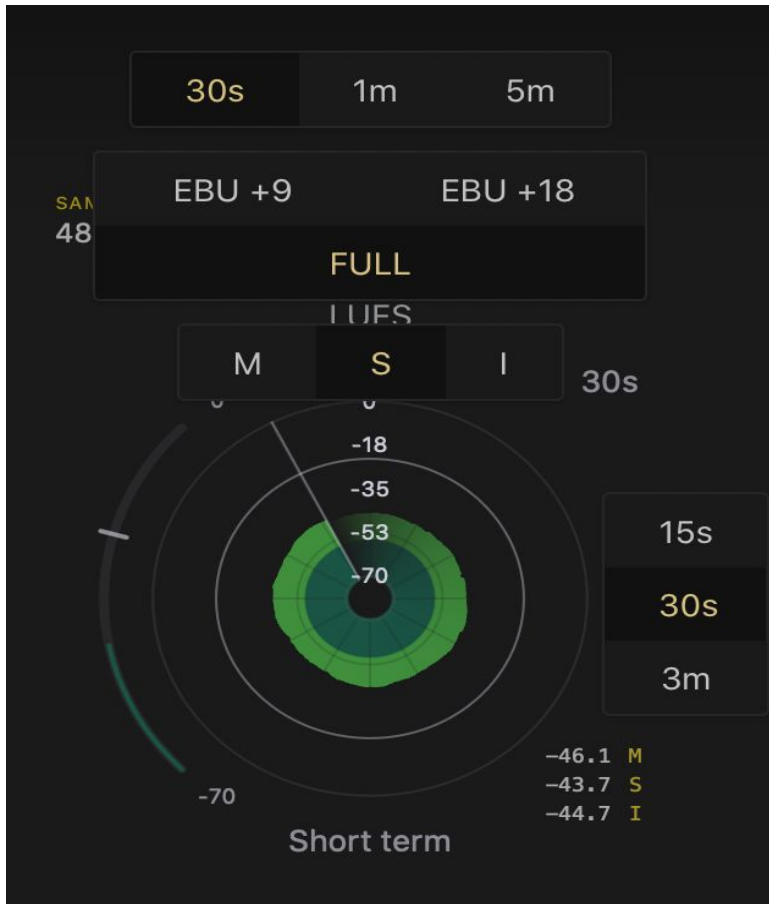


In the bottom right corner there are three time scales, M (Momentary), S (Short-term) and in I (Integrated). The time scales all have different time windows. M - 400ms, S - 3sec, I - from start to present. All three timescales show the present average loudness.

The radar displays either Momentary, short term or integrated EBU loudness over time. In the VB440 there are three optional modes *Full*, *EBU +9* and *EBU +18*. All three modes display different scales:

- *Full*, range from -70 to 0 LUFS.
- *EBU +9* range from -41 to -14 LUFS
- *EBU -18* range from -59 to - 5 LUFS.

From the main screen it is possible to choose between three different time intervals for the radar display, 15s, 30s, and 3m. By double clicking on the radar you also have the time intervals of 1m and 5m. In addition be able to edit the settings as shown below.



## Ancillary

The Ancillary view offers two tabs, Overview and SCTE 104.



## Overview

Matrox 4 Anc		Primary		Overview	SCTE 104	Per Frame	
Line	DID	SDID	Spec	Application		Packets	Words
8	41h	05h	ST 2016-3	AFD and Bar Data AFD Code: 0000 (Undefined) AR flag: Unset (4:3 or Bar) Top Bar: 10702 Bottom Bar: 10702		1	8
9	61h	01h	ST 334-1	Closed Captioning (CEA-708)		1	16
10	60h	60h	ST 12-2	Ancillary Time Code		1	16
10	41h	01h	ST 352	Payload Identification Codes ST 425-1 1080-line video payloads on a Level A 3 Gb/s SDI Payload ID: 89h Progressive Transport Progressive Structure Picture Rate: 50 Sampling: YCbCr-4:2:2 10-bit		1	4

Displays information associated with the ancillary flow. The different sections are elaborated in the table below.

<b>Line</b>	Shows the first and last line number containing this DID and SDID.
<b>DID</b>	The data identification.
<b>SDID</b>	The second data identification.
<b>Spec</b>	The specification, standard or recommendation that describes the technical structure of this DID/SDID.
<b>Application</b>	Reference for that DID/SDID.
<b>Packets</b>	The number of packets containing this DID/SDID per frame.
<b>Words</b>	The total User Data Words for that DID/SDID per frame.



# SCTE 104

Shows an overview of the SCTE 104 messages that are transmitted.

AncstestPrimary

OverviewSCTE 104

Time	Event ID	Duration	Info	
22:58:31	3682	0s	Time signal request Insert segmentation descriptor request Content identification Upid F12BET0052	>
22:58:19	3682	0s	Time signal request Insert segmentation descriptor request Content identification Upid F12BET0052	>
22:58:07	3682	0s	Time signal request Insert segmentation descriptor request Content identification Upid F12BET0052	>
22:57:55	3682	0s	Time signal request Insert segmentation descriptor request Content identification Upid F12BET0052	>



## System Administration

To access the admin page add “/admin” to the probe URL.

To login to cockpit for the first time use, username: root and password: elvis

For more information about accounts, see the account section.

## Software Activation

IP-Probe		Activated default
Version installed	6.0.1-1-375-g58c2c6f	×
Hardware key	0440-7335-4E80-B38E-5E1C	
Apply license key:	<input type="text" value="License or maintenance key"/>	<button>Add license</button>
<button>Remove as default</button> <button>Deactivate</button>		

At the top of the page the current software version is displayed, underneath you see the unique hardware key.

