Cobalt Digital Inc.

9990-TRX-MPEG
Multi-Standard Broadcast Transcoder

Product Manual

Version 1.0

9990-TRX-MPEG-OM
Version: 1.1

9990-TRX-MPEG • Multi-Standard Broadcast Transcoder Product Manual

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Before using this product and any associated equipment, refer to the "**Important Safety Instructions**" listed below to avoid personnel injury and to prevent product damage.

Products may require specific equipment, and/or installation procedures to be carried out to satisfy certain regulatory compliance requirements. Notices have been included in this publication to call attention to these specific requirements.

Symbol Meanings

This symbol on the equipment refers you to important operating and maintenance (servicing) instructions within the Product Manual Documentation. Failure to heed this information may present a major risk of damage or injury to persons or equipment.

Warning — *The symbol with the word "**Warning**" within the equipment manual indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.*

Caution — *The symbol with the word "**Caution**" within the equipment manual indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.*

Notice — *The symbol with the word "**Notice**" within the equipment manual indicates a situation, which if not avoided, may result in major or minor equipment damage or a situation which could place the equipment in a non-compliant operating state.*

ESD Susceptibility — *This symbol is used to alert the user that an electrical or electronic device or assembly is susceptible to damage from an ESD event.*

Important Safety Instructions

Caution — *This product is intended to be a component product of an 8300 series frame. Refer to the frame User Manual for important safety instructions regarding the proper installation and safe operation of the frame as well as its component products.*

Warning — *Certain parts of this equipment namely the power supply area still present a safety hazard, with the power switch in the OFF position. To avoid electrical shock, disconnect all A/C power cards from the chassis' rear appliance connectors before servicing this area.*

Warning — *Service barriers within this product are intended to protect the operator and service personnel from hazardous voltages. For continued safety, replace all barriers after any servicing.*
This product contains safety critical parts, which if incorrectly replaced may present a risk of fire or electrical shock. Components contained with the product's power supplies and power supply area, are not intended to be customer serviced and should be returned to the factory for repair. To reduce the risk of fire, replacement fuses must be the same time and rating. Only use attachments/accessories specified by the manufacturer.

Maintenance/User Serviceable Parts

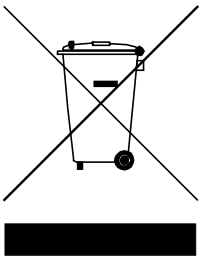
Routine maintenance to this Cobalt Digital Inc. product is not required. This product contains no user serviceable parts. If the frame does not appear to be working properly, please contact Technical Support using the numbers listed under the "Contact Us" section on the last page of this manual. All Cobalt Digital Inc. products are covered by a generous 5-year warranty and will be repaired without charge for materials or labor within this period. See the "Warranty and Repair Policy" section in this manual for details.

Environmental Information

The equipment that you purchased required the extraction and use of natural resources for its production. It may contain hazardous substances that could impact health and the environment.

To avoid the potential release of those substances into the environment and to diminish the need for the extraction of natural resources, Cobalt Digital Inc. encourages you to use the appropriate take-back systems. These systems will reuse or recycle most of the materials from your end-of-life equipment in an environmentally friendly and health conscious manner.

The crossed-out wheeled bin symbol invites you to use these systems.



If you need more information on the collection, reuse, and recycling systems, please contact your local or regional waste administration.

You can also contact Cobalt Digital Inc. for more information on the environmental performances of our products.

Contents

Electrostatic Discharge (ESD) and ESD Protection

Static electricity can damage boards, and other components. Before installing or removing cards, or making connections or disconnections, it is recommended you discharge static electricity by first touching a metal part of a grounded PC.

Safety Notice and Warnings

FCC Notice

This device complies with Subpart B of Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

No Telecommunications Network Voltage (TNV)-connected PCBs shall be installed.

Other Certifications

This class A digital apparatus complies with Canadian ICES-003, Issue 4.
Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.
This device complies with EN 55022 standards.
This device complies with EN 61000-3-2 standards.
This device complies with EN 61000-4-2 standards.
This device complies with CISPR 22 Edition 6.
This device complies with AS/NZS CISPR 22.

CE Mark Warning

This is a Class A product. In a domestic environment, this product may cause radio interference, in which case the user may be required to take adequate measures.

Introduction

The 9990-TRX-MPEG has the following features:

- Multi-Standard transcoder (MPEG-2 and H.264), with support for both SD (Standard Definition) and HD (High Definition) content. Up to 4 simultaneous transcoding instances are supported per board.
- Resolution resizing support.
- Audio pass-through support.
- Audio transcoding support: MPEG-1 Layer II, AAC-LC and Dolby AC-3 inputs, and MPEG-1 Layer II and AAC-LC outputs.
- 2 ASI input ports and 2 ASI output ports. All ports support the full ASI line rate of 213 Mb/s.
- 2 Ethernet ports with 100/1000 Mb/s support, capable of transmitting and receiving at line rate.
- Up to 8 simultaneous transmit and receive streams per Ethernet port.
- RTP support for Ethernet transmission/reception
- Advanced redundancy features.
- Internal program replication – individual programs can be routed to multiple outputs.
- Internal MPTS (Multi-Program Transport Stream) multiplexing and demultiplexing.
- (P)SI parsing and generation; ATSC table parsing.
- MPTS to SPTS Splitting support.

Typical application scenarios for the 9990-TRX-MPEG are:

- Contribution and Distribution: optimizing legacy MPEG-2 equipment for backhaul transmission.
- IPTV ingest of legacy content.
- IP and ASI protection switching.

Product Overview

The core of the 9990-TRX-MPEG is a switch that can select individual programs from transport stream inputs and connect these programs to transport stream outputs. This switch works as an intelligent demultiplexer for transport stream inputs, and an intelligent multiplexer for transport stream outputs. Additionally, individual programs can be routed to one of 4 transcoder instances to be processed prior to being connected to an output. A transcoder instance can change the compression format (between MPEG-2 and H.264), the bit rate, frame rate, and/or resolution of the stream, as well as change the audio compression format and bit rate.

The following inputs are available:

- 2 fixed-function ASI inputs

- Up to 8 IP inputs per Ethernet port (for a maximum of 16 IP inputs)
- 2 internal test packet generators (which can be used to generate ASI or IP test streams)

The following outputs are available:

- 2 fixed-function ASI outputs
- Up to 8 IP outputs per Ethernet port (for a maximum of 16 IP outputs)

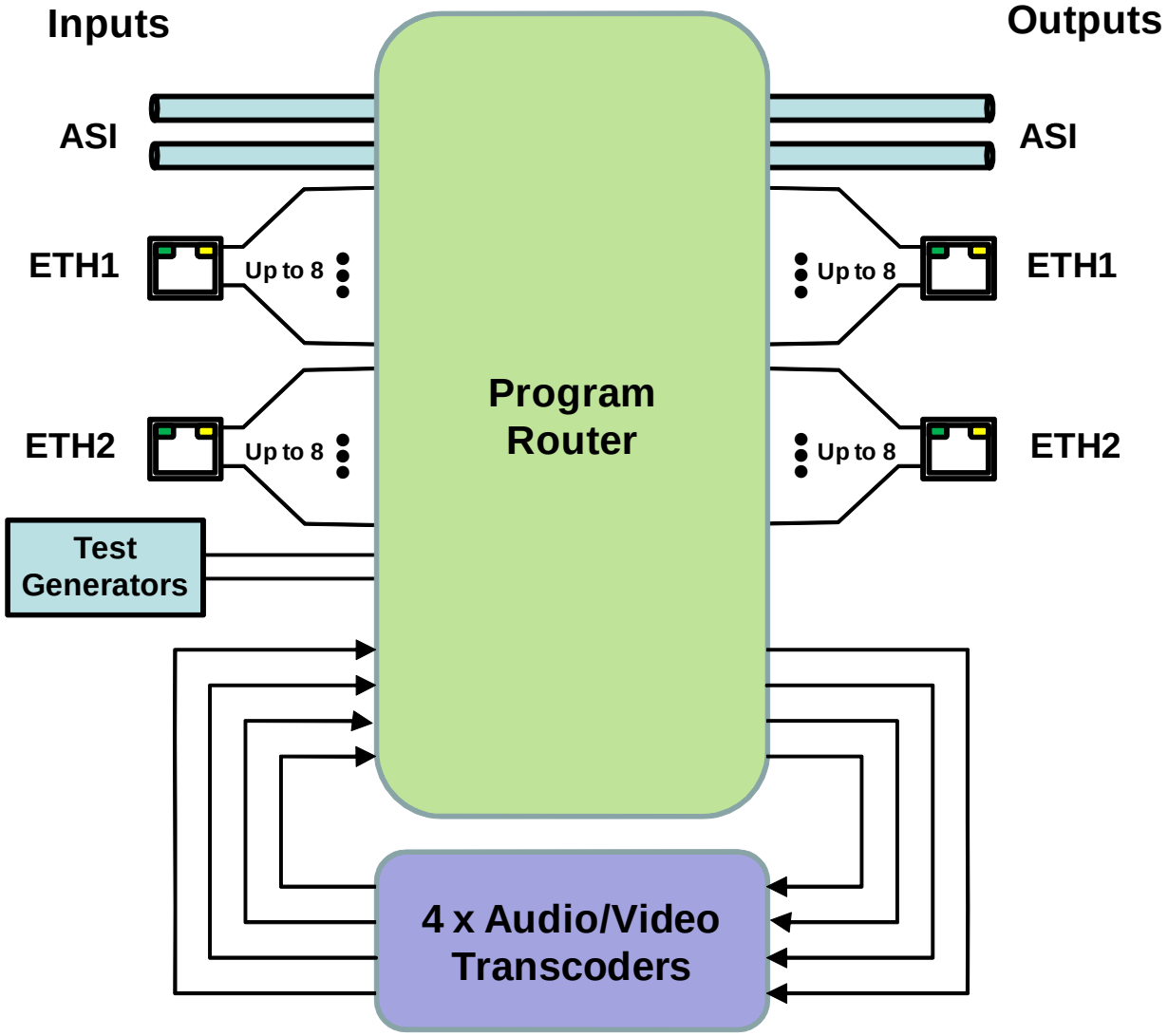
Additionally, any of the inputs can be routed to one of 4 transcoder instances for processing.

In general terms, configuring the 9990-TRX-MPEG is a three-step process:

Step 1: Configure the input.
Step 2: Configure a transcoding instance, if desired. As part of this step, a connection between the input and the transcoding instance can be established.
Step 3: Configure the output. As part of this step, a connection between the input and the output can be established.

If you are making one-to-many connections, steps 1 and 2 are performed once, and step 3 is performed multiple times. It is also possible to configure the output first (without making the connection to an input), configure the input next, and finally make the connection between the input and the output.

The overall architecture is depicted below.



For the remainder of this manual, we will use the term *port* for a physical input/output port (such as ASI or Ethernet), and *stream* for a transport stream present in the port. ASI ports support only one stream, while Ethernet ports support multiple streams. A transport stream can have one or more *programs*. In this manual, we will use the words *program* and *service* interchangeably.

Redundancy Options

The IP inputs in the 9990-TRX-MPEG can be configured to support transport stream redundancy. This means that the unit can be configured with a "primary transport" and a "backup transport". If the primary transport disappears, the unit may be set to automatically switch to the backup transport, after a configurable timeout. The redundancy function has the following features:

- Transport stream redundancy can be set to "Manual" or "Automatic". In "Automatic" mode, the unit will switch to the backup stream after a configurable timeout, if the

primary stream disappears. In "Manual" mode, the switch has to be performed by the operator.

- Regardless of the Automatic/Manual mode, the operator always has the ability to instruct the unit to switch to the other transport stream.

An IP Input receives a transport stream over UDP/IP or RTP/UDP/IP, on a given IP Address/UDP Port combination, with an optional Source IP address specification. For each IP Input, the unit allows an optional backup IP Address/UDP Port/Optional Source IP Address combination to be specified. If the transport stream disappears from the primary address/port combination, the port can switch to the backup address/port combination (if configured for automatic redundancy). The automatic switch timeout can be set to a value between 2 and 45 seconds.

This level of redundancy is available for all IP input ports, and is independent of any connections that may exist to the port. It uses no internal resources in the 9990-TRX-MPEG (i.e., it does not "count" as an input or as a connection), but it has the following limitations:

- It is only available for IP input ports.
- The primary and backup transport streams must be available on the same Ethernet port.
- The 9990-TRX-MPEG does not monitor the inactive stream. Therefore, if the active stream disappears and the other stream not running either, the 9990-TRX-MPEG will be switching back and forth until one of the two streams comes back.

9990-TRX-MPEG Indicators and Switches

The 9990-TRX-MPEG card can be installed in 20-slot HPF-9000, OG3-FR or 8321 frames. Prior to installing the card, first install the corresponding rear panel I/O module.

Rear I/O Panel Indicators

The 9990-TRX-MPEG rear I/O panel is depicted below. It includes 2 ASI inputs and 2 ASI outputs on standard BNC connectors[1], and two 100/1000 Mb/s Ethernet ports on standard RJ-45 connectors.

Each of the ASI input ports has a green indicator LED, with the following states:

- **LED off:** ASI port is disabled.
- **LED flashing once every 3 seconds:** the ASI port is not locked to a signal (i.e., there is no input signal).
- **LED flashing once per second:** the ASI port is is locked to a signal.

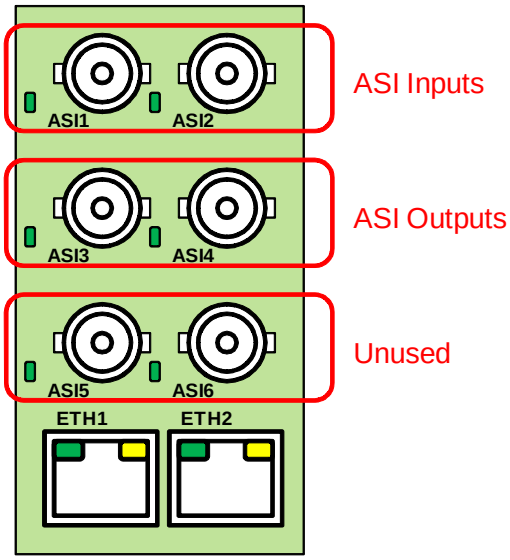
Each of the ASI output ports has a green indicator LED, with the following states:

- **LED off:** ASI port is disabled.
- **LED flashing multiple times per second:** ASI port is transmitting packets.

Each of the Gigabit Ethernet ports has two indicator LEDs, with the following states:

- **Green LED:**
  - **Off:** No link
  - **On:** Link
- **Yellow LED:**
  - **Off:** No activity (transmit and/or receive)
  - **Flashing:** Port is currently transmitting and/or receiving

[1] The I/O panel has two unused BNC connectors.



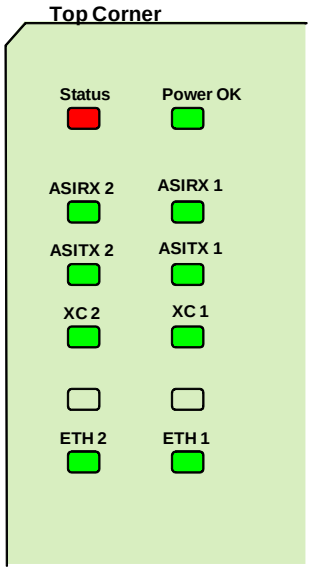
Front Indicators

A similar set of indicators exist in the front of the board. These are visible when the frame front door is opened. The indicator layout is depicted below.

The LED indicators are as follows:

- **Status LED:** indicates the overall status of the board.
  - **Green:** no active alarm
  - **Red:** at least one critical alarm present

  When inserting a board in the frame, this LED will be red until the board starts operation. At that point, it will turn green if there is no active alarm or red if there is at least one alarm.
- **Power OK LED:** indicates that the power received from the frame is OK.
  - **Green:** power OK
  - **Off:** no power (or insufficient voltage – check the frame power status)
- **ASIRX 1 and ASIRX 2 LEDs:** these behave exactly the same as the ASI input rear I/O panel indicators (ASI 1 and ASI 2).
- **ASITX 1 and ASITX 2 LEDs:** these behave exactly the same as the ASI output rear I/O panel indicators (ASI 3 corresponds to ASITX 1 and ASI 4 corresponds to ASITX 2).
- **XC 1 and XC 2 LEDs:** these LEDs flash if the unit is transcoding. XC 1 corresponds to transcoder instances 1 and 2, and XC 2 corresponds to transcoder instances 3 and 4.
- **ETH1 and ETH2 LEDs:** these indicate the status of the corresponding Ethernet connection.
  - **Off:** no link
  - **On:** link OK, no activity
  - **Blinking:** link OK, port is transmitting and/or receiving packets

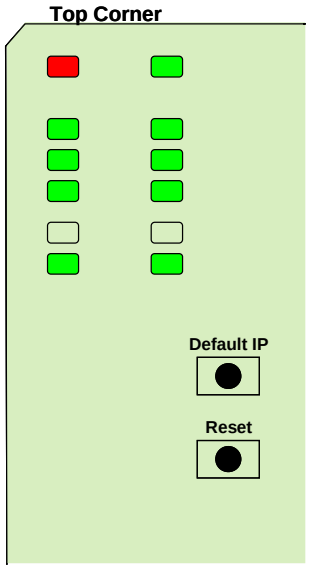


The 9990-TRX-MPEG board has other LEDs that may or may not be illuminated. They are intended for engineering debug only.

Front Switches

The 9990-TRX-MPEG board has two pushbutton-type switches in the front, just below the LEDs, as depicted below. Their operation is as follows:

- **Default IP Switch:** This switch is used to recover the board in the unlikely case of a corrupted or broken firmware update. In most cases, the 9990-TRX-MPEG will detect the error and automatically fall back into the factory-default firmware load. If it does not, pull the card out, press and hold this switch, and push the card back into the frame while still holding the switch. You can release the switch once the Status LED turns orange. This action causes the card to revert to the factory-default firmware.
- **Reset Switch:** Pressing this pushbutton switch causes the card to reset.

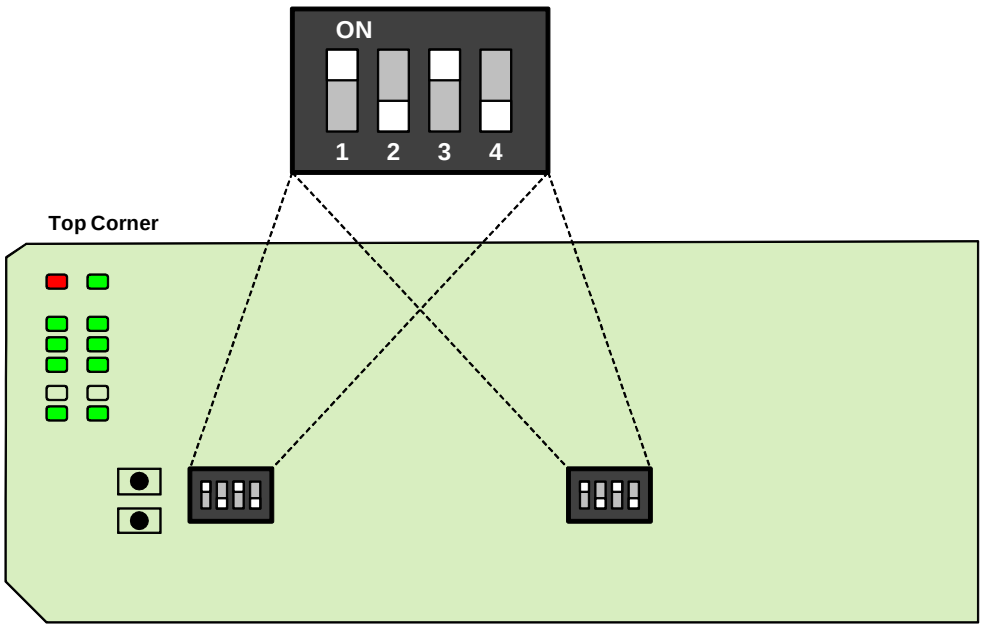


DIP Switches

The 9990-TRX-MPEG has two DIP Switches. These are for factory use only and their settings must not be modified. If any changes are made to the DIP Switch settings, the 9990-TRX-MPEG will stop operating. The correct settings for the two DIP Switches are:

1: ON
2: OFF
3: ON
4: OFF

These settings are illustrated below.



Each of the ASI input ports has a green indicator LED, with the following states:

- **LED off:** ASI port is disabled.
- **LED flashing once every 3 seconds:** ASI port is not locked to a signal (i.e., there is no input signal).
- **LED flashing once per second:** ASI port is locked to a signal.

Each of the ASI output ports has a green indicator LED, with the following states:

- **LED off:** ASI port is disabled.
- **LED flashing multiple times per second:** ASI port is transmitting packets.

Each of the Gigabit Ethernet ports has two indicator LEDs, with the following states:

- **Green LED:**
  - **Off:** No link
  - **On:** Link
- **Yellow LED:**
  - **Off:** No activity (transmit and/or receive)
  - **Flashing:** Port is currently transmitting and/or receiving

9990-TRX-MPEG Operation and Management

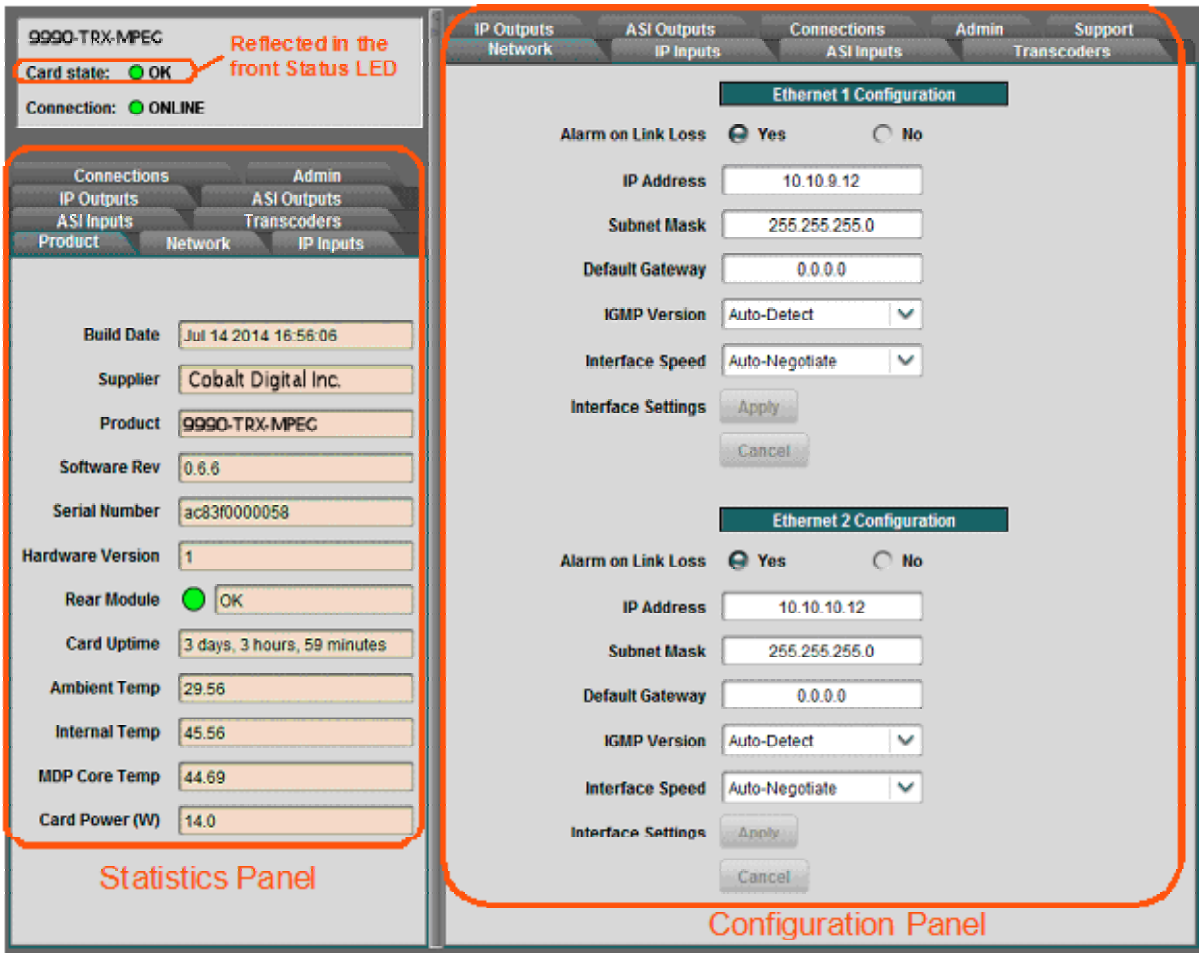
The 9990-TRX-MPEG is configured using the free Dashboard™ application, which is available for Windows, Apple OS X, and Linux. Dashboard can be downloaded from this link:

http://www.opengear.tv/?p=94

The 9990-TRX-MPEG user interface is depicted below. As with any openGear™ card, it is divided into a statistics panel on the left, and a configuration panel on the right. Each panel has multiple tabs, corresponding to the various functions in the card. Note that the **Card State** alarm indicator is also reflected in the green/red **Status** LED in the front of the board. The Status LED will be green when Card State is green or yellow, and will be red when Card State is red.

