AFN Platform

Encoders / Decoders / Multiplexers / Turn-Around Devices

User Manual

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Notices

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Safety Instructions

Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents.

Electric Shock Hazard

This equipment meets applicable safety standards. Refer to this equipment's Identification label or contact factory for details about regulatory compliance approvals.

WARNING: To reduce the risk of electric shock, follow only the instructions that are included in the operating instructions. Refer all servicing and installation to qualified service personnel only. Electric shock can cause personal injury or even death. Always avoid direct contact with dangerous voltages. The protective ground connection, where provided, is essential to safe operation and must be verified before connecting the power supply.

Know the following safety warnings and guidelines:

- Only trained and qualified personnel should be allowed to install, replace, or service this equipment.
- Only qualified service personnel are allowed to remove chassis covers and access any of the components inside the chassis.

Important Safety Instructions

- Read these instructions.
- Keep these instructions.
- Heed all warnings.
- Follow all instructions.
- Do not use this apparatus near water.
- Clean only with dry cloth.
- Do not block any ventilation openings.
- Install in accordance with the manufacturer's instructions.
- Do not install near any heat sources such as radiators, heat registers, stoves, or other apparatus (including amplifiers) that produce heat.
- Protect the power cord from being walked on or pinched particularly at plugs, convenience receptacles, and the point where they exit from the apparatus.
- Only use attachments/accessories specified by the manufacturer.
- Use only with the cart, stand, tripod, bracket, or table specified by the manufacturer, or sold with the apparatus.
- When a cart is used, use caution when moving the cart/apparatus combination to avoid injury from tip-over.
- Unplug this apparatus during lightning storms or when unused for long periods of time.
- Refer all servicing to qualified service personnel.
- Servicing is required when the apparatus has been damaged in any way, such as power-supply cord or plug is damaged, liquid has been spilled or objects have fallen into the apparatus, the apparatus has been exposed to rain or moisture, does not operate normally, or has been dropped.

WARNING:

To reduce the risk of fire or electric shock, do not expose this apparatus to rain or moisture. The apparatus shall not be exposed to dripping or splashing and no objects filled with liquids, such as vases, shall be placed on the apparatus.

Installation Site

When selecting the installation site, comply with the following:
Protective Ground - The protective ground lead of the building's electrical installation should comply with national and local requirements.
Environmental Condition - The installation site should be dry, clean, and ventilated. Do not use this equipment where it could be at risk of contact with water.

Installation Requirements

Installation of the equipment must comply with local and national electrical codes.

Equipment Placement

- Make sure the mounting surface or rack is stable and can support the size and weight of this equipment.
- The mounting surface or rack should be appropriately anchored according to manufacturer's specifications. Ensure this equipment is securely fastened to the mounting surface or rack where necessary to protect against damage due to any disturbance and subsequent fall.
- Installation of this equipment in a rack should be such that the amount of airflow required for safe operation of this equipment is not compromised.
- Only install this equipment in a humidity- and temperature-controlled environment that meets the requirements given in this equipment's technical specifications.

AC Power

- This product requires short-circuit (overcurrent) protection to be provided as part of the building installation. Install only in accordance with national and local wiring regulations. The outlet must be near this equipment and must be easily accessible.
- Connect this equipment only to the power sources that are identified on the equipment-rating label normally located close to the power inlet connector(s).
- The plug-socket combination must be accessible at all times because it serves as the main disconnecting device.
- Always pull on the plug or the connector to disconnect a cable. Never pull on the cable itself.
- Unplug this equipment when unused for long periods of time.

Circuit Overload

Know the effects of circuit overloading before connecting this equipment to the power supply. Take care when connecting units to the supply circuit so that wiring is not overloaded.

General Servicing Precautions

WARNING: Avoid electric shock! Opening or removing this equipment's cover may expose you to dangerous voltages.
Be aware of the following general precautions and guidelines:

- **Wristwatch and Jewelry** - For personal safety and to avoid damage of this equipment during service and repair, do not wear electrically conducting objects such as a wristwatch or jewelry.
- **Lightning** - Do not work on the system or connect or disconnect cables during periods of lightning activity.
- **Labels** - Do not remove any warning labels. Replace damaged or illegible warning labels with new ones.
- **Covers** - Do not open the cover of this equipment and attempt service unless instructed to do so in the instructions. Refer all servicing to qualified service personnel only. The covers are integral part of the safety design of the product. Do not operate the unit without the covers installed.
- **Safety Checks** - After service, assemble this equipment and perform safety checks to ensure it is safe to use before putting it back into operation.

Electrostatic Discharge

Electrostatic discharge (ESD) results from the static electricity buildup on the human body and other objects. This static discharge can degrade components and cause failures.

Take the following precautions against electrostatic discharge:

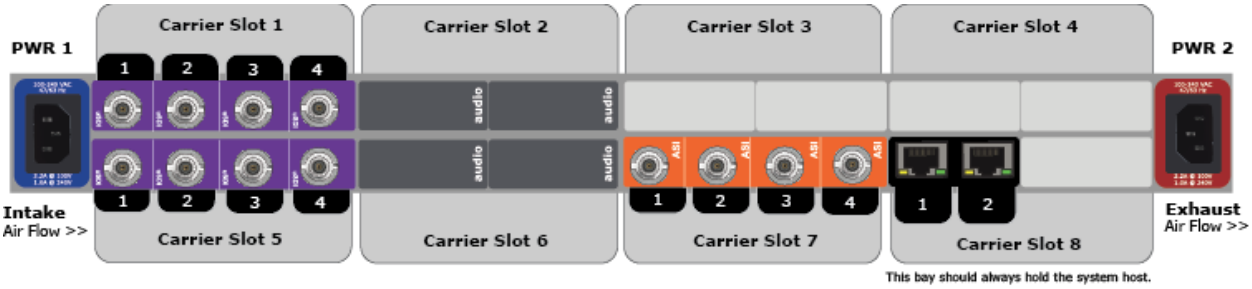
- Use an anti-static bench mat and a wrist strap or ankle strap designed to safely ground ESD potentials through a resistive element.
- Keep components in their anti-static packaging until installed.
- Avoid touching electronic components when installing a module.

Understanding AFN

AFN-1000 Chassis

The AFN-1000 chassis is designed to have eight (8) modular cards that make up the back panel along with two (2) power input modules and (2) power supplies that can be accessed through the removable front panel. The AFN-1000 chassis includes a system host carrier with IP multiplexing capabilities, a web-based user interface and front panel for base configuration. It can accommodate 7 additional function-based carriers.

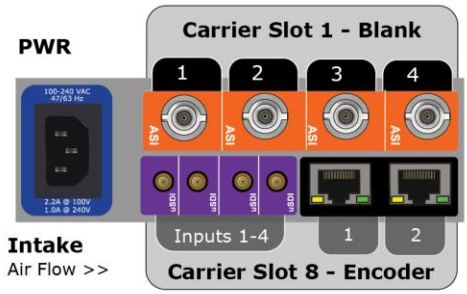
The slots are numbered in the web browser user interface from 1-8:



AFN-250 Hardware

The AFN-250 system is designed to have two (2) modular cards that make up the back panel along with a power input module and power supply.

The AFN-250 chassis is a light-weight portable chassis. While it has no front panel configuration, it shares the same intuitive, web-based UI for set-up and control as the AFN-1000. This durable chassis has space for 2 carriers, a primary carrier which includes a system host and multiplexer outputs and a secondary carrier for additional channels of video or audio encoding/decoding, multiplexing or transport conversion.



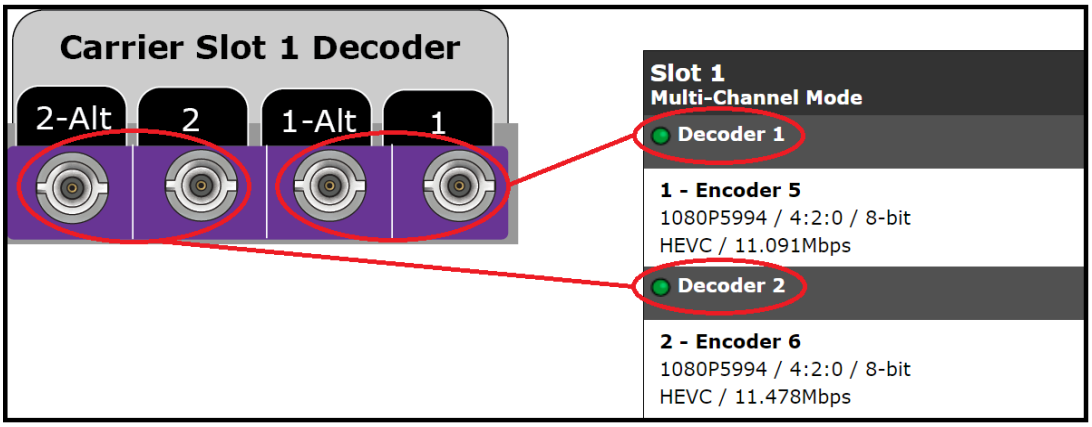
For the AFN-250, the slots are numbered 1 (top carrier) and 8 (bottom carrier)

Carrier Options

This platform is sold with a variety of hardware carrier options. These options can be installed at the time of initial chassis purchase or added later in-field. These carriers can be moved between AFN chassis for greatest flexibility, but the chassis must be completely filled for operation and the system host carrier (dual ethernet) must be present and located in Carrier Slot 8 for AFN-1000 platform. Should it be required to add, remove, or move other carriers in the chassis, make sure to power the chassis down.
If an active carrier needs to be removed or a carrier needs to be returned to Sencore for upgrade or repair, a blank carrier can be inserted so that the chassis can remain functional. Additional blanks can be purchased if needed.

Carrier Part Number	Carrier Function	AFN-1000	AFN-250
AFN-VEC0301-0600	4 Video Encodes with 4 BNC Inputs	X	X
AFN-VEC0301-0501	4 Video Encodes with 4 mini-DIN inputs and System host interface		X
AFN-AEC0101-0000	Adds 4 pair of Audio to VEC0301 inputs	X	X
AFN-VDC0301-0600	2 Video Decodes w embedded Audio with 4 BNC Outputs (2 mirrored) *	X	X
AFN-VDC0301-0501	2 Video Decodes w embedded Audio with 4 mini-DIN Outputs (2 mirrored) and System host interface		X
AFN-TMC0100-0100	IP Multiplexer with 2 GigE connectors	X	X
AFN-TMC0100-0400	ASI Multiplexer with 4 BNC Outputs	X	X
AFN-TMC0100-0600	ASI Multiplexer with 4 BNC Inputs	X	X

*Decoder card outputs are inverted if the VDC0301 is located in Slots 1-4 (top row):



Getting Started

Plugging in Power

To supply power, plug in standard IEC power cables to the power input modules on the rear panel. It is highly recommended to utilize both power inputs.

Accessing the User Interface

Networking configurations can be retrieved and changed via front panel. Google Chrome is the recommended web browser for the AFN user interface. To begin, connect the AFN platform via IP 1 directly to the local area network. Network settings can be found via the front panel System > Network Menu. The default IP Address of the unit is 192.168.10.48. If a different static IP address or DHCP needs to be used, these changes need to be made via the front panel Network Menu.
To connect directly to the device, make sure that the computer and the AFN have IP addresses within the same IP class range (ex. 192.168.10.48 for the AFN and 192.168.10.49 for the computer). Using a crossover cable, connect one end to the computer and the other to the IP 1 port of the AFN. (Some computers can auto-negotiate the connection and a crossover may not be necessary.)
To add the device to a LAN, connect a standard Ethernet cable to the network router or switch and then to the IP 1 port on the back of the AFN.

The default username: admin, password: none

Plugging in Sources

To supply SDI to the AFN platform, use the Standard BNC or mini-BNC connectors on the rear panel and the BNC conversion cables.
To supply a Transport Stream over IP use one of the RJ45 ethernet connectors on the rear panel. Port 1 is on the left, port 2 is on the right.