To activate your licence, your sales representative needs to receive the key to issue the software license. Paste the license key in the box and press *Add license*. Please note that the Probe should have come pre-installed with a license, so this is normally not needed.

## System

Shows information about the health of the system. This includes CPU usage, memory usage, disk I/O, and network traffic, as well as hardware and operating system details.



## Logs

September 10, 2020 ▾

Severity

Error and above ▾

Service

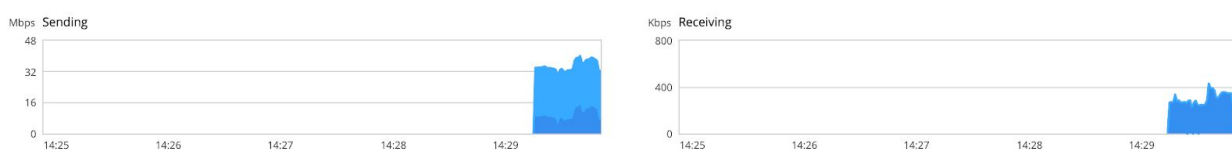
All ▾

September 10, 2020

▲	15:29	Failed to start LSB: Bring up/down ne...	systemd
▲	15:29	power_meter ACPI000D:00: Ignoring uns...	kernel
▲	15:29	[7.753] [127:p6p2] uds: sendto failed...	phc2sys
▲	15:29	could not find module by name='ipmi_m...	systemd-udevd
▲	15:29	could not find module by name='ipmi_d...	systemd-udevd
▲	15:29	could not find module by name='ipmi_s...	systemd-udevd
▲	15:29	Error parsing PCC subspaces from PCCT	kernel
▲	15:29	i8042: No controller found	kernel

Shows the system logs, including errors, warnings, and notices. Typically used for debugging. The log displays the newest entries first, with options to filter at the top of the page.

## Networking



At the top part of the page two performance graphs are displayed.

## Firewall

Firewall

0 Active Rules

NOTE, do not enable firewall without knowing how to configure the settings, you might lose connection to the Probe!



Firewall

Active zones

Add Zone

Zone		Interfaces	IP Range	
Public	✓ default	em2, p6p1	*	

Allowed Services

Add Services

Service	TCP	UDP	Zones	
> DHCPv6 Client		546	Public	
> Secure WWW (HTTPS)	443		Public	
> SSH	22		Public	
> WWW (HTTP)	80		Public	

The firewall configuration page is accessed by clicking the "firewall" link in the firewall section. The page gives you options to assign zones to specific interfaces and services to be configured to those zones.

To add a zone, click the "Add Zone" button and a popup window will appear. First choose the trust level for your zone. A short description will be displayed together with included services or ports that are allowed for that zone. Assign one of the available interfaces to the zone, then select allowed addresses. There are two options, to give access to the "Entire Subnet" or specify a "Range" of IP-addresses.

To allow other services than those who are pre defined, click Add Services. A New popup window will open in which there is an option to search/filter for a service. By selecting the custom ports, there are options to enter the port number into the TCP and/or UDP fields. There is also a possibility for an optional name to label the rule.

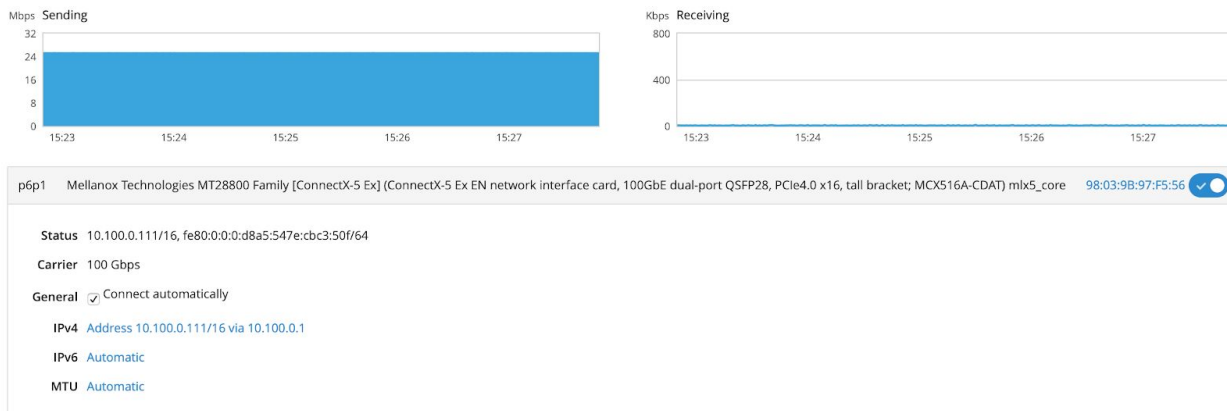
## Interfaces

Lists all interfaces assigned to the system. From the main view, the Name of the interface, IP addresses and the activity statistics for sending and receiving data is displayed.

Interfaces		Add Bond	Add Team	Add Bridge	Add VLAN
Name	IP Address	Sending		Receiving	
em1		Not available			
em2	10.0.28.210/22	317 Kbps		98.0 Kbps	
p6p1	10.100.0.111/16	1.38 Kbps		7.79 Kbps	
p6p2		Not available			



By clicking on one of the listed interfaces a new window will open with specific information for that interface.



To enable or disable the interface click the switch button in the top right corner. By default all settings are set to automatic, however there is also a possibility to manually configure the IP related settings in this view.