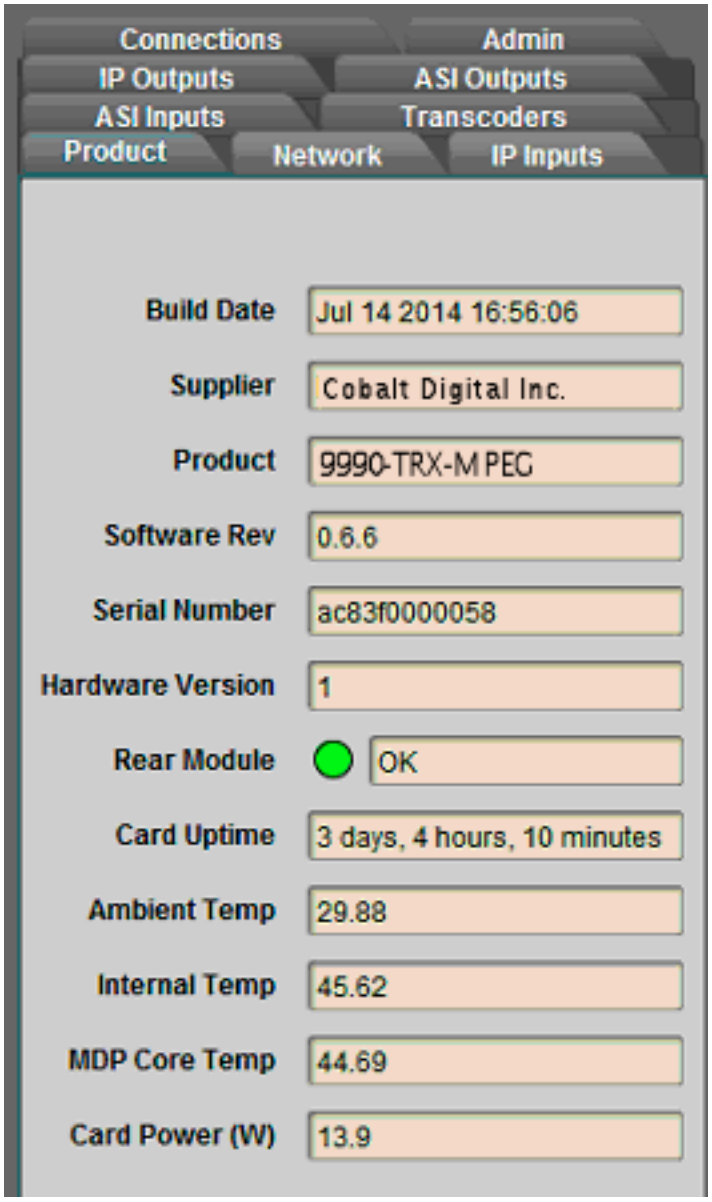
The following tabs are available:

- **Product:** this tab provides general information on the card, including firmware version, uptime, temperatures, and other parameters. It appears only on the Statistics panel.
- **Network:** this tab is used to configure the IP addresses and network information for the Ethernet ports. The statistics side of the panel includes some additional information such as link state.
- **ASI Inputs:** this tab is used to configure/monitor the ASI Input ports.
- **ASI Outputs:** this tab is used to configure/monitor the ASI Output ports.
- **IP Inputs:** this tab is used to configure/monitor the IP Input ports. The configuration panel provides the facilities to create, manage and delete ports; the statistics panel includes reception status information.
- **IP Outputs:** this tab is used to configure/monitor the IP Output ports. The configuration panel provides the facilities to create, manage and delete ports; the statistics panel includes transmission status information.
- **Transcoders:** this tab is used to configure/monitor the transcoder instances. The configuration panel provides facilities to configure each transcoder instance, and the statistics panel provides status information.
- **Connections:** this tab is used to configure connections. It provides facilities to create, edit and delete connections; the statistics panel provides a table where the status of all the connections in the unit can be inspected at a glance.
- **Admin:** this tab is used for general administrative functions, such as firmware upgrades, licensing, logs, and configuration management. The Test Packet Generator configuration is also found under this tab.
- **Support:** this tab has information on how to contact Customer Support, and has the ability to generate a tech support dump for the unit. When contacting support, always include the support dump from this tab.


9990-TRX-MPEC
Card state: OK
Reflected in the front Status LED
Connection: ONLINE
Connections
Admin
IP Outputs
ASI Outputs
ASI Inputs
Transcoders
Product
Network
IP Inputs
Build Date
Jul 14 2014 16:56:06
Supplier
Cobalt Digital Inc.
Product
9990-TRX-MPEC
Software Rev
0.6.6
Serial Number
ac83f0000058
Hardware Version
1
Rear Module
OK
Card Uptime
3 days, 3 hours, 59 minutes
Ambient Temp
29.56
Internal Temp
45.56
MDP Core Temp
44.69
Card Power (W)
14.0
Statistics Panel
IP Outputs
ASI Outputs
Connections
Admin
Support
Network
IP Inputs
ASI Inputs
Transcoders
Ethernet 1 Configuration
Alarm on Link Loss
Yes
No
IP Address
10.10.9.12
Subnet Mask
255.255.255.0
Default Gateway
0.0.0.0
IGMP Version
Auto-Detect
Interface Speed
Auto-Negotiate
Interface Settings
Apply
Cancel
Ethernet 2 Configuration
Alarm on Link Loss
Yes
No
IP Address
10.10.10.12
Subnet Mask
255.255.255.0
Default Gateway
0.0.0.0
IGMP Version
Auto-Detect
Interface Speed
Auto-Negotiate
Interface Settings
Apply
Cancel
Configuration Panel

Product Tab

The Product Tab contains basic information about the 9990-TRX-MPEG.



The following information is available:

- **Build Date:** Date the firmware image was built.
- **Supplier:** Cobalt Digital Incorporated.
- **Product:** 9990-TRX-

- **Software revision:** This indicates the firmware revision currently running. The format is Major Version • Minor Version • Build Number.
- **Serial Number:** This is the serial number of this particular 9990-TRX-MPEG card.
- **Hardware Version:** This indicates the board version number. All board versions are functionally equivalent.
- **Rear Module:** This indicates the status of the Rear I/O Module. It can have one of the following states:
    - **OK**: The Rear Module is the correct module for the 9990-TRX-MPEG.
    - **Not Installed**: The 9990-TRX-MPEG is not connected to a rear module. The card is operating normally, but it will not be useful as there are no input and output connections to it.
    - **Wrong Module:** The 9990-TRX-MPEG is connected to a rear module that was not designed for it (most likely from another openGear™ vendor). This alarm will cause the front status LED to turn red.
- **Card Uptime:** Indicates how long the card has been running since it was last rebooted.
- **Ambient Temperature:** Temperature, in degrees centigrade, of the air intake of the card (measured at the front edge of the card).
- **Internal Temperature:** Temperature, in degrees centigrade, at the back of the card.
- **MDP Core Temperature:** Temperature, in degrees centigrade, of the core processing element.
- **Card Power (W):** Indicates the current power draw of the unit, in watts.

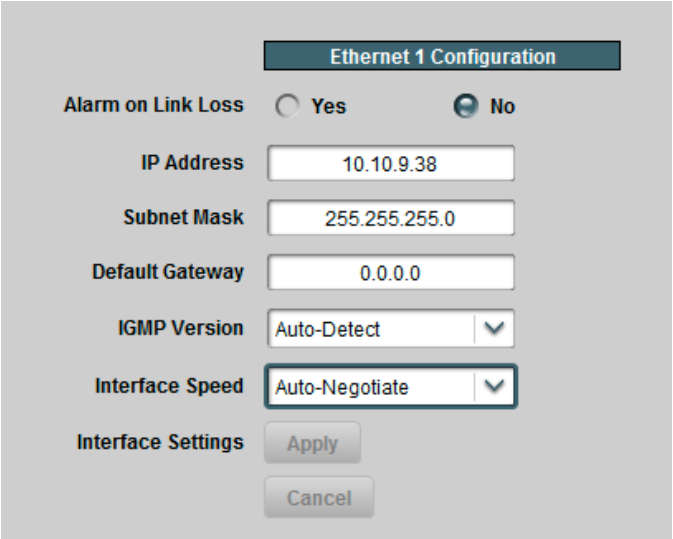
The openGear™ frame is designed to operate in environments with up to 40°C ambient. There is typically a 5°C temperature raise from the external ambient to the "Ambient Temperature" measured by the 9990-TRX-MPEG. If that measurement is at 45°C or higher, action must be taken to cool down the ambient temperature. The 9990-TRX-MPEG will log excessive temperature events.

Network Tab

The Network Tab allows for configuration/monitoring of the two Ethernet ports.

Network Configuration Tab

The Network Configuration Tab is used to set the individual parameters for each of the Ethernet ports.

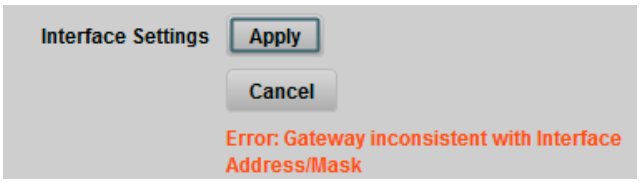


The following parameters can be configured:

- **Alarm on Link Loss:** If set to Yes, the card will raise an alarm if this Ethernet interface loses link. The Card State indicator in Dashboard™ and the front Status LED will both be red. If set to No, the card will still report loss of link in the Statistics page but no alarm will be raised. It is recommended to turn on the alarm for ports that are in use; only turn it off if you do not plan to connect that port to a network.
- **IP Address:** Enter the desired IP address for this Ethernet port. Please note that the 9990-TRX-MPEG uses a block of 4 IP addresses for internal communication; these addresses cannot be used for the external network interfaces. The reserved addresses are:
  - 10.253.254.252
  - 10.253.254.253
  - 10.253.254.254
  - 10.253.254.255

  Please contact Support if this is an issue for your network.
- **Subnet Mask:** Enter the desired subnet mask for this Ethernet port.
- **Default Gateway:** Enter the desired default gateway for this Ethernet port, or 0.0.0.0 if no gateway is available.
- **Interface Settings:** If you make any changes to the IP Address, Subnet Mask and/or Default Gateway fields, the **Apply** and **Cancel** buttons become active. The changes only take effect when you press the **Apply** button. Pressing the **Cancel** button reverts the

fields back to their original values. Note that the 9990-TRX-MPEG will check the consistency of the data entered and will reject invalid combinations. Once the **Apply** button is pressed, a status message appears just below the **Cancel** button, as follows:



- **IGMP Version:** The 9990-TRX-MPEG implements the IGMP protocol for multicast reception. This parameter controls the version of the protocol to be used.
    - **Auto-Detect:** The 9990-TRX-MPEG will attempt to auto-detect the IGMP version in use by inspecting the Group Membership Requests received from the router. It defaults to IGMP Version 3 if no messages are received.
    - **IGMP Version 1:** Force the use of Version 1 only (not recommended)
    - **IGMP Version 2:** Force the use of Version 2 only
    - **IGMP Version 3:** Force the use of Version 3 only
- **Interface speed:** Configures the speed of the interface. The 9990-TRX-MPEG Ethernet interfaces only support two modes: 100 Mb/s Full-Duplex and 1 Gb/s Full-Duplex[2].
    - **Auto-Negotiate:** The Ethernet port will auto-negotiate the speed.
    - **100 Mb/s Full-Duplex:** Force the port to 100Mb/s Full-Duplex mode. Note that the port will still perform auto-negotiation, but it will only advertise this mode.
    - **1Gb/s Full-Duplex:** restrict the operation to 1Gb/s Full-Duplex mode. Note that the port will still perform auto-negotiation, but it will only advertise this mode.

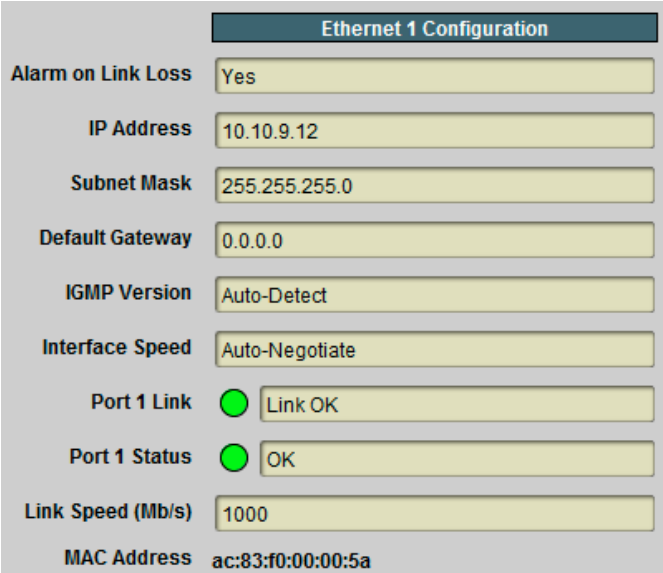
Notes:

- If the 9990-TRX-MPEG streaming Ethernet interfaces are connected to a 10 Mb/s switch, hub, or network feed, link will **not** be established and the port will not recognize the connection.
- If you select **100 Mb/s Full-Duplex** or **1 Gb/s Full-Duplex** and the corresponding streaming Ethernet interface is connected to a switch, hub or network feed that does not support the selected speed, link will **not** be established and the port will not recognize the connection.
- If the interface speed is set to **Auto-Negotiate**, the streaming Ethernet port will allow link to be established in 100 Mb/s Half-Duplex mode. However, this will be flagged as a warning in the Network Statistics Tab and in the Admin Event Log Tab.

[2] Support has been disabled for 10 Mb/s and Half-Duplex modes, as these are unsuitable for MPEG transport over IP applications. Moreover, any modern switch supports at least 100 Mb/s Full-Duplex.

Network Statistics Tab

The Network Statistics Tab reports the current IP configuration of each Ethernet port, as well as their link state and running status.



The following parameters are reported in the Network Statistics tab:

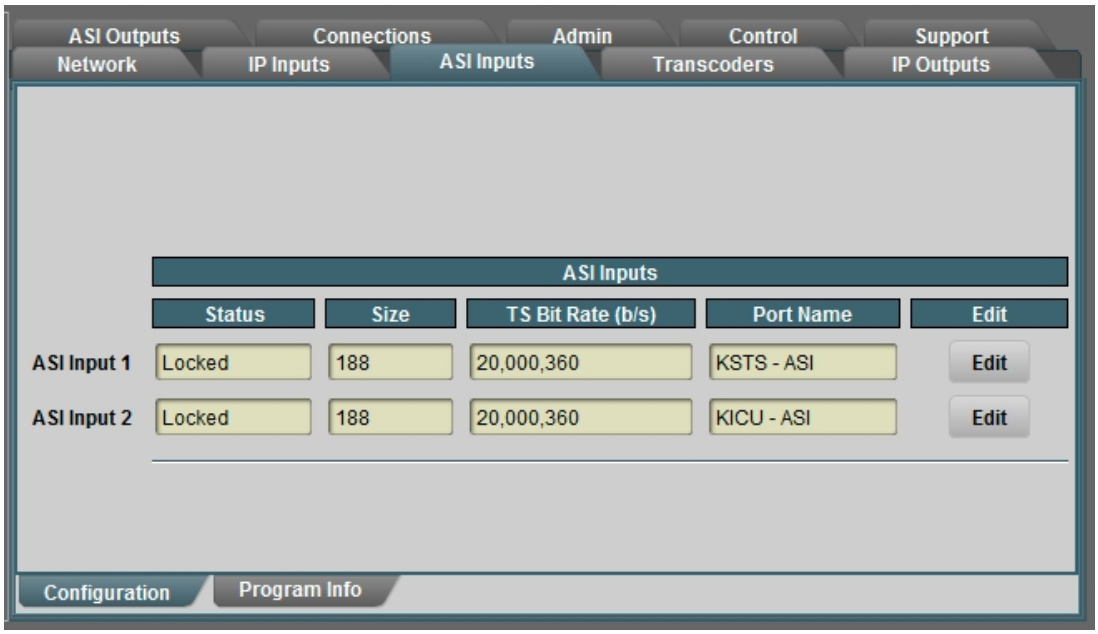
- **Alarm on Link Loss:** Reports the current setting of this parameter.
- **IP Address:** Reports the current IP Address for the port.
- **Subnet Mask:** Reports the current Subnet Mask for the port.
- **Default Gateway:** Reports the current Default Gateway for the port.
- **IGMP Version:** Reports the current setting for this parameter.
- **Interface Speed:** Reports the current setting for this parameter.
- **Port 1/2 Link:** This indicator has the following states:
  - **Link OK**: The port has established link with the switch.
  - **No Link:** The port does not currently have link. If Alarm on Link Loss is set to Yes, the Dashboard™ Card State will be red and the Status LED in the front of the board will also be red. If Alarm on Link Loss is set to No, this indicator will still be red, but the alarm will not propagate.
- **Port 1/2 Status:** This indicator is the port overrun status. It has the following states:
  - **OK**: The port is operating normally.
  - **TX Overflow:** In the current configuration, the IP outputs are attempting to transmit more than the port capacity (i.e., the overall output data for this port exceeds the interface speed of 100 Mb/s or 1 Gb/s). The Dashboard™ Card State will be red and the Status LED in the front of the board will also be red. In this case, reduce the output bit rate (either by externally controlling the inputs or by removing output ports). **If this indicator is red, data is being dropped.**
- **Link Speed (Mb/s):** This parameter reports the actual speed negotiated with the switch for the port. If the port has no link, the value reported here is zero.
- **MAC Address:** This reports the MAC address of the Ethernet port.

ASI Input Ports

The 9990-TRX-MPEG card has 2 fixed-function ASI Input Ports. This tab is used to configure and manage these ports.

ASI Inputs: Configuration Tab

The Configuration Tab for the ASI inputs is shown below:



As indicated in the picture, two bottom tabs are available:

- **Configuration:** this tab provides some basic statistics for the ports and allows for configuration of the ASI input parameters.
- **Program Info:** if the ASI input is receiving a transport stream, this tab provides information about the programs found in that transport stream.

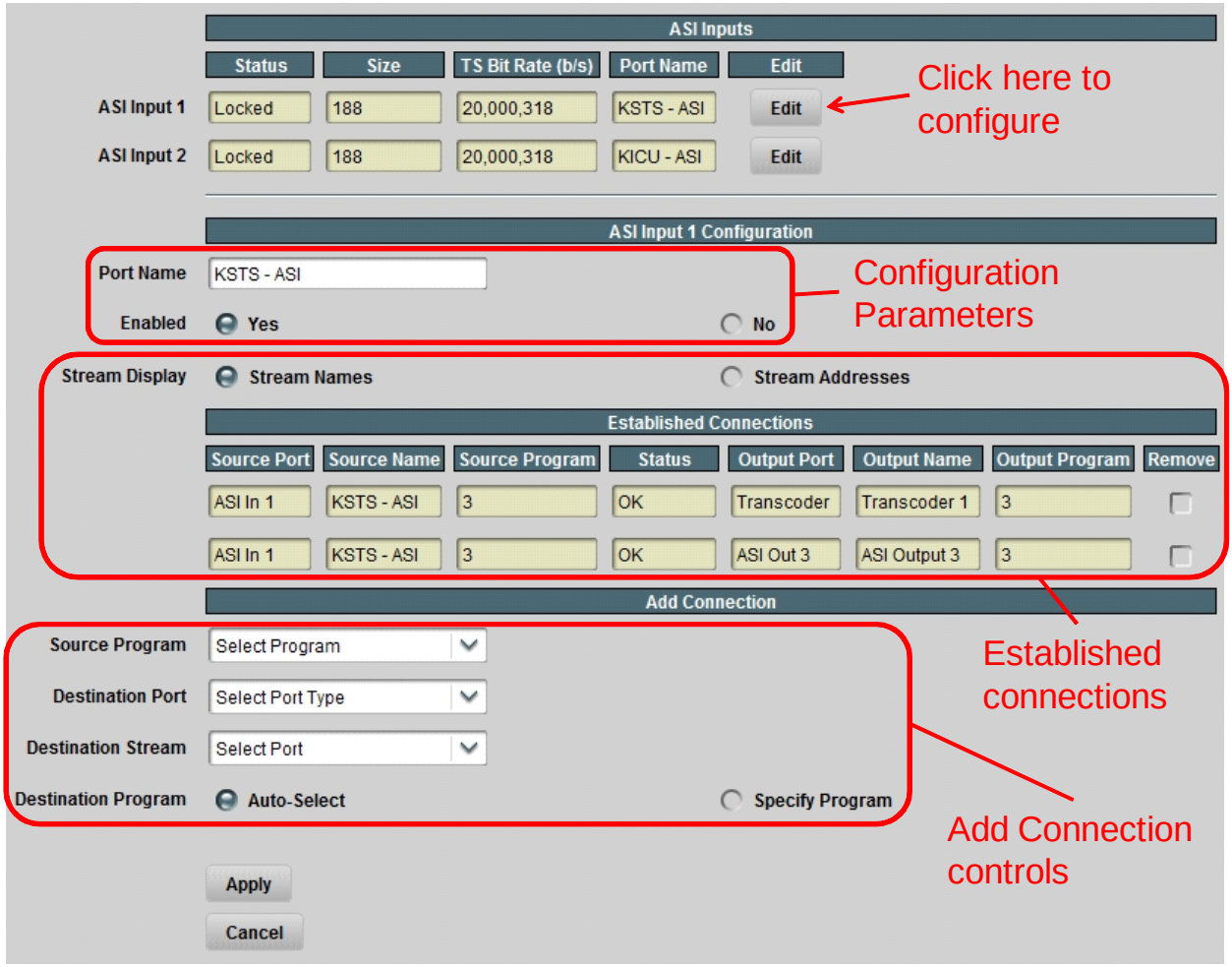
ASI Inputs: Configuration

The Configuration tab is divided into two areas:

- The **ASI Inputs** table, which displays an overview of the ports. It contains the following fields:
  - **Status:** Indicates the current status of the port. The possible values are:
    - **Locked:** the port is enabled and locked to a valid ASI signal.
    - **Unlocked:** the port is enabled, but has no signal.
    - **Disabled:** the port is disabled by user configuration.
  - **Size:** Indicates the detected ASI transport packet size (188 or 204 bytes). If the port is disabled or unlocked, this field will show a value of 0 (zero).
  - **TS Bit Rate (b/s):** Measured transport stream bit rate, in bits/second.

- **Port Name:** All 9990-TRX-MPEG ports can be assigned a user-defined name, which is displayed here. The default name is **ASI Input 1** or **ASI Input 2**.
- **Edit:** This button, when clicked, brings up the configuration area of the port.

- The configuration area of the port, which is accessed by clicking on the **Edit** button, as shown below.



The configuration area of the port is divided into three sections:

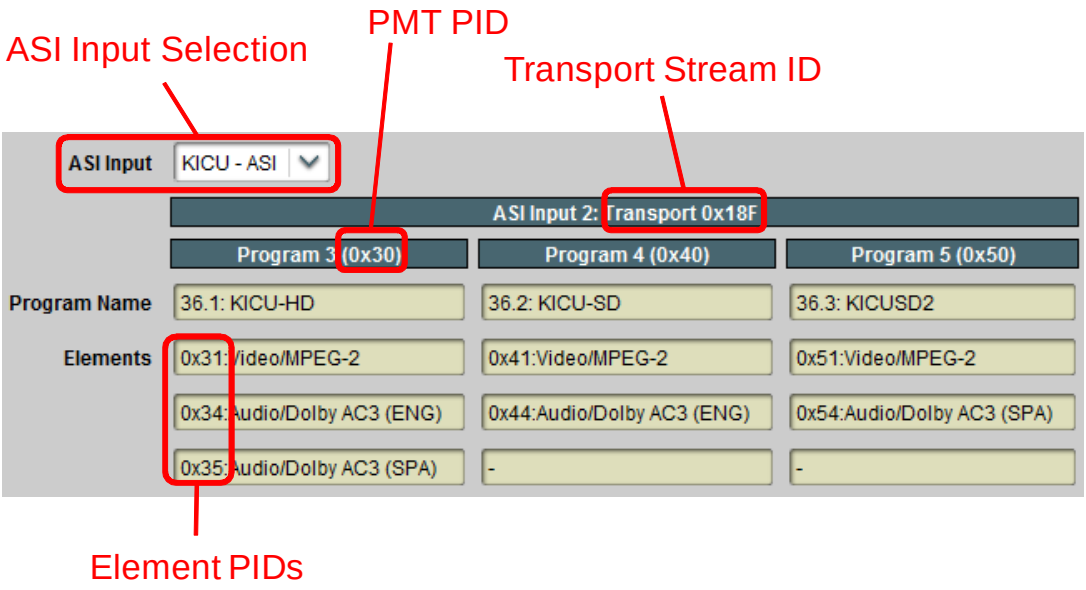
- The port configuration parameters. For ASI Inputs, the parameters are:
  - **Port Name:** All 9990-TRX-MPEG inputs and outputs can be assigned a user-defined port name. This name is used to identify the port later when making connections. Use any descriptive name suitable for your application, or accept the default.
  - **Enabled:** the ASI Input can be enabled/disabled using this parameter. When the port is disabled, the corresponding LED in the front and back panels stays off.
- The **Established Connections** table. This indicates all the current connections from the port. Connections can be removed by clicking on the corresponding box in the **Remove** column.

