SOFTWARE-DEFINED
VIDEO PLATFORM

Zixi Edge Compute (ZEC)
User Guide

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Main Features

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Introduction to Zixi Edge Compute (ZEC)

Zixi Edge Compute (ZEC) is an Edge video streaming system that is installed on-premises as a Zixi endpoint, replacing the Zixi Feeder (contribution) or Zixi Receiver (distribution). ZEC offers a more robust feature set and protocol support than the Zixi Feeder/Receiver. After its installation, ZEC can be configured to function as a Feeder (Contribution), as a Receiver (distribution) or as both Feeder and Receiver.

Main Features

- **Robust content delivery over IP** - communicates with a Zixi Broadcaster over UDP-based, video-optimized protocols on private and public IP networks for maximal quality at a predictable latency
- **Adaptive Bit Rate** - Dynamically adjusts stream rate to adapt to changing network conditions, using unicast or multicast, to meet specific application requirements.
- **Recording** - store streams as MPEG-TS files.
- **Time-shifting** – records the stream to delay its broadcasting.
- **Secure and rapid file transfer** – accelerated and secure file transfers delivered at wire speed and accelerated HTTP delivery including optimized playback of HLS over UDP.
- **Clustering and load balancing** – supports cluster architectures to provide continuous uptime.
- **TR-101 Transport Stream Analyzer** – MPEG-TS ETSI TR 101-290 analyzer (priorities 1 and 2)
- **Content Analysis** - analysis of the stream's audio and video content, including audio levels, audio silence detection, frozen video detection, and more.
- **Monitoring** - captures network and content specific statistical information in real-time.
- **Network bonding with hitless failover** – reunites divided streams coming from multiple network channels into a single stream, enabling simultaneous load balancing between multiple networks and ensuring high availability of the stream.
- **Hitless failover** - hitless failover for inputs enables undisrupted streaming when switching from one source to another. Zixi's new hitless failover feature is based on the SMPTE 2022-7 standard, which specifies "seamless" or hitless failover between binary-identical streams with synchronized RTP headers.
- **PID Mapping** - PID mapping ensures that the PIDs will have the desired values when they arrive from the Source downstream to the Target. PIDs can be specified for processing by specific PID numbers or they can be identified by category or type (i.e. codec). PIDS can be also designated to be nulled or removed completely from the stream.
- **AES stream encryption and decryption** - UDP, File and RTMP input streams can be encrypted by Zixi Broadcaster using a fixed key (AES 128, AES 192, AES 256), which can be entered into the input settings or automatically generated. Zixi Broadcaster can also

Main Features

decrypt contribution streams using a matching key, or securely forward encrypted streams to receivers, without being able to see or analyze the traffic.

- **MPTS demuxing** - MPTS streams can be demuxed into single SPTS input streams for specific programs.
- **SCTE-35** - SCTE-35 markers found in the source input will be used to segment the stream and the #EXT-X-CUE-IN/#EXT-X-CUE-OUT tags will be added to the manifest.
- **Low-latency HLS** - ZEC supports low latency HLS delivery using chunked transfer encoding, which starts sending an HTTP response as chunks of data when they are ready before the complete response is available. Chunked transfer encoding can be use with transport stream (TS) segments and with fragmented MP4 (fMP4), which is also called Common Media Application Format (CMAF).

Zixi Software-Defined Video Platform (SDVP)

Zixi's proprietary Software-Defined Video Platform or SDVP is the tight integration of four components that enable broadcast-quality live video workflows to be intelligently and centrally provisioned, deployed, managed, and monitored using software and integrated devices, regardless of the underlying network infrastructure. Employed by traditional broadcasters, OTT broadcast services, service providers to source, manage, and distribute live events and 24/7 live linear channels over any IP network, protocol, cloud provider, and/or edge device.

- **Protocols & Containers** – The SDVP accepts over 17 industry protocols and containers, advancing the market leading Zixi protocol while adding additional value to tangential offerings from other vendors, standards, and open-sourced initiatives. Most customers rely on the Zixi protocol for transport as it is congestion and network-aware and can dynamically adjust to varying network conditions and employ forward error correction techniques for error-free video delivery.

- **Video Solutions Stack** – Zixi's Video Solutions Stack provides essential tools and core media processing functions for broadcast-quality transport that corrects for packet loss and jitter. Patented Hitless Failover techniques provide 99.9999%+ reliable transport between sources and receivers. The Video Solutions Stack also provides broadcasters with enhanced tools to streamline workflows including protocol switching, analytics, live 4K transcoding and repackaging, recording, time shifted delivery, and auto-slating.

- **Intelligent Data Platform** – Zixi is constantly incorporating analytics, event correlation, AI and Machine Learning tools in its platform to aggregate a user's historical and real-time metadata and present it back to them to help better predict downtime, content quality, trends, and more in the form of alerts, notifications, and background monitoring.

- **ZEN Master** – With Zixi's ZEN Master control plane, cost-effectively manage and monitor complex deployments at scale and configure and orchestrate live broadcast channels across protocols and the Zixi Enabled Network. ZEN Master allows for control of the edge, network, and cloud with full telemetry visualization of network streams. It offers essential monitoring and management tools like workflow visualization, alerting, history, automation, scheduling, reporting, and root cause analysis across complex media supply chains.

Hitless Failover, Analytics, and Bonding
Users can take advantage of its Video Solutions Stack capabilities such as analytics, hitless failover and bonding across diverse ISPs to ensure high reliability and encrypt content with AES 256 encryption and DTLS for best-in-class security. The Video Solutions Stack's unique patented hitless failover techniques ensure reliability, and its robust analytics suite provides atomic-level

Zixi Software-Defined Video Platform (SDVP)

telemetry on stream health that allows users to address any issues impacting QoS before the consumer's QoE is affected. The analytics solution employs machine learning techniques to provide a real-time estimated PSNR (ePSNR) with no reference video required, helping the user determine if content providers are meeting SLAs for contribution stream quality.

ZEN Master Control Plane
ZEN Master integration allows remote access to the UIs of Zixi-integrated devices and software across the Zixi Enabled Network for optimal monitoring and control from one centralized control plane. With the ZEN Master control plane, users have extensive visibility into and control over workflows that go across Zixi-enabled multi-party supply chains, with the ability to leverage alerting, extensive history graphs, automated toolsets, and scheduling and reporting capabilities that abstract complexity to reduce engineering requirements and allow media organizations to leverage operational resources, providing democratized access with geographic agility.

Zixi Transport Stream Protocol

Zixi's transport stream protocol is a content and network-aware protocol that dynamically adjusts to varying network conditions and employs error correction techniques for error-free video streaming over IP. With minimum overhead to physical bandwidth, this dynamic mechanism provides low end-to-end latency, removes jitter, recovers and re-orders packets, smooths video delivery and regenerates video to its original form, all in real-time.
Zixi delivers outstanding performance (at low predictable latency), superior reliability (no packet loss) and broadcast-grade video quality (SD, HD, and UHD) with no tradeoffs to delay, resolution or stutter.

Streaming from one Zixi-enabled device/server to another Zixi-enabled device/server protects the stream from quality degradations along the path. It enables the streaming of high-quality video over any distance, while overcoming the varying network conditions of the public Internet, where the amount of network errors, packet loss, jitter and out-of-order packets fluctuate "every second".

The Zixi transport stream protocol can be also deployed on part of the path. For example, from a ZEC to a Zixi Broadcaster (Zixi protected path) and on to another ZEC and to the end user through UDP or RTMP. In this case, the path that has challenging conditions (e.g., long distance or unstable wireless conditions) will be protected by Zixi and then delivered on to the end-user on a standard UDP or RTMP protocol.

Zixi's transport stream technology includes the following features for ultimate quality and security:
- Network sensing
- Dynamic de-jitter
- MPEG specific optimizations
- Z-ARQ error recovery
- Z-FEC - Dynamic content aware forward error correction
- Active multi-path error recovery
- Adaptive bitrate over UDP, unicast or multicast
- Rate control and congestion avoidance
- 256-bit AES transport encryption

Supported Protocols

Input:
- Zixi Pull
- MPEG-TS over UDP and/or RTP
- RTMP pull
- RTMP push
- RTSP input
- RIST (TR-06-1)
- NDI
- SRT

Output:
- Zixi push
- MPEG-TS over UDP and/or RTP
- RTMP and RTMPS push
- NDI
- SRT
- RIST (TR-06-1)

Recording Options

Live stream inputs can be stored as MPEG-TS files to a local disk drive or mounted drive.

Multicast Options

Multicast streams can be received or be sent by the ZEC. ZEC serves as a gateway between Unicast and Multicast streams, while allowing reliable streaming over multicast.

Adaptive Options

ZEC can create an adaptive group, subsequently editing, recording, or playing it in conjunction with DASH, HLS, HDS or Zixi. You can also set a Pre-roll video/screen that will be played before the live streaming begins.

VOD Options

ZEC supports VOD (Video on Demand) playback of stored files in multiple formats such as TS, MP4, HLS, FLV.

Latency Considerations

Latency defines the delay in which the video stream will be delivered to the endpoint. This delay is essentially a buffer that is used for additional processing, thereby improving the quality of video stream. The latency should be considered based on the importance of immediacy. For example, if the video requires interaction (e.g., between a reporter in the field and an anchor in the studio), the latency should be set to a minimum so that the interaction does not suffer from any delay.
Latency can vary from tens of milliseconds to several seconds.
Zixi protocol can start providing benefit from one frame (30ms), while increasing the latency will provide more robustness for the error-recovery.

Billing Codes

Billing codes are used to identify and differentiate traffic on a ZEC. When a billing code is added to a Source or Target, Zixi can track the traffic on that ZEC input or output separately from other inputs and outputs on the same ZEC.

Typical use-cases for using billing codes are:
- **Differentiating Between Clients** - If you are receiving video content from different contributing clients or sending video content to multiple external organizations, you can designate distinct billing codes for each of your clients. You can then assign the client's

Billing Codes

billing code to each Source or Target associated with that client. Your organization will then be able to bill each of their clients according to their usage.

- **Charging only for Billable Usage** - When Zixi traffic is sent between distinct organizations, situations may arise in which the usage of only one of those organizations is billable. For example, if the contributor is using a Zixi Broadcaster to send outputs as if it were a ZEC, then only the receiving organization should be billed for that traffic. In that case, the receiving organization can request a billing code and assign it to their Targets. They can then ask the contributor to assign the identical billing code to each of the Sources that they are sending. In this way, Zixi will know to bill only the organization that is receiving the traffic.

Billing codes are created by Zixi personnel on the Zixi Customer Portal for a particular organization. Zixi can create multiple Billing codes for an organization, enabling them to apply different codes to different traffic. All billing codes are password protected. If you would like to use billing codes in your workflows, please discuss it with your Zixi representative.

Logging in to ZEC

➨ **To log in to ZEC:**

1. In your web browser, navigate to http://localhost:4444.
   A user authentication window opens.
2. In the **User Name** field, enter **'admin'**.
3. In the **Password** field, enter **'1234'**.
4. Click **OK**.
   The Broadcaster UI opens on the **Status** page.