## Add VLAN

VLANs can be created by someone with admin access to Cockpit. Click on the Add VLAN to access the configuration page. Select an interface from the parent list, assign a VLAN Id and a name or use the predefined. By default a name will be filled in by concatenating the parent name together with a dot followed by the VLAN Id. For example, interface `em1` with VLAN Id 2 will result in `em1.2`. To complete the configuration, press Apply.

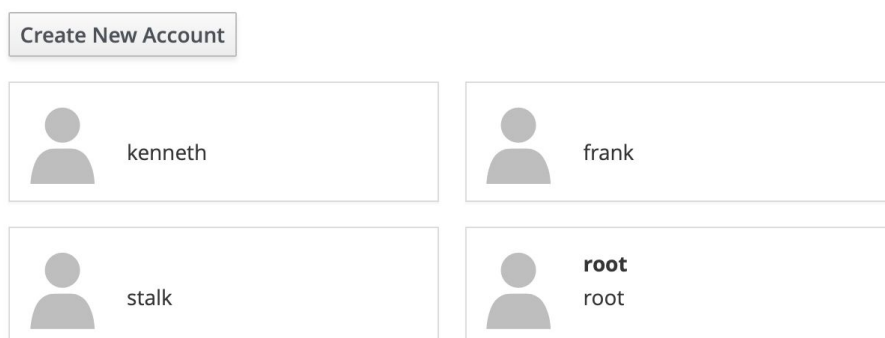
The VLAN will be added to the interface section.

## Bond, Team and Bridge

Are usually not needed in a probe environment – do not attempt to configure unless deep knowledge.



## Accounts



Lists all accounts connected to the system. To create a new account click “create new account” or click directly on an existing account to change account settings, feks, setting a new password.

## Diagnostic report

This page is used to create diagnostic reports which can be used by your support team to debug potential issues within the system.



## Software Updates

11 updates, including 2 security fixes

Last checked: a few seconds ago

Check for Updates

Available Updates

Install Security Updates

Install All Updates

Name	Version	Severity	Details
> perf, python-perf	3.10.0-1127.19...	6	2020-08-11** Augusto Caringi <acaringi@redhat.com> [3.10.0-1127.19.1.el7]
> btech-stprobe	6.0.1_1_1141_ge...		
> curl, libcurl	7.29.0-57.el7_8.1		2020-06-02** Kamil Dudka <kdudka@redhat.com> - 7.29.0-57.el7_8.1
> libmediainfo, mediainfo	20.08-1.el7		Update to 20.08.
> systemd, systemd-devel, systemd-libs, systemd-sysv	219-73.el7_8.9		2020-06-17** systemd maintenance team <systemd-maint@redhat.com> - 219-73.9

Update History

> 2020-06-03 16:46

3 Packages

bind-export-libs

bind-libs-lite

bind-license

> 2020-03-16 00:43

1 Package

At the top of the page information about the number of updates and security fixes are displayed together with when the system last checked for updates.

There is the possibility to choose between, *Install all updates* or to *install security updates only*. We recommend that you keep the Probe up to date with all updates.

### Available updates

Lists the packages that require updating. Each package is listed with name, version, severity and details. Security fixes are usually marked with a pink color. By clicking > you can expand the package window to see what the release contains.

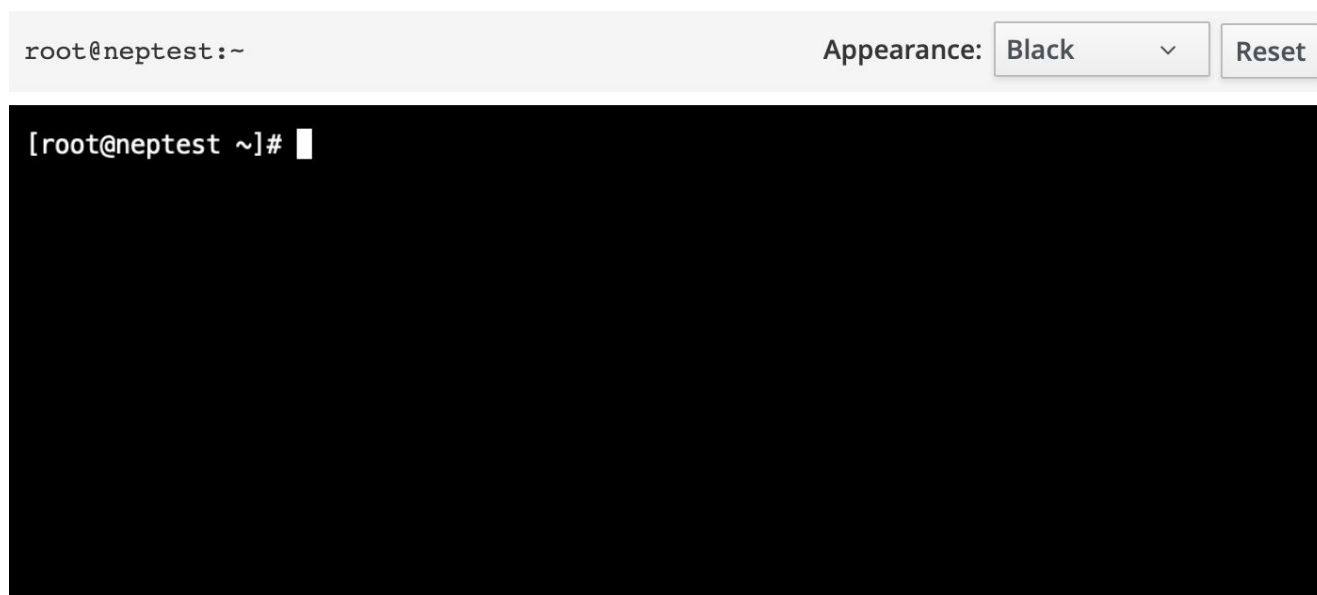
Also updates the Probe software, it's important to update frequently.