- The **Add Connection** area. This allows for a new connection to be added to this port. This control is available for all ports, and is described in detail in the Connections section.

Once the desired configuration is entered, click on the **Apply** button to have them take effect. This will cause the changes made in the Configuration Parameters to be implemented, any connections marked for deletion to be removed, and any new connection entered in the Add Connection area to be established. Clicking on the **Cancel** button will discard any changes.

ASI Inputs: Program Info Tab

For ASI Inputs with a valid transport stream containing at least one program, the **Program Info** tab shows the contents of the transport stream, as illustrated below:

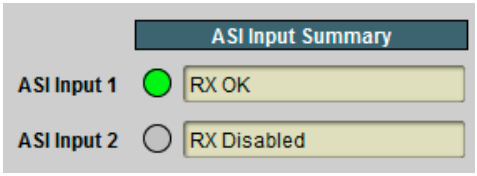


The following elements are present:

- **ASI Input:** Select which input to display. The selection uses the port names configured in the previous step.
- **Header Information:** The top header indicates the Transport Stream ID (TSID). For each program, an individual header is provided, showing the Program Number and the PMT PID.
- **Program Name:** If available, the Program Name is displayed. If the transport stream contains a Service Description Table (SDT), the Service Name is displayed here. If the transport stream contains a Virtual Channel Table (VCT – used in terrestrial ATSC broadcasts), this field will show the major and minor channel numbers, and the short channel name (as depicted above).
- **Elements:** For each program, a list of elements is provided. The list contains the Element PID, the element type (Audio/Video/other), and the type of compression if appropriate. For audio streams, if a language code is present, it is displayed here as well.

ASI Inputs: Statistics Tab

The Statistics Tab for the ASI Ports provides a quick visual summary status for the ports. A sample is depicted below:



Each of the ASI Input Port indicators can have the following values:

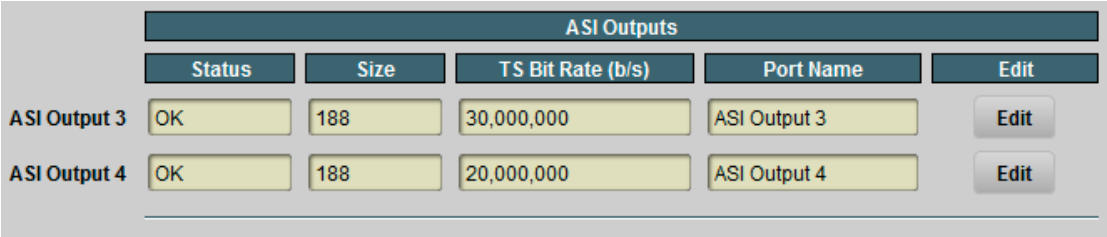
- **RX Locked**: The port is locked to an input signal.
- **RX Disabled:** The port is disabled.
- **RX Unlocked:** The port is in receive mode, and it is not locked to any signal. Dashboard Card State and the Status LED will be red if there is a connection to this port.

ASI Output Ports

The 9990-TRX-MPEG card has 2 fixed-function ASI Output Ports. This tab is used to configure and manage these ports.

ASI Output Ports: Configuration Tab

The ASI Output Configuration Tab is show below:



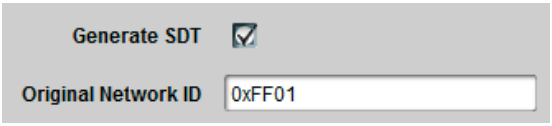
The **ASI Outputs** table is always displayed, and its columns are:

- **Status:** Indicates the port status. It can contain the following values:
  - **OK:** Port is operating normally.
  - **Unlocked:** Port is unlocked. This status means that the port is in Automatic mode and it has no input.
  - **Overflow:** This means that the ASI Output is in Manual mode, and the configured bit rate is insufficient to carry the input connected to it. This situation will raise an alarm.
- **Size:** Indicates the transport packet size, in bytes.
- **TS Bit Rate (b/s):** This reports the actual transport stream bit rate, in bits/second.
- **Port Name:** This reports the configured Port Name.
- **Edit Button:** Clicking on this button allows reconfiguration of the port. The ASI Port Configuration screen appears, with the settings for the selected port.

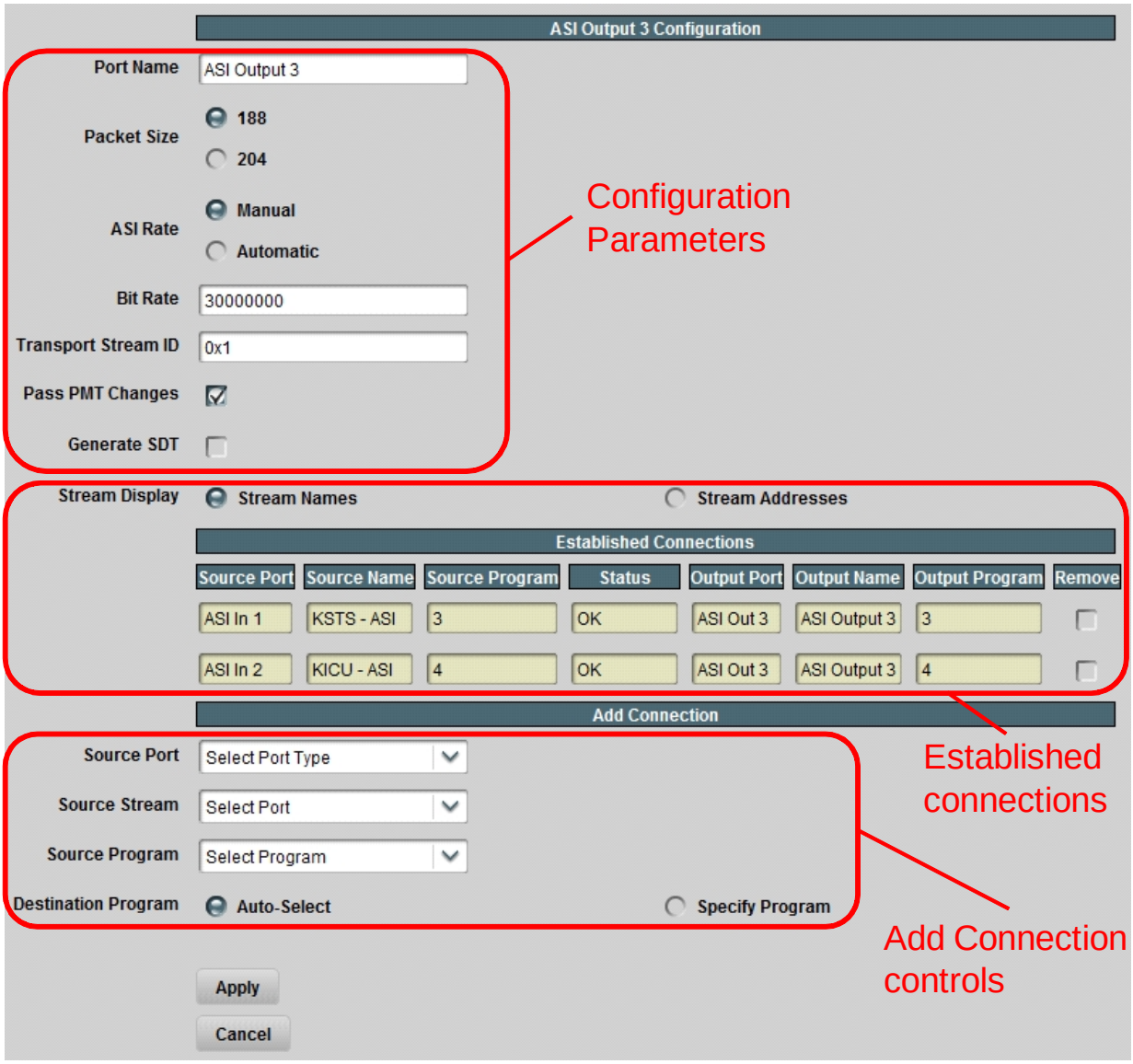
Click on the **Edit** button next to the port you want to configure. The configuration area of the port will open, as depicted below. It is divided into three sections:

- The port configuration parameters. For ASI Outputs, the parameters are:
  - **Port Name:** All 9990-TRX-MPEG inputs and outputs can be assigned a user-defined port name. This name is used to identify the port later when making connections. Use any descriptive name suitable for your application, or accept the default.
  - **Packet Size:** Select between 188 or 204 bytes.
  - **ASI Rate:** The available selections are:
    - **Manual:** In this mode, the ASI output bit rate is manually set. If the content routed to the port exceeds the configured bit rate, packets will be dropped and the port will raise an alarm.

        - **Automatic:** In this mode, the ASI output bit rate is automatically set by the 9990-TRX-MPEG to match the programs routed to the port.
    - **Bit Rate:** This field is only shown if the **ASI Rate** control is set to **Manual**. Enter the desired bit rate in bits/second.
    - **Transport Stream ID:** Enter the desired Transport Stream ID for the port. This value comes out in the Program Allocation Table (PAT).
    - **Pass PMT Changes:** This checkbox controls whether PMT descriptor changes from the connected programs are propagated to the output PMT for this port. This box defaults to checked, and in most cases it should be left checked. Only uncheck it if you want to isolate the devices downstream of the transcoder from table changes.
    - **Generate SDT:** If you check this box, a Service Description Table (SDT) will be generated. Service Names will come from the connected programs. If this box is checked, another field is displayed:



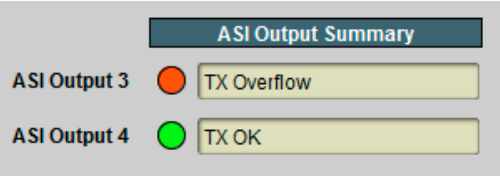
    - **Original Network ID:** Enter the desired Original Network ID. For applications where Network IDs have not been assigned, leave this field at 0xFF01.
- The **Established Connections** table. This indicates all the current connections from the port. Connections can be removed by clicking on the corresponding box in the **Remove** column.
- The **Add Connection** area. This allows for a new connection to be added to this port. This control is available for all ports, and is described in detail in the Connections section.



Once the desired configuration is entered, click on the **Apply** button to have them take effect. This will cause the changes made in the Configuration Parameters to be implemented, any connections marked for deletion to be removed, and any new connection entered in the Add Connection area to be established. Clicking on the **Cancel** button will discard any changes.

ASI Ports: Statistics Tab

The Statistics Tab for the ASI Ports provides a quick visual summary status for the ports. An example is depicted below.



Each of the ASI Port indicators can have the following values:

- **TX OK**: The port is operating normally in transmit mode (ASI Output).
- **TX Overflow:** The port is in transmit mode, manual bit rate setting, and the connected bit rate is excessive. The Dashboard Card State will be red and the Status LED in the front of the board will also be red. To correct this problem, either externally reduce the input bit rate, or increase the ASI output bit rate, or configure the port in Automatic mode. **If this alarm is active, data is being dropped.**
- **TX Unlocked:** The port is in transmit mode, automatic bit rate, and there is no data rate coming to it. Any downstream ASI receivers will lose lock. Dashboard Card State and the Status LED will be red if there is a connection to this port.

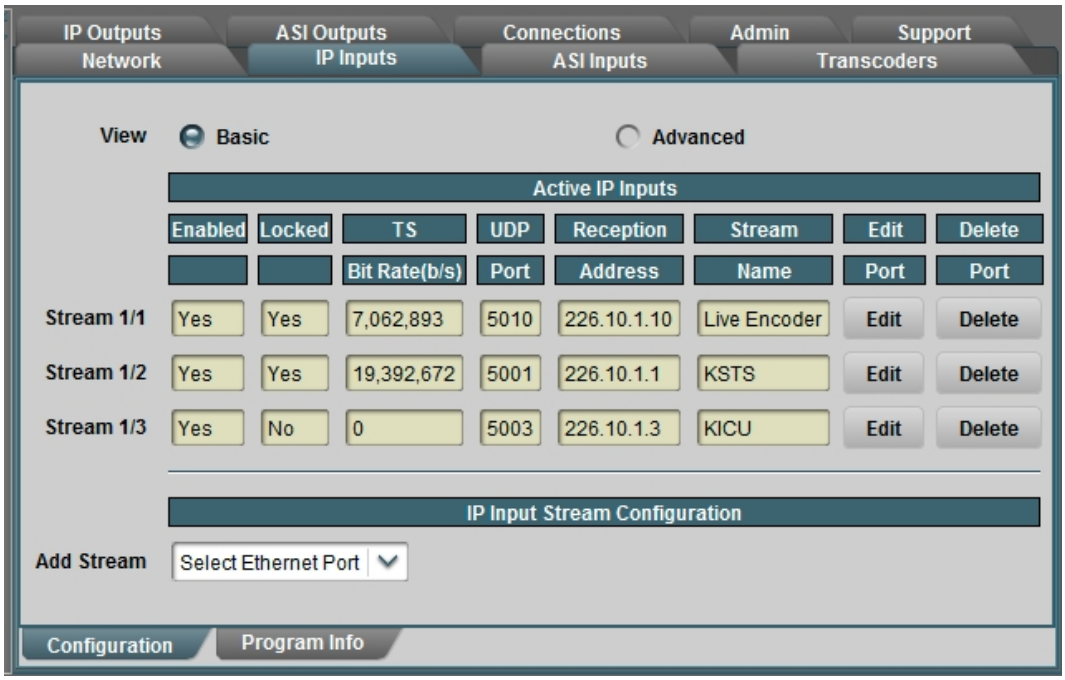
IP Inputs

IP Inputs receive transport streams over UDP/IP from the Ethernet ports and make them available for connections to outputs. The 9990-TRX-MPEG card supports up to 8 transport stream inputs per Ethernet port. IP Inputs have the following specifications:

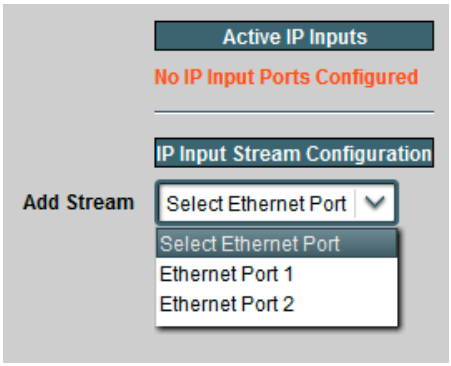
- Format support: MPEG-2 Transport Packets over UDP/IP or RTP/UDP/IP (auto-detected).
- Number of MPEG-2 Transport Packets per UDP datagram: between 1 and 7 (no support for IP fragmentation).
- Addressing support: unicast, multicast and broadcast.
- Configurable source IP address filtering.
- Configurable IP Address/UDP Port redundancy.

IP Inputs: Configuration Tab

The IP Inputs tab is similar to the ASI Inputs tab – it also features **Configuration** and **Program Info** bottom tabs:

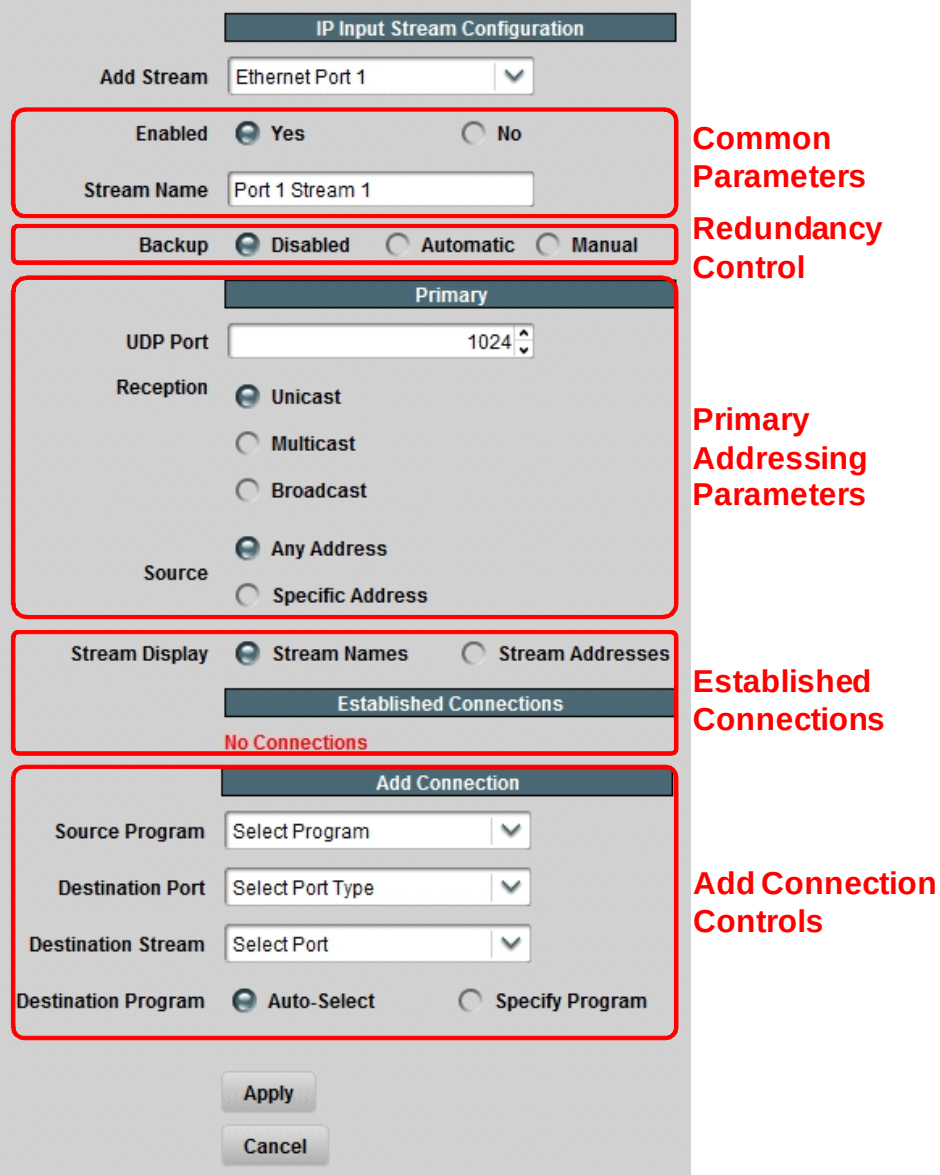


Using the IP Input Configuration tab, ports can be created, configured, and deleted. Before any ports are created, the Configuration Tab appears as depicted below:



To create an IP Input stream, first select the desired Ethernet port in the **Add Stream** drop-down box. Once that selection is made, the IP Input Stream Configuration is displayed, as depicted below. The configuration screen has three areas:

- **Common Parameters**: apply to the stream input as a whole, regardless of the redundancy options.
- **Redundancy Control**: allows selection of the redundancy mode.
- **Addressing Parameters**: allow selection of the network stream to be received.
- **Established Connections**: shows the connections currently established to the port, and provides the ability to delete individual connections.
- **Add Connection Controls**: allows the addition of a new connection to the port. This control is discussed in detail in the Connections section.



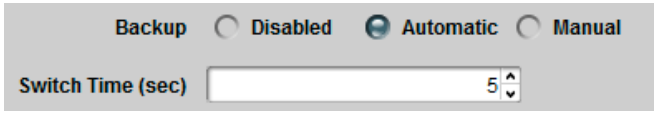
Common Parameters

- **Enabled:** This allows the stream to be enabled or disabled. If it is disabled, no packet reception takes place. This feature is provided for testing purposes (i.e., temporarily disable an input for fault-finding). Most users will leave the stream enabled.
- **Stream Name:** All 9990-TRX-MPEG inputs and outputs can be assigned a user-defined name. This name is used to identify the port later when making connections. Use any descriptive name suitable for your application, or accept the default.

Redundancy Control

As described in the Redundancy Options section, the IP Inputs offer option of defining a primary and a backup address/port combination. This is enabled in by the **Backup** parameter, which offers the following options:

- **Disabled:** no redundancy.
- **Automatic:** a redundant address/port can be defined, and the input will automatically switch between primary and backup if the stream disappears. If this option is selected, a new field is displayed, where the Switch Time can be configured; valid values are between 2 and 45 seconds:

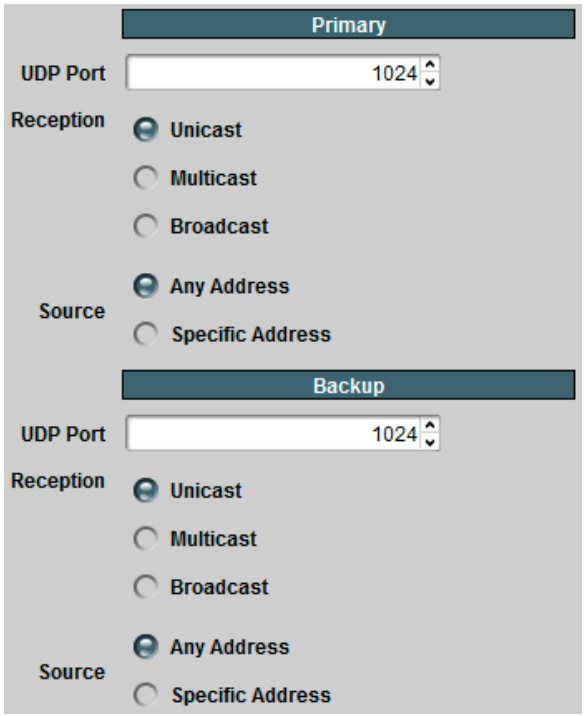


- **Manual:** a redundant address/port can be defined, but the input will **not** automatically switch – that will have to be done manually by the operator.

Manual redundancy flips are done by selecting an existing IP Input port for configuration. This operation is described in the Active IP Inputs Table section.

Addressing Parameters

The Addressing parameters allow the definition of one or two address/port combinations for reception. If **Backup** is set to **Disabled**, only the primary settings are displayed; otherwise, both the primary and backup settings are displayed, as shown below.

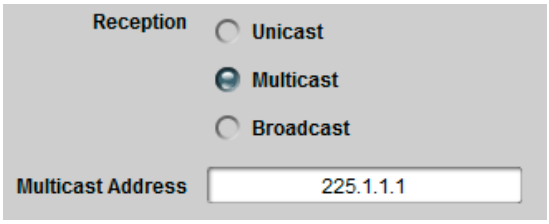


The Primary/Backup addressing parameters are configured as follows:

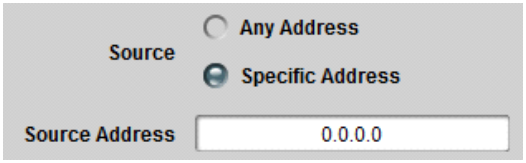
- **UDP Port:** selects the UDP port to receive from. Valid values are between 1 and 65535. Note that, in traditional IP networks, UDP ports between 1 and 1023 are reserved for

administrative uses. It is recommended to use UDP ports 1024 and higher. The 9990-TRX-MPEG, however, will accept any legal value.

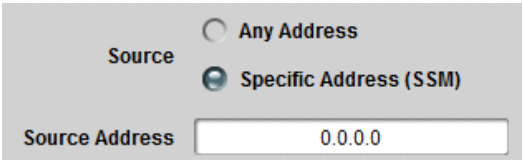
- **Reception:** selects the address to receive from. The options are:
  - **Unicast:** the packets are being sent to the IP address of this Ethernet port. The address of the Ethernet port can be set or reviewed in the Network Tab.
  - **Multicast:** the packets are being sent to a Class-D multicast address (between 224.0.0.0 and 239.255.255.255). If this option is selected, a new field is displayed to accept the multicast address:



    The 9990-TRX-MPEG will warn the user if the address entered in this field is not a multicast address. The device includes a full implementation of IGMP V1/V2/V3 to convey group membership information to upstream routers; IGMP is configured in the Network Tab.
  - **Broadcast:** the packets are being sent to a broadcast address (either the all-hosts broadcast address of 255.255.255.255 or a subnet broadcast address). Note that this is extremely rare in practice.
- **Source:** If desired, the 9990-TRX-MPEG can filter packets by source IP address. This is useful when the network includes a primary and a backup stream, sent to the same address, but from different sources. The options are:
  - **Any Address:** this input will accept packets from any address.
  - **Specific Address:** this input will only accept packets from a given specific address. When this option is selected, a new field appears where the desired source IP address can be entered:



Unicast/Broadcast



Multicast

    The **Source Address** must be a valid unicast address. In case of Multicast reception, the 9990-TRX-MPEG will go into SSM (Source-Specific Multicast) mode. If IGMP V3 is in use, the card will use it to inform the network of the choice selection. Note that the 9990-TRX-MPEG does **not** require an IGMP V3 network to operate in SSM mode, as it can filter packets in real-time at line rate.