Plugging in Outputs

ASI outputs have a BNC interface on the rear panel of the AFN.
For a Transport Stream over IP output use the RJ45 ethernet connectors on the rear panel that was configured during output setup.

Inputs Page

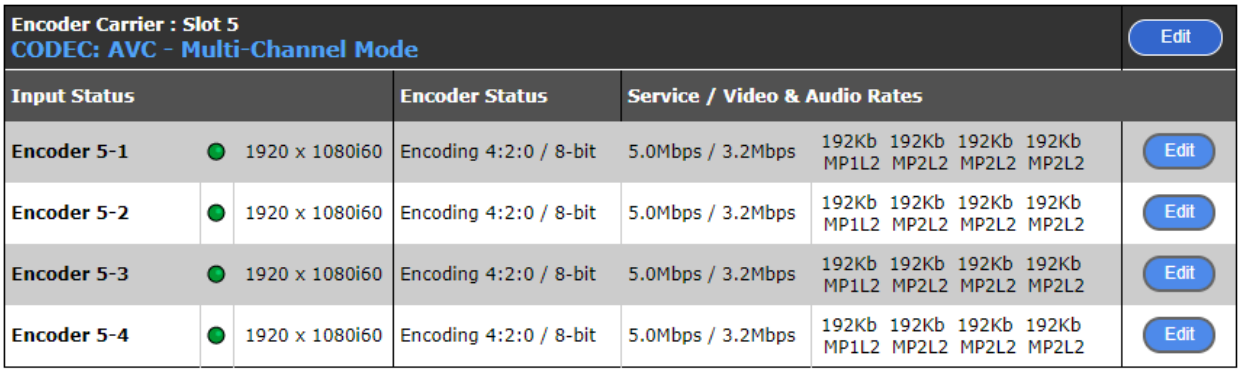
Clicking the blue icon at the top left of the user interface brings up the inputs page.

This page allows the configuration of all the input settings.

Depending on the hardware configuration there may be multiple input options that need to be configured. Multiple IP Interface / System Host Card - SHC0100 can be present in a single chassis for multiple network input interfaces. Multiple SDI Input / Video Encoder Card - VEC0301 can be present for dense encoder applications. Different inputs will be defined by what slot the carrier is installed in.

Inputs - Encoders

VEC0301 Encoder Carriers have carrier level settings as well as encoder level settings. To edit these settings, click on the Edit button in the top bar.

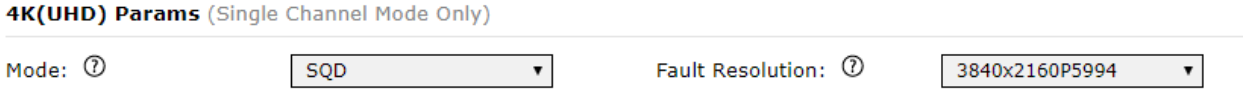


Multi-CODEC

CODEC can be changed to HEVC, AVC, or MPEG2. This CODEC is shared across all encoders on the carrier.

Single Channel Mode

For UHD applications, Single Channel Mode is required. In this mode the four inputs can be used for 3G-SDI inputs and combining them into one UHD video PID. 4K Parameters are found under the first encoder Edit button:



Input Service Configuration

For baseband inputs that need to be encoded the configurations are changed by clicking the Edit buttons.

Input

- Name - sets the name of the service
- Startup - turns the encoder engine ON and OFF
- Closed Captions - support for DTVCC set to ON or OFF

Service Rate Control and Encryption

- Service Rate - Sets the overall rate of the Service
- Auto Fill - When Autofill is set to ON the Service Rate will control the Video Rate by calculation the maximum video rate after Audio configurations
- Encryption Mode - Sets Encryption ON and OFF
- Encryption Type - Options are BISS1 and BISSE
- BISS1 Session Word - 12 digit hexadecimal Clear Session Word
- BISSE Session Word - 16 digit hexadecimal Encrypted Session Word
- BISSE Active ID - 14 digit hexadecimal User ID for BISSE decryption
    - All BISS entries will appear blank in the user interface for security purposes

Video Rates & Params

- Rate - Video Rate (Auto fill needs to be set to OFF)
- Chromatype - Options are 4:2:0 and 4:2:2
- Bit Depth - Options are 8-bit and 10-bit
- Latency - Options are Long, Normal, Low, and Very Low
- Trim – The latency can be trimmed up to 400ms off normal times (only works in Normal Latency mode)
- Fault Mode - User sets how the encoder responds to signal loss
- Fault Resolution - Changes the resolution when in Fault Mode

Ancillary Data

- Closed Captions - Turns DTVCC support ON and OFF
- VANC Start Line - The location of the embedded captioning in the VANC (vertical ancillary data space). In full raster, the data packets appear in the ninth line from the top of the frame, but are not displayed as part of the visible image
- VANC Line Count - Specify the number of vertical lines for searching vertical ancillary space. The start line must be located before the active video line. range 1..4
- VANC H Size - Specify the number of horizontal cycles for searching vertical ancillary space. Specify the multiple of twelve. range 12..2048

GOP Structure

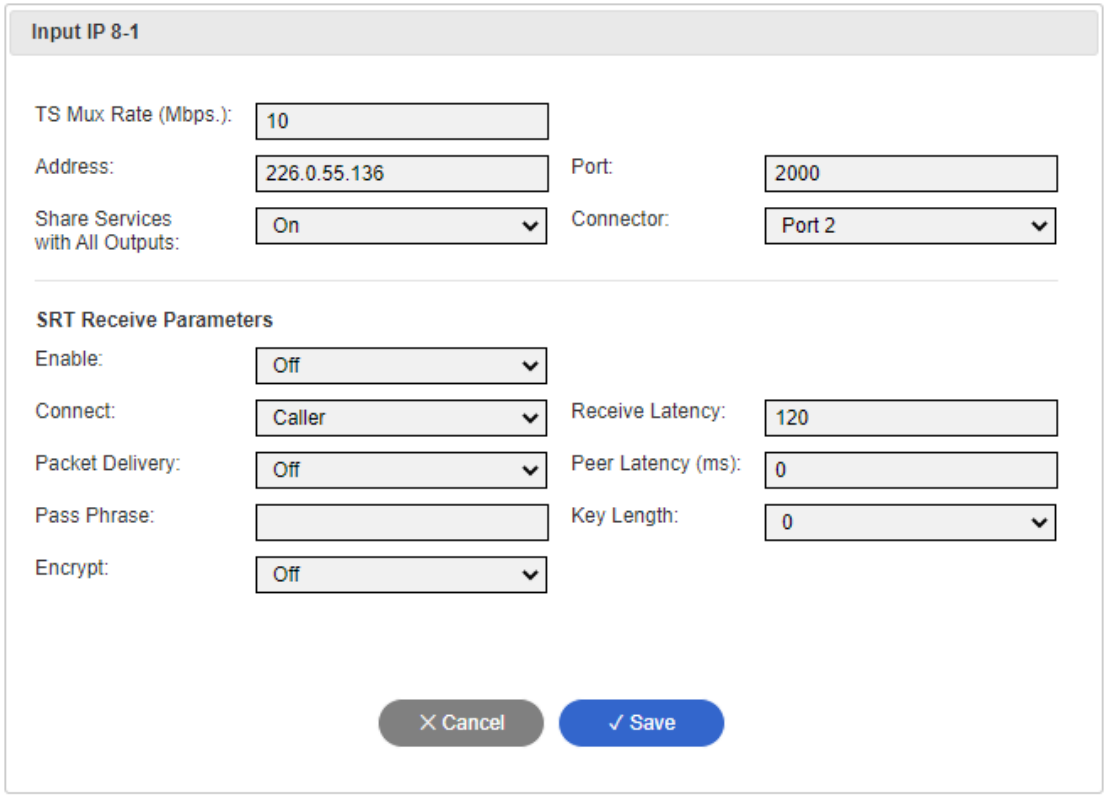
- Gop Type - Set to 1, 2, or 3 (1-IP, 2-IBP, 3-IBBP)
- GOP Length - Set the number of frames between I frames

Audio Settings

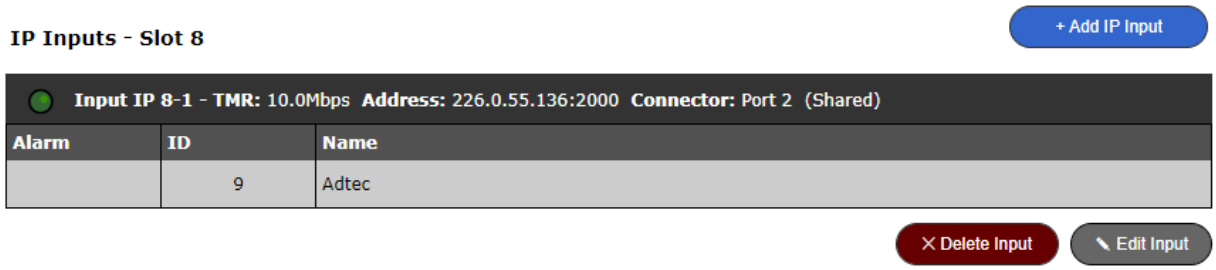
- Mode - Encode, Passthru, and OFF (Only 2 Passthru allowed per service)
- Sync - Set ms to sync with the Video
- Type - Sets audio type for encoding and passthru modes (Dolby and AAC parameters are configurable after Save)
- Rate - Sets the rate for encoded audio pairs
- Component Name - Names the audio PID
- Language Descriptor - Sets the language tag

Inputs - IP

For IP based inputs click the Add Network Input button and a configuration window will pop up:



If the parameters are configured correctly and the incoming TSoIP is available, the service will show up on the input page:



More information on configuring IP Inputs can be found in the AFN Link and SRT Guide section of the manual.

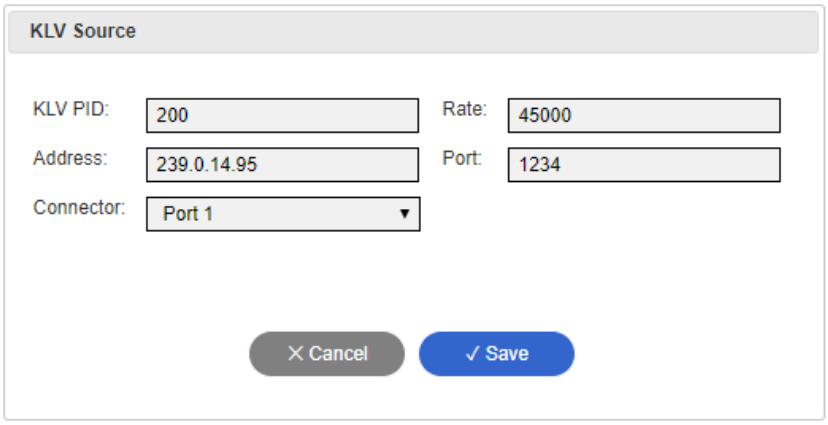
Inputs - ASI

For ASI input the user must set the TMR for the incoming ASI signal. The user can decide if the services are shared with other outputs.