### Update History

Shows the time, date and the number of packages for past updates.



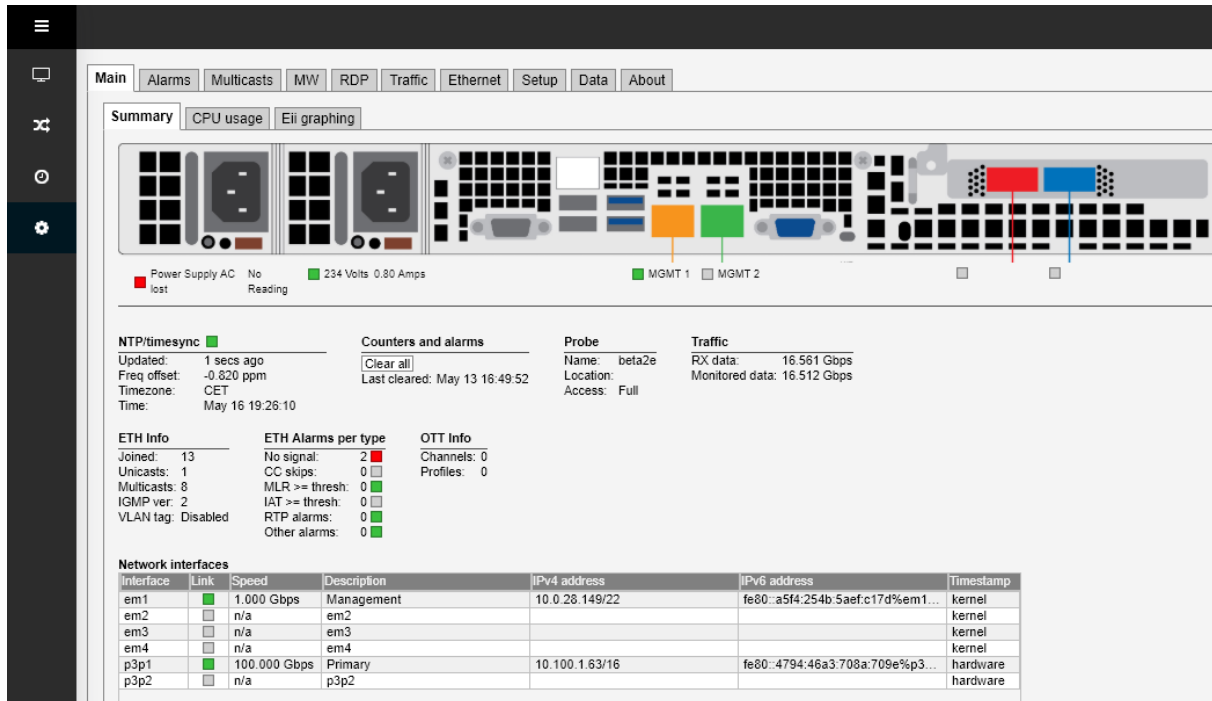
## Terminal



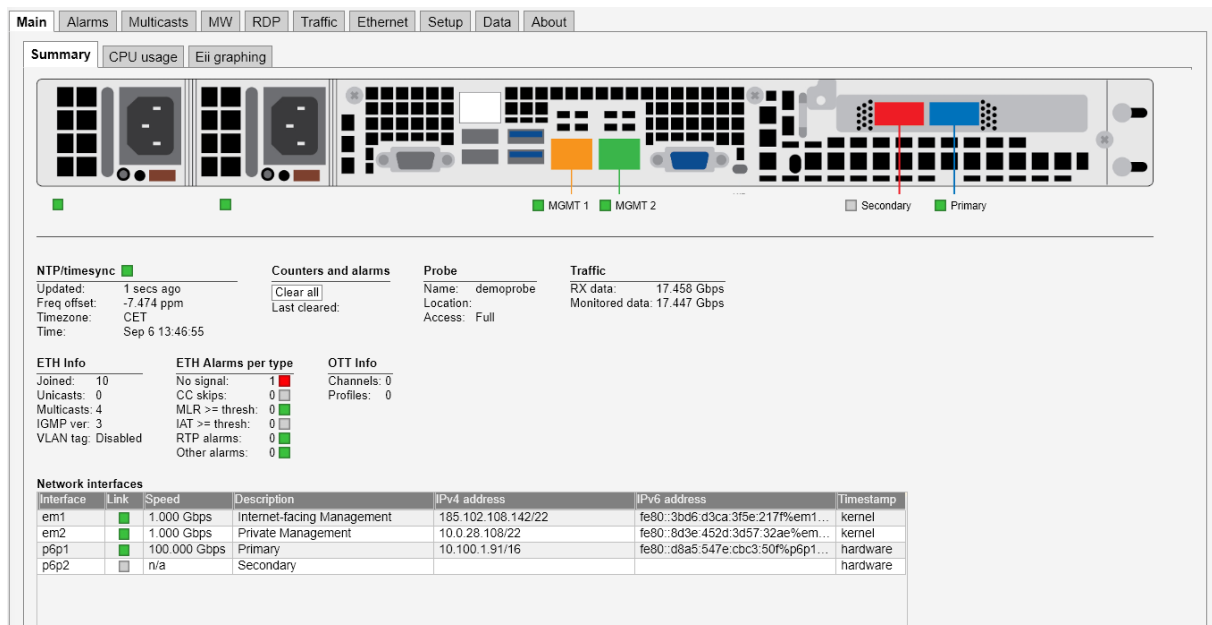
Opens an in-browser terminal with a command line session to the Cockpit system. In this terminal, you can run commands from your signed-in user account.