Activating Your License

In order to start using ZEC, first activate your license. ZEC and its optional features are activated by license files. Before using ZEC, and when adding optional features, **activate** the appropriate license.

Online Activation (License Key)

The following procedure requires connectivity to the Internet. If you are not able to connect, you can activate the Broadcaster using the procedure described in OFFLINE ACTIVATION (LICENSE FILE).

To Activate the License online using a License Key:

1. In the **Status** page of the ZEC UI, click **Options** in the menu bar.
    The drop-down menu is displayed.
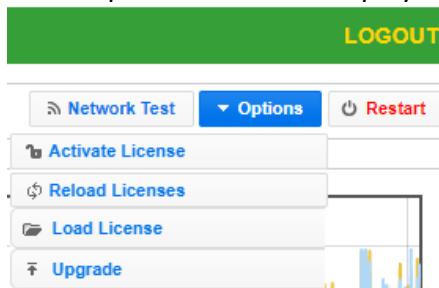
2. Click **Activate License.**
    The **Activate License** window appears.
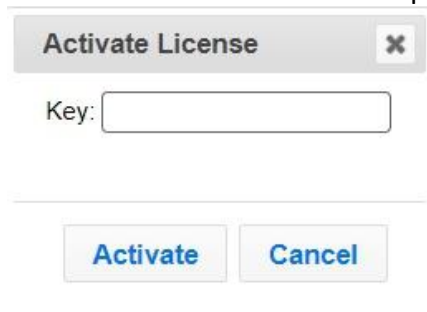
3. In the **Key** field, enter your Activation Key.
4. Click **Activate**.
    The Zixi Broadcaster is enabled.

Offline Activation (License File)

If you want to activate your license without an internet connection, you can upload a License File. To obtain a license file, please contact *Zixi Support* at support@zixi.com.

Reloading the License

➡ **To Load the License File:**

1. In the **Status** page of the ZEC UI, click **Options** in the menu bar.
   The drop-down menu is displayed.
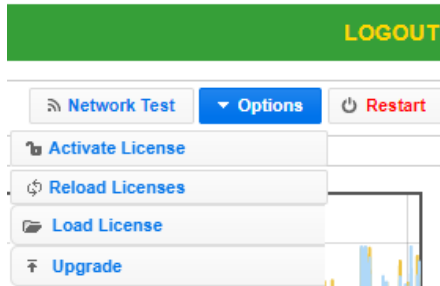
2. Click **Load License.**
   The directory of the local drive opens.
3. Navigate to the License File and click **Open**.
   A prompt window instructs you to Reload the license to activate the license.
4. Click again on **Options** and select **Reload Licenses** from the dropdown menu.
   The ZEC is enabled.

Reloading the License

In the event that your license expires, you must re-enter a new Zixi license key.

➡ **To reload the license:**

1. In the **Status** page of the Zixi Broadcaster UI, click **Options** in the menu bar.
   The drop-down menu is displayed.
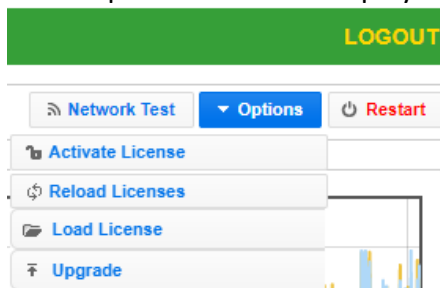
2. Click **Reload License.**
   The ZEC is enabled.

Upgrading the Product Version (Linux)

When a new version of ZEC becomes available, you will receive a new installation archive file (.tar.gz file) from your Zixi representative to upgrade your Zixi Broadcaster software. It is recommended to perform the installation within a "maintenance window" and notify end users that the streaming will be momentarily interrupted. The upgrade process may last a few minutes after which the streams will be automatically resumed.

Upgrading the Product Version (Linux)

> Downgrading from this release to previous versions will no longer be possible through the web UI. Downgrading is still possible via the normal software installation mechanisms.

➡ **To upgrade the version:**

1. In the **Status** page of the ZEC UI, click **Options** in the menu bar.
   The drop-down menu is displayed.
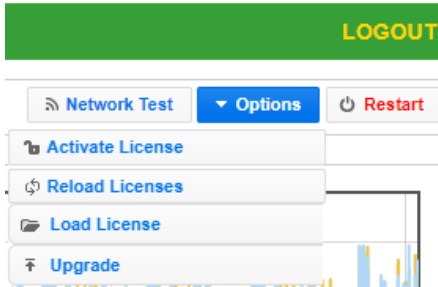
2. Click **Upgrade**.
3. Select the relevant installation archive file (.tar.gz file) and click **Open**.
   The installation process will begin. The process may take up to a few minutes. During the process, the streams and the management UI will not be available. After the upgrade, all streams will be automatically resumed.

Viewing Status

The Status screen displays aggregated statistics on all the input and output streams and a graph representing the network utilization of active streams over time.

➡ **To View the Status of the Streams:**

In the ZEC **Status** page, the **General** area, **Network Status** area, **License Information** area**, Machine Information** area and **Operating System** area are displayed.

General Status

General	
ID	The ZEC ID number
Host ID	Displays the ID of ZEC host.
Start Time	Displays the time that the ZEC began to actively stream content.
Up Time	The duration of time that the broadcast is running.
Inputs	The number of current active inputs
Outputs	The number of current active outputs
Remote In [kbps]	The current aggregate input bitrate from remote sources – ZEC Push/Pull (in Kbps)
Local In [kbps]	The current aggregate input bitrate from local sources – UDP streams (in Kbps)
Remote Out [kbps]	The current aggregate output bitrate to remote destinations (in Kbps)
Local Out [kbps]	The current aggregate output bitrate to local destinations (in Kbps)
HTTP Out [kbps]	The current aggregate output bitrate for HTTP streams - FLV/RTMP/HLS/ MPEG-TS over HTTP (in Kbps)
kBytes Sent	The cumulative traffic transmitted (in Kbps)
kBytes Received	The cumulative traffic received (in Kbps)
RTMP Server	Active – the RTMP server is enabled (See Settings > Live Protocols > RTMP Server section) Off – the RTMP server is disabled

Network Status

Viewing Current License Information

The network status graph displays the total input/output bitrate during the last hour. The changes in the amplitude of both the input (gold) and output (blue) presented in 10-minute intervals.
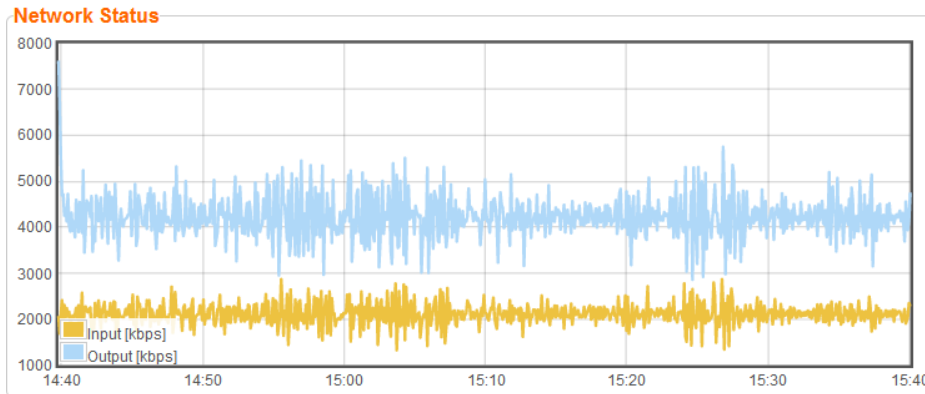
Viewing Current License Information

You can view the current license information in the **Zixi License Status** section.
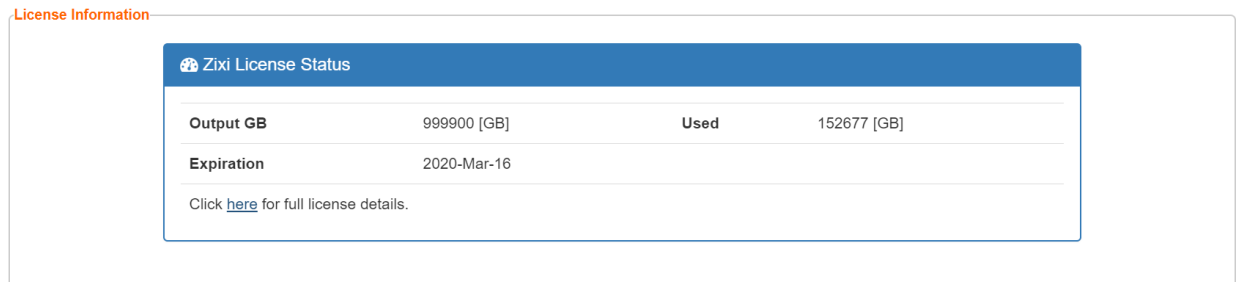
The section includes the following elements:

Element	Description
Output GB	The total amount of output traffic in GB per month that is allowed in the license.
Expiration	License expiration date.
Used	The actual usage this month so far in GB.

To view additional license terms and usage statistics, click the link at the bottom of the Zixi License Status section.

The License Status Screen is displayed.

Viewing Current License Information

License Status Screen

The screen includes the following elements:

Element	Description
Application	The product version and license key.
Meters	• Output GB - The total amount of output traffic used in GB per month and the total amount allowed in the license. • Expires - license expiration date.
Limits	License usage restrictions. Unlimited - no restrictions.
Features	List of enabled/disabled features.
Daily Usage	Daily traffic statistics. Click the Host drop-down menu to select a specific host.

Daily Bitrate	Daily bitrate statistics. Click the Host drop-down menu to select a specific host.

Machine Information

This pane shows information about the machine on which ZEC is installed.

Machine Information
System Model:	Xen HVM domU
Processor Model:	Intel(R) Xeon(R) CPU E5-2686 v4 @ 2.30GHz
Processors:	1
Logical Cores:	2
Installed RAM:	4 GB
GPU(s):	Not Found

The pane includes the following data:

Parameter	Description
System Model	The model of the machine on which the ZEC is installed.
Processor Model	The model and specifications of the machine's processor.
Processor	The number of CPUs installed on this machine.
Logical Cores	The number of logical cores per processor (for each processor).
Installed RAM	The size of the RAM installed on the machine.
GPU(s)	The number of GPUs. If no GPUs - Not Found.

Operating System Information

This pane shows information about the operating system running on the machine.

OS Information
OS:	Amazon Linux release 2 (Karoo)
Build:	4.14.88-88.73.amzn2.x86_64
Architecture:	x86_64

Network Cards (Linux only)

The pane Includes the following data:

Parameter	Description
OS	The operating system running on the machine.
Build	The operating system build (version) number.
Architecture	The system architecture of the operating system, number of bits.

Network Cards (Linux only)

This pane shows information about the network cards running on the machine. Each line represents another network card.

Network Cards			
NIC	**Link Speed**	**Duplex**	**IPs**
eth0		Full	172.31.17.149

The pane Includes the following data:

Parameter	Description
NIC	The name of the Network Interface Controller (a.k.a network card).
Link Speed	The link speed capability of the network card.
Duplex	Full - full duplex Half - half duplex
IPs	The IP of the network card.