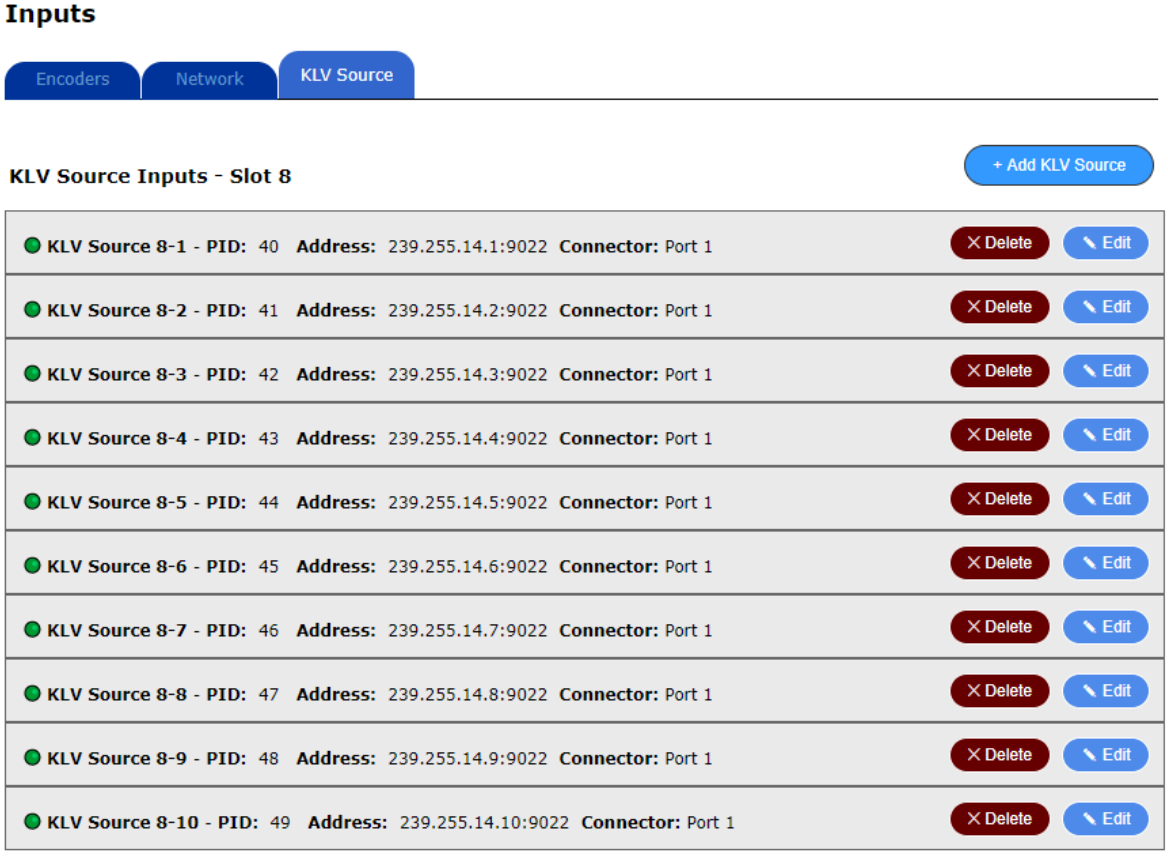
Inputs - KLV Source

AFN Link supports UDP packets containing KLV metadata and can format those packets into KLV TS packets and inject them to one or more outputs.

For KLV inputs, click the Add KLV Source button and a configuration window will pop up.



KLV PID is assigned by the user. Rate is the space (bps) allocated for the KLV PID.
Address and Port must match the multicast information from the KLV transmitter.
KLV can only be mapped to outputs on the same slot/card.
When the KLV inputs are synchronized, the indicator will be green



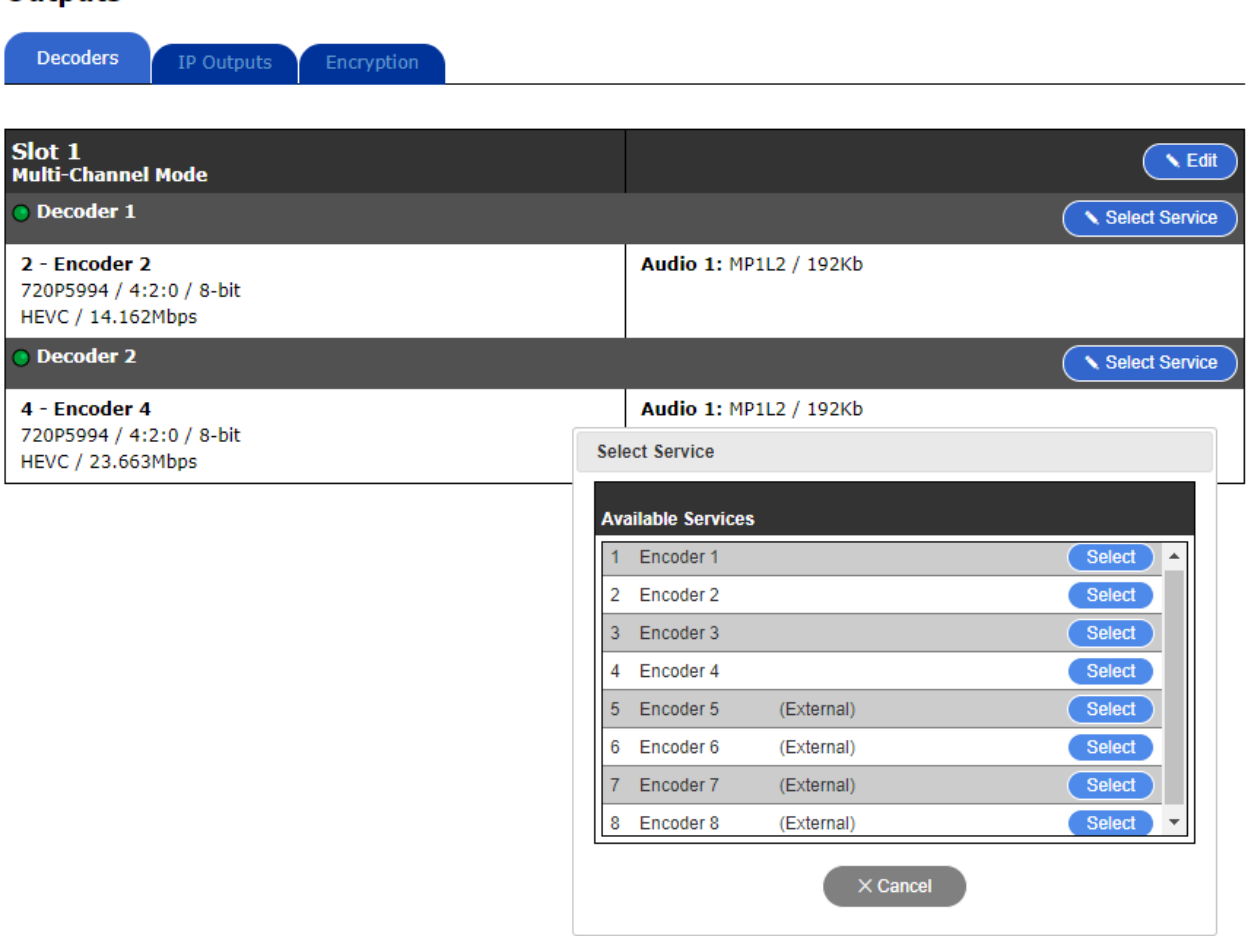
Outputs Page

Clicking the yellow icon at the top left of the user interface brings up the outputs page.
This page allows configuration of all the output baseband and transport stream settings.

Depending on the hardware configuration, there may be multiple output options that can be configured. Multiple IP Interface / System Host Card - SHC0100 can be present in a single chassis for multiple network output interfaces. ASI Output Card - TMC0100 allows for 4 transport stream outputs. Different outputs will be defined by what slot the carrier is installed in.

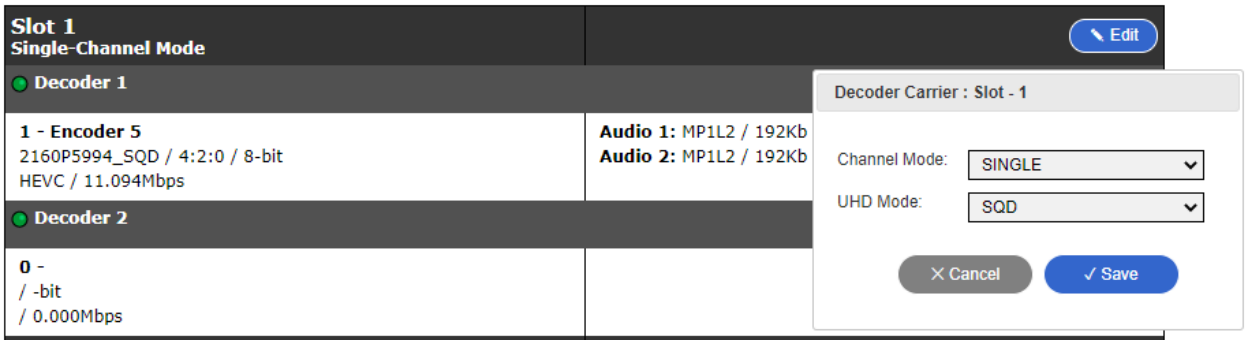
Decoded Outputs

Each Decoder card is able to decode 2 services independently and can be selected by the Select Service button:



UHD Single-Channel Mode Decode

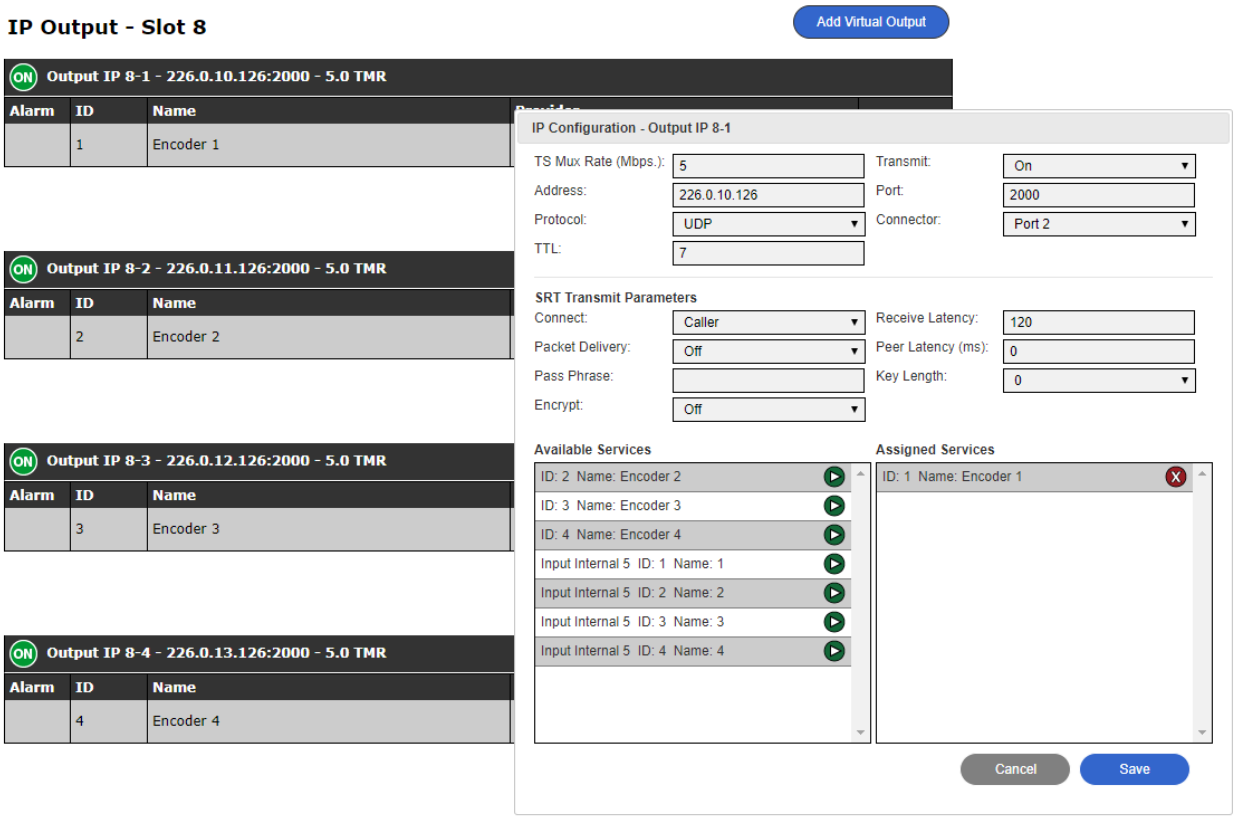
For 4K applications that use a single Video PID the Decoder must be set to Single Mode:



In single channel mode the 4 SDI outputs will be independent and not mirrored pairs.