## 5 The VB440 expert user interface



### 5.0.1 Monitoring/configuration – Summary



The intention of this page, together with the **alarm list**, is to provide enough information for the operator to immediately see if there is anything seriously wrong with one or more input streams.



At the very top, a graphic is displayed representing the front panel of the probe, indicating the status of the different inputs.

Below this display, the following parameters are shown:

---

<i>NTP/timesync</i>	
<b>(Bulb):</b>	The NTP/timesync bulb indicates whether the VB440 clock is locked to an external time reference signal. Green indicates that the VB440 is locked to an external reference whereas grey indicates that the VB440 runs in unlocked mode.
<b>Updated:</b>	The time since the last time synchronization update.
<b>Freq offset:</b>	Indicates the measured frequency offset for the system clock.
<b>Timezone:</b>	The time zone as selected by the operator in the <b>Setup — Params</b> view.
<b>Time:</b>	The current local time (configured in the <b>Setup — Params</b> or <b>Setup — Time</b> view).

---

---

<i>Counters and alarms</i>	
<b>Clear all:</b>	Click the <b>Clear all</b> button to reset all counters, graphs and alarms. All VB440 measurement and alarm history is cleared. Note that it is not possible to undo this operation.
<b>Last cleared:</b>	The time the <b>Clear all</b> button was last clicked. If no time is indicated the counters have not been cleared since VB440 startup/reboot time.

---

---

<i>Probe</i>	
<b>Name:</b>	The VB440 name as defined by the operator in the <b>Setup — Params</b> view.
<b>Location:</b>	The VB440 location as defined by the operator in the <b>Setup — Params</b> view.
<b>Access:</b>	The access rights of the current user. Access rights are either full access or read only access, and are defined by the operator in the <b>Setup — Security</b> view.

---

---

<i>Traffic</i>	
<b>RX data:</b>	The total bitrate of received data traffic
<b>Monitored data:</b>	The total bitrate of multicasts and unicasts monitored (analyzed) by the probe

---

At the very bottom of the Summary page, an overview of the Ethernet network interfaces on the VB440 are displayed.

---

<i>Network interfaces</i>	
<b>Interface:</b>	The ID of the selected network interface.
<b>Link:</b>	Indicates whether the interface is connected.
<b>Speed:</b>	Shows the current bitrate for the interface.
<b>Description:</b>	Provides a human-readable description of the interface, if available.
<b>IPv4 address:</b>	Lists the IPv4 address and netmask of the network interface, if set.
<b>IPv6 address:</b>	Lists the IPv6 address and netmask of the network interface, if set.

---



---

**Timestamp:** Indicates whether the network interface supports hardware timestamping for precise measurements, or if kernel timestamping is used.

---

## 5.0.2 Multicasts — Streams

Property	Value	Description
Name	Playout Video@Primary	Identifier for referring to this stream
Group Names	Playout	Groups that this stream belongs to
Address	239.20.48.10	Multicast/unicast address
Port	50000	Multicast/unicast port
Ethernet thresholds	Default ▼	Defined in Multicasts/Ethernet thresh.
VBC thresholds	Default ▼	Defined in Setup/VBC thresh
Join stream	<input checked="" type="checkbox"/>	Check to monitor stream
Join interface	p3p1 - Primary ▼	On which interface to monitor stream
Page	Page 2 ▼	On which page to display stream

Close Apply changes

In this view the operator can define multicasts available to the probe and associate a name with each multicast address. This name will be used by the probe when referring to the multicast. If no name has been defined the probe will use the multicast address:port notation.

It is possible to add, delete or edit several entries simultaneously. Several entries are selected by using the regular *Ctrl + click* or *Shift + click* functionality. When adding new entries the current dialogue values will be used as the template with the values for Name and Address incremented for each.

Note that both multicast and unicast addresses can be entered here.

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

Clicking **Add new** or selecting one or more multicasts and clicking **Edit selected** will open the **Multicast — Streams — Edit** pop-up view. When multicasts have been defined, clicking **Join selected** will join the selected multicasts and enable monitoring. The probe will only analyze joined multicasts. Clicking **Join all** will join all multicasts in the list (up to the licensed maximum number of channels). Unjoining one or more multicasts is done by selecting multicasts and clicking **Unjoin selected** or by clicking **Unjoin all**.

When the Edit button is clicked it is possible to define the following multicast parameters (note that some parameters are only relevant and selectable when the probe is equipped with the correct options):



Property	Value	Description
Name	BBC_WORLD_NEWS	Identifier for referring to this stream
Address	239.255.0.18	Multicast/unicast address
Port	5500	Multicast/unicast port
Ethernet thresholds	HDTV	Defined in Multicasts/Ethernet thresh.
VBC thresholds	Default	Defined in Setup/VBC thresh
Join stream	<input checked="" type="checkbox"/>	Check to monitor stream
Extract thumbnails	<input checked="" type="checkbox"/>	Check to extract thumbnails
Join interface	eth0 - Data RJ45	On which interface to monitor stream
Page	Page 1	On which page to display stream

**Status**

Close Apply changes

---

### General

---

**Name:** A name should be assigned to each unicast/multicast. The name will be used throughout the VB440 user interface when referring to this stream. It may also be used by an external management system like the VBC Controller. To add copy of one stream for use with 2022-7, give the two streams the same name, but add a different class to them. The class is everything added after @ in the name. The probe will know that two streams are related, if they have the same name, only differing by the class.