Network Test

Network Cards (Linux only)
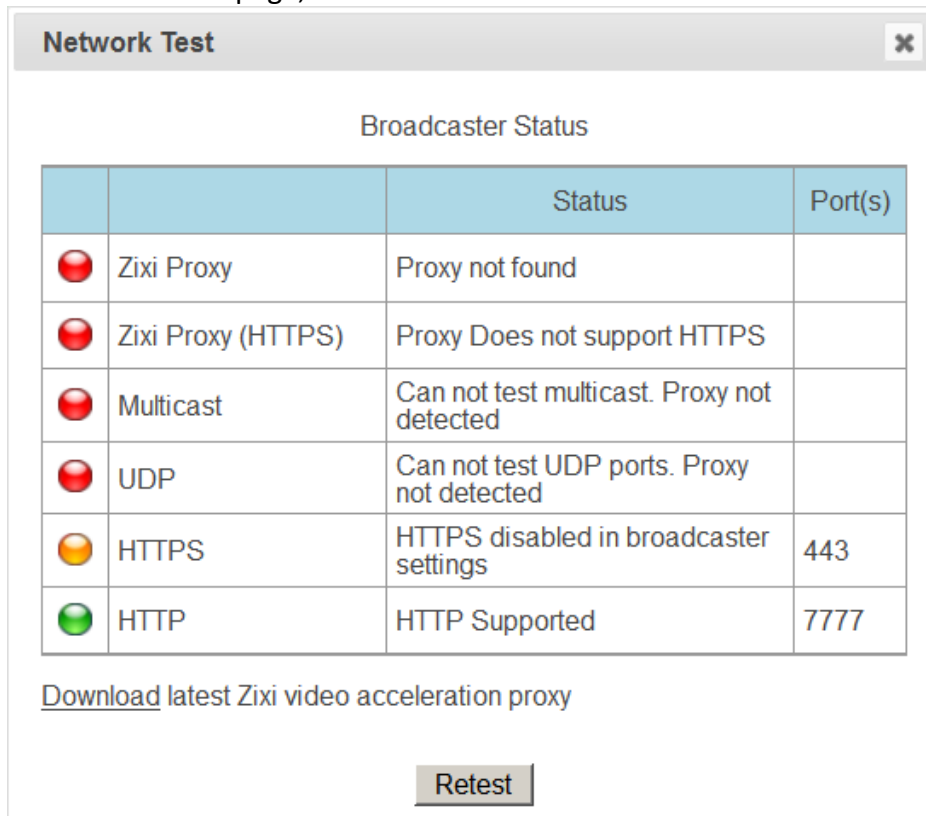
Network Test

You can test the ZEC status, the status of the http or https connection with the relevant port, and the status of the Zixi Video Acceleration Proxy component. This can be accomplished remotely after the installation of the ZEC and subsequently any time after that.

➡ **To Test the Network:**

1. In the ZEC **Status** page, click [Network Test]. The **Network Test** screen is displayed:

The ZEC Status table lists the various components of the ZEC with the relevant ports and status (description) and the following health indicators:
- **Green** – component has been tested and was found available.
- **Yellow** – component has been disabled.
- **Red** – component was not found or is not available.

2. Click **Retest** to run an additional test on all the server's current connections and their relative ports.

The following tests will be displayed:
- **Zixi Proxy** – checks that the Zixi Video Acceleration Proxy is running on the local machine and is listening through port 4500 (HTTP).

Installing the Zixi Video Acceleration Proxy

- **Zixi Proxy (HTTPS)** – checks that the Zixi Video Acceleration Proxy is running on the local machine and is listening through port 4501 (HTTPS).
- **Multicast** – checks if the multicast feature is enabled.
- **UDP** – checks if ZEC can be accessed through UDP (port 2077).
- **HTTP** – checks if ZEC can be accessed through HTTP (HTTP server port 80).
- **HTTPS** - checks if ZEC can be accessed through HTTPS (HTTPS server port 8080)

Installing the Zixi Video Acceleration Proxy

The Zixi Video Acceleration Proxy is a software component, which is installed on the local machine, that enables pulling a stream from ZEC over HTTP, while using the Zixi protocol. The Zixi Video Acceleration Proxy is mainly used to preview a stream to assess its quality, by playing it on a local player. VLC video player has another version of the proxy, called Zixi VLC Plugin, which offers the same functionality. For more information, see Zixi VLC Plugin Setup Guide.

The Zixi Video Acceleration Proxy component is installed on the local machine, while ZEC can be running on another machine (e.g., in the cloud) or can be running on the same machine. The Proxy uses port 4500 (HTTP) or 4501 (HTTPS) to listen to the stream.

The Zixi Video Acceleration Proxy is also required when using ZEC to transfer large files. In this case, the component allows both uploading and downloading the files. For more information, see **Error! Reference source not found..**

➡ **To Install the Zixi Video Acceleration Proxy:**

1. In the ZEC **Status** page, click . The **Network Test** screen is displayed.

Installing the Zixi Video Acceleration Proxy

2. On the **Network Test** screen, click the **Download** link below the table.

		Status	Port(s)
🔴	Zixi Proxy	Proxy not found	
🔴	Zixi Proxy (HTTPS)	Proxy Does not support HTTPS	
🔴	Multicast	Can not test multicast. Proxy not detected	
🔴	UDP	Can not test UDP ports. Proxy not detected	
🔴	HTTPS	HTTPS Request failed	
🔴	HTTP	HTTP Request failed	

Download latest Zixi video acceleration proxy
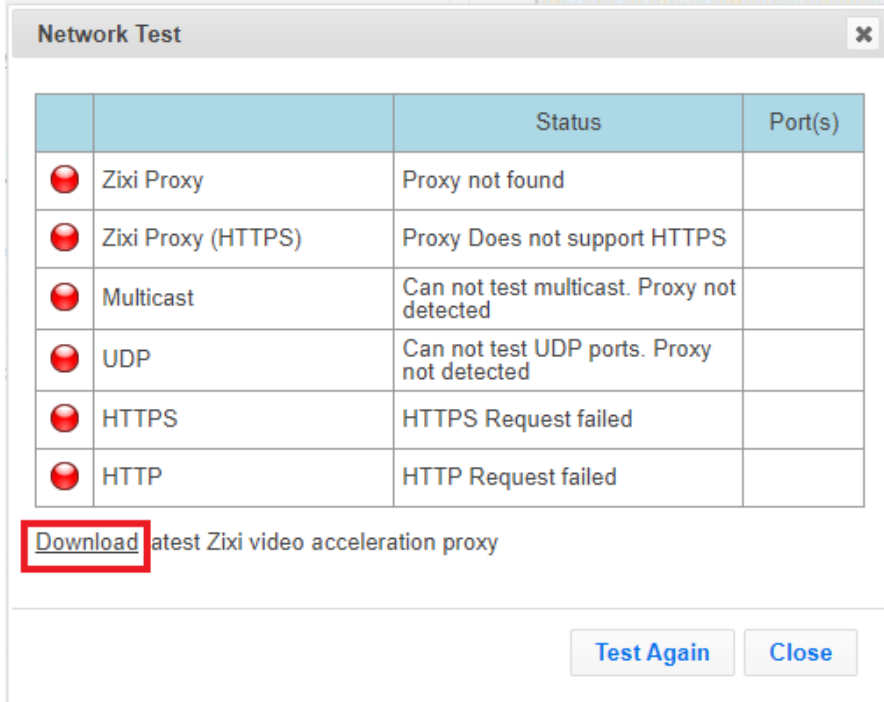
The setup file will be downloaded locally.