IP Outputs

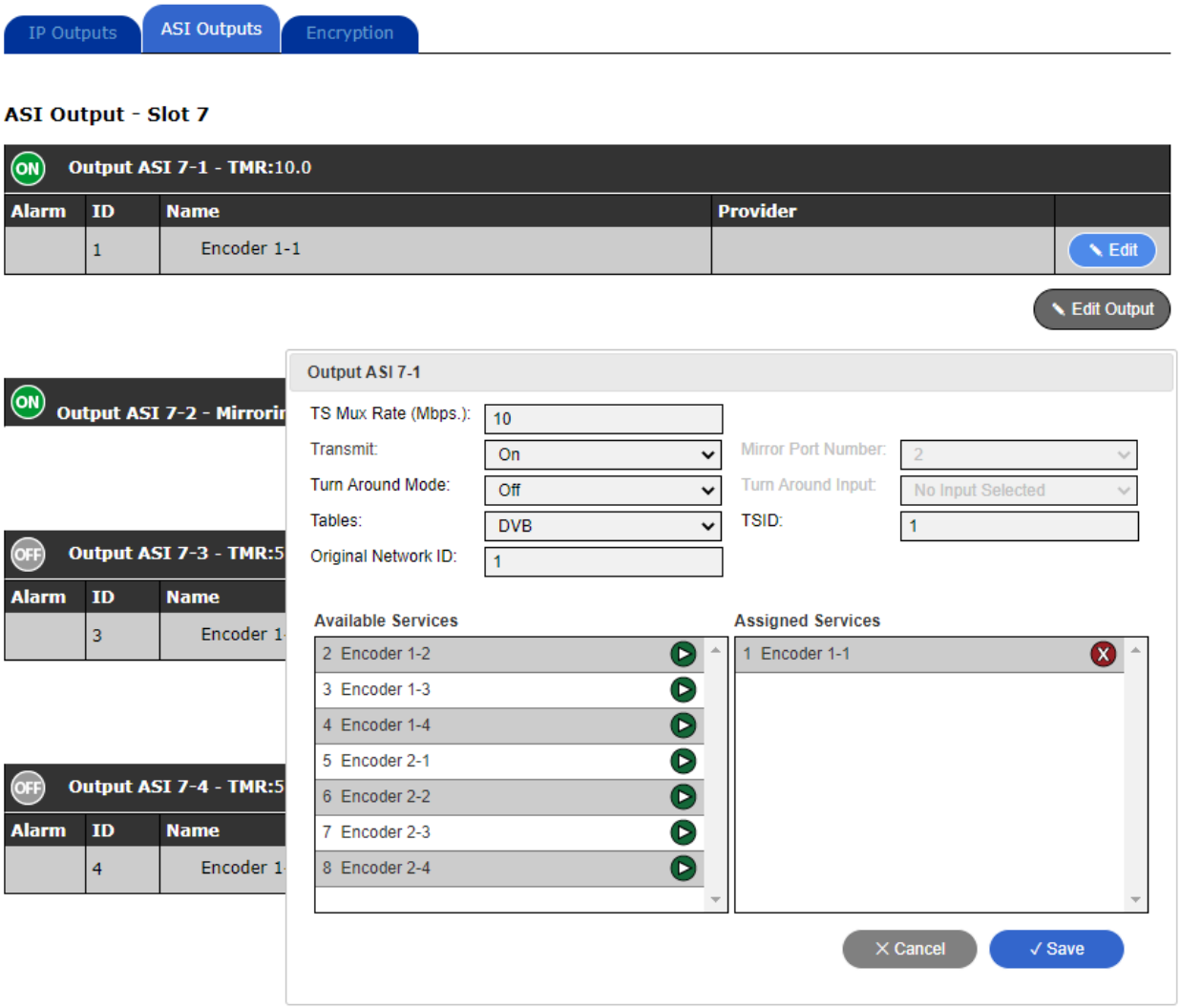
Multiple IP outputs can be created, configured, and deleted from this page:



No more than 210 Mb/s and/or 20 transport streams is recommended for reliable delivery.

ASI Outputs

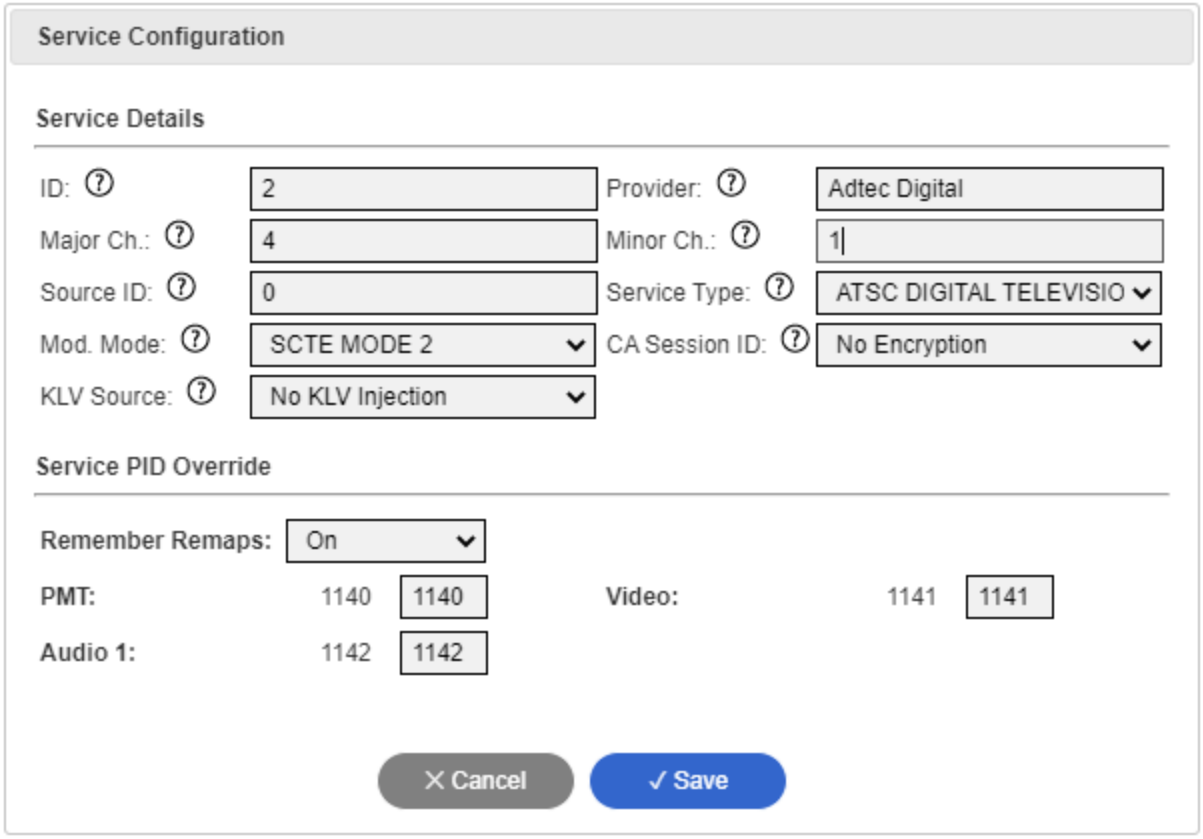
4 ASI outputs can be created, configured, and deleted from this page:



The maximum bandwidth of the 4 ASI outputs is 210Mb/s. Mirrored outputs do not allocate any bandwidth.

Output Service Configuration and PID Remapping

By clicking the Edit button to the left of the Service bar the user can access the Service Configuration tab. This allows the user to set configurations independent to every output.

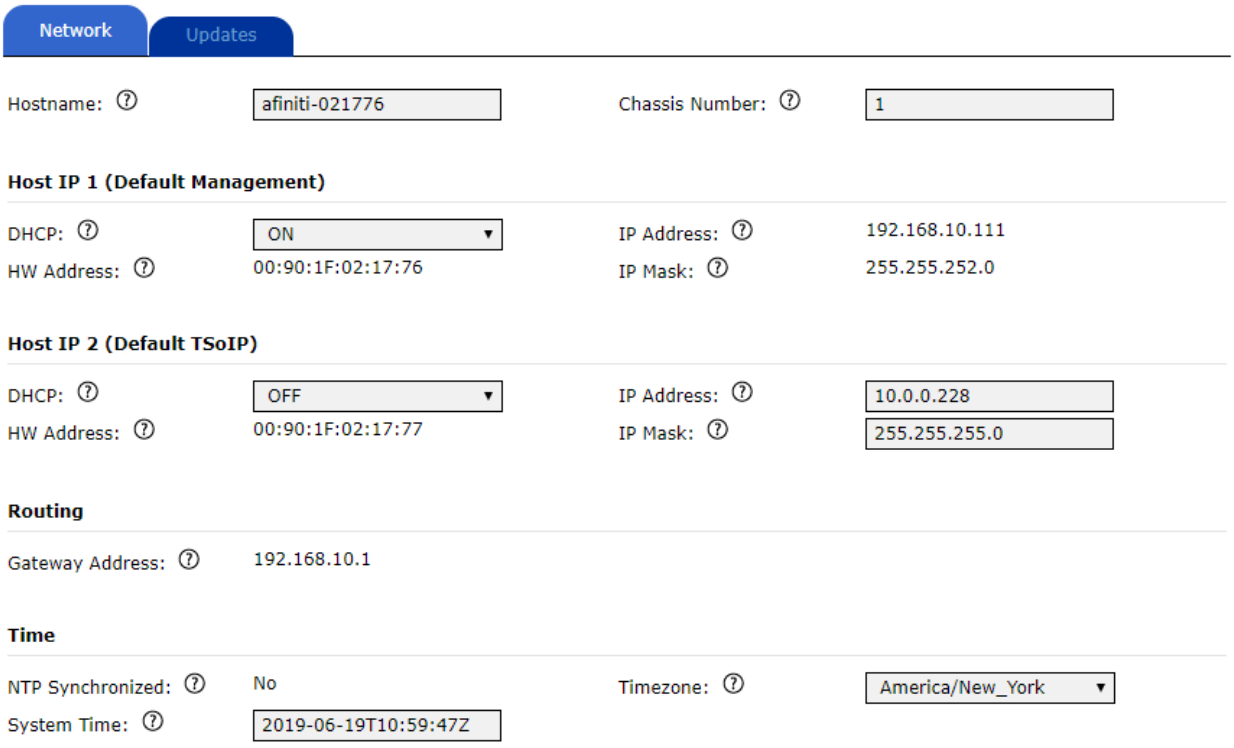


System Page

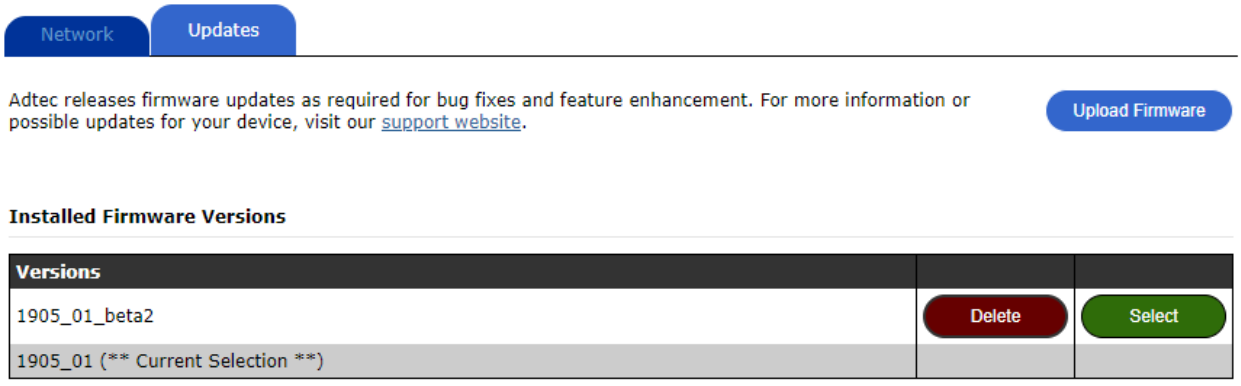
Clicking the green icon at the top left of the user interface brings up the system page.