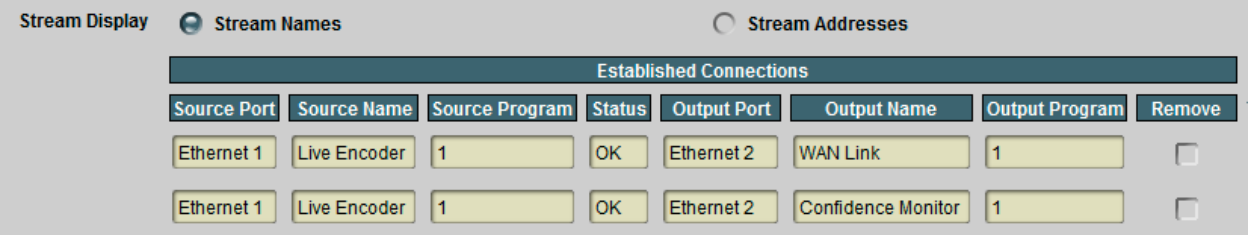
The IP Input Ports will automatically detect the use of RTP, in a packet-by-packet basis. The 9990-TRX-MPEG will only accept RTP version 2 packets satisfying the following conditions:

- No header extensions (X=0)
- No CSRC list (CC=0)
- Payload type set to MPEG-2 Transport Streams (PT=33)

For more details, please consult RFC 1889, section 5.1. The 9990-TRX-MPEG does not receive, require, or process RTCP packets.

Established Connections

This section lists output connections currently established to the selected IP input. An example of the list is displayed below:



Individual connections can be removed the checking the corresponding box in the **Remove** column.

The Apply/Cancel Buttons

Once the configuration information is filled in, click on the **Apply** button to make it active. If there are no errors, the port will be created, and the configuration area disappears. If any errors are detected, they will be displayed at the top of the **Apply** button. The following errors are flagged:

- ***Error: enter a Source Address or select "Any Address"***: you selected **Specific Address** for **Source** but left the **Source Address** field as 0.0.0.0.
- ***Error: X.X.X.X is NOT a multicast address***: you selected multicast reception, and entered an address that is not multicast. Multicast addresses go from 224.0.0.0 to 239.255.255.255.
- ***Error: X.X.X.X is NOT a valid unicast address***: you entered an invalid unicast address. Valid unicast addresses go from 0.0.0.1 to 223.255.255.255, with the exception of the loopback range of 127.0.0.0 to 127.255.255.255.
- ***Error: Primary and Backup settings are the same***: you entered the exact same configuration settings for the primary and backup address/port. They must have at least one difference.
- ***Error: Primary/Backup UDP Port/Address conflict with Port X/Y Primary/Backup***: you are attempting to configure an address/port combination that is already in use by another input in the same Ethernet port. The 9990-TRX-MPEG is capable of internally replicating transport streams; just use the other port again in the connection. There is,

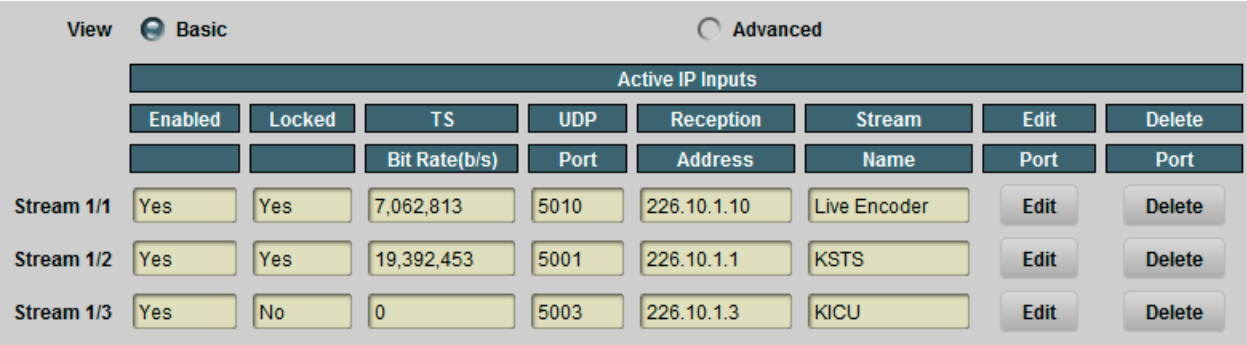
however, one special case: if you want to configure an input with a given address/port combination and any source, and another input with the same address/port combination and a specific source, you must configure the input with specific source first.

- ***Maximum number of streams exceeded on this port***: you will receive this message if you attempt to create more than 8 IP inputs on a given Ethernet port.

Clicking on **Cancel** discards all the changes.

Active IP Inputs Table

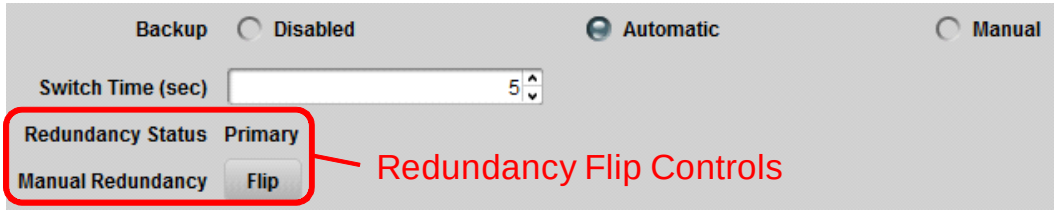
Once the input is created, it is added to the **Active IP Inputs** table, which has **Basic** and **Advanced** views. This table provides a summary of the configuration and status of the input stream. An example of this table, in the Basic view, is depicted below



The Basic view includes the following:

- **Enabled:** The configured value of this parameter.
- **Locked:** This column will have **Yes** for inputs that are receiving a valid transport stream, and **No** for inputs that are not.
- **TS Bit Rate (b/s):** This column provides the measured bit rate of the input transport stream. This does not include UDP and IP overhead.
- **UDP Port:** The active reception UDP port (i.e., the UDP port currently being used by the input).
- **Reception Address:** The active reception address (i.e., the address being currently used by the input). If you selected **Unicast**, this field will contain the IP address of the corresponding Ethernet interface. If you selected **Multicast**, this field will contain the configured multicast address. If you selected **Broadcast**, this field will contain the word "Broadcast".
- **Stream Name:** The configured stream name.
- **Edit Port:** If you click on this button, you can modify all the parameters for this input. The configuration area will re-open with the current input settings.
- **Delete Port:** If you click on this button, the port is deleted and removed from the table.

When you click on the **Edit Port** button for an IP Input configured with primary/backup reception addresses, the Redundancy Control part of the configuration screen will include one additional control, to permit manual redundancy flips:



The new fields are:

- **Redundancy Status:** this field indicates which address (primary or backup) is currently being used for reception.
- **Manual Redundancy:** if the **Flip** button is clicked, the port will flip the redundancy (i.e., it will switch to the other configured address).

When the Advanced view is selected, additional fields appear in the table, as depicted below:

View: Basic / Advanced

Active IP Inputs

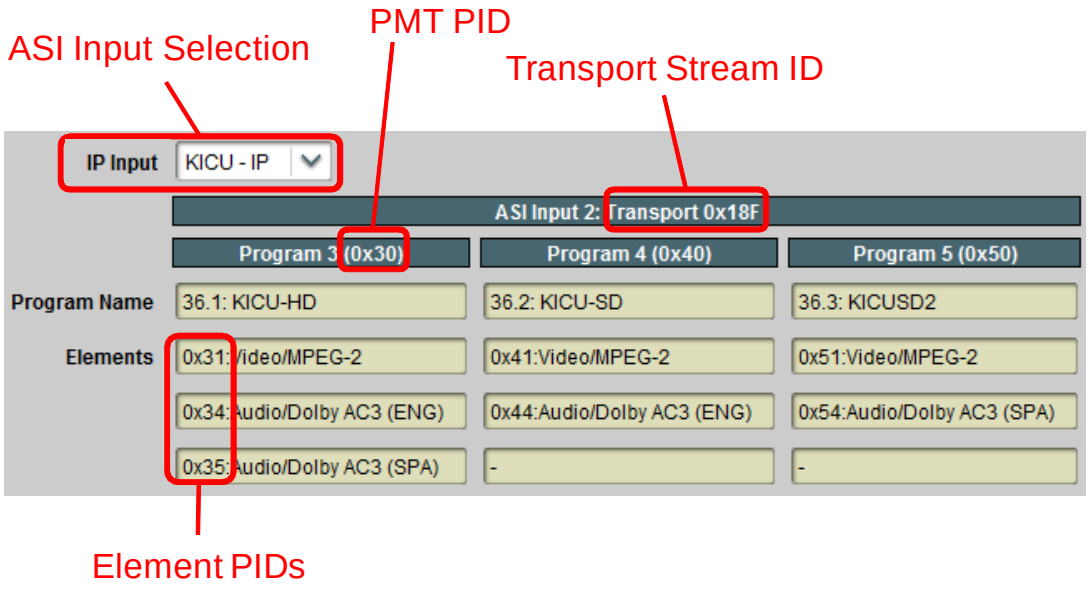
	Enabled	Locked	Backup Mode	TS Bit Rate(b/s)	IP Packet Rate(pkt/s)	UDP Port	Reception Address	Source Address	Stream Name	Edit Port	Delete Port
Stream 1/1	Yes	Yes	Automatic	7,068,177	671	5010	226.10.1.10	Any	Live Encoder	Edit	Delete
Stream 1/2	Yes	Yes	Disabled	19,392,718	1,842	5001	226.10.1.1	Any	KSTS	Edit	Delete
Stream 1/3	Yes	No	Disabled	0	0	5003	226.10.1.3	Any	KICU	Edit	Delete

The Advanced view includes all items in the Basic view plus the following:

- **Backup Mode:** The configured value of this parameter.
- **IP Packet Rate (pkts/s):** The measured IP input packet rate, in packets/second. This field is useful for debugging: if you have a non-zero IP Packet Rate, but a zero TS Bit Rate, this indicates that the packets being received by the 9990-TRX-MPEG do not contain a valid transport stream. This allows differentiation between a transport network problem (no packets being received) and a data format problem (packets contain invalid data).
- **Source Address:** The active source address (i.e., the address currently being used by the input). This will have the word "Any" if the Source was configured as **Any Source**, or the configured IP address.

IP Inputs: Program Info Tab

For IP Inputs with a valid transport stream containing at least one program, the **Program Info** tab shows the contents of the transport stream, as illustrated below:

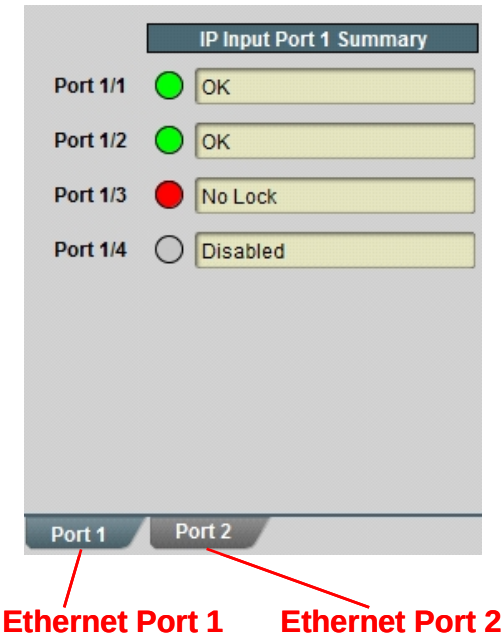


The following elements are present:

- **IP Input:** Select which input to display. The selection uses the port names configured in the previous step.
- **Header Information:** The top header indicates the Transport Stream ID (TSID). For each program, an individual header is provided, showing the Program Number and the PMT PID.
- **Program Name:** If available, the Program Name is displayed. If the transport stream contains a Service Description Table (SDT), the Service Name is displayed here. If the transport stream contains a Virtual Channel Table (VCT – used in terrestrial ATSC broadcasts), this field will show the major and minor channel numbers, and the short channel name (as depicted above).
- **Elements:** For each program, a list of elements is provided. The list contains the Element PID, the element type (Audio/Video/other), and the type of compression if appropriate. For audio streams, if a language code is present, it is displayed here as well.

IP Inputs: Statistics Tab

The Statistics tab for the IP input ports contains a summary of each port status. There are two sub-tabs: one for Ethernet 1, and another for Ethernet 2. The tab is depicted below:



The indicators can have the following values:

- **OK**: The IP Input is receiving a valid transport stream.
- **No Lock:** The IP Input is not receiving a valid transport stream. If there is a connection to this input, Dashboard Card State and the Status LED will be red.
- **Disabled:** The IP Input has been disabled (by setting **Enable** to **No**).

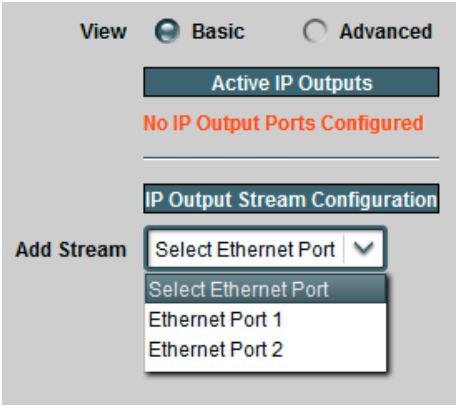
IP Outputs

IP Outputs receive data from connected inputs, format this data for transmission over UDP/IP, and send it with over the Ethernet ports. The 9990-TRX-MPEG card supports up to 8 transport stream outputs per Ethernet port. IP Outputs have the following specifications:

- Formats supported:
  - MPEG-2 Transport Packets over UDP/IP
  - MPEG-2 Transport Packets over RTP/UDP/IP
- Number of MPEG-2 Transport Packets per UDP datagram: fixed at 7.
- Addressing support: unicast, multicast and broadcast.
- Advanced control over the IP header fields available.

IP Outputs: Configuration Tab

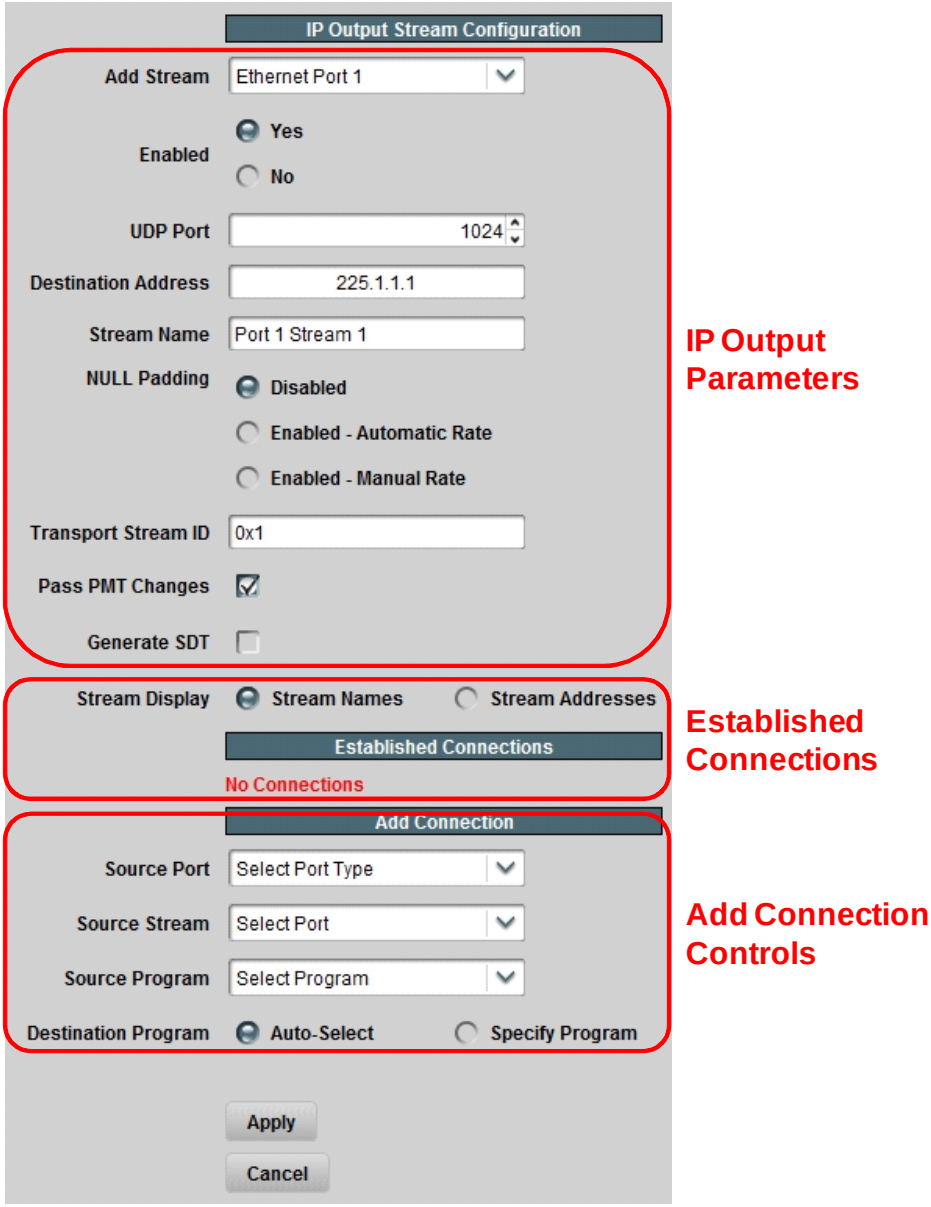
The IP Output Configuration follows a similar workflow as the IP Inputs. Ports can be created, configured, and deleted. Before any ports are created, the Configuration Tab appears as depicted below:



To create an IP Output stream, first select the desired Ethernet port in the **Add Stream** drop-down box. Once that selection is made, the IP Output Stream Configuration is displayed, as depicted below (Basic View). The configuration screen has the following areas:

- **IP Output Parameters:** these are the parameters specific to the IP Output configuration. The set of parameters available for configuration depends on the **View** selection. In the **Basic** view, suitable default values are entered for the advanced parameters.
- **Established Connections**: shows the connections currently established to the port, and provides the ability to delete individual connections.
- **Add Connection Controls**: allows the addition of a new connection to the port. This control is discussed in detail in the Connections section.

The Connection Parameters are common to all output ports, and will be described in the Connections section, later in this document.



The Basic View configuration parameters are as follows:

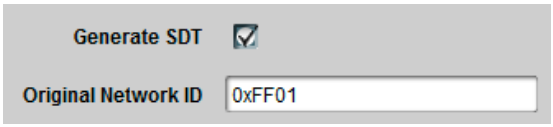
- **Enabled:** This allows the output stream to be enabled or disabled. If it is disabled, no packet transmission takes place. This feature is provided for testing purposes (i.e., temporarily disable an output for fault-finding). Most users will leave the stream enabled.
- **UDP Port:** selects the UDP port to transmit to. Valid values are between 1 and 65535. Note that, in traditional IP networks, UDP ports between 1 and 1023 are reserved for

administrative uses. It is recommended to use UDP ports 1024 and higher. The 9990-TRX-MPEG, however, will accept any legal value.

- **Destination Address:** selects the IP address to transmit to. Any unicast or multicast address can be entered here, with the exception of the loopback range (127.0.0.0 to 127.255.255.255). The 9990-TRX-MPEG will also accept the broadcast IP address of 255.255.255.255, and will transmit the packets as Ethernet broadcasts. Use of broadcasts, however, is strongly discouraged.
- **Stream Name:** All 9990-TRX-MPEG input and output ports can be assigned a user-defined name. This name is used to identify the port later when making connections. Use any descriptive name suitable for your application, or accept the default.
- **NULL Padding:** This setting controls whether or not NULL packets are transmitted, making the stream completely CBR. IP networks are inherently VBR, and do not require NULL packets (which carry no information). However, the decoders may need them. The following is a good set of rules for deciding whether or not to send NULL packets:
    - If all your decoders are consumer IP set-top boxes or PCs running software decoders, NULL packets can be disabled.
    - If your decoders include professional IRDs, NULL packets must be enabled. The great majority of professional IRDs will not work without them.
    - If you are generating an MPTS, enable NULL packets. An MPTS without NULL packets is technically illegal as per ISO/IEC 13818-1, but some systems support it.
    - If you are not sure about what kind of decoder will be receiving the stream, enable NULL packets.

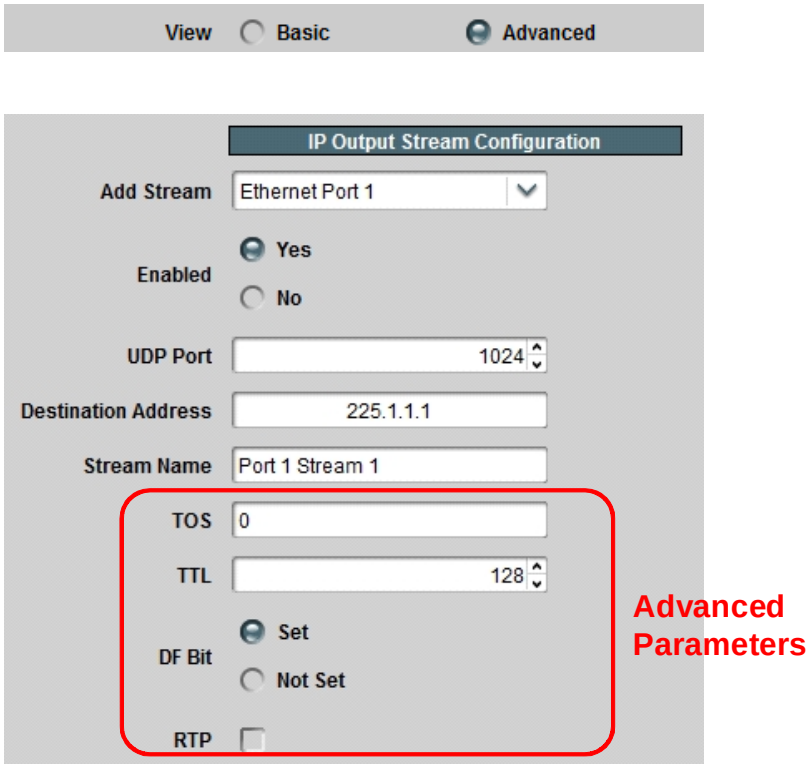
  This control offers the following options:
    - **Disabled:** NULL packets are disabled and will not be transmitted. This will cause the stream to be somewhat VBR, even if the transcoder is set to CBR mode.
    - **Enabled – Automatic Rate:** This setting enables NULL packets, but the bit rate is automatically set by the 9990-TRX-MPEG to the minimum suitable value. If you later reconfigure inputs connected to this stream, the rate will be automatically adjusted.
    - **Enabled – Manual Rate**: This setting allows you to specify the overall stream bit rate. If you specify the bit rate, it must be high enough to support the connected inputs. Specifying a rate that is not high enough will cause the IP Output to drop packets. Note that if this option is selected, the IP Output will be transmitting continuously at the selected bit rate, regardless of connections or the state of the transcoders. If there is no connection to the IP Output, it will transmit only NULL packets; if there are connections and the transcoders are stopped, it will transmit NULL packets plus (P)SI tables.
- **Transport Stream ID:** Enter the desired Transport Stream ID for the port. This value comes out in the Program Allocation Table (PAT).
- **Pass PMT Changes:** This checkbox controls whether PMT descriptor changes from the connected programs are propagated to the output PMT for this port. This box defaults to checked, and in most cases it should be left checked. Only uncheck it if you want to isolate the devices downstream of the transcoder from table changes.
- **Generate SDT:** If you check this box, a Service Description Table (SDT) will be generated. Service Names will come from the connected programs. If this box is

checked, another field is displayed:



- **Original Network ID:** Enter the desired Original Network ID. For applications where Network IDs have not been assigned, leave this field at 0xFF01.

If the Advanced View is selected, four more parameters are available for configuration:

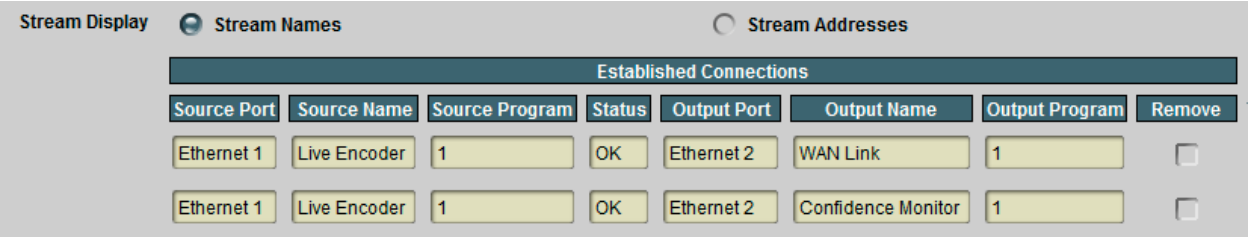


- **TOS:** This parameter allows the configuration of the Type-Of-Service (TOS) byte in the IP header (also known as the Differentiated Services – DS – field). Valid values are between 0 and 255. Configuring this is only useful if the downstream router is configured to honor the field.
- **TTL:** This parameter allows the configuration of the Time-To-Live (TTL) byte in the IP header. Valid values are between 0 and 255. If not explicitly configured, it defaults to 128. This field controls how many hops the packet can traverse before it is dropped by a router. The default value of 128 is suitable for virtually all applications.
- **DF Bit:** This parameter allows the configuration of the Do-not-Fragment (DF) bit in the IP header. The 9990-TRX-MPEG will never produce fragmented packets, and with the UDP payload set to 7 transport packets, the IP packets are guaranteed to fit inside the Ethernet MTU. This control is provided for compatibility with legacy switches/routers.