3. Run the downloaded file to open the setup wizard.
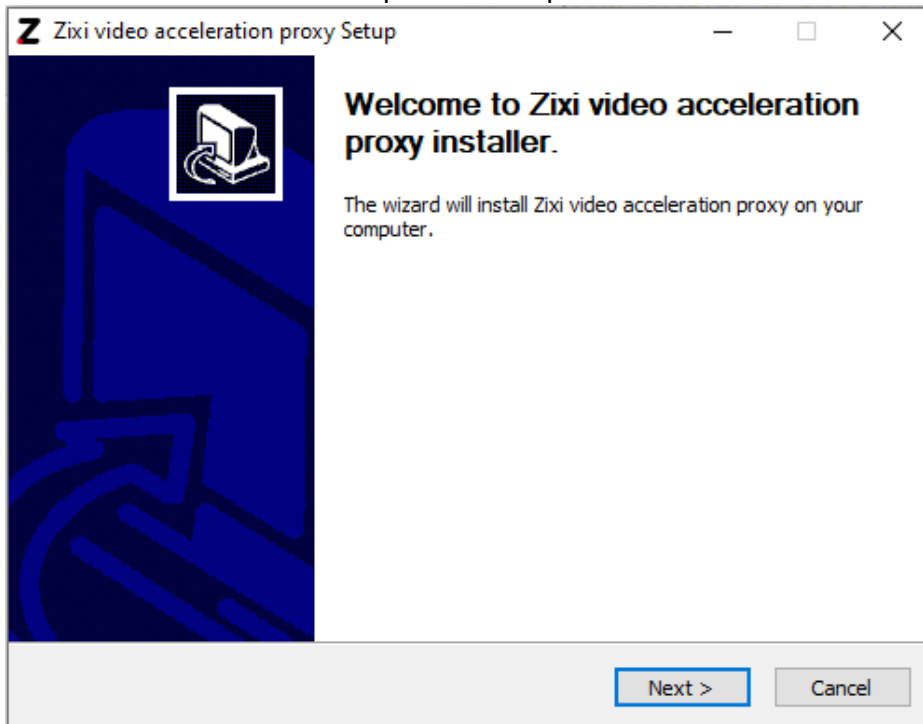
4. Click **Next**.

Installing the Zixi Video Acceleration Proxy

5. Select a destination folder to install.
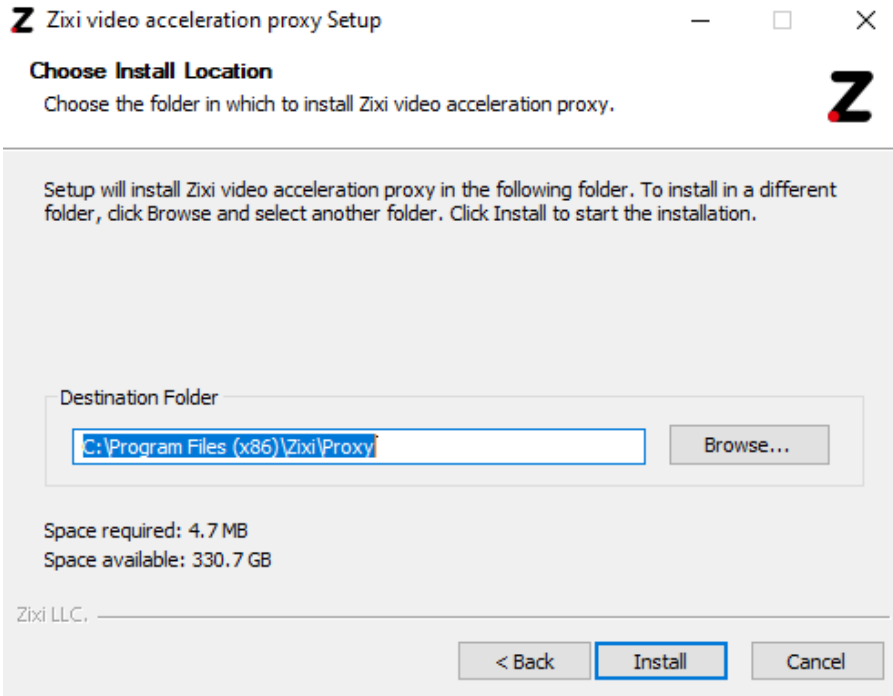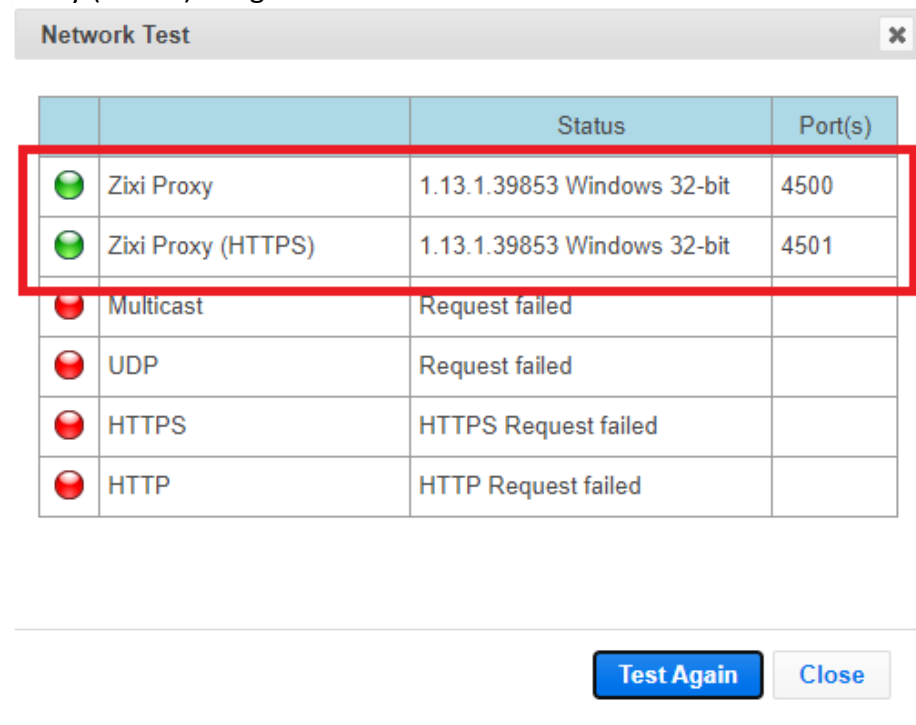
6. Click **Install**.
7. After the installation process, click **Finish**.
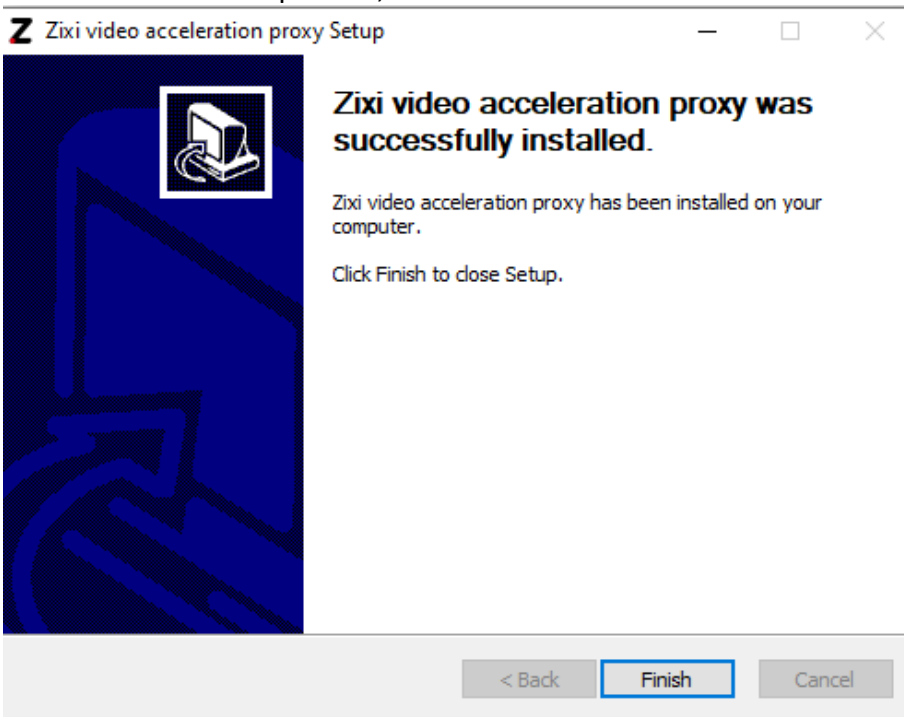
Using the Zixi Video Acceleration Proxy for previewing a stream

If you will run the network test again, you should be able to see that the Zixi Proxy and Zixi Proxy (HTTPS) are green.

Using the Zixi Video Acceleration Proxy for previewing a stream

The Zixi Video Acceleration Proxy can be used for previewing a stream through a video player. The locally installed Proxy can be accessed through the following IP address – `127.0.0.1`. The following URL - `127.0.0.1:4500/version.json` will provide a response that includes the version and build numbers of the Proxy.

➡ **To playback a stream using the Zixi Video Acceleration Proxy:**

1. In a web-connected video player, enter the following network URL:
   http://127.0.0.1:4500/?url=<broadcaster_ip>:2077/<stream_name>.

Using the Zixi Video Acceleration Proxy for previewing a stream

The video will be streamed to the player through the locally installed Proxy.
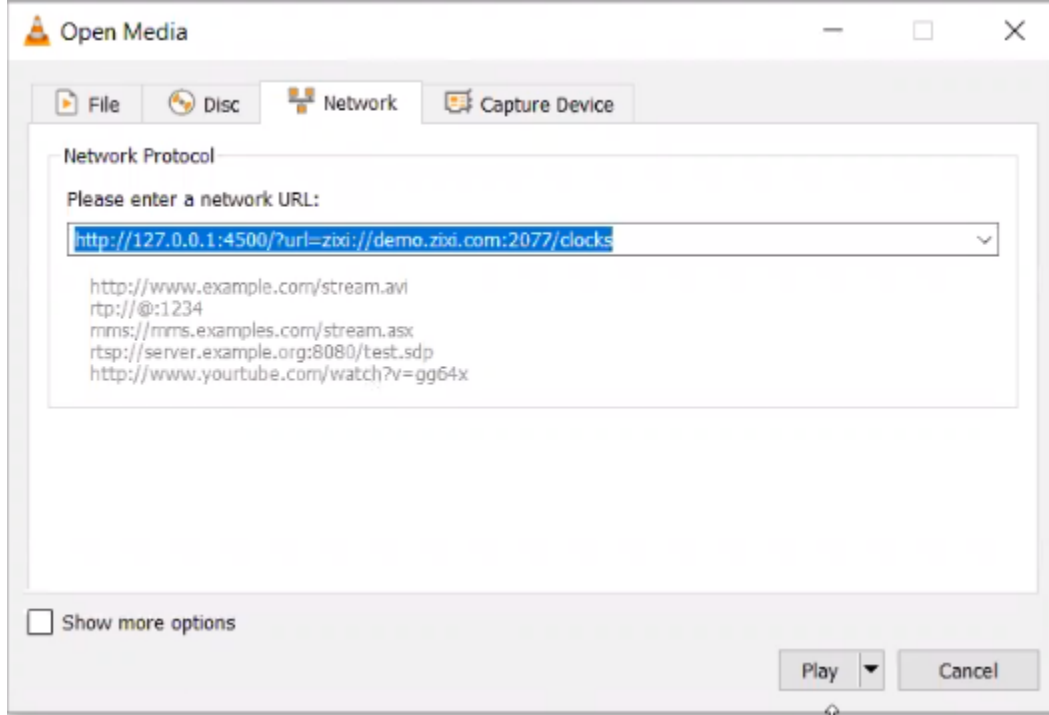
ZEC Inputs

You can add input streams to ZEC from one of the following sources:

- **Another ZEC Instance (Pull)** – ZEC can pull a stream from another ZEC instance. Since both components use the Zixi protocol, the stream can be protected by the Zixi protocol.
- **UDP streams** - the source is a UDP or RTP stream, RTP + SMPTE 2022 FEC over unicast or multicast.
- **Delayed** - input stream will be stored on the local disk, while a variant of the input is created and delayed according to the specified duration.
- **Local files (for VOD)** – the source in this case is a local transport stream file from your local computer or local network.
- **RTMP streams** - The source is an RTMP stream, pushed into ZEC or pulled by it.
- **RTSP** - The source is an RTSP stream, pushed into ZEC, or pulled by it.
- **HLS** - The source is an HLS stream that is pulled by ZEC.
- **HTTP Pull/Push (TS over HTTP)** - The source is a Transport Stream over HTTP, which is pushed into ZEC or pulled by it.
- **RIST** – The source is a RIST stream using Simple or Main Profile over unicast or multicast.
- **SRT** – The source is an SRT stream and is configured via Zen Master or ZEC API only.

Adding Input Streams

ZEC enables you to add various types of streams. When you create a new stream, select the stream type and then fill in the fields that are applicable for that stream type.

Adding Pull Streams

Typically, a Pull Stream is transmitted from another ZEC. In this case, the stream is initiated by your ZEC.
If the stream is an MPTS stream and you want to demux it into separate SPTS input streams, create the stream, by following the instructions below, and then follow the instruction in the **Demuxing an MPTS Stream** section

➡ **To Add a Pull Stream:**

1. In the ZEC Navigation menu, click the **Inputs** tab.
2. In the Menu bar, click **New Input**. The **Add a new input stream** window is displayed.
3. Enter the unique **Stream ID.** for ZEC.

> Note: this must be identical (case sensitive) to the stream name configured in the Zixi Feeder.

Adding Input Streams

4. Select the maximum concurrent connections to this stream from the **Max. Outputs** drop-down list. Default: Unlimited.

> This setting can be modified without interrupting an existing stream.

5. Select the **Show in Matrix** check box to display this stream in the Matrix (see **Using the Matrix**). Default: Selected.
6. Select **Pull** for the input stream.

7. Specify the **Stream Parameters** (see Input Stream Parameter table).
8. If you want to **Enable time shift**, select this checkbox (see Input Stream Parameter table). The stream will be recorded and broadcasted after the specified delay. The time shift feature is typically used to broadcast a live event across time zones (due to the time differences between locations).
9. If you want to **Transmit as multicast**, select this checkbox (see Input Stream Parameter table).
10. If you want to configure the **Recording Parameters**, specify them in the respective fields (see Input Stream Parameter table).
11. You can decrypt an encrypted stream as it enters the ZEC. To decrypt a stream, select the **Decrypt Stream** checkbox and fill in the parameters as describes in the Input Stream Parameter Table below. For more information, see **Decrypting an Input Stream in .**

Adding Input Streams

> 12. Click **OK**. The "Input added" message appears on the top of the screen. The Pull Stream is added to ZEC and now appears in the list of streams available in ZEC inputs UI.