This page allows configuring all the host system settings.

Under the Network tab, the network information can be configured for the host carrier and any other SHC0100-0100's installed in the chassis.



Under the Updates tab is where firmware upgrades can be managed. It is also where the support information is located.



Latency and GOP

- GOP Type has a direct correlation with Latency performance
- GOP Type options are 1 - IP frames, 2 - IBP frames, and 3 - IBBP frames
- For optimal latency performance GOP type should be set to 1
- Latency trim only works in Normal mode and can be set as low as -400ms
- Setting GOP to 1, Latency to Normal, and Latency Trim to -400 produces the lowest latency numbers

Examples of some latency testing numbers:

Latency	**GOP Type 1 - IP**	**GOP Type 2 - IBP**	**GOP Type 3 - IBBP**
Long	875ms		
Normal	754ms	1138ms	1157ms
Low	502ms		
Very Low	451ms		
Normal -400 trim	354ms		

AFN Link Guide

Terminology:

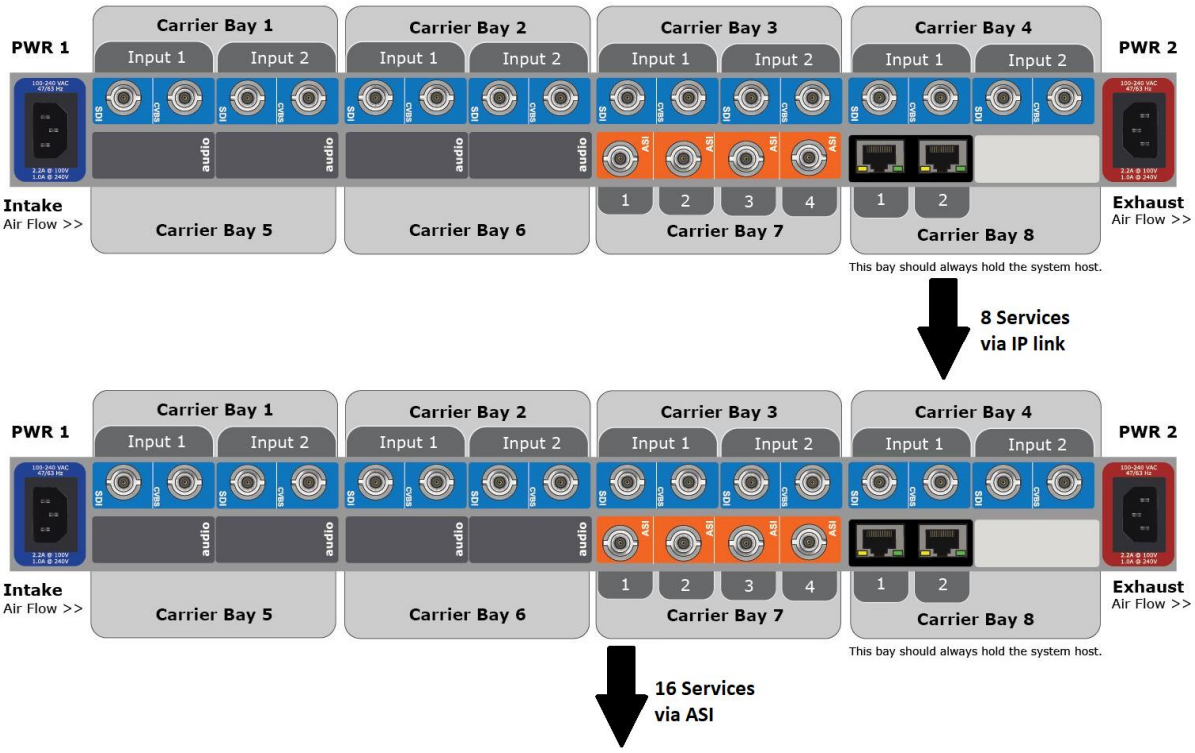
- **AFN Link** refers to the ability for an AFN Platform to accept a Transport Stream (TS) via TSoIP input and multiplex the incoming service(s) with other TSoIP inputs and the native service(s) that are being encoded by the AFN Video Encoder cards. Therefore, the transport stream output (ASI and IP) can be configured to multiple MPTS's containing service(s) from multiple encoding devices in addition to the service(s) native to the AFN Platform.
- **Network Input** refers to the bandwidth and parameters the user must define to allocate space for the incoming TS.
    - TS Mux Rate: should be set to the same bitrate as the incoming TS signal ****Important: TS Mux Rate MUST match the incoming rate, any mismatch will lead to ERRORS!****
    - Address: should be set to the Multicast address of the incoming TSoIP
    - Port: should be set to the Port address of the incoming Multicast
    - Share Services with All Outputs: allows for service from this input to be available to all cards with TS output capability.
    - Connector: looking at the rear panel, Port 1 is on the left, Port 2 is on the right
- **Upstream AFN** refers to a unit that is supplying the transport stream for the remux
- **Downstream AFN** refers to a unit that is receiving the transport stream and multiplexing the signal.

Things to be aware of:

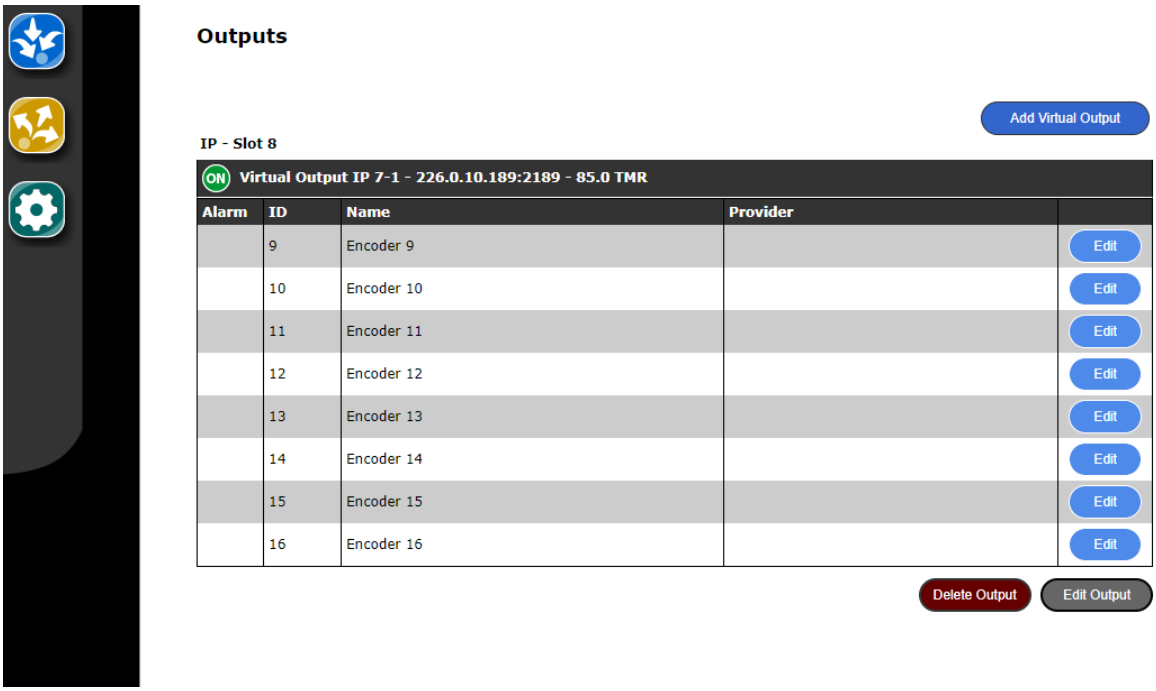
1. On the System page under the Network tab there is Chassis Number, the options are 1,2, and 3 and any linked AFN systems need to have different Chassis Numbers.
2. Output TS Mux Rate of Upstream AFN MUST match Network Input TS Mux Rate of Downstream AFN.
3. Network configuration for TSoIP handshake is necessary, if IPs are conflicting, link may not occur.
4. Multiple Network Inputs require different Port numbers.
5. Keep the ID numbers independent of each other, ID numbers can be set using the Edit button on the output page (after configuring the output).

Setup Example:

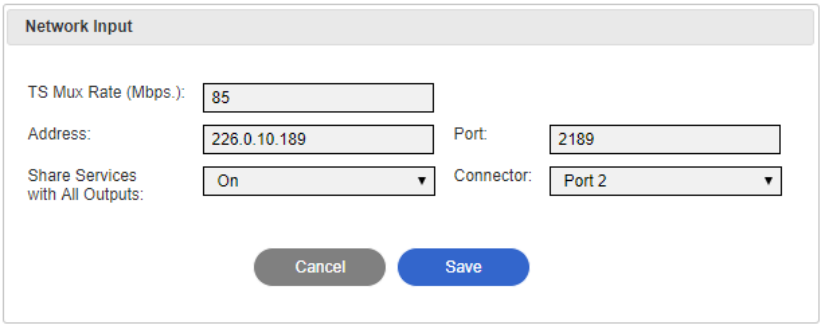
Link a pair of 8 channel AFN chassis to create a transport stream with 16 services on ASI.



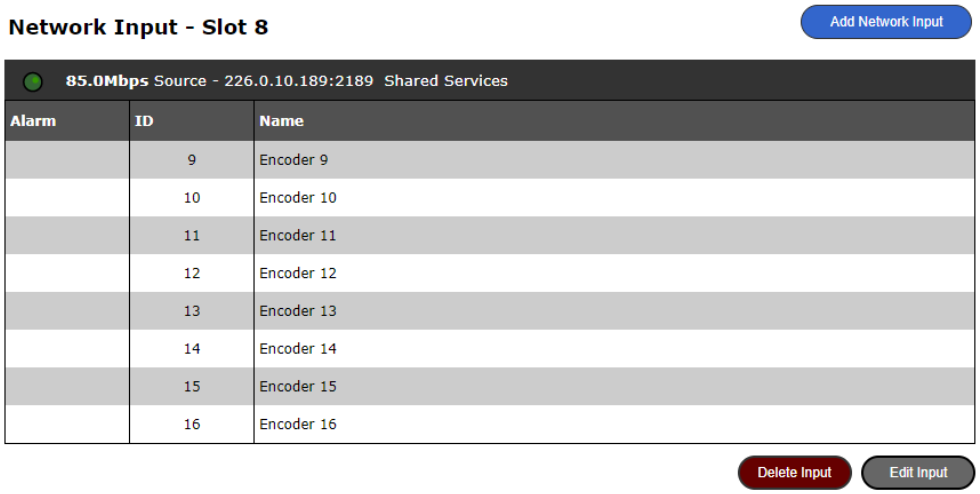
- User sets the output for the Upstream AFN
  - In this example it is 8 services with a mux rate of 85 Mb/s



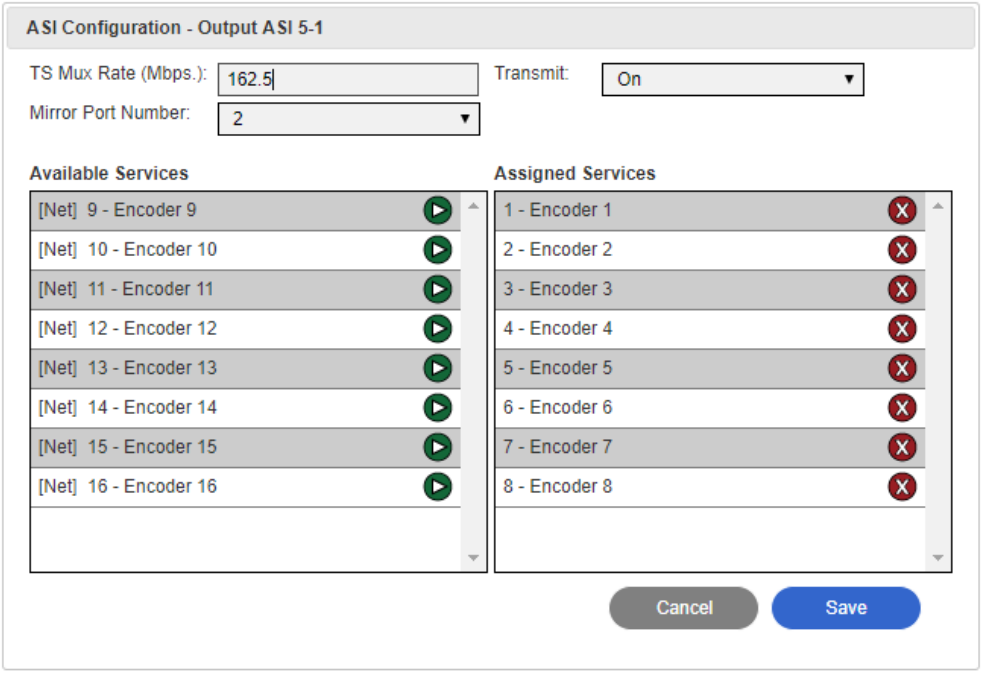
- User sets the Network Input of the Downstream AFN by clicking the ‘Add Network Input’ button and setting the parameters.