Some legacy equipment may exhibit performance problems if this bit is not set. This is not an issue with current network equipment.

- **RTP:** If this box is checked, the 9990-TRX-MPEG will include RTP (Real Time Protocol) headers in the output flow. If it is not checked, the transport stream will be sent over UDP/IP without any additional headers. Note that RTP requires the use of even UDP port numbers. The 9990-TRX-MPEG will not generate RTCP packets.

The Established Connections section lists input connections currently established to the selected IP output. An example of the list is displayed below:



Individual connections can be removed the checking the corresponding box in the **Remove** column.

Once the configuration information is filled in, click on the **Apply** button to make it active. If there are no errors, the port will be created, and the configuration area disappears. If any errors are detected, they will be displayed at the top of the **Apply** button. Two types of errors can be reported:

1. Errors related to the port configuration itself. These are listed below.
2. Errors related to the connection, if you are configuring one. These will be described in the Connections section.

The following configuration-related errors are flagged:

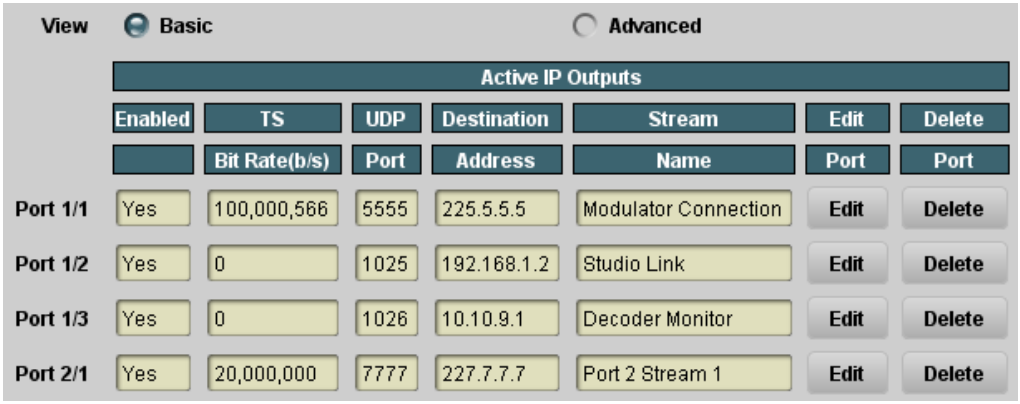
- ***Error: UDP Port/Address conflict with Port X/Y***: you have configured two IP Output streams with the same destination IP Address and UDP port, on the same Ethernet interface. Please review your settings.
- ***Error: address X.Y.Z.W is the same as Ethernet 1/2 address***: you have configured a unicast destination address that is the same as the IP address assigned to the corresponding Ethernet port. Loopback to the same port is not supported.
- ***Maximum number of streams exceeded on this port***: you will receive this message if you attempt to create more than 8 IP outputs on a given Ethernet port.
- ***Error: UDP Port must be even if RTP is enabled***: if you check the RTP box in the **Advanced** view, the UDP port number must be even. Either select an even number or uncheck the RTP box.

If the configuration is successful, the output stream will be added to the Active IP Outputs table.

If the **Cancel** button is clicked, no changes are made.

Active IP Outputs Table

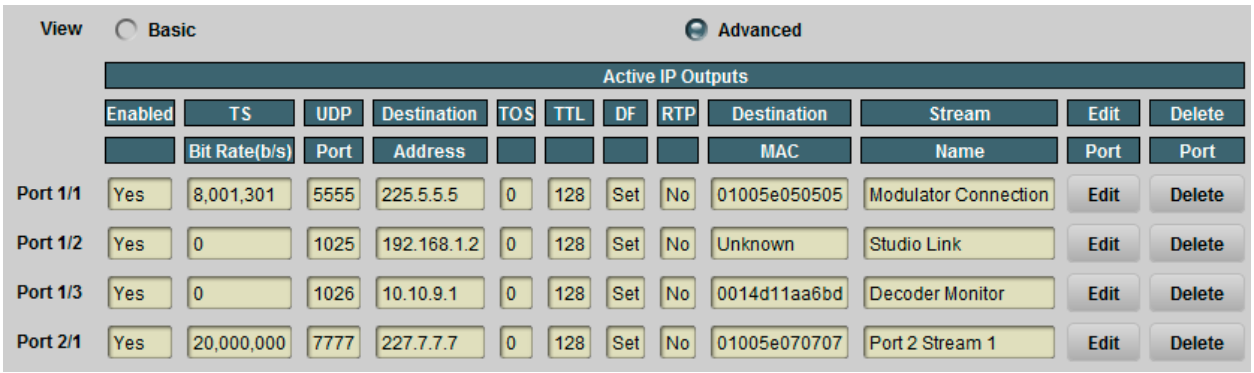
Once the output is created, it is added to the **Active IP Outputs** table, which has **Basic** and **Advanced** views. This table provides a summary of the configuration and status of the output stream. An example of this table, in the Basic view, is depicted below



The Basic view includes the following:

- **Enabled:** The configured value of this parameter.
- **TS Bit Rate (b/s):** This column provides the current bit rate of the output transport stream. This does not include UDP and IP overhead.
- **UDP Port:** The configured value of this parameter.
- **Destination Address:** The configured value of this parameter.
- **Stream Name:** The configured stream name.
- **Edit Port:** If you click on this button, you can modify all the parameters for this output. The configuration area will re-open with the current output settings.
- **Delete Port:** If you click on this button, the port is deleted and removed from the table.

When the Advanced view is selected, additional fields appear in the table, as depicted below:



The Advanced view includes all items in the Basic view plus the following:

- **TOS:** The configured value of this parameter.
- **TTL:** The configured value of this parameter.
- **DF:** The configured value of this parameter.
- **RTP:** The configured value of this parameter
- **Destination MAC:** The destination MAC address for this IP Output. For multicast destination addresses, this is derived from the destination IP address using the rules from RFC 1112. For unicast destination addresses, this is obtained using the ARP protocol. If this entry is the word **Unknown**, the 9990-TRX-MPEG has failed to obtain a destination MAC address. The port is **not** streaming. A more detailed description of the unicast MAC address algorithms used in the 9990-TRX-MPEG is presented below.

Managing Unicast MAC Addresses

When the 9990-TRX-MPEG is configured with a unicast destination address, it needs to obtain a corresponding MAC address (corresponding to either the final destination, if it is in the same subnet, or to the default gateway). These MAC addresses are obtained using the ARP protocol. The 9990-TRX-MPEG uses a custom MAC address management algorithm, designed specifically for MPEG operation.

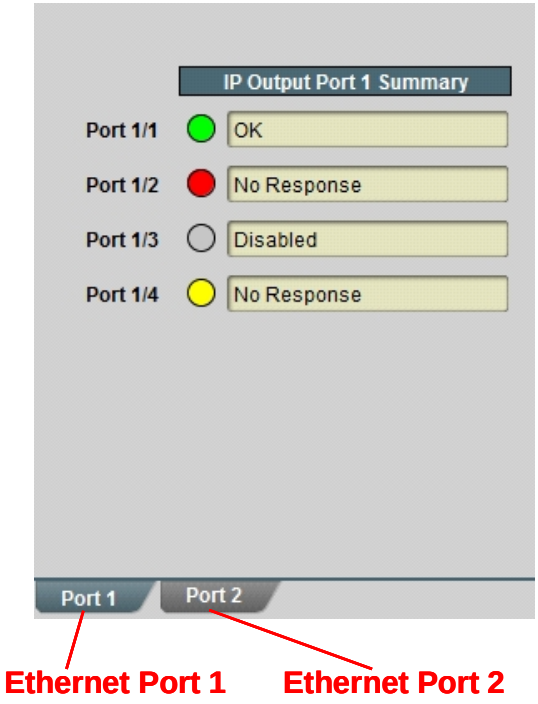
When an IP Output port with a unicast destination address is created, the 9990-TRX-MPEG immediately starts attempting to obtain a MAC address for it, using standard ARP requests. These requests are issued every two seconds until answered. No packets will be transmitted on that IP Output until a MAC address can be obtained. Note that this process will happen even if the port is configured to be in the disabled state.

Once a MAC address is obtained, the 9990-TRX-MPEG will cache it for about 5 minutes, as it is usual for IP devices. Unlike other IP devices, the 9990-TRX-MPEG will keep on using the MAC address until a response is received, to avoid stream interruptions. If no response is received at that time, the 9990-TRX-MPEG will raise a yellow alarm. This alarm can be seen in the IP Output Statistics tab, described in detail below.

The current state of the 9990-TRX-MPEG current streaming ARP cache is available in the Advanced View of the Active IP Outputs table, described above.

IP Outputs: Statistics Tab

The Statistics tab for the IP output ports contains a summary of each port status. There are two sub-tabs: one for Ethernet 1, and another for Ethernet 2. The tab is depicted below:



The indicators can have the following values:

- **OK**: The IP Output is operating normally (either streaming or ready to stream).
- **No Response:** The IP Output is configured for unicast operation, but it does not have a destination MAC address. Dashboard Card State and the Status LED will be red if there is a connection to this port.
- **No Response:** The IP Output is configured for unicast operation, and the destination stopped responding to ARP. The IP Output is using an old cached MAC address. Dashboard Card State will be yellow if there is a connection to this port.
- **Disabled:** The IP Output has been disabled (by setting **Enable** to **No**).

Transcoders

The Transcoders Configuration Tab allows the configuration of up to 4 transcoding sessions. The Statistics tab provides quick feedback on the status of each transcoding session.

Transcoders Configuration Tab

The **Transcoder Channels** table, shown below, has a summary of the status of each transcoding session and its more important parameters.

	Transcoder Channels							
	Status	Video Rate (b/s)	Compression	Audio	Resolution	Frame Rate	Port Name	Edit
Transcoder 1	Running	2,000,000	H.264	Input Pass-Through	720x480	Same as Input	Transcoder 1	Edit
Transcoder 2	Idle	0	H.264	MPEG 1 Layer II	Same as input	Same as Input	Transcoder 2	Edit
Transcoder 3	Running	2,000,000	H.264	Input Pass-Through	Same as input	Same as Input	Transcoder 3	Edit
Transcoder 4	Idle	0	H.264	Input Pass-Through	Same as input	15 fps	Transcoder 4	Edit

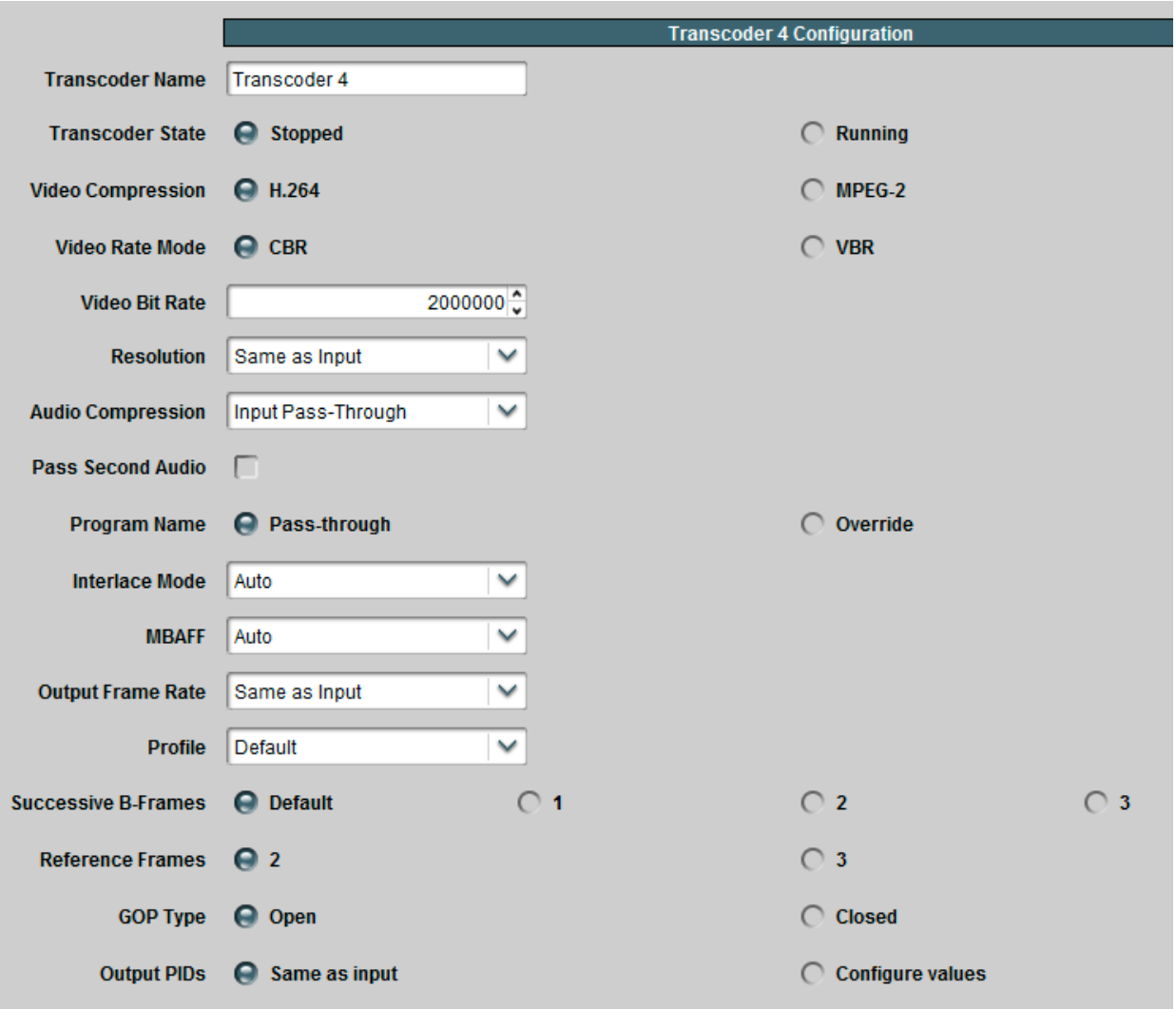
The **Status** column indicates the overall state of the session at a glance. If it indicates **Running**, the transcoding session is operating normally. If it indicates **Idle**, the transcoding session is not operating; more detail can be found in the Transcoder Statistics Tab.

Click on the **Edit** button to configure a specific transcoder session. When the button is clicked, the transcoder configuration area is displayed. This area is divided into three parts:

- The **Transcoder Configuration** section, which contains all the transcoder parameters.
- The **Established Connections** section, which lists all current connections to the transcoder (both inputs and outputs). This section is available in the configuration area for all 9990-TRX-MPEG input and output ports.
- The **Add Connections Controls**, which allows new input and output connections to the transcoder to be added. This section is available in the configuration area for all 9990-TRX-MPEG input and output ports.

Transcoder Configuration Parameters

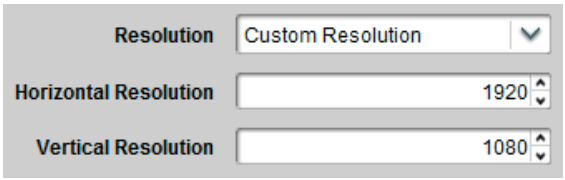
The Transcoder Configuration section is depicted below. It is pre-populated with the current configuration for the selected transcoder session.



The transcoder configuration parameters are:

- **Transcoder Name:** all 9990-TRX-MPEG ports have a user-defined name. It can be configured in this field.
- **Transcoder State:** use this control to enable (**Running**) or disable (**Stopped**) a transcoder session.
- **Video Compression:** selects the output compression standard of the transcoding session. The options are **H.264** (MPEG-4 Part 10) or **MPEG-2**. The 9990-TRX-MPEG only supports two MPEG-2 sessions. Not all parameters described below are available for MPEG-2.
- **Video Rate Mode:** selects between **CBR** (Constant Bit Rate) and **VBR** (Variable Bit Rate) video compression.
- **Video Bit Rate:** enter the desired video bit rate, in bits/second. The range of supported bit rates is between 200 kb/s and 20 Mb/s.

- **Resolution:** the 9990-TRX-MPEG is capable of down-scaling the incoming picture. This drop-down menu has a number of pre-defined resolutions, from 1920×1080 to 320×240. It also has two additional selections:
  - **Same as Input:** this will cause the output resolution to be the same as the input resolution.
  - **Custom Resolution:** this setting allows for an arbitrary resolution, other than the pre-defined set. If this is selected, new fields appear as shown below:

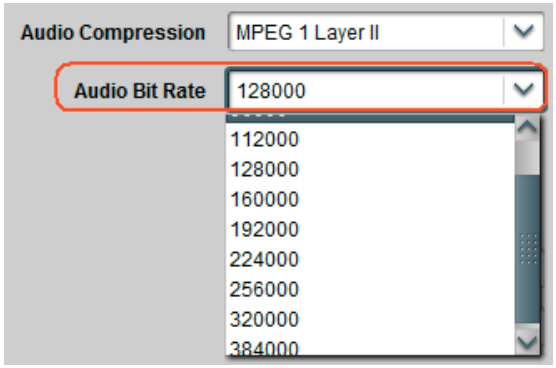


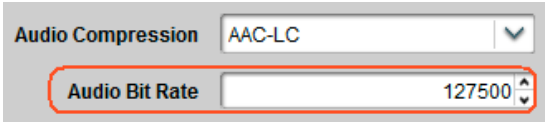
Arbitrary horizontal and vertical resolutions can be entered, with the following constraints:

- Resolutions must be a multiple of 16.
- The 9990-TRX-MPEG will never output a resolution that is higher than the input resolution.

- **Audio Compression:** The following selections are available:
  - **Input Pass-Through:** do not transcode the audio, pass it unmodified to the output.
  - **MPEG-1 Layer II:** transcode the input audio to MPEG-1 Layer II[3].
  - **AAC-LC:** transcode the input audio to AAC-LC[3].

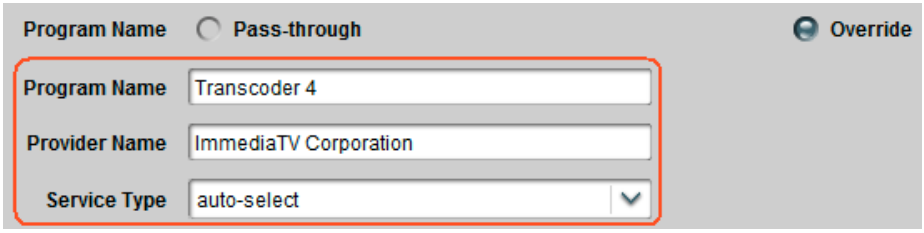
If **MPEG-1 Layer II** or **AAC-LC** is selected, the **Audio Bit Rate** field is displayed where the desired audio bit rate can be entered. For MPEG-1 Layer II, this is a drop-down menu with the valid selections; for AAC-LC any bit rate between 64 kb/s and 384 kb/s can be entered.





[3] An optional license is required to transcode an incoming Dolby AC-3 audio stream into MPEG-1 Layer II or AAC-LC (see the Admin License Keys Tab section). If the incoming stream is Dolby AC-3 and a license is not available, the audio will revert to Input Pass-Through regardless of this selection.

- **Pass Second Audio:** if this box is checked, a secondary audio PID is passed though the transcoder if present. Secondary audio can only be passed from input to output; transcoding is not available.
- **Program Name:** this setting controls how the program name is handled through the transcoder. The options are:
    - **Pass-through:** if this option is selected, the program name is retained through the transcoding process, as long as the input program contains a valid name. If the input program does not have a name (i.e., no SDT or VCT), then there will be no name for the transcoded program.
    - **Override:** if this option is selected, the incoming program name is ignored, and a new program name can be assigned to the transcoded content. New fields become available:

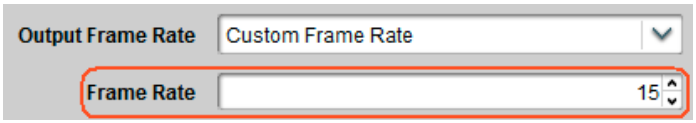


        - **Program Name:** enter the desired program name.
        - **Provider Name:** enter the desired provider name.
        - **Service Type:** this configures the service type, as per ETSI EN 300 468 section 6.2.32. It is recommended to leave this setting on **auto-select**, which directs the 9990-TRX-MPEG to choose the appropriate service type depending on the compression standard and bit rate. Otherwise, the following types can be selected:
            - **digital television service:** used for MPEG-2 SD.
            - **MPEG-2 HD digital television service:** used for MPEG-2 HD.
            - **advanced codec SD digital television service:** used for H.264 SD.
            - **advanced codec HD digital television service:** used for H.264 HD.
- **Interlace Mode:** this control selects the output interlace mode. It has the following options:
    - **Auto:** automatically set the interlace mode.
    - **Interlaced:** convert the content to interlaced mode.
    - **Progressive:** convert the content to progressive mode.

  If the **Interlaced** or **Progressive** modes are selected, the **Output Frame Rate** setting (see below) is forced to **Custom Frame Rate**, and the actual output frame rate must be specified.
- **MBAFF:** this parameter controls the use of the H.264 **M**acro**B**lock-**A**daptive **F**rame/**F**ield coding tool. This tool allows a single frame to be encoded partially in progressive mode and partially in interlaced mode, depending on the content. Use of this tool improves video quality for interlaced content; however, some low-end decoders may not support it. The following options are available:
    - **Auto:** automatically set the MBAFF mode.

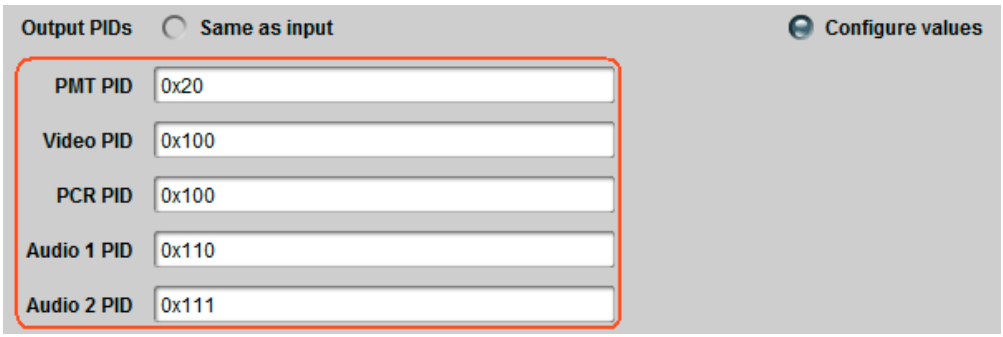
- **Follow Input:** use MBAFF if the input stream uses MBAFF.
- **ON:** always use MBAFF for interlaced content.
- **OFF:** turn off MBAFF for interlaced content.

- **Output Frame Rate:** the 9990-TRX-MPEG is capable of reducing the incoming frame rate. This parameter controls the output frame rate. It offers the following options:
  - **Same as Input:** the output frame rate is not changed.
  - **Custom Frame Rate:** the output frame rate can be configured. When this option is selected, a new parameter becomes available:



The desired output frame rate, in frames/second can be entered in the **Frame Rate** field. Note that the actual output frame rate will always be an integer division of the input frame rate. In other words, if the input frame rate is *F*, the output frame rate can only be *F/N*, where *N*=1, 2, 3, … The actual output frame rate will be the integer division of the input frame rate closest to the value entered.

- **Profile:** this selects the H.264 Profile. The options are:
  - **Default:** automatically choose the profile based on the transcoder settings.
  - **High:** use High Profile.
  - **Main:** use Main Profile.
  - **Baseline:** use Baseline Profile.
- **Successive B-Frames:** this parameter selects the number of successive B-Frames in the GOP.
- **Reference Frames:** this parameter selects the number of reference frames when encoding B-Frames.
- **GOP Type:** this parameter selects whether or not GOPs are Open or Closed. In Open GOPs, B-Frames make references to frames outside the GOP; in Closed GOPs they do not.
- **Output PIDs:** this parameter allows the transcoder output PIDs to be managed. The options are:
  - **Same as input:** the transcoder will use the same PID values as the input program.
  - **Configure values:** if this option is selected, the transcoder PID values can be arbitrarily remapped. A set of new parameters becomes available:



The following applies to all the PID fields:

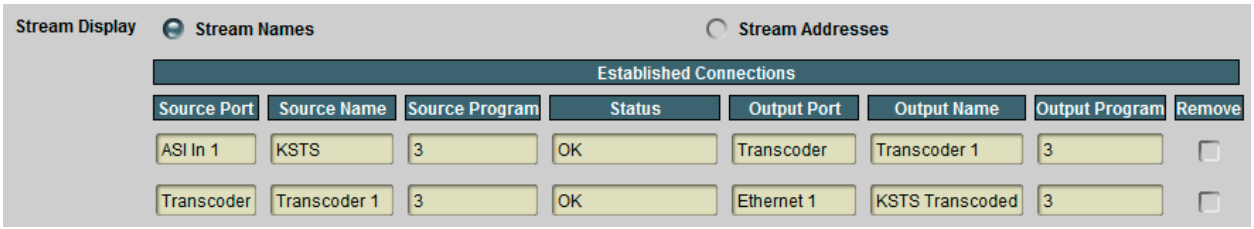
- PIDs can be entered in decimal or hexadecimal. For decimal values, simply enter the desired value. For hexadecimal values, precede them by "0x" as depicted above.
- PID values must be between 0x20 and 0x1FFE (32 and 8190 in decimal).
- PID values must be distinct, with the exception of **Video PID** and **PCR PID**. These can be the same or distinct.