Input Stream Parameters table

Parameter	Description
Stream Parameters	The general stream settings.
Host	Enter the IP Address of the remote ZEC server. Note that additional (failover) destinations can be added by clicking the adjacent **"+"** button
Port	Enter the port through which ZEC receives the stream from another ZEC server. Default: 2088 The default input port for ZEC is UDP port **2088**. This port *must be open* on any firewalls between ZEC and other devices it is communicating with.
Stream	Enter the unique stream ID from another ZEC server.
Password (Optional)	If desired, enter the string for authentication. It must be identical to the string configured on the other ZEC.
Latency [ms]	Specify the maximum number of milliseconds that ZEC should protect the stream for. For example, 6000 milliseconds would ensure that the stream is protected for up to six seconds of delay in the network. This setting affects memory usage as higher levels of protection require more buffering. Default:6000.
Ignore TLS certificate error	Select this option when connecting to a trusted server that does not have a valid certificate. When this option is selected, ZEC will ignore the TLS certificate errors. This setting can be modified without interrupting an existing stream.
Bind to IP	Select from the drop-down list the local IP address to be used for this Input, OR select *Any* to enable any IP to be used.
Bind to NIC	Select from the drop-down list the NIC to be used for this Input, OR select *Any* to enable any NIC to be used.

Adding Input Streams

Billing Codes	Billing codes are used to identify and differentiate traffic on a ZEC for billing purposes. When a billing code is added to a Source or Target, ZEC can track the traffic on that ZEC input or output separately from other inputs and outputs on the same ZEC. Billing codes are created by ZEC personnel on the ZEC Customer Portal for a particular organization.
Billing Code	Enter the billing code that corresponds to this stream. The relevant billing can be obtained from the organization that received the billing code from Zixi.
Billing password	Enter the password that corresponds to this billing code.
Enable time shift	Select this checkbox to record the stream content and broadcast it after a specified delay. To deploy an input stream that uses the current stream's time shift, you need to configure a "Delayed" input stream. (See **Adding Delayed Streams**).
Maximum delay [hh:mm:ss] (for Time Shift enabled)	Specify the time of a delayed transmission of this stream. Maximum: 24 hours
Transmit as multicast	Select this checkbox to enable the transmission of this stream's outputs as multicast. A ZEC that will pull the stream will receive it in multicast. By default ZEC is configured to allow transparent fallback to unicast if it is out of the LAN. Requires enabling **Multicast Pull** in the **Settings**. This setting can be modified without interrupting an existing stream.
Multicast-Only (for multicast enabled)	If desired, specify multicast-only outputs.
Decrypt stream	Select this checkbox to decrypt the Input stream. Please note that the stream will not be encrypted as it passes through the ZEC path. For more information, see **Decrypting an Input Stream in** .
Decryption type (for Decrypt stream enabled)	Specify the type of encryption that is being used in the stream. This setting can be modified without interrupting an existing stream.

Adding Input Streams

Decryption key (for Decrypt stream enabled)	Specify the key for decryption.
	This setting can be modified without interrupting an existing stream.
Enable Encryption	Select this checkbox to encrypt the Input stream. For more information, see **Encrypting an Input Stream in .**
Encryption type (for Encryption enabled)	Specify the type of Encryption (AES 128/192/256).
Encryption key (for Encryption enabled)	Click **Generate** to generate an encryption key. The generated encryption key must be sent to the end-user to decipher the received encoded stream.
Recording parameters	Select this checkbox to customize the recording parameters.
Destination Type	Select the radio button for the desired storage type and then fill in the relevant parameters. • **Record to disk –** the recording is saved on the local disk. It is possible to record to an external destination by replacing the default storage location with a symbolic link. To learn more, see Using an External Storage section. • **Record to S3** – the file is saved to your AWS S3 Bucket.
Record to Disk Parameters	

Adding Input Streams

File Name Template	Specify the file name pattern that Zixi will use to generate when saving the recorded content. A separate file will be generated for each recording up to the time specified in the Max recorded file duration parameter (see above). After this duration a new file will be generated.
	The file name pattern can include any string and up to five variables listed below. Only the %T=HH.MM.SS creation time is mandatory. You can change the order of these variables and add text as long as you maintain the legitimate structure of the file in Linux and Windows:
	• %S=stream id - optional.
	• %Y=year - optional
	• %M=month - optional
	• %D=day - optional
	• %T=HH.MM.SS creation time - mandatory
	For example, the following pattern %Y_recording%T.ts will generate the following file name 2017_recording15:32:35.ts.
Max recorded file duration [hours]	Specify the maximum time allotted for recording a video stream. Default: 2 hours
Keep recorded files for [hours]	Specify the maximum time for storing the recording. Default: 0 hours
Custom Path	Optionally specify a storage location for the recorded files that is relative to the root folder. This location bypasses the location specified as the root folder in the **Settings** > **General** screen.
Record to S3 Parameters	

Adding Input Streams

File Name Template	Specify the file name pattern that ZEC will use to generate when saving the recorded content. A separate file will be generated for each recording up to the time specified in the Max recorded file duration parameter (see above). After this duration a new file will be generated. The file name pattern can include any string and up to five variables listed below. Only the %T=HH.MM.SS creation time is mandatory. You can change the order of these variables and add text as long as you maintain the legitimate structure of the file in Linux and Windows: • %S=stream id - optional. • %Y=year - optional • %M=month - optional • %D=day - optional • %T=HH.MM.SS creation time - mandatory For example, the following pattern %Y_recording%T.ts will generate the following file name 2017_recording15:32:35.ts.
Max recorded file duration [hours]	Specify the maximum time allotted for recording a video stream. Default: 2 hours
URL	Specify the URL of the S3 bucket.
Ignore TLS certificate errors	TLS certificate for S3 bucket might be detected as faulty if bucket name contains dot[s]. When this option is selected, ZEC will ignore the TLS certificate errors and transmit the stream to its destination.
Access Key	The access key that is used for accessing the S3 bucket.
Secret Key	The secret key that is used for accessing the S3 bucket.

Adding UDP Streams

This enables ZEC to receive a UDP stream. The UDP stream is not protected by the Zixi protocol. The UDP streams can be one of the following types:

- **UDP** – the input stream is plain UDP.

- **RTP** – the input stream uses the RTP protocol, which adds RTP headers to the UDP stream. RTP adds a 12-byte header, which includes a sequence number and a timestamp that can be used to detect dropped packets. The sequence number in the RTP headers can be used to do automatic reordering and the timestamps can help overcome inter-packet gaps, also known as IAT (Inter Arrival Time).
However, plain RTP does not feature error recovery or error protection. By default, the RTP headers (which include the timestamps and sequences) are being used on the input side, but then they are stripped off and they no longer propagate to outputs.

- **RTP + SMPTE 2022 FEC** – the input stream includes forward error correction, which enables error recovery or error protection.

If the stream is an MPTS stream and you want to demux it into separate SPTS input streams, create the stream, by following the instructions below, and then follow the instruction in the **Demuxing an MPTS Stream** section.

➡ **To Add a UDP Stream:**

1. In the ZEC Navigation menu, click the **Inputs** tab.
2. In the Menu bar, click **New Input**. The **Add a new input stream** window is displayed.
3. Enter the unique **Stream ID.**

> 🖊 Note this must be identical (case sensitive) to the stream name configured in the ZEC Feeder.

4. Select the maximum concurrent connections to this stream from the **Max. Outputs** drop-down list. Default: Unlimited.
5. Select the **Show in Matrix** check box to display this stream in the Matrix (see **Using the Matrix**). Default: Selected.
6. Select **UDP** for the input stream.

Adding Input Streams

7. Specify the **Stream Parameters** (see Input Stream Parameters Table).
8. If you want to **Enable time shift**, select this checkbox (see Input Stream Parameters Table).
9. If you want to **Transmit as multicast**, select this checkbox (see Input Stream Parameters Table).
10. If you want to configure the **Recording Parameters**, specify them in the respective fields (see Input Stream Parameters Table).
11. If you want to **Enable encryption**, select this checkbox (see Input Stream Parameters Table). For more information, see **Encrypting an Input Stream in .**
12. Click **OK**.
    The "Input added" message appears on the top of the screen. The UDP Stream from the ZEC Feeder is added to ZEC and now appears in the list of streams available in the ZEC inputs UI.

Input Stream Parameters Table

Parameter	Description
Stream Parameters	The general stream settings.
Port	Specify the port to listen on. This port must be open on all firewalls between ZEC and other devices it is communicating with.

Adding Input Streams

Multicast IP	If multicast, type the Multicast IP address (or leave blank in the case of Unicast).
SSM Source	Specify the source IP for a source-specific multicast.
Type	Select the appropriate protocol type from the drop-down list: **UDP** – the input stream is plain UDP. **RTP** – the input stream uses the RTP protocol, which adds RTP headers to the UDP stream. RTP adds a 12-byte header, which includes a sequence number and a timestamp that can be used to detect dropped packets. The sequence number in the RTP headers can be used to do automatic reordering and the timestamps can help overcome inter-packet gaps, also known as IAT (Inter Arrival Time). However, plain RTP does not feature error recovery or error protection. By default, the RTP headers (which include the timestamps and sequences) are being used on the input side, but then they are stripped off and they no longer propagate to outputs. **RTP + SMPTE 2022 FEC** – the input stream includes forward error correction, which enables error recovery or error protection.
Bind to IP	Select from the drop-down list the local IP address to be used for this Input, OR select *Any* to enable any IP to be used.
Max. bitrate [kbps]	Specify the maximum expected bitrate for memory allocation. Recommended: 2X the actual bitrate, which will prevent buffer overruns (especially with VBR streams). Default: 8000. Note – Overflows will typically occur when the Max Bitrate isn't sufficient.
Dejitter Buffer [ms]	A buffer size used to de-jitter RTP and UDP inputs. For RTP packet timing is fixed according to packet arrival times and RTP timestamps. For UDP dejiterring is only based on arrival times. Default: 0. Assuming that the timestamps in the RTP are accurate, this feature is helpful when the encoder generates an accurate timestamp on the stream, but the arrival is jittery/bursty. In case of jitter, specify a higher value than the RTP input jitter. To view the Jitter level of the input stream, create the input and select it on the Inputs screen, the Jitter metric will be displayed in the **Stats** pane at the bottom of the screen.
Billing Codes	Billing codes are used to identify and differentiate traffic on a ZEC for billing purposes. When a billing code is added to a Source or Target, ZEC can track the traffic on that ZEC input or output separately from other inputs and outputs on the same ZEC. Billing codes are created by Zixi personnel on the Zixi Customer Portal for a particular organization.
Billing Code	Enter the billing code that corresponds to this stream. The relevant billing can be obtained from the organization that received the billing code from ZEC.
Billing password	Enter the password that corresponds to this billing code.