- Available services will be displayed.



- These Network Input services will be available and are preceded by [Net].



- The Services can be added to the mux to create a 16 channel MPTS.

Outputs

IP Outputs | ASI Outputs

Used TMR: 162.5 Mbps **Max TMR: 210 Mbps**

162.5	47.5
1	**Free**

ASI - Slot 5

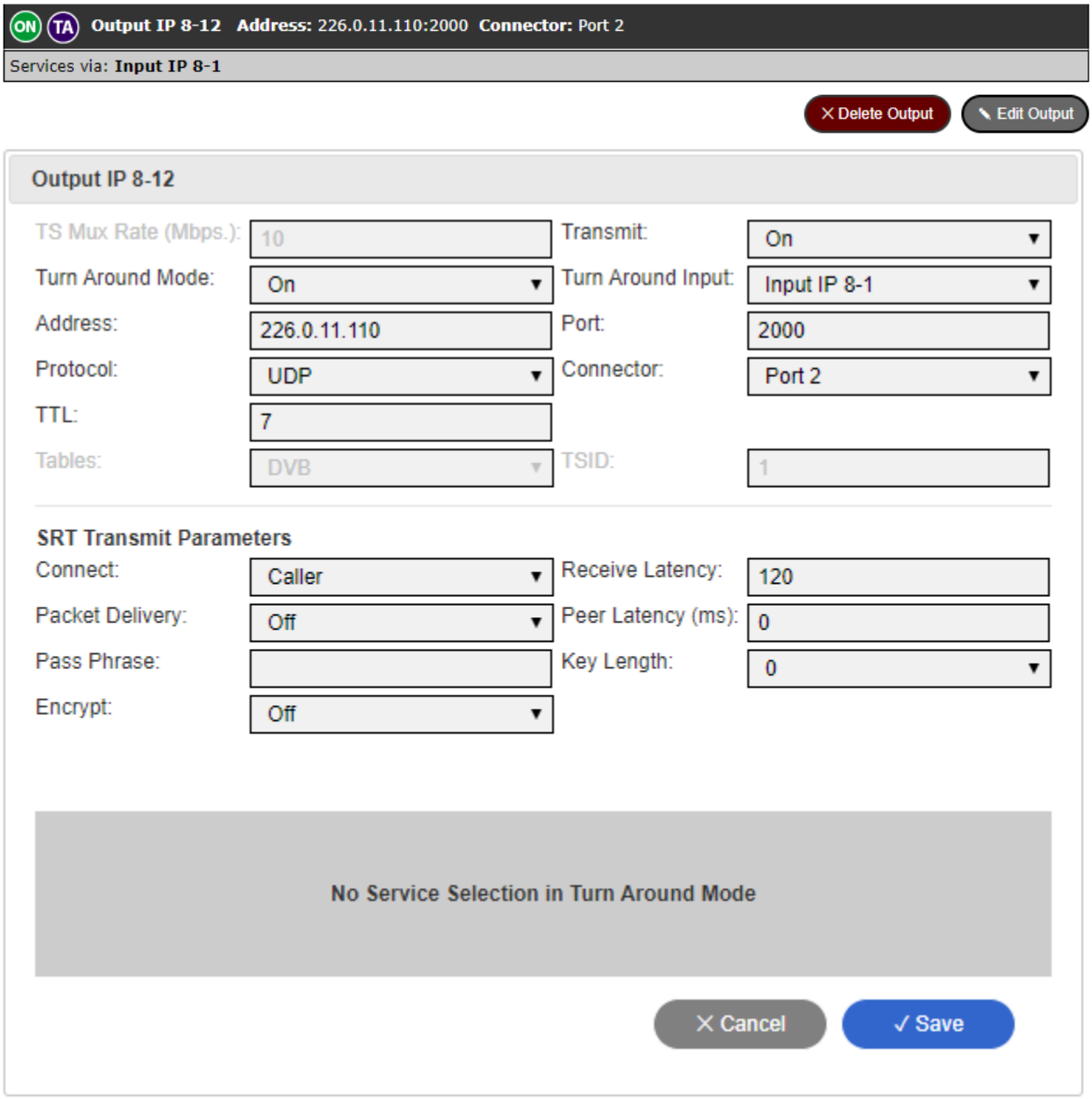
ON Output ASI 5-1 - 162.5 TMR

Alarm	ID	Name	Provider	
	1	Encoder 1	Adtec Digital	Edit
	2	Encoder 2	Adtec Digital	Edit
	3	Encoder 3	Adtec Digital	Edit
	4	Encoder 4	Adtec Digital	Edit
	5	Encoder 5	Adtec Digital	Edit
	6	Encoder 6	Adtec Digital	Edit
	7	Encoder 7	Adtec Digital	Edit
	8	Encoder 8	Adtec Digital	Edit
	9	Encoder 9	Adtec Digital	Edit
	10	Encoder 10	Adtec Digital	Edit
	11	Encoder 11	Adtec Digital	Edit
	12	Encoder 12	Adtec Digital	Edit
	13	Encoder 13	Adtec Digital	Edit
	14	Encoder 14	Adtec Digital	Edit
	15	Encoder 15	Adtec Digital	Edit
	16	Encoder 16	Adtec Digital	Edit

Edit Output

Turn Around Mode

When AFN is configured for network inputs, they can be turned around to assigned outputs. Turn Around Mode is configured under the Edit Output button on the output pages. When Turn Around Mode is turned ON the user can select what input is to be passed along to the output. Turn Around Mode will just pass TS Mux Rate, Tables, and TSID information. It is important that the Network Inputs are set to Share Services with All Outputs to ON.



SRT Guide

Terminology:

- **Secure Reliable Transport** - SRT is an open-source video transport protocol and technology stack that optimizes streaming performance across unpredictable networks with secure streams and easy firewall traversal, bringing the best quality live video over the worst networks. The SRT open-source project, driven by the SRT Alliance, is a collaborative community of industry leaders and developers striving to achieve lower latency internet video transport by continuously improving open-source SRT.” - SRT Alliance.
- **Caller** - Sets a source or destination device as the initiator of an SRT connection. The Caller device must know the public IP address and port number of the Listener.
- **Listener** - Sets a device to wait for a request to open an SRT connection. The Listener device only needs to know that it should listen for SRT packets on a certain port. The Listener IP Address should be set to 0.0.0.0
- **Rendezvous** - Sets a device to wait for a request to open an SRT connection. The Rendezvous device only needs to know that it should listen for SRT packets on a certain port.
- **Address** - The hostname or IP address of the SRT destination.
- **Port** - The port number for the connection. The source and destination device UDP ports are configurable. Each stream only requires a single port. The port is user-defined and can be between 1025 and 65,535. Specific port requirements for firewalls may depend on the security policies of the user’s organization. Consult with your network system administrator.
- **Receive Latency** - The size, in milliseconds, of the recovery buffer for the SRT stream. If not specified, the default value of **120** is used.
- **Peer Latency**
- **Pass Phrase** - The passphrase used to secure the SRT stream. For AES-128 encryption, a 16-character passphrase must be entered; for AES-256 encryption, a 32-character passphrase must be entered.
- **Key Length** - The type of AES encryption determines the length of the key (passphrase). AES-128 uses a 16-character (128-bit) passphrase, and AES-256 uses a 32-character (256-bit) passphrase.

SRT Parameters

This section describes the various parameters that have an effect on an SRT stream’s performance.

- **Round Trip Time -** Round Trip Time (RTT) is the time it takes for a packet to travel from a source to a destination and back again. It provides an indication of the distance (indirectly, the number of hops) between endpoints on a network. Between two SRT

devices on the same fast switch on a LAN, the RTT should be almost 0. Within the Continental US, RTT over the Internet can vary depending on the link and distance but can be in the 60 to 100 ms range. Transoceanic RTT can be 60-200 ms depending on the route. RTT is used as a guide when configuring Bandwidth Overhead and Latency. To find the RTT between two devices, the ping command can be used.

- For example: ping 198.51.100.20
- Response (RTT = 6.633 ms)
  - 56 data bytes 64 bytes from 198.51.100.20: seq=1 ttl=64 time=6.633 ms

- **RTT Multiplier -** The RTT Multiplier is a value used in the calculation of SRT Latency. It reflects the relationship between the degree of congestion on a network and the Round Trip Time. As network congestion increases, the rate of exchange of SRT control packets (as well as retransmission of lost packets) also increases. Each of these exchanges is limited by the RTT for that channel, and so to compensate, SRT Latency must be increased. The factor that determines this increase is the RTT Multiplier, such that:
  - SRT Latency = RTT Multiplier * RTT
  - The RTT Multiplier, then, is an indication of the maximum number of times SRT will try.
- **Packet Loss Rate -** Packet Loss Rate is a measure of network congestion, expressed as a percentage of packets lost with respect to packets sent.
  - Constant loss refers to the condition where a channel is losing packets at a constant rate. In such cases, the SRT overhead is lower bound limited, such that: **Minimum Bandwidth Overhead = 1.65 * Packet Loss Rate**
  - Burst loss refers to the condition where a channel is losing multiple consecutive packets, up to the equivalent of the contents of the SRT latency buffer. In such cases, the SRT overhead is lower bound limited, such that:
    - Minimum Bandwidth Overhead = 100 ÷ RTT Multiplier
  - Burst losses that last longer than the SRT Latency will result in stream artifacts. SRT Latency should always be set to a value above the worst case burst loss period.
  - Burst losses that last longer than the SRT Latency will result in stream artifacts. SRT Latency should always be set to a value above the worst case burst loss period.
- **Bandwidth Overhead -** The control packets associated with an SRT stream do, of course, take up some of the available bandwidth, as do any media packet retransmissions. When configuring an SRT stream, a Bandwidth Overhead value needs to be specified to allow for this important factor.
  - The portion of audio and video content in the stream is determined by their respective bit rate settings, which are configured on the audio and video encoders themselves. SRT Bandwidth Overhead is calculated as a percentage of the A/V bit rate, such that the sum of the two represents a threshold bit rate, which is the maximum bandwidth the SRT stream is expected to use.
  - The SRT Bandwidth Overhead is assigned as a percentage, based in part on the quality of the network over which the stream will be traversing. Busier networks