If the **Video Compression** parameter is set to **MPEG-2**, the following parameters are not available:

- **MBAFF**
- **Profile**
- **Successive B-Frames**
- **Reference Frames**
- **GOP Type**

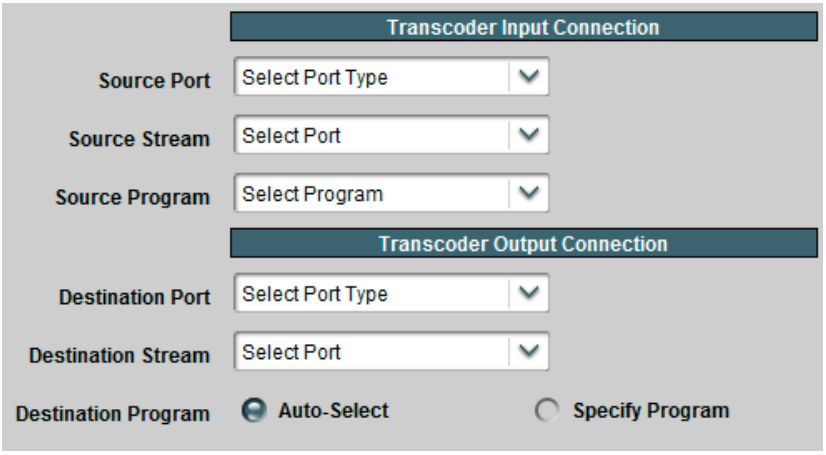
Transcoder Established Connections

If there are any connections already established to the transcoder session, they will be shown in the Established Connections area. Individual connections can be removed by checking the box in front of them.



Transcoder Add Connections

Connections to the transcoder can be added directly after configuration. The transcoder has both an input (to receive a stream to be transcoded) and an output (to provide the transcoded stream); therefore, two fields are provided:



Note that transcoders only support one input connection. If a given transcoder already has an input connection, the corresponding field will not be shown.

Transcoder Apply/Cancel Buttons

When the **Apply** button is clicked, the following actions take place:

- The transcoder configuration takes effect.
- Any connections selected for removal in the Established Connections are deleted.
- Any new transcoder input/output connections are added.

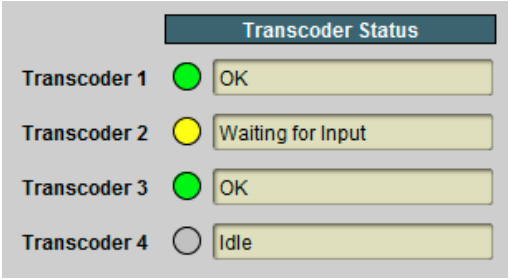
If there are no errors, the transcoder configuration area closes. If any errors are detected, the configuration area remains open and an error message is displayed by the **Apply** button. The possible error messages are:

- ***Error: no available transcode licenses***: there are no more licensed transcoder sessions available (check the Admin License Keys Tab). Contact Support if you need to acquire additional licenses.

If the **Cancel** button is clicked, all changes are discarded and the transcoder configuration area closes.

Transcoder Statistics Tab

This tab provides a summary status of all the transcoding sessions. A sample is depicted below.



The possible indicator status values are:

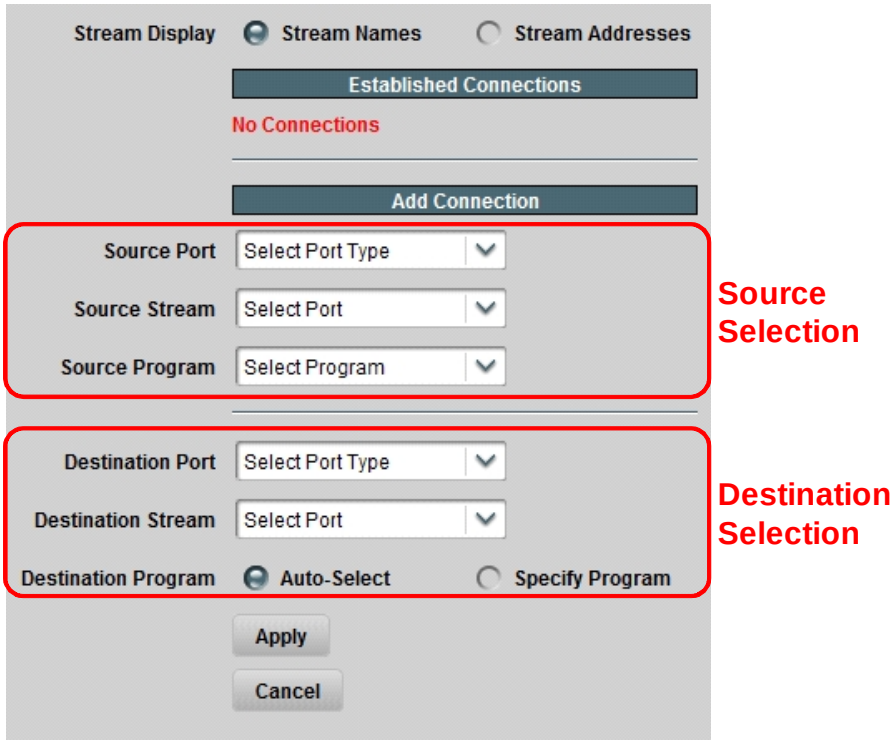
- **OK**: The transcoder session is operating normally (it has a valid input and is transcoding that input).
- **Waiting for Input:** The transcoder session is configured and enabled, but it has no input. This can be because it has no connection to an input port, or because the port has no programs, or because the selected program is not available in the connected port. Dashboard Card State will be yellow unless there is a higher-priority alarm active.
- **No Output:** The transcoder is not generating an output stream. This can happen if the input stream is corrupted, encrypted, or has an unsupported compression type. This status may also be briefly displayed when the transcoder is starting. Check the input to see if it is decodable. Contact Support if you get this status with a clean decodable stream. Dashboard Card State and the Status LED will be red.
- **Status Unknown:** The control system is unable to manage the transcoder session. Contact Support if you get this status. Dashboard Card State and the Status LED will be red.
- **Config Failed:** The configuration parameters are invalid. Contact Support if you get this status. Dashboard Card State and the Status LED will be red.
- **Idle:** The transcoder session is disabled (by setting **Transcoder State** to **Stopped** in the Transcoder Configuration Parameters).

Connections

The Connections Configuration Tab allows the creation, deletion, and management of input-output connections. The Statistics tab includes all connected input/output status, which allows the operator to immediately pinpoint errors.

Connections Configuration Tab

The Connections configuration tab is depicted below. The message "No Connections" will be displayed if there are no configured input/output connections in the 9990-TRX-MPEG. As indicated in the figure, the Connections configuration area is divided into two parts: a source selection, and a destination selection.



To establish a connection, simply select a source and a destination, and click on Apply. Each connection end-point is determined by three parameters:

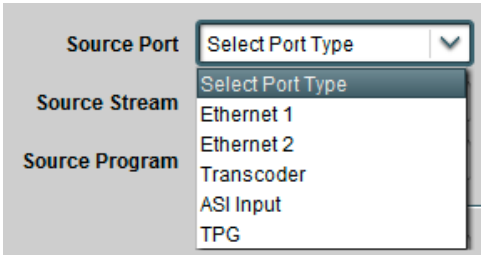
- The port type: ASI, Ethernet, Transcoder.
- The actual port (stream): the ASI port number, the actual Ethernet stream.
- The program: since in general a stream can have multiple programs, an individual program number will need to be specified.

Source Selection

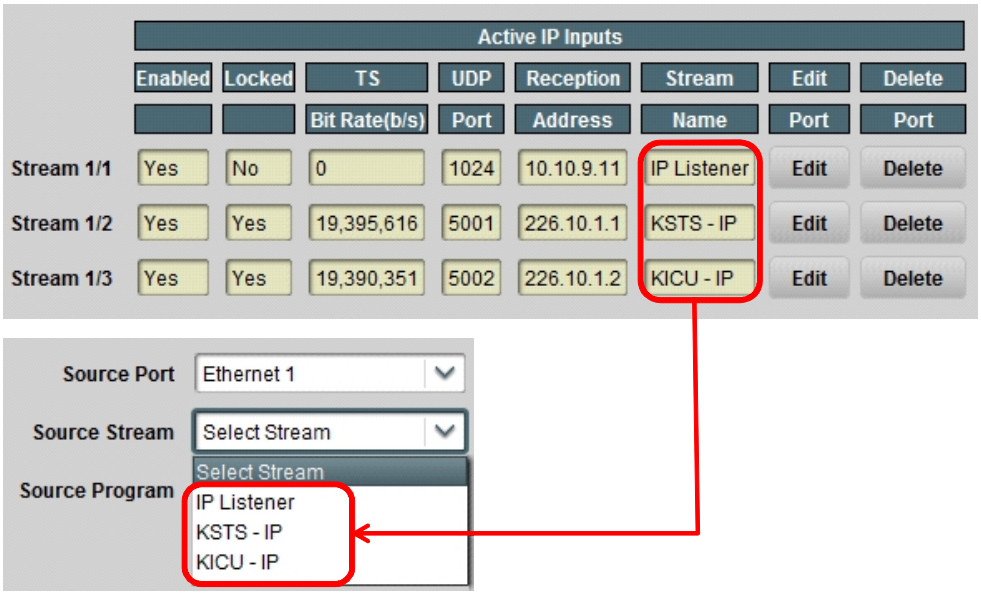
The Source Selection area is available in the Connections tab, as well as in the Transcoder, ASI Outputs and IP Outputs tabs. This allows a connection to a given output to be established as part of the configuration actions for the output. The operation is the same regardless of the location of the control.

The Source Port Selection is a three-step process:

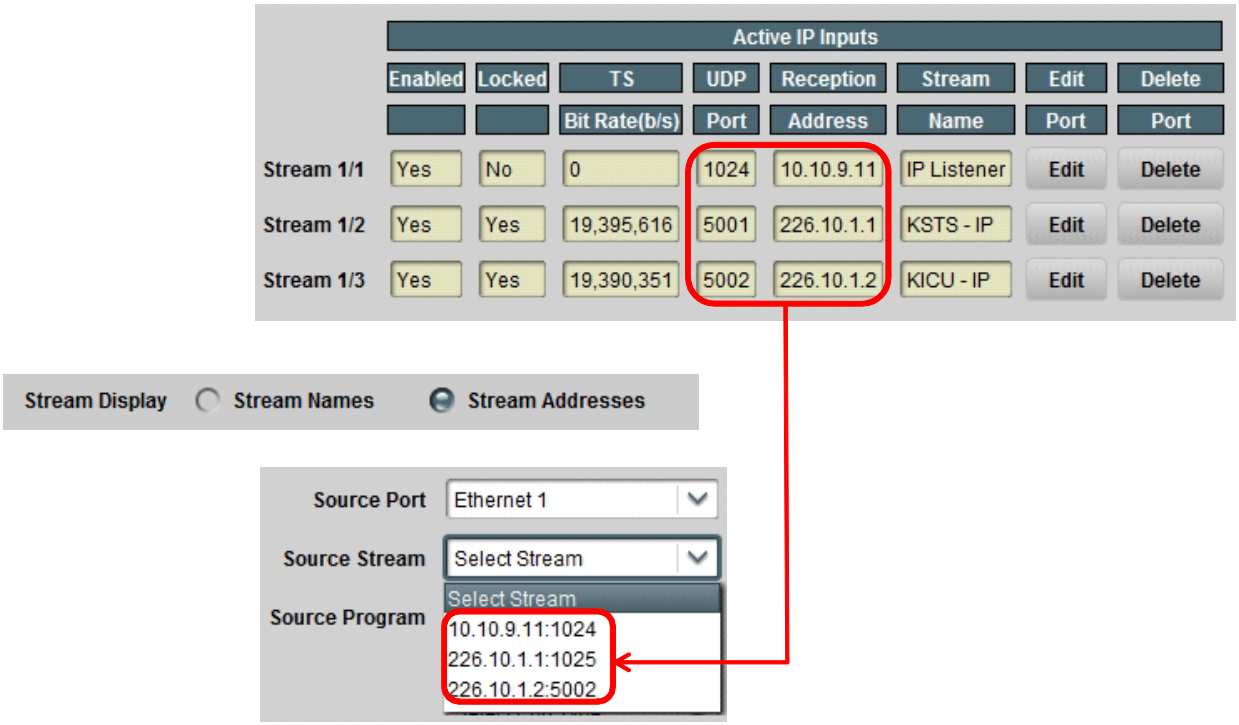
- **Step 1:** Select the port type in the **Source Port** drop-down list. The options are:
  - **Ethernet 1:** UDP/IP Input streams from Ethernet Port 1.
  - **Ethernet 2:** UDP/IP Input streams from Ethernet Port 2.
  - **Transcoder:** Transcoded programs.
  - **ASI Input:** Streams from one of the two ASI Inputs.
  - **TPG:** Test Packet Generator (internal test streams). TPG configuration is discussed in the Admin Test Packet Generator Tab section.



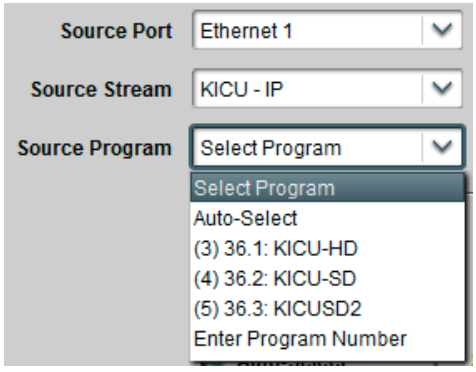
- **Step 2:** Select the individual stream in the **Source Stream** drop-down list. The names presented here are the Stream Names configured when the ports were created. If no streams were configured in that port, no options will be presented. This process is illustrated below.



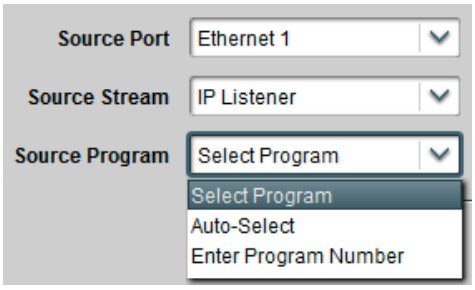
In some situations, it may be desirable to identify the IP streams by their address/port combinations rather than using a name. This mode can be enabled by selecting **Stream Addresses** in the **Stream Display** control, as depicted below. This operation does not affect the user-defined names.



- **Step 3:** Select the desired program in the transport stream. If the port is already actively receiving a transport stream, this list will be pre-populated with the programs found in that transport stream. Moreover, if the service names (or ATSC channel names) are present in the transport stream, these will be shown as well. The two cases are illustrated below.



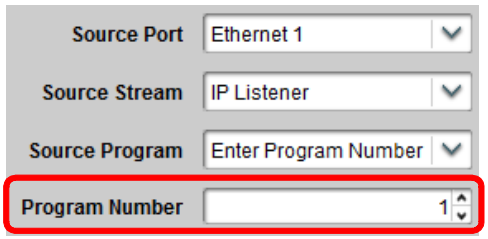
Transport Present



Transport Not Present

If a specific program is desired, it can be selected from the list. Otherwise, the following options are always available:

- **Auto-Select:** This option is useful when the transport is not yet present, and the program numbers are unknown. If this option is selected, the 9990-TRX-MPEG will select the first program found in the transport. When operating in an SPTS environment, it is sufficient to use this option for all connections. The actual program number can be found in The Current Connections Table once the route is established.
- **Enter Program Number:** If the transport is not yet present, but a specific program number to be connected is known a priori, this option can be selected. However, please note that no data will be transferred if this program is not present in the transport. If this option is selected, a new field will appear:



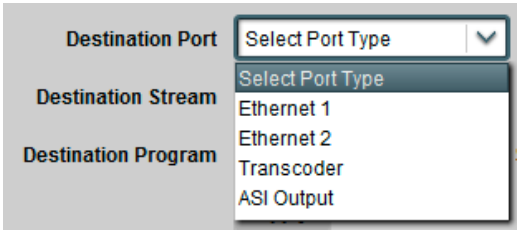
Any valid program number can be entered in the **Program Number** field.

Destination Selection

The Destination Selection operates in the same fashion as the Source Selection. It is again a three-step process, where a port is selected, then a stream on that port is selected, and finally a desired output program number is selected.

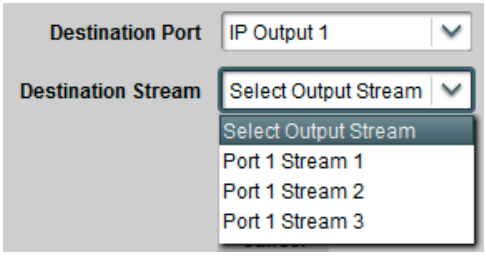
The Destination Port Selection is depicted below. The options are as follows:

- **Ethernet 1:** UDP/IP Output streams transmitted on Ethernet Port 1.
- **Ethernet 2:** UDP/IP Output streams transmitted on Ethernet Port 2.
- **Transcoder:** Programs to be transcoded.
- **ASI Output:** Streams for one of the two ASI Outputs.

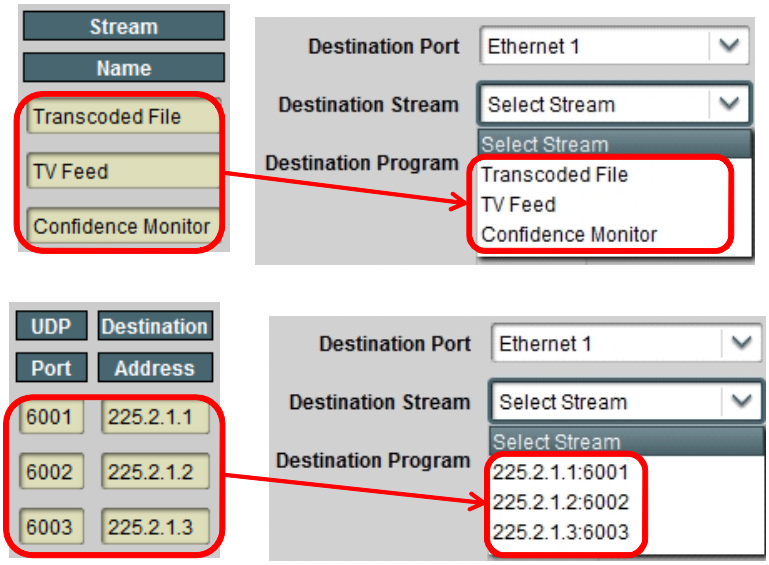


Note that the list may not include all the possible ports – it depends on the Source Selection. Some Source-Destination combinations are not allowed by the 9990 (for example, Ethernet to ASI Output).

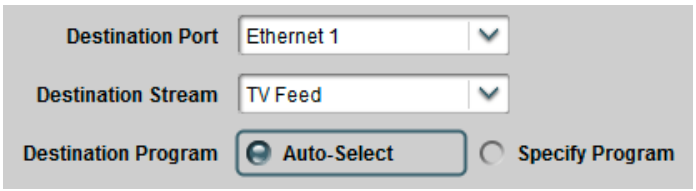
Once the port is selected, the **Destination Stream** drop down menu is populated with the available output streams on that port:



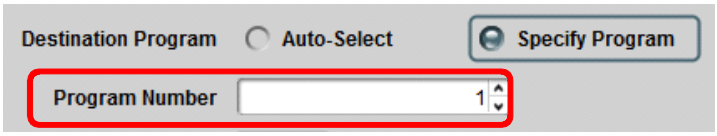
In the same fashion as with the Source Selection, the names can be customized, and the selection can be presented as addresses rather than names. Both situations are illustrated below.



Finally, the **Destination Program** number can be configured. It offers two options:



- **Auto-Select:** the Destination Program number will be automatically selected by the 9990. If possible, the card will use the same program number as the Source Program. The program number will be changed only if there are already other connections to this particular output, and the program number is already in use. The actual program number used can be found in The Current Connections Table.
- **Specify Program:** if you want to control the destination program number, you can choose this option. A new field will open for this configuration:



Note that the 9990 will use this program number only if it not already in use, otherwise it will use the closest available number. For example, if there is a Program 1 already established in the output, and a second program is added with a requested program number of 1, the actual program number will be 2. The actual program numbers can be found in The Current Connections Table.

Establishing the Connection

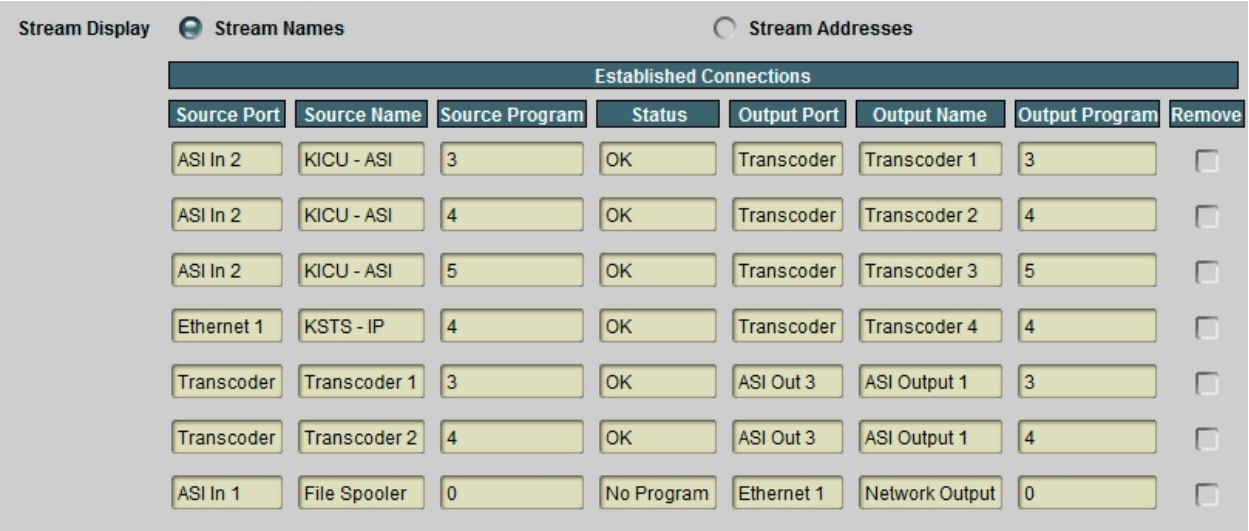
Once the connection is configured, click on **Apply** to establish it. If the source and destination have been completely specified, the connection is established and added to the **Current Connections** Table. If any information is missing, the 9990-TRX-MPEG will take no action. Clicking on the **Cancel** button will clear all selections.

The Current Connections Table

As connections are established (either in the Connections tab, or as part of the output port configuration), they are added to the Current Connections table. Regardless of how they got added, the connections can be edited or deleted using the functions in this table. A sample of this table is depicted below.

The following columns are available in this table:

- **Source Port, Source Name:** these columns have the current source for the connection. Source Port indicates the type of port, and Source Name indicates the configured name for the stream. The Source Name column will change to indicate address/port (for IP Inputs) if **Stream Display** is set to **Stream Addresses**.
- **Source Program:** this column has the actual source program number. It will have a value of 0 (zero) if the program is not present.
- **Status:** this column indicates whether or not the routed program is present in the input. It will indicate **OK** if the routed program exists or **No Program** if the routed program is not present in the input.
- **Destination Port, Destination Name:** this column contains the destination for the connection, in the same fashion as the Source Port and the Source Name. The Destination Name column will change to indicate address/port if **Stream Display** is set to **Stream Addresses**.
- **Destination Program:** this column contains the actual destination program number for the connection. It will have a value of 0 (zero) if the program is not present.
- **Remove:** check this box if you want to delete specific connections. The connections will be deleted if you click on the **Apply** button. Clicking on **Cancel** un-checks all rows.