Adding Input Streams

Enable time shift	Select this checkbox to record the stream content and broadcast it after a specified delay. To deploy an input stream that uses the current stream's time shift, you need to configure a "Delayed" input stream. (See **Adding Delayed Streams**).
Maximum delay [hh:mm:ss] (for Time Shift enabled)	Specify the maximum time delay of this input.
Transmit as multicast	Select this checkbox to enable the transmission of this stream's outputs as multicast. A ZEC receiver that will pull the stream will receive it in multicast. By default ZEC is configured to allow transparent fallback to unicast if it is out of the LAN. Requires enabling Multicast Pull in the Settings.
Multicast-Only (for multicast enabled)	Selecting this checkbox will force the transmission of this stream only in multicast.
Enable Encryption	Select this checkbox to encrypt the Input stream. For more information, see Encrypting an Input Stream in
Encryption type (for Encryption enabled)	Specify the type of Encryption (AES 128/192/256).
Encryption key (for Encryption enabled)	Click **Generate** to generate an encryption key. The generated encryption key must be sent to the end-user to decipher the received encoded stream.
Recording parameters	Select this checkbox to customize the recording parameters.
Destination Type	Select the radio button for the desired storage type and then fill in the relevant parameters. • **Record to disk** – the recording is saved on the local disk. It is possible to record to an external destination by replacing the default storage location with a symbolic link. To learn more, see Using an External Storage section. • **Record to S3** – the file is saved to your AWS S3 Bucket.
Record to Disk Parameters	

Adding Input Streams

File Name Template	Specify the file name pattern that ZEC will use to generate when saving the recorded content. A separate file will be generated for each recording up to the time specified in the Max recorded file duration parameter (see above). After this duration a new file will be generated. The file name pattern can include any string and up to five variables listed below. Only the %T=HH.MM.SS creation time is mandatory. You can change the order of these variables and add text as long as you maintain the legitimate structure of the file in Linux and Windows: • %S=stream id - optional. • %Y=year - optional • %M=month - optional • %D=day - optional • %T=HH.MM.SS creation time - mandatory For example, the following pattern %Y_recording%T.ts will generate the following file name 2017_recording15:32:35.ts.
Max recorded file duration [hours]	Specify the maximum time allotted for recording a video stream. Default: 2 hours
Keep recorded files for [hours]	Specify the maximum time for storing the recording. Default: 0 hours
Custom Path	Optionally specify a storage location for the recorded files that is relative to the root folder. This location bypasses the location specified as the root folder in the **Settings** > **General** screen.
Record to S3 Parameters	

Adding Input Streams

File Name Template	Specify the file name pattern that ZEC will use to generate when saving the recorded content. A separate file will be generated for each recording up to the time specified in the Max recorded file duration parameter (see above). After this duration a new file will be generated. The file name pattern can include any string and up to five variables listed below. Only the %T=HH.MM.SS creation time is mandatory. You can change the order of these variables and add text as long as you maintain the legitimate structure of the file in Linux and Windows: • %S=stream id - optional. • %Y=year - optional • %M=month - optional • %D=day - optional • %T=HH.MM.SS creation time - mandatory For example, the following pattern %Y_recording%T.ts will generate the following file name 2017_recording15:32:35.ts.
Max recorded file duration [hours]	Specify the maximum time allotted for recording a video stream. Default: 2 hours
URL	Specify the URL of the S3 bucket.
Ignore TLS certificate errors	TLS certificate for S3 bucket might be detected as faulty if bucket name contains dot[s]. When this option is selected, ZEC will ignore the TLS certificate errors and transmit the stream to its destination.
Access Key	The access key that is used for accessing the S3 bucket.
Secret Key	The secret key that is used for accessing the S3 bucket.

Adding Delayed Streams

You can delay the broadcasting of an input stream by selecting **Enable time shift** and then creating a Delayed input stream that uses the Input with the time shift as a source. In this case the input stream will be stored on the local disk, while a variant of the input is created and delayed according to the specified duration. The input stream of the time-shifted stream will be stored on the local disk. In parallel, you can create a "Delayed" stream that will stream the "time-shifted" input stream according to the specified delay. For example, you can specify a 6-hour time-shift to "Stream_A". This means that 6 hours of streaming are stored. You can then create a delayed stream that will stream "Stream_A" with a two-hour delay. This means that the delayed stream will always stream with a two-hour delay.

> The duration of the delayed stream should be less or equal to the time shifted stream.

➡ **To Add a Delayed Stream:**

1. Make sure at least one of the existing inputs has the **Enable time shift** setting selected.
2. In the ZEC Navigation menu, click the **Inputs** tab.
3. In the Menu bar, click **New Input**. The **Add a new input stream** window is displayed.
4. Enter the unique **Stream ID.**
5. Select the maximum concurrent connections to this stream from the **Max. Outputs** drop-down list. Default: Unlimited.
6. Select the **Show in Matrix** check box to display this stream in the Matrix (see **Using the Matrix**). Default: Selected.
7. Select **Delayed** for the input stream.

8. Specify the **Stream Parameters** (see Input Stream Parameters Table).
9. If you want to **Transmit as multicast**, select this checkbox (see Input Stream Parameters Table).

Adding Input Streams

10. Click **OK**.
   The "Input added" message appears on the top of the screen. The Delayed Stream is
   added to ZEC and now appears in the list of streams available in ZEC inputs UI.

Input Stream Parameters Table

Parameter	Description
Stream Parameters	The general stream settings.
Source	Select one of the input streams that were configured to enable "time shift".
Delay	Specify the delay period relative to the original stream in the following format: hh:mm:ss.
Transmit as multicast	Select this checkbox to enable the transmission of this stream's outputs as multicast. A Zixi receiver that will pull the stream will receive it in multicast. By default ZEC is configured to allow transparent fallback to unicast if it is out of the LAN. Requires enabling **Multicast Pull** in the **Settings**.
Multicast-Only (for Multicast enabled)	If desired, specify multicast only outputs.

Adding Input Streams

Adding RTMP Streams

This enables you to create a Push or Pull RTMP input stream.

➡ **To Add a RTMP Stream:**

1. In the ZEC Navigation menu, click the **Inputs** tab.
2. In the Menu bar, click **New Input**. The **Add a new input stream** window is displayed.
3. Enter the unique **Stream ID.**

> Note: this must be identical (case sensitive) to the stream name configured in the Zixi Feeder.

4. Select the maximum concurrent connections to this stream from the **Max. Outputs** drop-down list. Default: Unlimited.
5. Select the **Show in Matrix** check box to display this stream in the Matrix (see **Using the Matrix**). Default: Selected.
6. Select **RTMP** for the input stream.

7. Specify the **Stream Parameters** (see Input Stream Parameters Table).
8. If you want to **Enable time shift**, select this checkbox (see Input Stream Parameters Table).
9. If you want to **Transmit as multicast**, select this checkbox (see Input Stream Parameters Table).
10. If you want to **Enable encryption**, select this checkbox (see Input Stream Parameters Table). For more information, see **Encrypting an Input Stream in** .

Adding Input Streams

11. If you want to configure the **Recording Parameters**, specify them in the respective fields (see Input Stream Parameters Table).
12. Click **OK**. The "Input added" message appears on the top of the screen. The RTMP Stream is added to ZEC and now appears in the list of streams available in the ZEC inputs UI.

Input Stream Parameters Table

Parameter	Description
Stream Parameters	The general stream settings.
Type	Select the desired type for the RTMP stream: • Push – the stream is pushed to ZEC (not initiated by the ZEC). No additional connection parameters need to be filled. If the stream name will match, the stream will be inputted. • Pull – ZEC will initiate the stream by accessing it through the following parameters:
URL (for Pull)	Type the Stream URL from which ZEC will access. Use the following URL format: `rtmp://host:[port]/app/stream`. You can define RTMPS clients with the proven security of a secure socket layer (SSL), by using the `rtmps:// url`
Stream Name (for Pull)	Type the unique name for the stream that has been defined in the RTMP server.
User Name (for Pull)	Specify the user name to authenticate on the remote RTMP server
Password (for Pull)	Specify the string that is used for authorization on the remote RTMP server.
Ignore TLS certificate	Select this option when connecting to a trusted server that does not have a valid certificate. When this option is selected, ZEC will ignore the TLS certificate errors.
Disconnect if inactive	Disconnects the connection if inactive.
Padding	If the stream's bitrate fluctuates you can pad the stream with null packets to create a steady bitrate. Select this checkbox to enable padding.

Adding Input Streams

Muxing bitrate (for Padding enabled)	Specify the padding level in kbps.
Smoothing Latency [ms]	The Smoothing feature uses a buffer to time packets according to the stream's clock. This is useful when there are bursts in the rate in which the stream arrives. The smoothing features creates a queue in the buffer, allowing smoother entry into ZEC. The Smoothing parameter defines the size of the buffer in Milliseconds. A larger buffer enables smoother entry, however, it may influence the latency rate.
Enable time shift	Select this checkbox to record the stream content and broadcast it after a specified delay. To deploy an input stream that uses the current stream's time shift, you need to configure a "Delayed" input stream. (See **Adding Delayed Streams**).
Maximum delay [hh:mm:ss] (for Time Shift enabled)	Specify the maximum time delay of this input.
Transmit as multicast	Select this checkbox to enable the transmission of this stream's outputs as multicast. A ZEC receiver that will pull the stream will receive it in multicast. By default, ZEC is configured to allow transparent fallback to unicast if it is out of the LAN. Requires enabling Multicast Pull in the Settings.
Multicast Only (for Multicast enabled)	Select the check box to force only Multicast outputs.
Enable Encryption	Select this checkbox to encrypt the Input stream. For more information, see **Encrypting an Input Stream in**
Encryption type (for Encryption enabled)	Specify the type of Encryption (AES 128/192/256).
Encryption key (for Encryption enabled)	Click **Generate** to generate an encryption key. The generated encryption key must be sent to the end-user to decipher the received encoded stream.
Recording parameters	Select this checkbox to customize the recording parameters.
Destination Type	Select the radio button for the desired storage type and then fill in the relevant parameters. **Record to disk** – the recording is saved on the local disk. It is possible to record to an external destination by replacing the default storage location with a symbolic link. To learn more, see **Using an External Storage** section. • **Record to S3** – the file is saved to your AWS S3 Bucket.