will require exchanging more control packets, as well as resending media packets, and therefore a higher percentage value.
    - **SRT Bandwidth Overhead should not exceed 50%
- **Sample Bandwidth Overhead Calculation –** As an example, the streaming video is at a bit rate of 1000 kbps and audio at 128 kbps. This gives a total of 1128 kbps, which is rounded up to 1200 kbps to account for any metadata and other ancillary data. This is the Average Bandwidth, which is calculated automatically based on the actual output settings. If the default Bandwidth Overhead setting of 25% is accepted, then the total bandwidth reserved for the SRT stream will be:
    - 1200 + (25% * 1200) = 1500 kbps (1.5 Mbps) - This is the maximum bandwidth SRT will use. If there is no loss, only a slight overhead for control is used. As long as this total SRT bandwidth is less than or equal to the bandwidth available between the SRT source and destination devices, the stream should flow from one to the other without incident.
- **Latency -** There is a time delay associated with sending packets over a (usually unpredictable) network. Because of this delay, an SRT source device has to queue up the packets it sends in a buffer to make sure they are available for transmission and re-transmission. At the other end, an SRT destination device has to maintain its own buffer to store the incoming packets (which may come in any order) to make sure it has the right packets in the right sequence for decoding and playback. SRT Latency is a fixed value (from 20 to 8000 ms) representing the maximum buffer size available for managing SRT packets.
    - An SRT source device's buffers contain unacknowledged stream packets (those whose reception has not been confirmed by the destination device).
    - An SRT destination device's buffers contain stream packets that have been received and are waiting to be decoded.
    - The SRT Latency should be set so that the contents of the source device buffer (measured in msecs) remain, on average, below that value, while ensuring that the destination device buffer never gets close to zero.
    - The value used for SRT Latency is based on the characteristics of the current link. On a fairly good network (0.1-0.2% loss), a "rule of thumb" for this value would be four times the RTT. In general, the formula for calculating Latency is:
        - SRT Latency = RTT Multiplier * RTT
    - SRT Latency can be set on both the SRT source and destination devices. The higher of the two values is used for the SRT stream.
- **Encrypting SRT Streams -** SRT streams can be encrypted using AES cryptographic algorithms and decrypted at their destination. To implement encryption on an SRT stream, the user must specify the type of encryption on the source device, and then a pass phrase on both source and destination.
    - Encryption does not affect the bandwidth. However, applying encryption is a processor-intensive task, and may have an impact on the number and bit rate of the streams an encoder is able to output.SRT.

Configuring an SRT Stream

With the source and destination devices set up (including having established call modes and any firewall settings), follow these steps to configure an SRT stream:

1. Measure the Round Trip Time (RTT) using the ping command.
   If the RTT is <= 20 ms, then use 20 ms for the RTT value. This is because SRT does not respond to events on time scales shorter than 20 ms.
2. Measure the Packet Loss Rate.
   a. A channel's Packet Loss Rate drives the SRT Latency and Bandwidth Overhead calculations. This loss rate can be extracted from iperf stats.
      - If using iperf is not possible, set up a test SRT stream, and then use the resent.
        bytes / sent bytes (as reported on the SRT stream's Statistics page) over a 60 second period to calculate the Packet Loss Rate as follows:

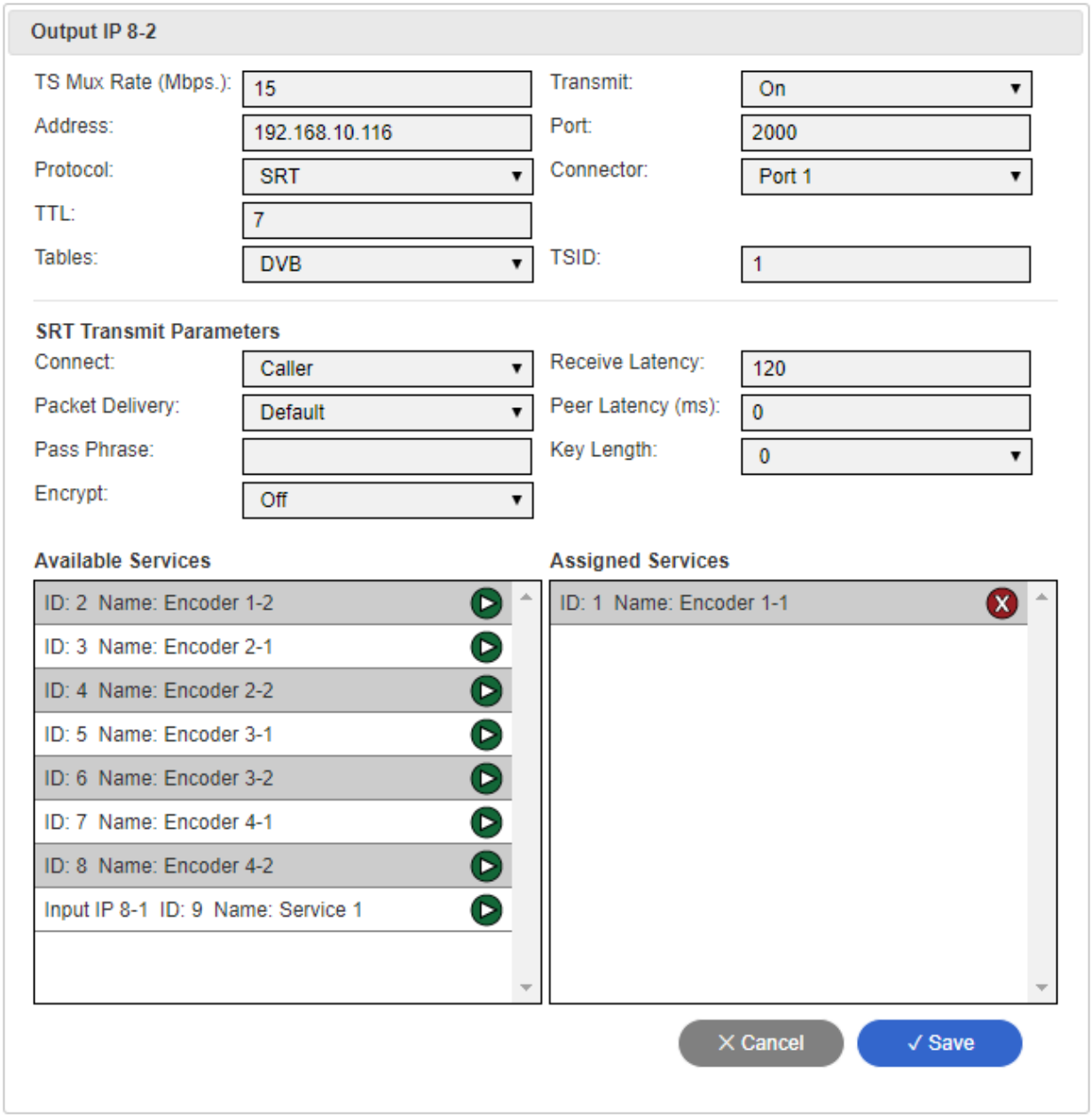
   Packet Loss Rate = Resent Bytes ÷ Sent Bytes * 100
3. Using the following table*, find the RTT Multiplier and Bandwidth Overhead values that correspond to the measured Packet Loss Rate:

Worst Case Loss Rate (%)	RTT Multiplier	Bandwith Overhead (%)	Minimum SRT Latency (for RTT <= 20ms)
<= 1	3	33	60
<= 3	4	25	80
<= 7	5	20	100
<= 10	6	17	120

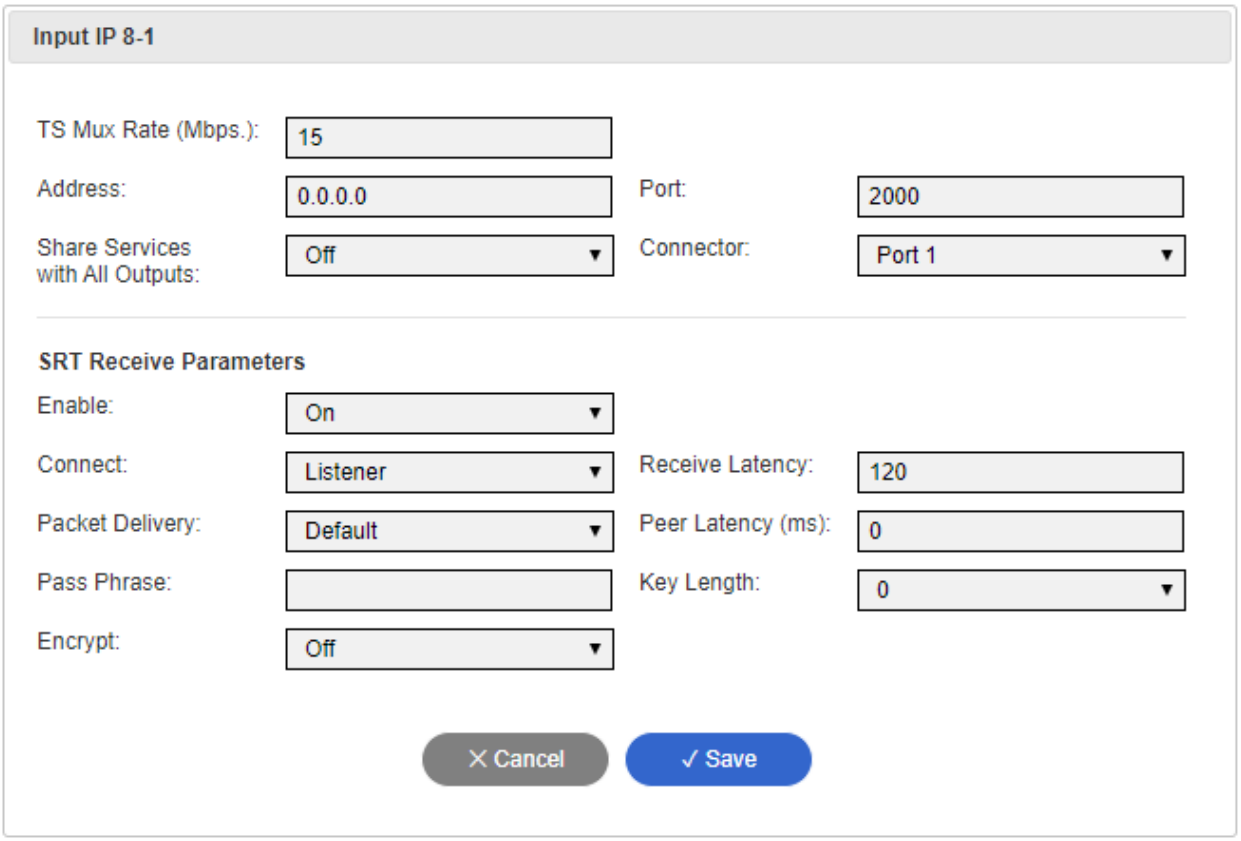
* This table takes into account constant loss and burst loss

4. Determine the SRT Latency value using the following formula:
   SRT Latency = RTT Multiplier * RTT
   If RTT < 20, use the Minimum SRT Latency value in the table above.
5. Determine the stream bitrate.
   a. The stream bitrate is the sum of the video, audio and metadata essence bit rates, plus an SRT protocol overhead. It has to respect the following constraint:

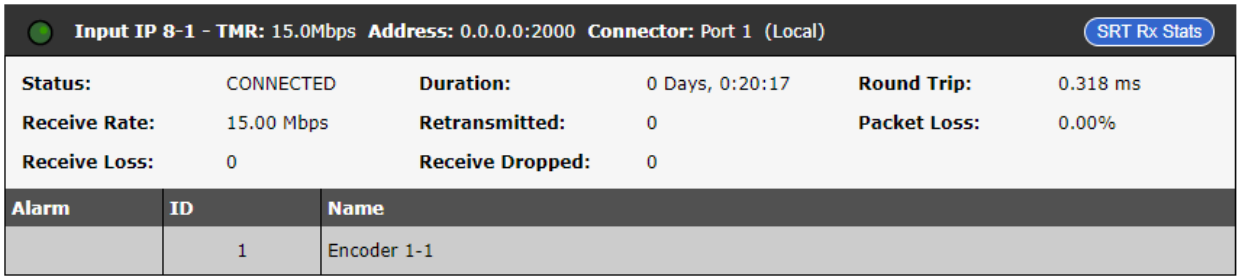
   Channel Capacity > SRT Stream Bandwidth * (100 + BandwidthOverhead) ÷ 100


Output IP 8-2
TS Mux Rate (Mbps.): 15
Transmit: On
Address: 192.168.10.116
Port: 2000
Protocol: SRT
Connector: Port 1
TTL: 7
Tables: DVB
TSID: 1
SRT Transmit Parameters
Connect: Caller
Receive Latency: 120
Packet Delivery: Default
Peer Latency (ms): 0
Pass Phrase:
Key Length: 0
Encrypt: Off
Available Services
ID: 2 Name: Encoder 1-2
ID: 3 Name: Encoder 2-1
ID: 4 Name: Encoder 2-2
ID: 5 Name: Encoder 3-1
ID: 6 Name: Encoder 3-2
ID: 7 Name: Encoder 4-1
ID: 8 Name: Encoder 4-2
Input IP 8-1 ID: 9 Name: Service 1
Assigned Services
ID: 1 Name: Encoder 1-1
Cancel
Save

Listener Example:



When the Listener successfully receives the media the SRT Rx Stats will populate:



SRT Stats

This section describes the various parameters that have an effect on an SRT stream's performance.