Connection Statistics Tab

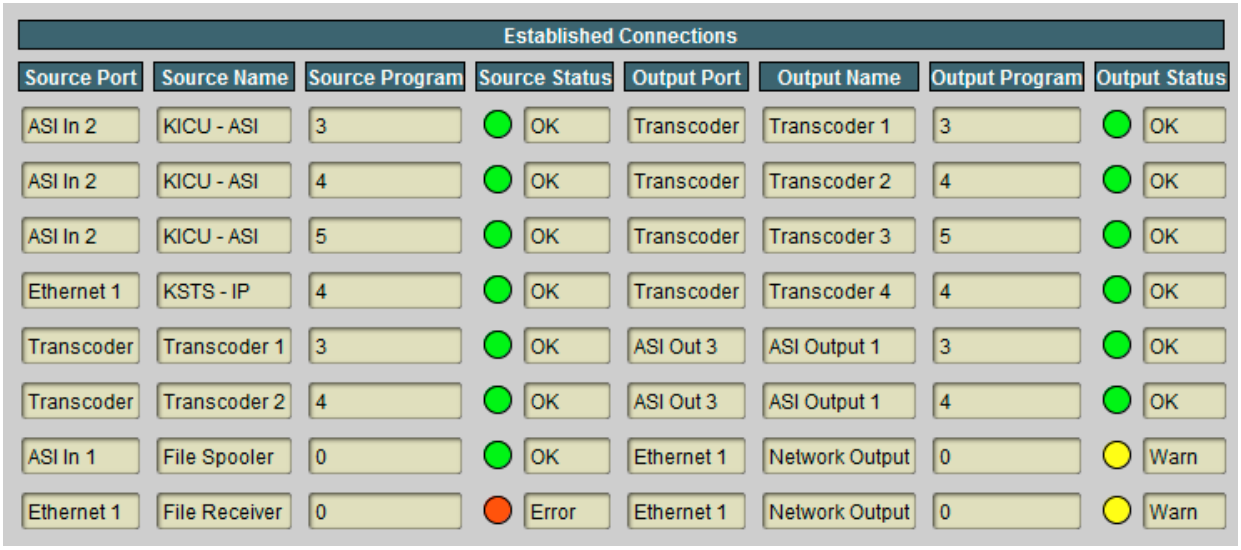
The Connection Statistics Tab presents the combined status of all the established connections, in one table. It includes the Source Port, Name Stream, Source Program, Destination Port, Destination Name and Destination Program fields (with the same meaning as in the Current Connections Table). The Statistics tab contains two additional fields, the **Source Status** and the **Destination Status**. Since these are color-coded, it is simple to quickly identify any problems. If any Status indicator is red, the DashBoard card status will also be red. If any status indicator is yellow, the DashBoard card status will also be yellow, unless there is a higher priority red alarm.

The meaning of the indicators is as follows:

- **OK**: The stream is operating normally. If it is an input, it means that a transport stream is being received by it; if it is an output, it means that it is either transmitting or ready to transmit.
- **Warning:** The stream is configured but may not be running. The situations where this can happen are:
    - The port has been disabled by user configuration. This applies to ASI and IP ports, and to the Test Packet Generators.
    - IP Output ports will have this status if they are in unicast mode and the destination stopped responding to ARP.
    - Transcoders will have this status if they are configured and started, but not receiving a program to transcode (either because they do not have a route, or because the selected program is not present in the input).
- **Error:** The stream is configured but has detected a problem. If it is an input, this normally means that no data is being received (e.g., an IP input is not seeing any packets, an ASI input is not locked). If this is an output, it normally means that the output is either unable to send (e.g., an IP output configured for unicast but unable to find the

destination MAC address) or dropping packets (e.g., oversubscribed ASI or IP outputs). ASI Outputs with Automatic Rate will be in this state if they do not have data to transmit. Transcoders can also be in this state if they encounter an error.

A sample of the Connection Statistics Tab is depicted below.

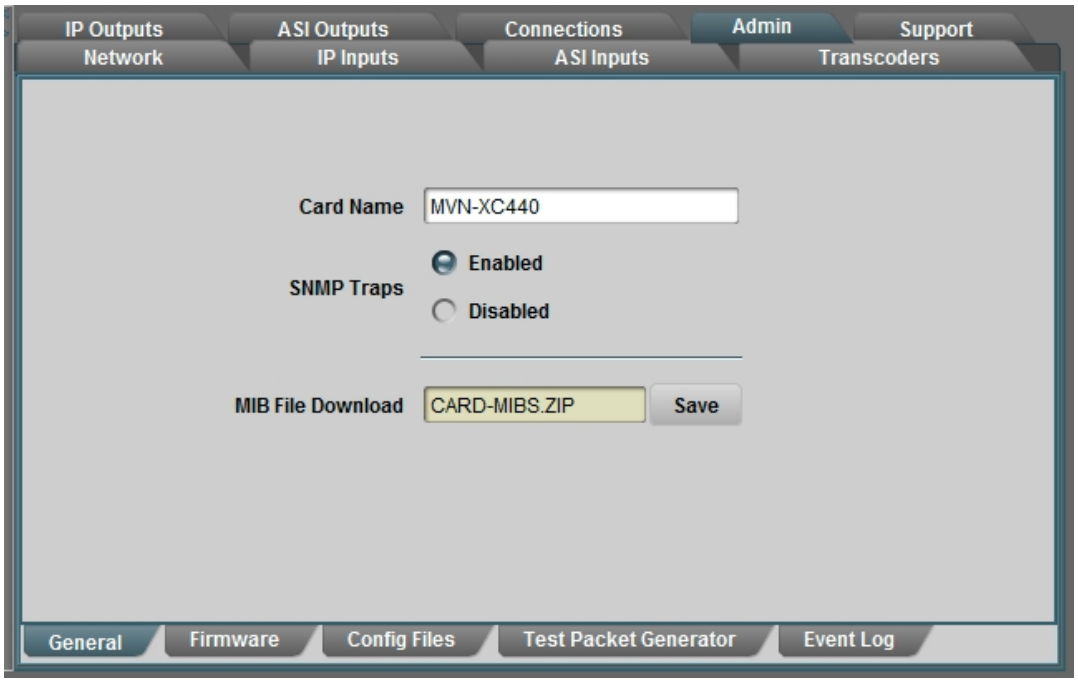


Established Connections

Source Port	Source Name	Source Program	Source Status	Output Port	Output Name	Output Program	Output Status
ASI In 2	KICU - ASI	3	OK	Transcoder	Transcoder 1	3	OK
ASI In 2	KICU - ASI	4	OK	Transcoder	Transcoder 2	4	OK
ASI In 2	KICU - ASI	5	OK	Transcoder	Transcoder 3	5	OK
Ethernet 1	KSTS - IP	4	OK	Transcoder	Transcoder 4	4	OK
Transcoder	Transcoder 1	3	OK	ASI Out 3	ASI Output 1	3	OK
Transcoder	Transcoder 2	4	OK	ASI Out 3	ASI Output 1	4	OK
ASI In 1	File Spooler	0	OK	Ethernet 1	Network Output	0	Warn
Ethernet 1	File Receiver	0	Error	Ethernet 1	Network Output	0	Warn

Admin

The Admin tab contains a number of general administrative functions, each on its own tab. The general layout is shown below:



The Admin tabs are:

- **General:** Manages a number of general card parameters; provides an SNMP MIB download.
- **Firmware:** Manages firmware images.
- **Config Files:** The 9990-TRX-MPEG has the ability to store multiple configurations, and it has a number of pre-set configurations as well. These are managed in this tab.
- **Test Packet Generator:** Manages the Test Packet Generator.
- **License Keys:** Contains the current licensing state of the 9990-TRX-MPEG, and allows for new license keys to be entered.
- **Event Log:** The 9990-TRX-MPEG contains a non-volatile event log. It can be inspected and downloaded from this tab.

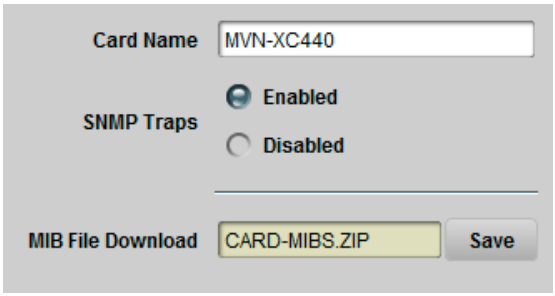
The Admin Statistics tabs are simplified read-only versions of the corresponding Admin Configuration tabs. They will not be explicitly described here.

Admin General Tab

The Admin General Tab includes the following parameters:

- **Card Name:** This field defaults to "9990-TRX-MPEG" but can be set to any descriptive name. The name provided here will also appear in the Dashboard™ Tree View.
- **SNMP Traps:** This allows SNMP traps to be enabled or disabled[4]. Note that this setting does not take effect immediately – it will become active the next time the card is rebooted.
- **MIB File Download:** The 9990-TRX-MPEG provides an up-to-date copy of its MIBs. If you click on the **Save** button, a zip file with the relevant MIBs will be downloaded to your computer. This zip file contains the card MIBs, as well as the Ross Video and openGear MIBs required to compile the card MIBs.

The Admin General Tab is depicted below:



Admin Firmware Tab

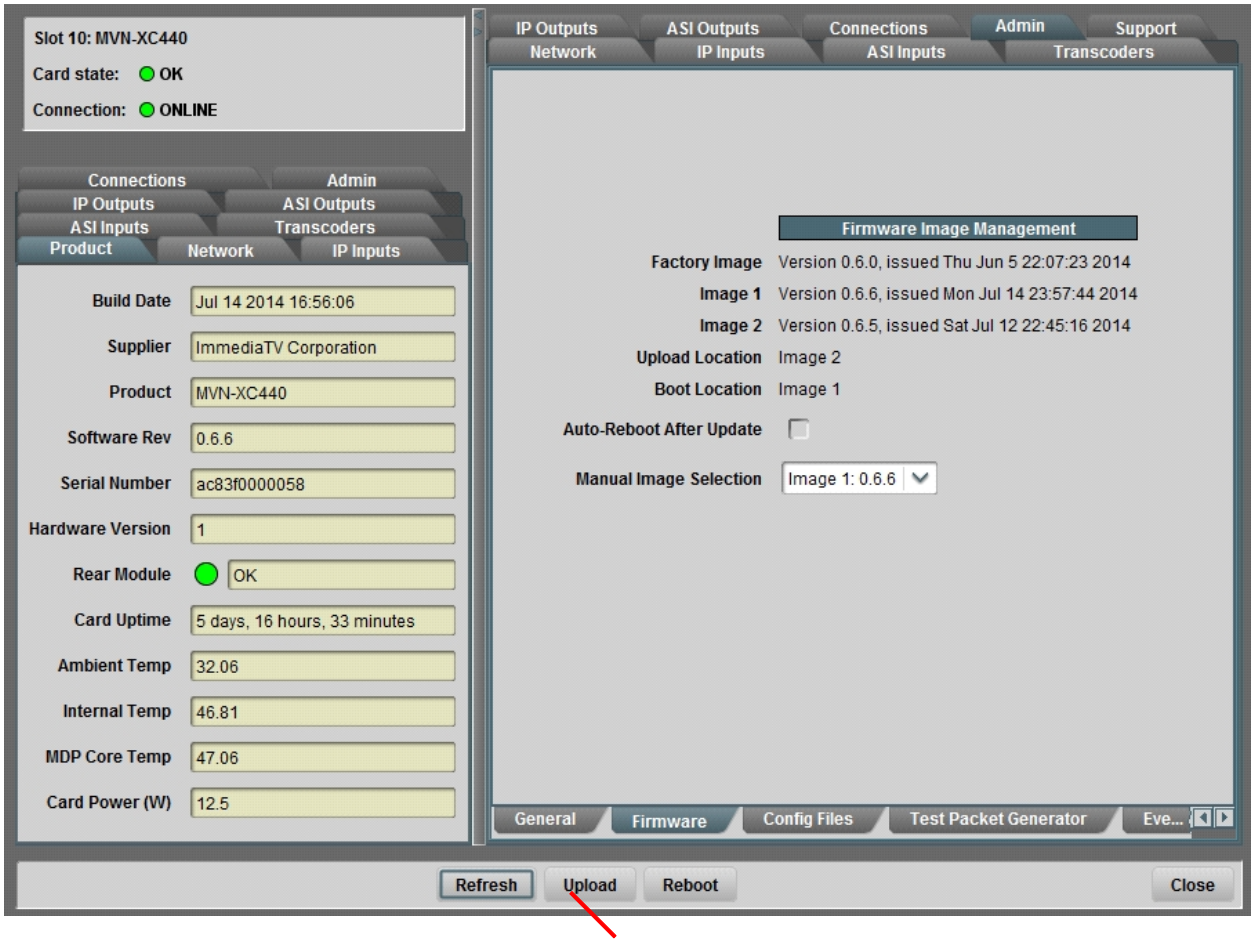
The 9990-TRX-MPEG can hold up to three distinct firmware images: a **Factory** image, and two upgrade images, called **Image 1** and **Image 2**. The Factory image can never be overwritten, and will always be available as a fall-back in case of problems or failed updates. Image 1 and Image 2 can be updated at will. Since the card offers two upgrade images, it is always possible to fall back to the previous image if there are any problems with the current one. The card will also automatically fall back to the factory image if it detects a corrupted firmware image. Finally, the push buttons on the front of the card allow for a forced override to the factory image, as described in the Front Switches section.

9990-TRX-MPEG firmware is updated in the same fashion as with any standard openGear™ card. Once you obtained the upgrade image from Cobalt, place it anywhere in your computer and click on the **Upload** button, as shown below. A dialog box allows you to select the upgrade file. Note that you can simultaneously upgrade all of your 9990-TRX-MPEG cards over multiple chassis if you wish. For more detail, consult the **Dashboard User Manual**, chapter 6, section **Upgrading Device Software**. The Dashboard manual can be downloaded from:

http://www.opengear.tv/n/?p=94

[4] SNMP is an optional feature in the openGear™ frame controller. The 9990-TRX-MPEG SNMP functions are only available if SNMP is licensed in the frame controller.

Note that uploading firmware to the 9990-TRX-MPEG does not affect its operation in any way and does not introduce any glitches in the inputs/outputs.



The fields in the Firmware Image Management tab are:

- **Factory Image, Image 1, and Image 2:** These contain version and release date information for the corresponding firmware images. If no image is present, this field will indicate **No Image**.
- **Upload Location:** This field contains the location where the image upload will go. The 9990-TRX-MPEG automatically chooses a location that will not overwrite the currently running image.
- **Boot Location:** This field indicates which image will be used in the next boot. If an image is successfully uploaded through Dashboard, this automatically changes to point to that image. It can also be manually changed.
- **Auto-Reboot After Update:** This field controls whether or not the 9990-TRX-MPEG will automatically reboot after a successful firmware upload through Dashboard. By

default, the 9990-TRX-MPEG will **not** reboot after an update. You can upload the firmware at any time, and reboot later during a maintenance window.

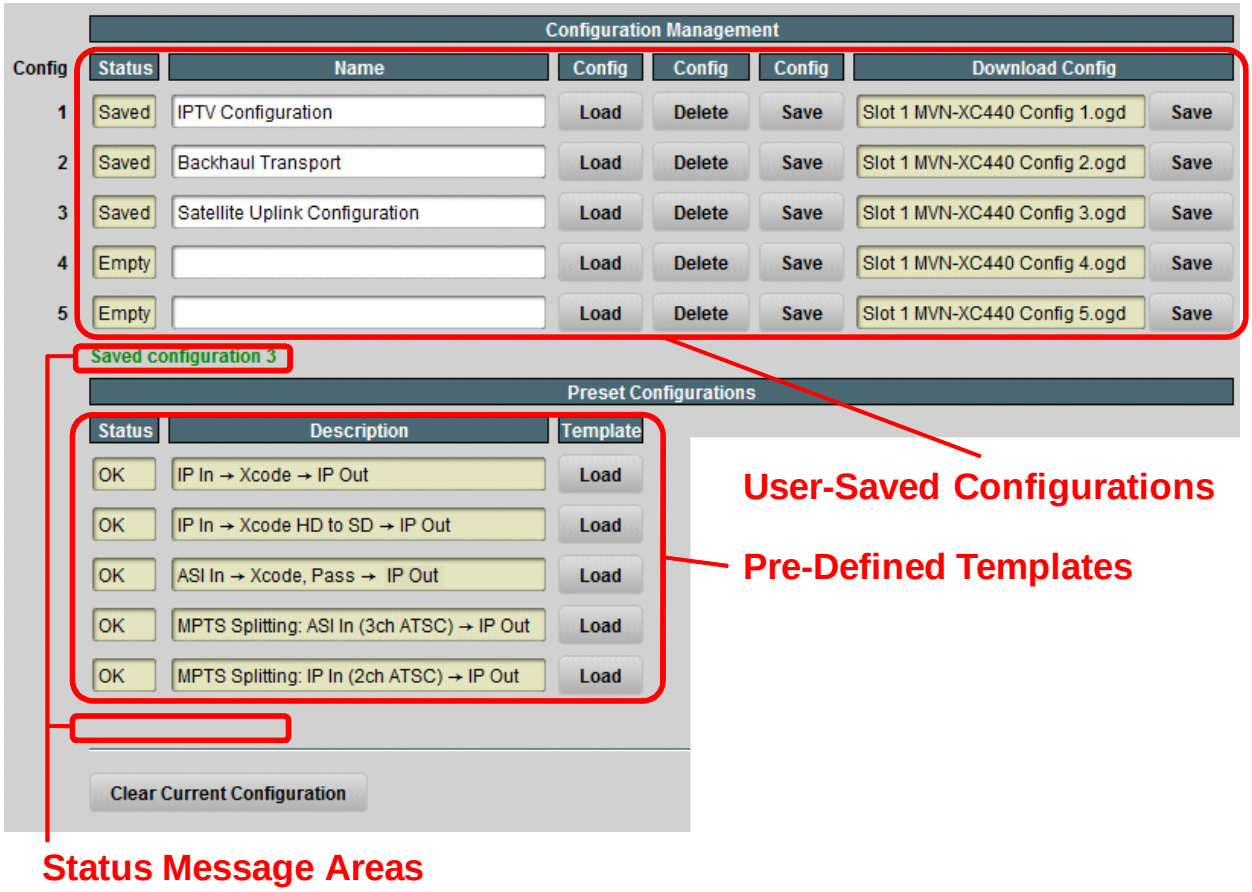
Admin Config Files Tab

As you make configuration changes to the 9990-TRX-MPEG, they are automatically persisted in non-volatile storage. If the card is rebooted or power-cycled, it will come back in the same configuration.

In addition to automatic configuration persistency, the 9990-TRX-MPEG also offers the ability to save up to 5 complete configurations, load them, and even export them. This can be used to quickly configure it for different scenarios, or for saving configuration "checkpoints" as a complex configuration is built. Since configurations can be exported, they can be archived outside the card as well.

Finally, the 9990-TRX-MPEG also offers 5 pre-saved configuration templates for some common scenarios.

The layout of the Admin Config Files tab is shown below.



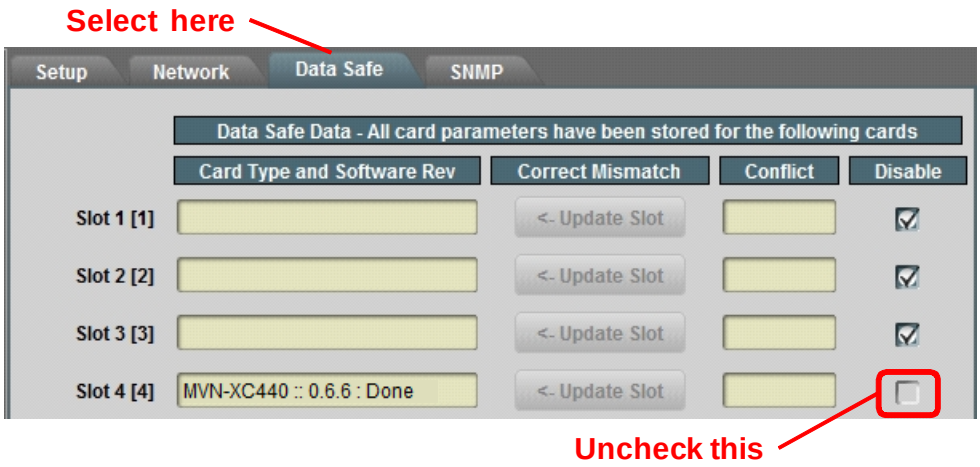
User-Saved Configurations

The fields in the user-saved configuration are:

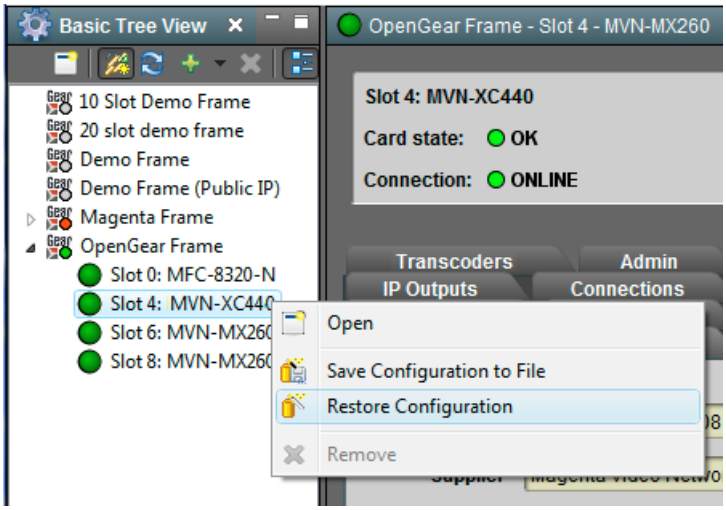
- **Status:** This indicates whether there is a saved configuration on that particular slot. It will contain the words **Saved** or **Empty**.
- **Name:** This is an optional name for the configuration. It is not required but highly advisable. The name can be edited at any time (even when there is no saved configuration).
- **Config Load Button:** If you click on this button, the corresponding configuration is loaded in the 9990-TRX-MPEG card. It will replace the currently-running configuration. Dashboard™ will take a few seconds to reload (longer if you are accessing over a wide-area network), but the actual configuration in the 9990-TRX-MPEG is virtually instantaneous. The Status Message Area will indicate the result of the operation.
- **Config Delete Button:** If you click on this button, the corresponding configuration and its description are deleted.
- **Config Save Button:** If you click on this button, the current card configuration is saved on the corresponding slot, possibly replacing the configuration saved there if it is not empty.
- **Download Config:** If you click on the **Save** button, the corresponding file is downloaded to your computer. This feature is provided to allow configuration backups.

If you save a configuration to your computer, and later wish to restore it to the 9990-TRX-MPEG, use the following procedure:

1. On Dashboard™, open the user interface for the frame controller (slot 0).
2. Select the **Data Safe** tab in the configuration area.
3. Uncheck the **Disable** checkbox corresponding to the card you wish to restore the configuration. This step is depicted below.



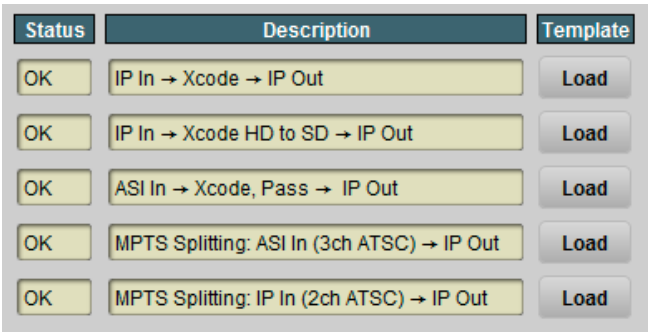
4. On the Dashboard™ Tree View, right-click on the card, and select **Restore Configuration.** Follow the prompts and navigate to the file you wish to restore. This process is illustrated below



This process is discussed in further detail in the **Dashboard User Manual**, chapter 5, section **Restoring Configurations to Devices**.

Pre-defined Templates

The 9990-TRX-MPEG offers 5 pre-defined configuration templates, as indicated below.



To load a template, just click on the **Load** button next to it. The pre-defined templates are;

- **IP In → Xcode → IP Out**: This template creates two IP Inputs associated on Ethernet 1, using multicast reception addresses, routes the first program from each input to a transcoder, transcodes it to H.264, and routes the resulting programs to two IP Outputs on Ethernet 1, also with multicast IP addresses.
- **IP In → Xcode HD to SD → IP Out**: This template is similar to the previous template, but the programs are transcoded to SD resolution (and converted to interlaced if they are progressive).

- **ASI In → Xcode, Pass → IP Out**: This template takes the first program from ASI Input 1, transcodes it, and transmits it to an IP Output on Ethernet 1 with a multicast destination address. Additionally, the original program is also routed to a second IP Output on Ethernet 1.
- **MPTS Splitting: ASI In (3ch ATSC) → IP Out**: This template demonstrates MPTS Splitting (i.e., converting MPTS to SPTS) from ASI Input 1 to IP Outputs on Ethernet 1. Programs 3, 4 and 5 on ASI Input 1 (which is the typical usage for ATSC feeds) are routed.
- **MPTS Splitting: IP In (2ch ATSC) → IP Out**: This template demonstrates MPTS Splitting from an IP Input to an IP Output. It creates an IP Input with a multicast address on Ethernet 1, and routes programs 3 and 4 (typical of ATSC feeds) to IP Outputs on Ethernet 1 with multicast addresses.

Clear Current Configuration Button

The **Clear Current Configuration** button clears all the configured ports and streams as follows:

- All ASI Ports are disabled.
- All IP Inputs are deleted.
- All IP Outputs are deleted.
- All Connections are removed.
- All Transcoders are reset to their default configuration and disabled.
- The Test Packet Generator is disabled.

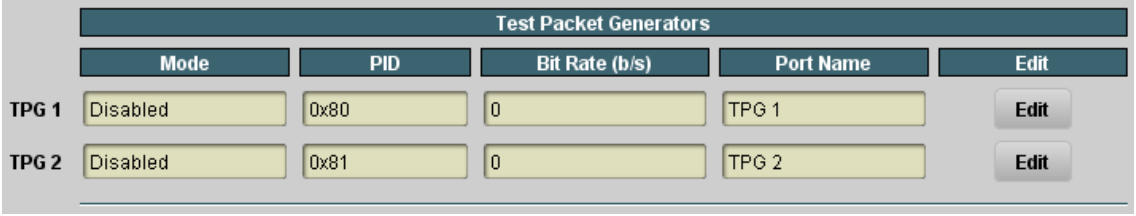
The button does not affect the following areas:

- The settings in the **Network** tab are not changed.
- The settings in the **Admin General** tab are not changed.
- Saved configurations are not modified in any way.