Adding Input Streams

Record to Disk Parameters	
File Name Template	Specify the file name pattern that ZEC will use to generate when saving the recorded content. A separate file will be generated for each recording up to the time specified in the Max recorded file duration parameter (see above). After this duration a new file will be generated. The file name pattern can include any string and up to five variables listed below. Only the %T=HH.MM.SS creation time is mandatory. You can change the order of these variables and add text as long as you maintain the legitimate structure of the file in Linux and Windows: • %S=stream id - optional. • %Y=year - optional • %M=month - optional • %D=day - optional • %T=HH.MM.SS creation time - mandatory For example, the following pattern %Y_recording%T.ts will generate the following file name 2017_recording15:32:35.ts.
Max recorded file duration [hours]	Specify the maximum time allotted for recording a video stream. Default: 2 hours
Keep recorded files for [hours]	Specify the maximum time for storing the recording. Default: 0 hours
Custom Path	Optionally specify a storage location for the recorded files that is relative to the root folder. This location bypasses the location specified as the root folder in the **Settings** > **General** screen.
Record to S3 Parameters	
File Name Template	Specify the file name pattern that ZEC will use to generate when saving the recorded content. A separate file will be generated for each recording up to the time specified in the Max recorded file duration parameter (see above). After this duration a new file will be generated. The file name pattern can include any string and up to five variables listed below. Only the %T=HH.MM.SS creation time is mandatory. You can change the order of these variables and add text as long as you maintain the legitimate structure of the file in Linux and Windows: • %S=stream id - optional. • %Y=year - optional

Adding Input Streams

- %M=month - optional

- %D=day - optional

- %T=HH.MM.SS creation time - mandatory

For example, the following pattern %Y_recording%T.ts will generate the following file name 2017_recording15:32:35.ts.

Max recorded file duration [hours]	Specify the maximum time allotted for recording a video stream. Default: 2 hours
URL	Specify the URL of the S3 bucket.
Ignore TLS certificate errors	TLS certificate for S3 bucket might be detected as faulty if bucket name contains dot[s]. When this option is selected, ZEC will ignore the TLS certificate errors and transmit the stream to its destination.
Access Key	The access key that is used for accessing the S3 bucket.
Secret Key	The secret key that is used for accessing the S3 bucket.

Adding Input Streams

Adding RTSP Streams

This enables you to create RTSP streams.

➡ **To Add RTSP Streams:**

1. In the ZEC Navigation menu, click the **Inputs** tab.
2. In the Menu bar, click **New Input**. The **Add a new input stream** window is displayed.

3. Enter the unique **Stream ID.**

4. ✎   Note: this must be identical (case sensitive) to the stream name configured in the ZEC Feeder.

5. Select the maximum concurrent connections to this stream from the **Max. Outputs** drop-down list. Default: Unlimited.
6. Select the **Show in Matrix** check box to display this stream in the Matrix (see **Using the Matrix**). Default: Selected.
7. Select **RTMP** for the input stream.
8. Specify the **Stream Parameters** (see Input Stream Parameters Table).
9. If you want to **Enable time shift**, select this checkbox (see Input Stream Parameters Table).
10. If you want to **Transmit as multicast**, select this checkbox (see Input Stream Parameters Table).

Adding Input Streams

11. If you want to **Enable encryption**, select this checkbox (see Input Stream Parameters Table).
12. If you want to configure the **Recording Parameters**, specify them in the respective fields (see Input Stream Parameters Table).
13. Click **OK**. The "Input added" message appears on the top of the screen. The RTMP Stream is added to ZEC and now appears in the list of streams available in the ZEC inputs UI.

Input Stream Parameters Table

Parameter	Description
Stream Parameters	The general stream settings.
URL	Type the Stream URL from which ZEC will access.
Video UDP Port	Specify the UDP port to be used for streaming the video.
Audio UDP Port	Specify the UDP port to be used for streaming the audio.
Pad to bitrate	If the stream's bitrate fluctuates you can pad the stream with null packets to create a steady bitrate. This setting determines the padding level in kbps.
Latency	Specify the maximum latency you can tolerate for the stream in milliseconds. Recommended - the length of two frames.
TCP	Select this checkbox for streams that use TCP protocol. Leave unselected in case the stream uses UDP.
Enable time shift	Select this checkbox to record the stream content and broadcast it after a specified delay. To deploy an input stream that uses the current stream's time shift, you need to configure a "Delayed" input stream. (See **Adding Delayed Streams**).
Maximum delay [hh:mm:ss] (for Time Shift enabled)	Specify the maximum time delay of this input.
Transmit as multicast	Select this checkbox to enable the transmission of this stream's outputs as multicast. A ZEC receiver that will pull the stream will receive it in multicast. By default ZEC is configured to allow transparent fallback to unicast if it is out of the LAN. Requires enabling Multicast Pull in the Settings.
Multicast Only (for Multicast enabled)	Select the check box to force only Multicast outputs.
Enable Encryption	Select this checkbox to encrypt the Input stream. For more information, see **Encrypting an Input Stream in** .

Adding Input Streams

Encryption type (for Encryption enabled)	Specify the type of Encryption (AES 128/192/256).
Encryption key (for Encryption enabled)	Click **Generate** to generate an encryption key. The generated encryption key must be sent to the end-user to decipher the received encoded stream.
Recording parameters	Select this checkbox to customize the recording parameters.
Destination Type	Select the radio button for the desired storage type and then fill in the relevant parameters. • **Record to disk** – the recording is saved on the local disk. It is possible to record to an external destination by replacing the default storage location with a symbolic link. To learn more, see **Using an External Storage** section. • **Record to S3** – the file is saved to your AWS S3 Bucket.
Record to Disk Parameters	
File Name Template	Specify the file name pattern that ZEC will use to generate when saving the recorded content. A separate file will be generated for each recording up to the time specified in the Max recorded file duration parameter (see above). After this duration a new file will be generated. The file name pattern can include any string and up to five variables listed below. Only the %T=HH.MM.SS creation time is mandatory. You can change the order of these variables and add text as long as you maintain the legitimate structure of the file in Linux and Windows: • %S=stream id - optional. • %Y=year - optional • %M=month - optional • %D=day - optional • %T=HH.MM.SS creation time - mandatory For example, the following pattern %Y_recording%T.ts will generate the following file name 2017_recording15:32:35.ts.
Max recorded file duration [hours]	Specify the maximum time allotted for recording a video stream. Default: 2 hours
Keep recorded files for [hours]	Specify the maximum time for storing the recording. Default: 0 hours

Adding Input Streams

Custom Path	Optionally specify a storage location for the recorded files that is relative to the root folder. This location bypasses the location specified as the root folder in the **Settings** > **General** screen.
Record to S3 Parameters	
File Name Template	Specify the file name pattern that ZEC will use to generate when saving the recorded content. A separate file will be generated for each recording up to the time specified in the Max recorded file duration parameter (see above). After this duration a new file will be generated. The file name pattern can include any string and up to five variables listed below. Only the %T=HH.MM.SS creation time is mandatory. You can change the order of these variables and add text as long as you maintain the legitimate structure of the file in Linux and Windows: • %S=stream id - optional. • %Y=year - optional • %M=month - optional • %D=day - optional • %T=HH.MM.SS creation time - mandatory For example, the following pattern %Y_recording%T.ts will generate the following file name 2017_recording15:32:35.ts.
Max recorded file duration [hours]	Specify the maximum time allotted for recording a video stream. Default: 2 hours
URL	Specify the URL of the S3 bucket.
Ignore TLS certificate errors	TLS certificate for S3 bucket might be detected as faulty if bucket name contains dot[s]. When this option is selected, ZEC will ignore the TLS certificate errors and transmit the stream to its destination.
Access Key	The access key that is used for accessing the S3 bucket.
Secret Key	The secret key that is used for accessing the S3 bucket.

Adding Input Streams

Adding HLS Streams

This screen enables ZEC to receive an HLS stream. The HLS stream is not protected by the Zixi protocol. There are two options for pulling the stream:

- **Single source (adaptive bitrate)** - the stream can be an adaptive bitrate stream. In this case, ZEC will pull the main playlist to adapt between bitrates according to network conditions.
- **Multiple sources** - it is possible to pull multiple input streams with static individual bitrates. In this case, ZEC will automatically create a separate input for each bitrate.

➡ **To Add an HLS stream:**

1. In the ZEC Navigation menu, click the **Inputs** tab.
2. In the Menu bar, click **New Input**. The **Add a new input stream** window is displayed.
3. Enter the unique **Stream ID**.

   > Note: this must be identical (case sensitive) to the stream name configured in the ZEC Feeder.

4. Enter the maximum concurrent connections to this stream from the **Max. Outputs** drop-down list. Default: Unlimited.
5. Select the **Show in Matrix** check box to display this stream in the Matrix (see **Using the Matrix**). Default: Selected.

Adding Input Streams

6. Select **HLS** for the input stream.

7. Specify the **Stream Parameters** (see Input Stream Parameters Table below).
8. If you want to **Enable time shift**, select this checkbox (see Input Stream Parameters Table).
9. If you want to **Transmit as multicast**, select this checkbox (see Input Stream Parameters Table).
10. If you want to configure the **Recording Parameters**, specify them in the respective fields (see Input Stream Parameters Table).
11. If you want to **Enable encryption**, select this checkbox (see Input Stream Parameters Table).
12. Click **OK**.
The "Input added" message appears on the top of the screen. The HLS stream is added to ZEC and now appears in the list of streams available in the ZEC inputs UI. If the "multiple sources" option was select, ZEC will automatically create a separate input for each bitrate.

Input Stream Parameters Table

Parameter	Description
Stream Parameters	The general stream settings.

Adding Input Streams

Master Playlist URL	Specify the URL of the HLS stream.
Download Type	Specify whether the variants will be pulled from a single source (adaptive bitrate) or multiple sources (pull all bitrates).
Smoothing Latency	The Smoothing feature uses a buffer to time packets according to the stream's clock. This is useful when there are bursts in the rate in which the stream arrives. The smoothing features creates a queue in the buffer, allowing smoother entry into the ZEC. The Smoothing parameter defines the size of the buffer in Milliseconds. A larger buffer enables smoother entry, however, it may influence the latency rate.
Inject SCTE35 on CUE Marks	Select this checkbox to inject SCTE markers into the adaptive stream manifest. SCTE-35 markers found in the source input will be used to segment the stream and the #EXT-X-CUE-IN/#EXT-X-CUE-OUT tags will be added to the manifest.
Enable time shift	Select this checkbox to record the stream content and broadcast it after a specified delay. To deploy an input stream that uses the current stream's time shift, you need to configure a "Delayed" input stream. (See **Adding Delayed Streams**).
Maximum delay [hh:mm:ss] (for Time Shift enabled)	Specify the maximum time delay of this input.
Transmit as multicast	Select this checkbox to enable the transmission of this stream's outputs as multicast. A ZEC receiver that will pull the stream will receive it in multicast. By default, ZEC is configured to allow transparent fallback to unicast if it is out of the LAN. Requires enabling Multicast Pull in the Settings.
Multicast Only (for Multicast enabled)	If desired, specify multicast only outputs.
Enable Encryption	Select this checkbox to encrypt the Input stream. For more information, see **Encrypting an Input Stream in** .
Encryption type (for Encryption enabled)	Specify the type of Encryption (AES 128/192/256).
Encryption key (for Encryption enabled)	Click **Generate** to generate an encryption key. The generated encryption key must be sent to the end-user to decipher the received encoded stream.
Recording parameters	Select this checkbox to customize the recording parameters.