**Group Names:** A comma separated list of groups this stream belongs to. All streams with the same group will be bundled together into a service, easily selectable in the Instrument View.

**Address:** The IP address of the unicast or multicast.

**Port:** The port number of the unicast or multicast.

**Ethernet thresholds:** The Ethernet thresholds specify various error limits. Selectable Ethernet thresholds templates are defined in the **Multicasts — Ethernet thresh.** view.

**Join stream:** Check the 'Join stream' check box to join a multicast or unicast. Only joined streams are analyzed. A stream may also be joined from the **Multicasts — Join** or **Multicasts — Streams** views, and the status of this check box will be updated accordingly.

**Join interface:** Select which interface to join the selected multicast. The data interface(s) are listed, as well as any enabled VLAN interface (defined in **Setup — VLANs**).

**Page:** For easy navigation, each stream can be assigned a specific page. The names of the pages are defined in **Setup — Pages**.

---



**Edit Multicast**

General **SSM** ETR T2MI Redundancy

Property	Value	Description
SSM source 1	10.0.20.67	Username Main Source-address if SSMGMPv3 is enabled
SSM source 2	10.0.20.68	Username Spare Additional source (use 0.0.0.0 for none)
SSM source 3	0.0.0.0	Username source3 Additional source (use 0.0.0.0 for none)
SSM source 4	0.0.0.0	Username source4 Additional source (use 0.0.0.0 for none)
SSM source 5	0.0.0.0	Username source5 Additional source (use 0.0.0.0 for none)

The multicast will be joined with any nonzero source-address.  
For any source address match the Mon page's **Src address** column will display the **Username**.  
These settings are only relevant if SSM is used.

Close Apply changes

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### *SSM*

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**SSM source 1:** If a zero source address is specified for a multicast it will be joined without a source. This allows both source specific multicasts and non-source specific multicasts to co-exist in the same network and be joined by the VB440.

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**SSM source 2:** Additional SSM source addresses may be specified to enable back-up solutions. Note that it is the operator's responsibility to ensure that a multicast is only transmitted by one SSM source at any time.

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**SSM source 3:** Additional SSM source address

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**SSM source 4:** Additional SSM source address

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**SSM source 5:** Additional SSM source address

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**Edit Multicast**

General SSM ETR **Uncompressed**

Stream content	2022-6 SDI	What kind of content is in the stream
Audio bit depth	24-bit	Bits per audio sample
Audio sample rate	48 kHz	Audio sample rate
Sender type	Auto	Select what sender type to expect and alarm accordingly
TR offset mode	Default value	Select if the default or specified value should be used
TR offset value	0	Value to be used if TR offset mode is set to 'Specified value'

Close Apply changes

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### *Uncompressed*

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**Stream content** Tell the probe which kind of stream this is. If auto is selected the probe will assign the following RTP types to the respective stream type. 96: 2110-20 (Video), 97: 2110-30/AES67 (Audio), 98-99: 2022-6 and 100: 2110-40 (Ancillary). This heuristic is subject to change in a future software update. Once a mapping has been made, the stream configuration is updated to ensure that working mappings persist across software updates.

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<b>Audio bit depth</b>	Specifies how many bits per sample is in the audio. This field only applies to 2110-30/AES67.
<b>Audio sample rate</b>	Specifies the sample rate for the audio. This field only applies to 2110-30/AES67.
<b>Sender type</b>	Specifies what kind of timing model the transmitter has. This has effect for the 2110-21 measurements.
<b>TR offset mode</b>	Toggle between the default value, based on the signal type, and a specific value, specified in the next field.
<b>TR offset value</b>	If TR offset mode is not set to the default, then this field will be the TR offset in use.



## 5.1 Data

### 5.1.1 Data — Configuration

Full and partial configuration of the VB440 Studio Probe can be exported as XML documents. This is achieved by clicking one of the links inside the **Export XML** frame. A new browser window pops up containing the selected XML document. The browser will allow the contents of the page to be saved to file.

Restoring the VB440 Studio Probe configuration, multicast stream list or OTT channel list is just as simple. Just click the **Browse** button and select the file that contains the XML document. Then click the **Go!** button and the information in the XML document will be applied. The configuration, stream list and thresholds exports can all be imported.

Configuration files generated by a probe can be imported by the VB440. Multicast stream lists, OTT channel lists and scheduling information can also be exported to and imported from the VB288 Objective QoE Content Extractor.

You can also import and export license and software maintenance keys in XML format from this page.

To import documents that have been manually edited the CRC attribute at the very top of the document must be deleted (i.e. delete `crc="..."` from the file). This will bypass the checksum verification mechanism.