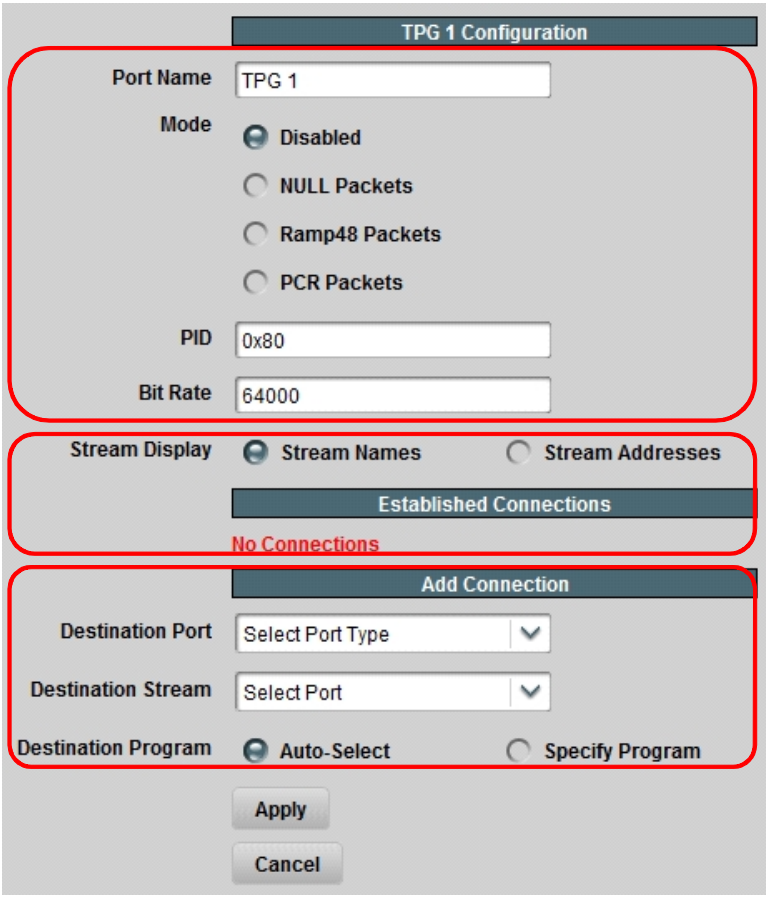
Dashboard™ will take a few seconds to reload (longer if you are accessing over a wide-area network), but the actual configuration in the 9990-TRX-MPEG is virtually instantaneous. The Status Message Area will indicate the result of the operation.

Admin Test Packet Generator Tab

The 9990-TRX-MPEG includes two Test Packet Generators (TPGs), capable of generating a configurable constant bit rate sequence of MPEG-2 Transport Packets with very strict timing. The TPGs are considered a source (input), and are available to be connected to any output. The user interface for the TPGs includes a current status table, which reports the current configuration of the generators.



To configure one of the TPGs, click on the **Edit** button on its row. The following configuration parameters are displayed:



The configuration interface is divided into the following areas:

- **TPG Configuration Parameters**, described in this section.
- The **Established Connections** table. This indicates all the current connections from the port. Connections can be removed by clicking on the corresponding box in the **Remove** column.
- The **Add Connection** area. This allows for a new connection to be added to this port. This control is available for all ports, and is described in detail in the Connections section.

The TPG Configuration Parameters are:

- **Port Name:** All 9990-TRX-MPEG ports have a user-defined name, to facilitate routing. Enter any suitable name.
- **Mode:** controls the type of MPEG-2 transport packets generated. The options are:
    - **Disabled:** TPG is disabled. No packets are being generated.

    - **NULL Packets:** TPG is generating NULL packets. If you select this option, the **PID** parameter becomes read-only with the value 1FFF.
    - **Ramp48 Packets:** TPG is generating packets with a "Ramp48 Payload". A "Ramp48 Payload" is composed of the bytes 0x48, 0x49, 0x4A, …, 0xFF. Generated packets have the Payload bit set, no Adaptation Field, and a valid Continuity Counter field. On request, Cobalt can supply a test program for Windows or Linux that receives the Ramp48 packets and checks them.
    - **PCR Packets:** TPG is generating packets with a valid PCR field (stamped corresponding to the packet's departure time at the configured bit rate). The packets have a small payload with random data, so the Continuity Counter field is valid and counting.
- **PID:** controls the PID of the generated packets. This field accepts both decimal and hexadecimal values (prefixed with 0x).
- **Bit Rate (bps):** controls the bit rate of the generated packets. The minimum value is 64,000 bps and the maximum value is 213,000,000 bps.

Admin License Keys Tab

The 9990-TRX-MPEG has a number of optional licensable features. The Admin License Keys Tab is used to manage these features. Using this tab, you can see how many licenses you have for each optional feature, and how many you are currently using.

The 9990-TRX-MPEG has the concept of a temporary license. If you want to try out a certain feature, contact Cobalt. You will receive a license key that enables that feature for a specific period of running time (license time does not "count" when the card is off).

The Admin License Keys Tab includes a License Status table, and a configuration area, as shown below. The table rows are license counts, and the columns correspond to different licensable features. The rows are:

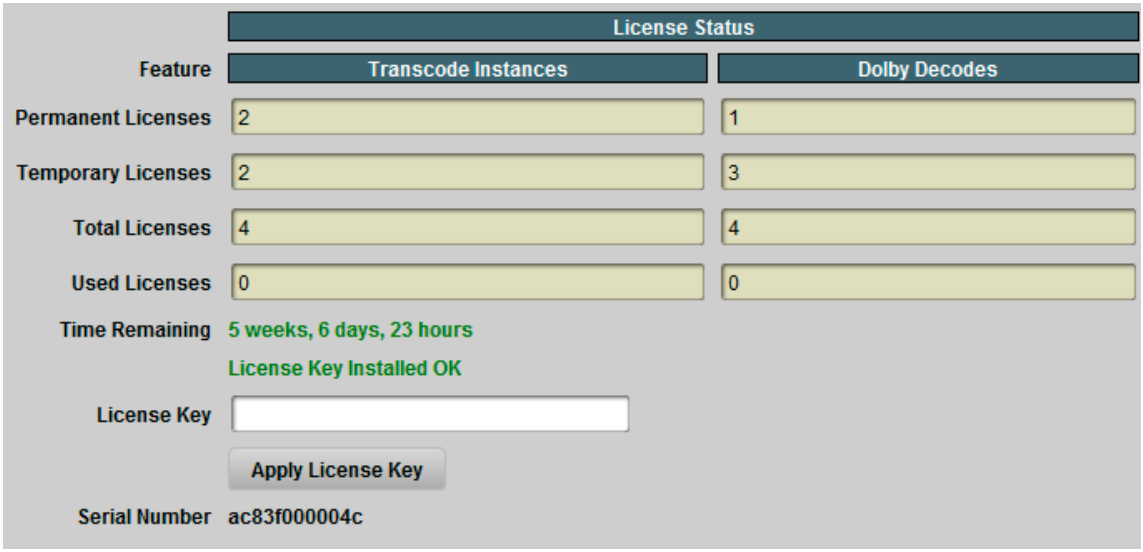
- **Permanent Licenses:** This is the number of non-expiring licenses for each feature.
- **Temporary Licenses:** This is the number of temporary licenses for each feature. Once the license period expires, they are removed.
- **Total Licenses:** This is the total number of licenses for each feature. It is simply the sum of the permanent and temporary licenses.
- **Used Licenses:** This is the number of licenses in use for each feature by the current card configuration.

If you have temporary licenses, the **Time Remaining** field indicates how long until they expire. If you do not have temporary licenses, this field has the message "No active temporary licenses".

The table columns correspond to the licensable features, as follows:

- **Transcode Instances:** This field indicates the number of simultaneous transcode instances the unit is licensed for.

- **Dolby Decodes:** This field indicates the number of Dolby decode licenses the unit is licensed for. A Dolby Decode License is required to transcode one Dolby audio stream into MPEG-1 Layer II or AAC-LC. No license is required to pass-through Dolby streams.



If you want to request a license key from Cobalt, you will need to provide the card serial number. It can be found in the Product Tab and in the Admin License Key Tab as well. Once you receive the key from Cobalt, enter it in the **License Key** field shown above, and click on the **Apply License Key** button. If the key is accepted, you will see the message *License Key Installed OK*, as illustrated above. If there are any problems, you will see an error message in the same location. The following are the possible error messages:

- ***Invalid key: missing characters***: the key you entered is too short. Double-check that you entered all the characters.
- ***Invalid/Corrupted Key***: the key you entered has the correct number of characters, but it is invalid. Double check what you entered.
- ***Serial number mismatch: this key is for serial xxxxxxxxxxxx***: 9990-TRX-MPEG license keys are specific to a card. You entered a valid license key, but it is intended for a different card, whose serial number is displayed in the message. You must use this key on the correct card.
- ***This key has already been applied***: License keys can only be applied once. This is a valid key for this card, but you have already applied it, and its features are already available.

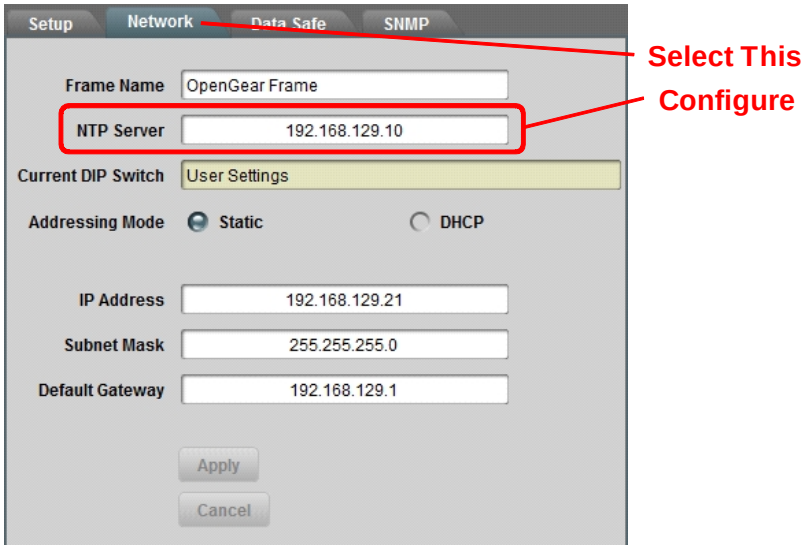
Admin Event Log Tab

The 9990-TRX-MPEG includes an Event Log in non-volatile storage. This event log can be used for fault-finding, and to check for error conditions. The following information is included in each 9990-TRX-MPEG event in the log:

- **Date:** The calendar date in which the event occurred.
- **Time:** The time at which the event occurred.
- **Severity:** The severity of the event. The 9990-TRX-MPEG defines three severity levels:
    - **Error:** These are events that affect the operation of the device. For example, an ASI Input losing lock or an IP Input no longer receiving packets. An error will impact service until addressed.
    - **Warning:** These are events that may produce visible glitches, but they do not have a continuous service impact. Examples of warnings are automatic redundancy switches and ARP renewal failures.
    - **Info:** These are informational events. All configuration actions are logged with this severity. When an error is cleared (for example, an ASI Input regains lock), the event is logged with this severity as well.
- **Subsystem:** The subsystem affected by the event. This may be a port, a stream, or the card itself.
- **Event:** This is a textual description of the event.

The 9990-TRX-MPEG does not have a battery-backed real-time clock. It depends on the frame controller to obtain the current date and time, and the frame controller depends on an external Network Time Protocol (NTP) server to obtain current date and time. By default, the 9990-TRX-MPEG will initialize its internal time-of-day clock to January 1, 2010, GMT. If the frame controller is NTP-synchronized, the 9990-TRX-MPEG will then accept time from it and set its time-of-day clock accordingly.

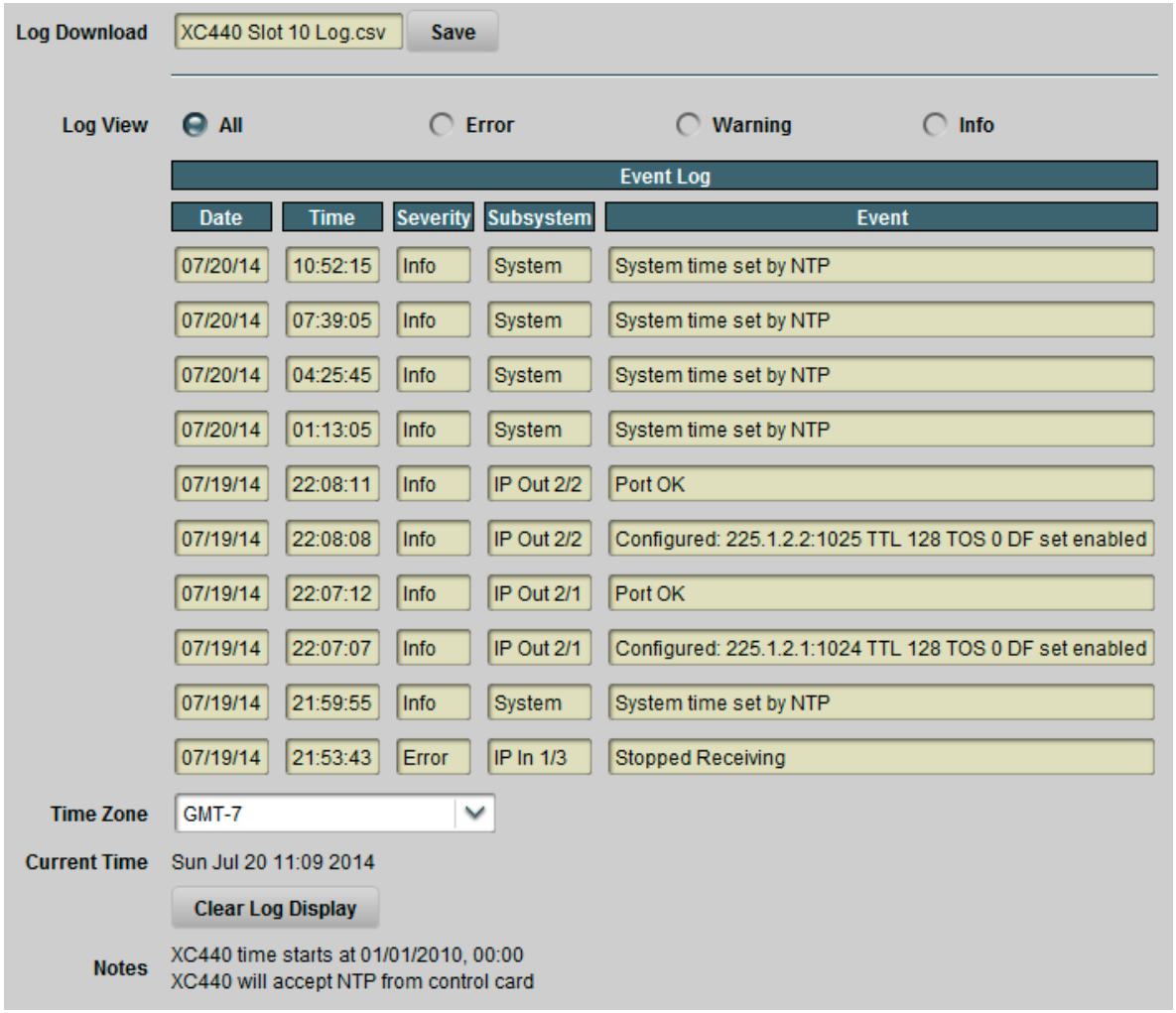
In order to configure the frame controller for NTP, open its configuration screen on Dashboard™, select the **Network** Tab, and enter the IP address of an available NTP server:



If your frame controller has access to the Internet, you can point it to one of the public NTP servers for your region. You can find more details on this link:

http://psp2.ntp.org/bin/view/Servers/WebHome

The full Admin Event Log tab is displayed below:



The fields are:

- **Log Download:** The user interface only displays the last 10 events of each type. If you would like to see the whole event log, it can be downloaded to your computer by clicking on the **Save** button. The log will be in CSV format, and it can be opened by any utility that can read text files; ideally, you should use a spreadsheet program such as Microsoft Excel or similar so it is presented in tabular format. The log will be in chronological order, oldest entry to newest.
- **Log View:** The user interface can display the last 10 events. You can choose to see the last 10 events of any kind by selecting **All**, or you can restrict the view only to **Info**, **Warning**, or **Error**.
- **Event Log:** This table presents the last 10 events of the selected type.
- **Time Zone:** To simplify the correlation of the events with your local time, you can set your time zone using this drop-down menu. Note that the 9990-TRX-MPEG presents a

simplified list, with standard GMT offsets. Note that standard GMT offsets do not change back and forth with Daylight Savings; you will need to make this adjustment manually if it is relevant to you.

- **Current Time:** This field indicates the 9990-TRX-MPEG view of what the current date and time is. If your frame is not NTP-synchronized, this is useful to figure out "how long ago did this event happen".
- **Clear Log Display:** If you click on this button, it clears all log views. This is useful to quickly identify any new events after the unit has been set up. Note that this action does not clear the logs stored in non-volatile memory.

The 9990-TRX-MPEG will store up to about 400 kBytes of logs in non-volatile memory. When that limit is reached, the oldest half of the stored logs will be deleted to make space for new logs.

Support Tab

If you need support with your XC440 transcoder, you can contact Cobalt Support by phone or e-mail as shown in this manual.

If you need to contact Technical Support, please be prepared to provide the following information:

1. A detailed description of the problem, and any actions taken to solve it.
2. A detailed description of the environment around the gateway. This includes the make and model of any connected devices being used, as well as the connection network (IP or ASI) between the gateway and any other devices.
3. The Technical Support information from the gateway itself. This is downloaded from the **Support** tab:

   Select the **Support** Tab, and click on the **Save** button next to **Support Info Download**. This will create a file called **TECHSUPPORT.TXT** in the computer running DashBoard.

The **TECHSUPPORT.TXT** file contains the following information:

- The current configuration of the unit
- A copy of the Event Log (which can also be obtained via the Admin Event Log Tab)

This file does not contain any information that would allow remote access to the unit.

Playing Video on a Web Page

In general, there are two ways of playing video on a web page:

- Using a web-browser plugin
  or
- Using the HTML5 **<VIDEO>** tag, for browsers that support it

Unfortunately, the HTML5 standard did not actually specify what type of audio/video encoding and container was to be supported. Therefore, even though the current versions of all major browsers support the **<VIDEO>** tag, there is no single format that will work on all browsers. Moreover, since the 9990-TRX-MPEG is a transcoder designed primarily for the broadcast market, it uses the transport stream container, which is not supported natively by any browser[5]. Therefore, it is not possible to use the HTML5 **<VIDEO>** tag with content generated by the 9990-TRX-MPEG.

In order to play the bitstream coming from the 9990-TRX-MPEG in a web page, a plugin with the appropriate audio, video and container support must be installed in the web browser. The Open-Source VideoLAN player includes appropriate plugins that will work with the bitstream coming from the 9990-TRX-MPEG. The VideoLAN player can be downloaded from:

http://www.videolan.org/vlc/

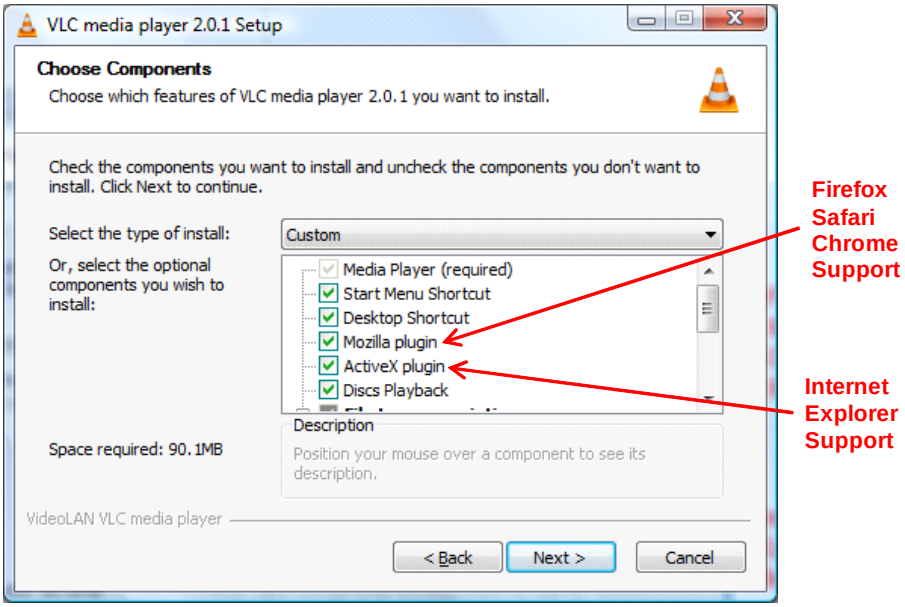
There are two types of plugins:

- ActiveX controls, used by Internet Explorer
- "Mozilla" (Netscape) style plugins, used by most other browsers (Firefox, Chrome, Safari)

When installing the VideoLAN player, make sure to select the appropriate plugins for the browsers you intend to use. The figure below indicates the choices to be made during the VideoLAN installation in order to get the plugins installed on a Windows PC. If multiple browser support is required, both types of plugins can be selected (but at least one "Mozilla-style" browser must be already installed).

We recommend VideoLAN version 2.0.1 or later. Earlier versions had stability problems with the Mozilla plugin and did not support HTTP Live Streaming.

[5] A number of browsers support the MP4 container format, but this container does not support real-time encoded video.



Web Pages Served by the 9990-TRX-MPEG

The 9990-TRX-MPEG automatically generates web pages that will display the video being transmitted, as long as the output destination address is multicast. This functionality assumes the following:

- The VideoLAN plugin has been installed to provide playback services.
- There is multicast connectivity between the 9990-TRX-MPEG and the where the web browser is running. This will typically be the case if the transcoder and the client are in the same subnetwork, but may not work across routers unless they have multicast support enabled, and will definitely **not** work across the Internet.

To get started, simply point a web browser to the IP address of the desired 9990-TRX-MPEG Ethernet port:

`http://transcoder_ip`

The 9990-TRX-MPEG will respond with a Web page with the appropriate links to access the streams, depending on the current configuration. Note that the pages served by each Ethernet port will be different, since each page will only list the multicast outputs defined on that particular interface. Both UDP and RTP streams are supported.

Clicking on any of the streams will take you to a web page where the video may be playing. Video will only actually play if the 9990-TRX-MPEG is actually transmitting, and will always be displayed in a window of 640×360 resolution; you can double click on the video window to make if full-screen.

Note that, if the stream has multiple programs, only the first one will be played. Moreover, if the stream has more than one audio service, only the first audio will be played.

Web Browser Support

The web pages generated by the 9990-TRX-MPEG are known to work with the VideoLAN plugin versions 2.0.1 to 2.1.3 and the following web browsers (Windows):

- Internet Explorer versions 9.0.2 – 9.0.29
- Mozilla Firefox versions 7.0 – 31.0
- Google Chrome versions 14.0.835.186 – 36.0.1985.125
- Apple Safari 5.1 – 5.1.7

Other browsers and operating systems may work, as long as the VideoLAN plugin is installed. You may need to authorize the plugin to run the first time you access the page.

Warranty and Repair Policy

Cobalt Digital Inc. Limited Warranty

This product is warranted to be free from defects in material and workmanship for a period of five (5) years from the date of shipment to the original purchaser, except that 4000, 5000, 6000, 8000 series power supplies, and Dolby® modules (where applicable) are warranted to be free from defects in material and workmanship for a period of one (1) year.

Cobalt Digital Inc.'s ("Cobalt") sole obligation under this warranty shall be limited to, at its option, (i) the repair or (ii) replacement of the product, and the determination of whether a defect is covered under this limited warranty shall be made at the sole discretion of Cobalt.

This limited warranty applies only to the original end-purchaser of the product, and is not assignable or transferrable therefrom. This warranty is limited to defects in material and workmanship, and shall not apply to acts of God, accidents, or negligence on behalf of the purchaser, and shall be voided upon the misuse, abuse, alteration, or modification of the product. Only Cobalt authorized factory representatives are authorized to make repairs to the product, and any unauthorized attempt to repair this product shall immediately void the warranty. Please contact Cobalt Technical Support for more information.

To facilitate the resolution of warranty related issues, Cobalt recommends registering the product by completing and returning a product registration form. In the event of a warrantable defect, the purchaser shall notify Cobalt with a description of the problem, and Cobalt shall provide the purchaser with a Return Material Authorization ("RMA"). For return, defective products should be double boxed, and sufficiently protected, in the original packaging, or equivalent, and shipped to the Cobalt Factory Service Center, postage prepaid and insured for the purchase price. The purchaser should include the RMA number, description of the problem encountered, date purchased, name of dealer purchased from, and serial number with the shipment.

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