- **Status:** Connected or Disconnected
- **Duration:** Time that current SRT connection has been active
- **Round Trip:** Refer to RTT in Parameters section above

- **Send/Receive Rate:** Rate of connection in Mbps

Caller specific Stats

- **Buffer Avail.:** The amount of buffer not being utilized by the connection
- **Flow Window:** Number of packets transmitted per
- **Send Loss:** Packets lost by the caller
- **Send Dropped:** Packets dropped by the caller
- **Retransmitted:** Packets resent because they were either lost or dropped

Listener specific Stats

- **Retransmitted:** Packets retransmitted by caller
- **Packet Loss:** % of packets lost by the listener
- **Receive Loss:** Loss packets detected from the caller and resent
- **Receive Dropped:** Packets dropped by the listener

BISS-CA

The AFN platform supports BISS-CA encryption. The configurations are located on the outputs page under the Encryption tab. Any output slot can be configured for independent BISS-CA settings. Under the Add Session button the user configures:

BISS-CA is a modern stream protection system that uses rolling keys to prevent unauthorized access to the stream. BISS CA uses public-private key pairs for each receiver (or group of receivers). The public key is used by the transmitter to send entitlement messages in the stream. The private key is used by the receiver to decrypt entitlement messages. Once entitled, the receiver can decrypt the control messages which contain the rolling stream keys. Configuring the system for BISS-CA varies between a receiver and a transmitter.

Transmitter

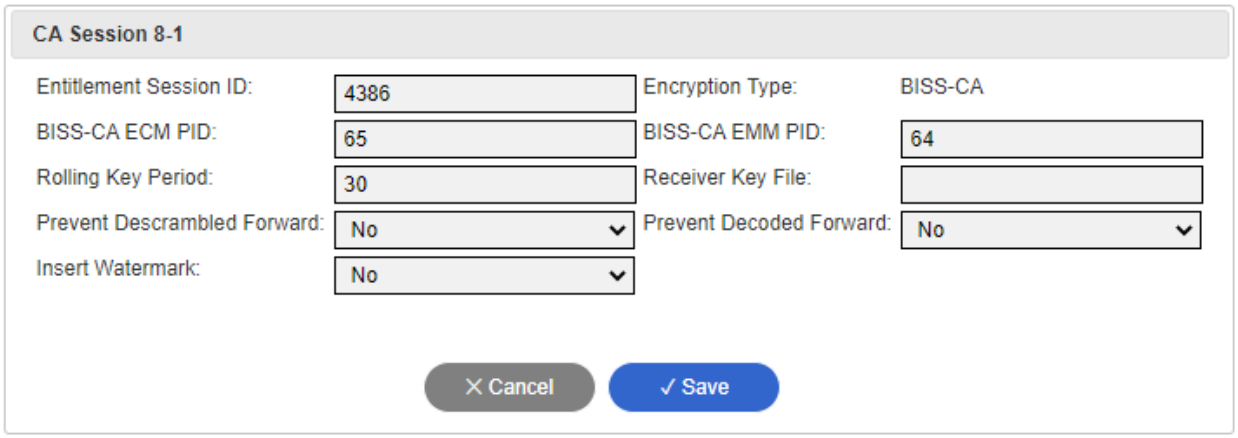
Each IP or ASI output can support BISS-CA encryption as a transmitter.

Features

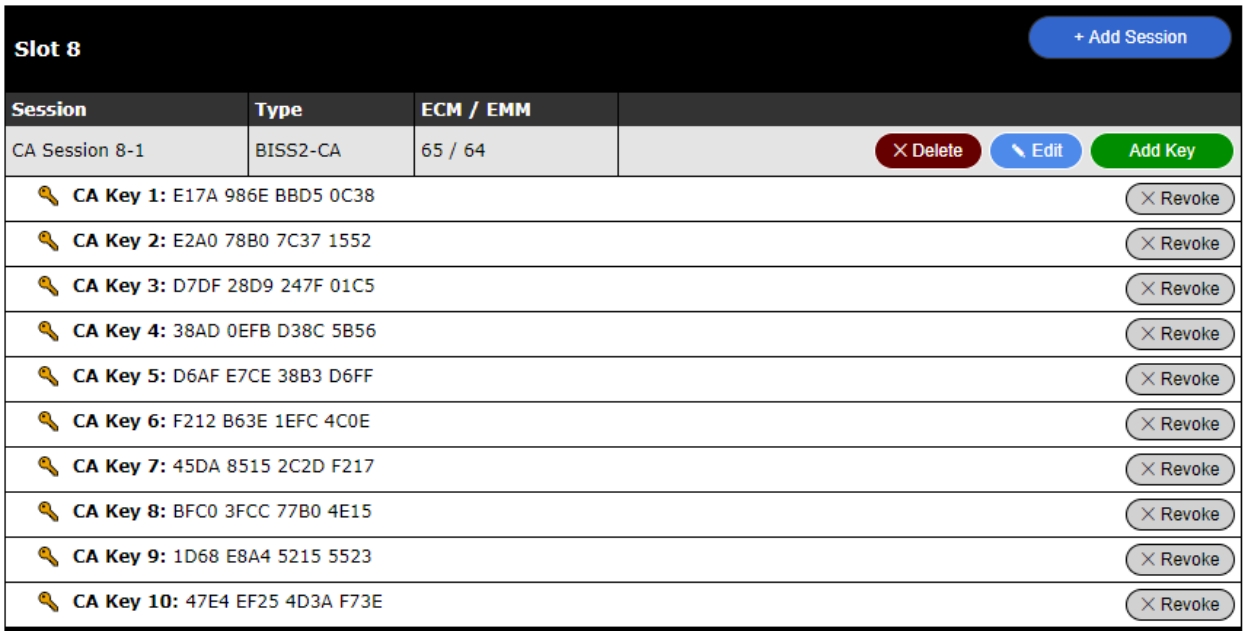
- Allow control of key rolling period, ECM period, and EMM period.
- Support up to 10 entitled receiver keys.
- Single entitlement session per output program.

Configurations

- Entitlement Session ID is a number identifying the entitlement session.
- ECM Period is the frequency of sending ECM messages. The minimum period is 100 msec. Default 1 second.
- ECM Key Rolling Period is the frequency of changing stream encryption keys. The minimum is 1 second. Default is 10 seconds.
- EMM Period is the frequency of sending EMM messages. The minimum period is 200 msec. Default is 2 seconds.
- Entitled Receiver Key is a public key for each receiver or group of receivers that are allowed to receive the protected content. Plan to support 10 entitled receivers.
- EMM bandwidth is constrained to 1 Mbps per specification.

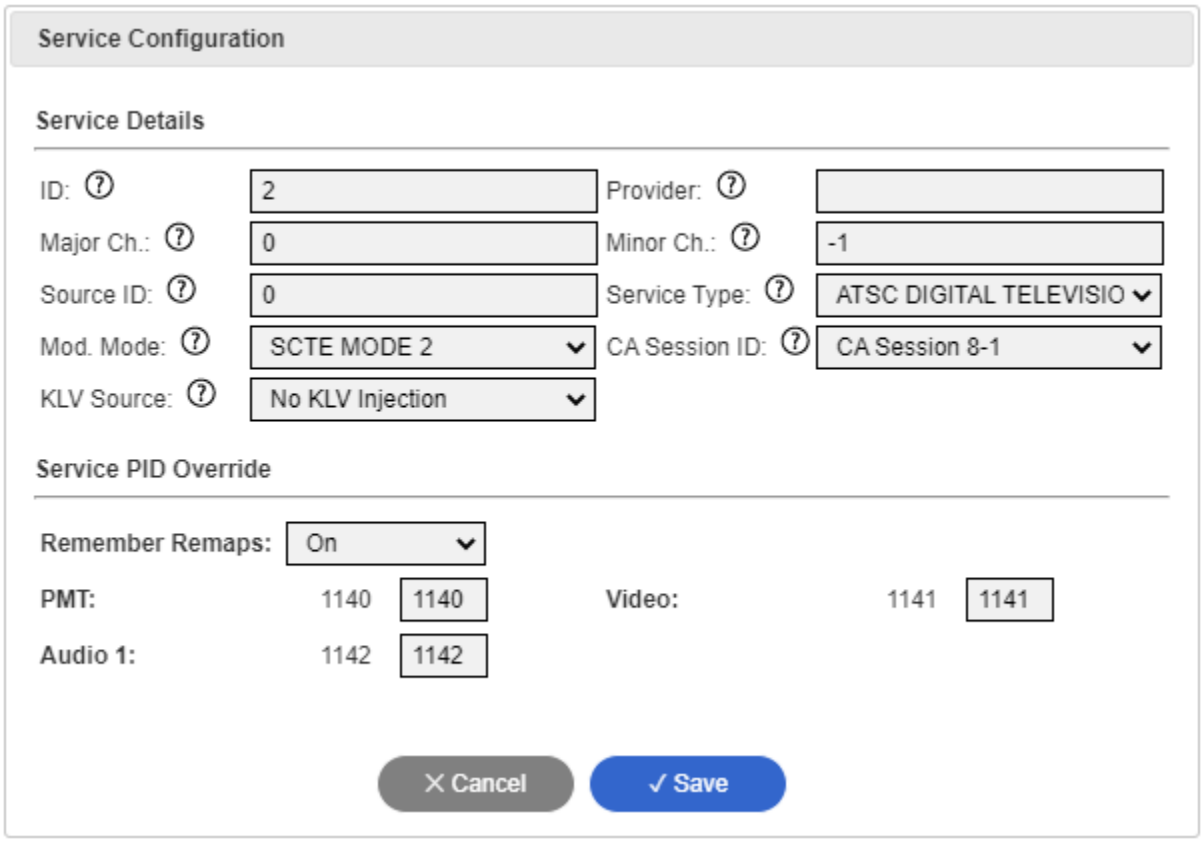


When BISS-CA is configured correctly the CA Keys will be listed:



BISS-CA (cont.)

The Encryption can be added to outputs by clicking the Edit button next to the service to open the Service Configuration window:



Receiver

Each IP or ASI input can support BISS-CA decryption as a receiver. A receiver is factory configured with a private key called the Buried Key. Additionally, a receiver can be configured with external private keys called Injected Keys. The configured keys will display an identifier to be used for selection and entitlement purposes. The configured keys also provide a means of downloading/copying the public key that matches a given private key. This allows the communication of public keys to a transmitter through email or text files.

Configurations

- System Buried Public Key (read-only)
- System Injected Public Key (read-only)
- System Injected Private Key (admin write-only, **operator no change**)