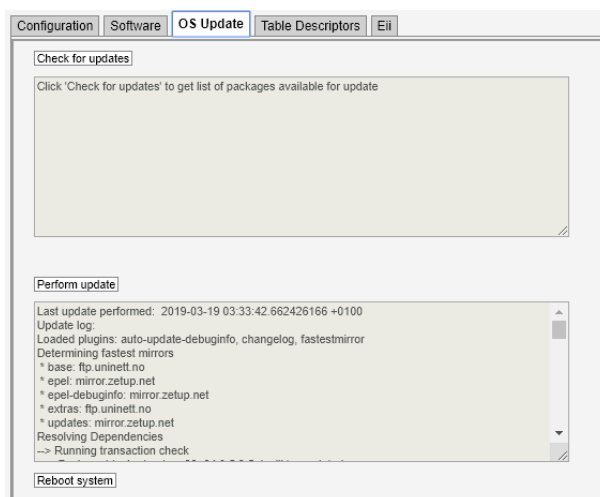
Please refer to the document **Eii External Integration Interface** for detailed information about XML import and export.

Note that the Ethernet setup parameters (IP address, netmask and gateway) and probe name and location are not part of the XML document. Hence exporting the full configuration of one VB440 Studio Probe and restoring it on another will make the two VB440 Studio Probes identical except for the network settings.



Clicking the Debug data export option will generate a document containing debug information that may be useful if VB440 Studio Probe misbehavior is reported. This file should be sent along with a description of the misbehavior.

### 5.1.2 Data — OS Update



On this page you can update the whole OS, including the probe software to the latest version. Press **Check for updates** to see what is available. To install the latest version, press **Perform update** and wait until it finishes. This might take a long time (several minutes). Please do not turn off, or reboot the machine while the update is running. It might be advisable to reboot the server after an upgrade. To do so, press the **Reboot system** button.

### 5.1.3 Data — Eii



The **External integration interface** (Eii) allows inclusion of Bridge Technologies equipment into 3rd party NMS systems. In order to facilitate integration the **Data — Eii** view allows export of XML files containing the data typically being requested by an NMS system via the regular Eii interface.



Please refer to the document **Eii External Integration Interface** for detailed information about Eii.



## A Appendix: PTP and BMCA

There are usually five different types of clocks that are mentioned in relation to PTP. The first three are defined as ordinary clocks and the last two are used by different types of switches or routers.

<b>Slave clock only</b>	Will always act like a slave and receive time from a master clock.
<b>Preferred grand master</b>	Only acts as a master. It has the ability to get standard time, for example from a GPS receiver.
<b>Master clock or slave clock</b>	This is a device that can act as a slave or a master. It usually starts out in a slave state, but has the possibility to become a master in case there are no better suited masters on the network.
<b>Transparent clock</b>	A switch that simply adds its own switching delay to passing PTP packets.
<b>Boundary clock</b>	A Switch that receives sync messages from an upstream ptp master clock on its slave port and synchronizes its internal clock to it and generates a new sync message to its master ports.

The VB440 always acts as a slave clock only, and it will not show other slave clocks. The clocks shown will be clocks which present themselves as master clocks, this includes boundary clocks. The chosen grandmaster will at all times be marked with a star under *Preferences* in the PTP clock section.

In order to accommodate the PTP client and BMCA, the setup for PTP in expert view must be correct. The following configurable fields are available:

- Mode
- Domain number (0-127)
- Priority1 (0-255)
- Sync Interval (-7 to -1)



- Announce Interval (-3 to +1)
- Annonse Receipt Timeout (2-255)

Note that if *Mode* is not configured correctly, “out of mode” will appear as a warning underneath *PTP clocks*. An example might be that L2 Multicast has been selected instead of IP multicast traffic. The Domain number on the VB440 needs to be the same as the clock it's going to synchronize to.

Priority1 indicates the VB440s own internal Priority1. Please note that this means the VB440 will never synchronize to a clock with a higher value in the *Priority1* field (Lower priority) than its own.

The table below shows the ‘Logarithm to the base 2’ mapping between the configured values, packets per second and seconds between packets.

Log2	Packets per second	Seconds between packets
-7	128	0.008
-6	64	0.016
-5	32	0.031
-4	16	0.063
-3	8	0.125
-2	4	0.250
-1	2	0.500
0	1	1.000
1	0.5	2.000

*Sync interval* indicates how often VB440 synchronizes to the master clock. The *Announce Interval* specifies how often master clocks should announce themselves, whereas *Announce Receipt Timeout* specifies the number of announce intervals that can pass before the selected master clock is considered lost if no announce packets received.

‘Best Master Clock Algorithm’ (BMCA) performs a selection between the available clocks to ensure that the best suitable clock is acting as master at all times. The algorithm compare the clocks in the following order:

- a) Priority 1 (0-255)



- b) Clock Class
- c) Clock Accuracy
- d) offsetScaledLogVariance
- e) Priority 2 (0-255)
- f) Clock identity

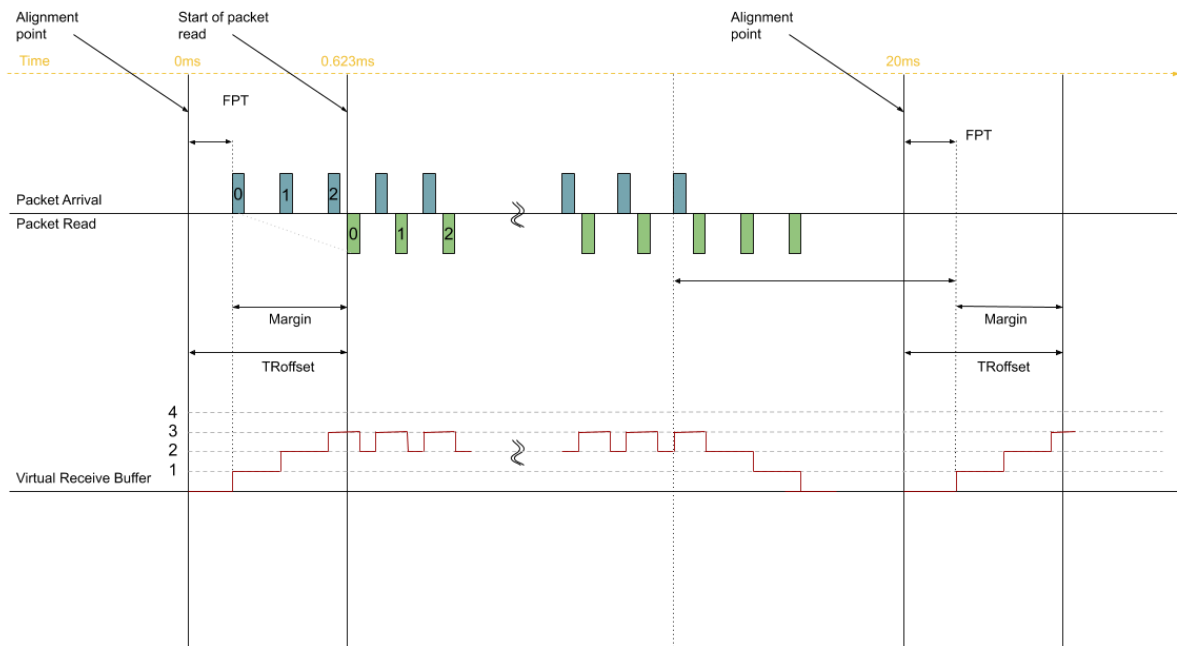
BMCA will at each step compare available clocks, only clocks with the “best” values will be selected to continue, until BMCA is left with one clock. That clock will then be the selected master clock. Since Priority 1 and 2 are user settable fields they can have an impact on the BMCA selection.

For example, If only one clock is configured with the value “1” (high priority) in the *Priority 1* field and others with the value “10” (lower priority). The clock with the value “1” will be selected as the master without any further comparison in the following steps. This means that that clock will be acting as master as long as it is online, even if it loses sync.



## B Appendix: 2110 Timing model

To understand the Timing view it's helpful to understand the timing model. The figure is meant to visualise SMPTE ST 2110-21 standard.



The figure above illustrates the timing model, which puts constraints on the timing of packets on the output of the sending device. The network compatibility model (C), Virtual receiver buffer (VRX) and packet read schedule (PRS) all ensure that the delivery timing is upheld by shaping the transmission.

The packet read schedule specifies the interval the packets are to be drained from the Virtual Receiver Buffer. There are two different read schedules, the *Gapped* illustrated in the figure and the *Linear*. As opposed to the Linear which sends equally spaced packets throughout the whole frame interval, the Gapped packet read schedule is set to model the SDI signal and thereby contains a gap between the last packet of a frame and the first packet of the consecutive frame.

The alignment point (referred to as " $N * T_{FRAME}$  since epoch" in the standard).  $N$  meaning the number of frames since Epoch and  $T_{FRAME}$  is the time period between succeeding frames.  $N * T_{FRAME}$  will depend on the prevailing frame rate.



Start of packet read ( $T_{VD}$  in the Standard) is a given time where the packet must be available to be read. The time is calculated by adding the values of Alignment Point with  $TR_{OFFSET}$ .

When the first packet in the frame arrives, the RTP timestamp will be compared to the arrival time, that time difference constitutes Path Delay. The packets can arrive both before and after the alignment point. The RTP Align Offset graph displays the time difference between the RTP timestamp in the packets and Alignment point. FPT (first packet time) shows the time difference between the Alignment Point and the timestamp at the arrival time.

Since the RTP clock ticks at 90kHz, and because of that has a resolution of 11.111us the accuracy of RTP based timing can not be higher than that. For example at 50fps the RTP counter will tick 1800 ticks per frame (  $90\text{kHz}/50\text{FPS} = 1800$  ).

The time interval between the packet arrival and start of packet read constitutes the Margin. The FPT margin indicates how closely the packet arrives to the start of the packet read, which is when the packet needs to be available at the latest.

Resolution	Framerate	Narrow			Wide	
		$VRX_{FULL}$	$C_{MAX}$ (Gapped)	$C_{MAX}$ (Linear)	$VRX_{FULL}$	$C_{MAX}$
720P	50	8	4	4	720	16
720P	60	8	4	4	720	16
1080P	50	8	4	4	720	16
1080P	60	8	5	5	730	16
3840P	50	27	17	16	2433	33
3840P	60	32	21	20	2920	40

There are three different types of senders defined in the standard. Narrow, NarrowLinear and Wide. The sender types are specified to accommodate the Packet read schedule, VRX and The network compatibility model (C). The table above gives an overview of VRXFULL and CMAX for some well used video streams.



The Virtual receiver Buffer (VRX) is based on the leaky bucket algorithm and will be drained according to the Packer Read Schedule. In the Timing View, the Virtual receiver Buffer only measures the number of packets present during the steady state window, the reason being that the VRX buffers up at the beginning of a frame and drains it down to zero at the end of the frame before the gap. The capacity of the VRX is a preset value specified in the standard and scales according to sender type. The sender needs to ensure that the packets enter the buffer and are ready to be drained at Start Of Packet Read, for the VRX to neither overflow or underflow.

C, is like the Virtual Receiver Buffer based on the leaky bucket algorithm, which task is to distribute packets evenly to avoid buffers to overflow. The graph in the timing view shows average and maximum packets in real time. The maximum value is pre-defined based on the type of transmitter. C overflow shows the number of packets exceeding the maximum allowed value.