Adding Input Streams

Destination Type	Select the radio button for the desired storage type and then fill in the relevant parameters. • **Record to disk** – the recording is saved on the local disk. It is possible to record to an external destination by replacing the default storage location with a symbolic link. To learn more, see **Using an External Storage** section. • **Record to S3** – the file is saved to your AWS S3 Bucket.
Record to Disk Parameters	
File Name Template	Specify the file name pattern that ZEC will use to generate when saving the recorded content. A separate file will be generated for each recording up to the time specified in the Max recorded file duration parameter (see above). After this duration a new file will be generated. The file name pattern can include any string and up to five variables listed below. Only the %T=HH.MM.SS creation time is mandatory. You can change the order of these variables and add text as long as you maintain the legitimate structure of the file in Linux and Windows: • %S=stream id - optional. • %Y=year - optional • %M=month - optional • %D=day - optional • %T=HH.MM.SS creation time - mandatory For example, the following pattern %Y_recording%T.ts will generate the following file name 2017_recording15:32:35.ts.
Max recorded file duration [hours]	Specify the maximum time allotted for recording a video stream. Default: 2 hours
Keep recorded files for [hours]	Specify the maximum time for storing the recording. Default: 0 hours
Custom Path	Optionally specify a storage location for the recorded files that is relative to the root folder. This location bypasses the location specified as the root folder in the **Settings** > **General** screen.
Record to S3 Parameters	
File Name Template	Specify the file name pattern that ZEC will use to generate when saving the recorded content. A separate file will be generated for each recording up to the time specified in the Max recorded file duration parameter (see above). After this duration a new file will be generated.

	The file name pattern can include any string and up to five variables listed below. Only the %T=HH.MM.SS creation time is mandatory. You can change the order of these variables and add text as long as you maintain the legitimate structure of the file in Linux and Windows:

- %S=stream id - optional.
- %Y=year - optional
- %M=month - optional
- %D=day - optional
- %T=HH.MM.SS creation time - mandatory

For example, the following pattern %Y_recording%T.ts will generate the following file name 2017_recording15:32:35.ts.

Max recorded file duration [hours]	Specify the maximum time allotted for recording a video stream. Default: 2 hours
URL	Specify the URL of the S3 bucket.
Ignore TLS certificate errors	TLS certificate for S3 bucket might be detected as faulty if bucket name contains dot[s]. When this option is selected, ZEC will ignore the TLS certificate errors and transmit the stream to its destination.
Access Key	The access key that is used for accessing the S3 bucket.
Secret Key	The secret key that is used for accessing the S3 bucket.

Adding TS over HTTP (Pull) Streams

In this mode ZEC pulls a Transport Stream over TCP from an HTTP server. In this case, the stream is initiated by your ZEC.

➡ **To Add a TS over HTTP (Pull) Stream:**

1. In the ZEC navigation menu, click the **Inputs** tab.
2. In the Menu bar, click **New Input**. The **Add a new input stream** window is displayed.
3. Enter the unique **Stream ID**.

> Note: this must be identical (case sensitive) to the stream name configured in the ZEC Feeder.

1. Select the maximum concurrent connections to this stream from the **Max. Outputs** drop-down list. Default: Unlimited.
2. Select the **Show in Matrix** checkbox to display this stream in the Matrix (see **Using the Matrix**). Default: Selected.
3. Select **TS over HTTP** for the input stream.

Adding Input Streams

4. In the **Type** field, select **Pull**.

5. Specify the **Stream Parameters** (see Input Stream Parameter table).
6. If you want to **Enable time shift**, select this checkbox (see Input Stream Parameter table). The stream will be recorded and broadcasted after the specified delay. The time shift feature is typically used to broadcast a live event across time zones (due to the time differences between locations).
7. If you want to **Transmit as multicast**, select this checkbox (see Input Stream Parameter table).
8. If you want to **Enable encryption**, select this checkbox (see Input Stream Parameters Table).
9. If you want to configure the **Recording Parameters**, specify them in the respective fields (see Input Stream Parameter table).
10. Click **OK**.

Input Stream Parameters table

Parameter	Description
Stream Parameters	The general stream settings.
TS URL	Enter the URL of the Transport Stream.

Adding Input Streams

Smoothing	The Smoothing feature uses a buffer to time packets according to the stream's clock. This is useful when there are bursts in the rate in which the stream arrives. The smoothing features creates a queue in the buffer, allowing smoother entry into ZEC. The Smoothing parameter defines the size of the buffer in Milliseconds. A larger the buffer enables smoother entry. However, it may influence the latency rate.
Enable time shift	Select this checkbox to record the stream content and broadcast it after a specified delay. To deploy an input stream that uses the current stream's time shift, you need to configure a "Delayed" input stream. (See **Adding Delayed Streams**).
Maximum delay [hh:mm:ss] (for Time Shift enabled)	Specify the time of a delayed transmission of this stream. Maximum: 24 hours
Transmit as multicast	Select this checkbox to enable the transmission of this stream's outputs as multicast. A ZEC that will pull the stream will receive it in multicast. By default, ZEC is configured to allow transparent fallback to unicast if it is out of the LAN. Requires enabling **Multicast Pull** in the **Settings**.
Multicast-Only (for multicast enabled)	If desired, specify multicast-only outputs.
Enable Encryption	Select this checkbox to encrypt the Input stream. For more information, see **Encrypting an Input Stream in** .
Encryption type (for Encryption enabled)	Specify the type of Encryption (AES 128/192/256).
Encryption key (for Encryption enabled)	Click Generate to generate an encryption key. The generated encryption key must be sent to the end-user to decipher the received encoded stream.
Recording parameters	Select this checkbox to customize the recording parameters.
Destination Type	Select the radio button for the desired storage type and then fill in the relevant parameters. • **Record to disk** – the recording is saved on the local disk. It is possible to record to an external destination by replacing the default storage location with a symbolic link. To learn more, see **Using an External Storage** section. • **Record to S3** – the file is saved to your AWS S3 Bucket.

Adding Input Streams

Record to Disk Parameters	
File Name Template	Specify the file name pattern that ZEC will use to generate when saving the recorded content. A separate file will be generated for each recording up to the time specified in the Max recorded file duration parameter (see above). After this duration a new file will be generated. The file name pattern can include any string and up to five variables listed below. Only the %T=HH.MM.SS creation time is mandatory. You can change the order of these variables and add text as long as you maintain the legitimate structure of the file in Linux and Windows: • %S=stream id - optional. • %Y=year - optional • %M=month - optional • %D=day - optional • %T=HH.MM.SS creation time - mandatory For example, the following pattern %Y_recording%T.ts will generate the following file name 2017_recording15:32:35.ts.
Max recorded file duration [hours]	Specify the maximum time allotted for recording a video stream. Default: 2 hours
Keep recorded files for [hours]	Specify the maximum time for storing the recording. Default: 0 hours
Custom Path	Optionally specify a storage location for the recorded files that is relative to the root folder. This location bypasses the location specified as the root folder in the **Settings** > **General** screen.
Record to S3 Parameters	

File Name Template	Specify the file name pattern that ZEC will use to generate when saving the recorded content. A separate file will be generated for each recording up to the time specified in the Max recorded file duration parameter (see above). After this duration a new file will be generated.
	The file name pattern can include any string and up to five variables listed below. Only the %T=HH.MM.SS creation time is mandatory. You can change the order of these variables and add text as long as you maintain the legitimate structure of the file in Linux and Windows:
	• %S=stream id - optional.
	• %Y=year - optional
	• %M=month - optional
	• %D=day - optional
	• %T=HH.MM.SS creation time - mandatory
	For example, the following pattern %Y_recording%T.ts will generate the following file name 2017_recording15:32:35.ts.
Max recorded file duration [hours]	Specify the maximum time allotted for recording a video stream. Default: 2 hours
URL	Specify the URL of the S3 bucket.
Ignore TLS certificate errors	TLS certificate for S3 bucket might be detected as faulty if bucket name contains dot[s]. When this option is selected, ZEC will ignore the TLS certificate errors and transmit the stream to its destination.
Access Key	The access key that is used for accessing the S3 bucket.
Secret Key	The secret key that is used for accessing the S3 bucket.

Adding TS over HTTP (Push) Streams

In this mode ZEC will receive a Transport Stream over TCP from an HTTP server. In this case, the stream is initiated by the source HTTP Server, while ZEC remains in "listening mode" until the stream (with the specified stream ID) is initiated.

➡ **To Add a TS over HTTP (Push) Stream:**

1. In the ZEC Navigation menu, click the **Inputs** tab.
2. In the **Menu** bar, click **New Input**. The **Add a new input stream** window is displayed.
3. Enter the unique **Stream ID** for ZEC.

> Note: this must be identical (case sensitive) to the stream name configured in the ZEC Feeder.

Adding Input Streams

4. Select the maximum concurrent connections to this stream from the **Max. Outputs** drop-down list. Default: Unlimited.
5. Select the **Show in Matrix** checkbox to display this stream in the Matrix (see **Using the Matrix**). Default: Selected.
6. Select **TS over HTTP** for the input stream
7. In the **Type** field, select **Push**.

8. Specify the **Stream Parameters** (see Input Stream Parameters Table below).
9. If you want to **Enable time shift**, select this checkbox (see Input Stream Parameter Table below). The stream will be recorded and broadcasted after the specified delay. The time shift feature is typically used to broadcast a live event across time zones (due to the time differences between locations).
10. If you want to **Transmit as multicast**, select this checkbox (see Input Stream Parameter Table).
11. If you want to **Enable encryption**, select this checkbox (see Input Stream Parameters Table).
12. If you want to record the stream, you can configure the **Recording Parameters** (see Input Stream Parameter Table).
13. Click **OK**.

Adding Input Streams

Input Stream Parameters Table

Parameter	Description
Stream Parameters	The general stream settings.
Smoothing	The Smoothing feature uses a buffer to time packets according to the stream's clock. This is useful when there are bursts in the rate in which the stream arrives. The smoothing features creates a queue in the buffer, allowing smoother entry into ZEC. The Smoothing parameter defines the size of the buffer in Milliseconds. A larger buffer enables smoother entry, however, it may influence the latency rate.
User	If the stream is password protected, enter the username to access the stream.
Password	If the stream is password protected, enter the password.
Enable time shift	Select this checkbox to record the stream content and broadcast it after a specified delay. To deploy an input stream that uses the current stream's time shift, you need to configure a "Delayed" input stream. (See **Adding Delayed Streams**).
Maximum delay [hh:mm:ss]	Specify the time of the delayed transmission of this stream. Maximum: 24 hours.
Transmit as multicast	Select this checkbox to enable the transmission of this stream's outputs as multicast. A ZEC receiver that will pull the stream will receive it in multicast. By default, ZEC is configured to allow transparent fallback to unicast if it is out of the LAN. Requires enabling **Multicast Pull** in the **Settings**.
Multicast Only	Selecting this checkbox will force the transmission of this stream only in multicast.
Enable Encryption	Select this checkbox to encrypt the Input stream. For more information, see **Encrypting an Input Stream in** .
Encryption type (for Encryption enabled)	Specify the type of Encryption (AES 128/192/256).
Encryption key (for Encryption enabled)	Click Generate to generate an encryption key. The generated encryption key must be sent to the end-user to decipher the received encoded stream.
Recording parameters	Select this checkbox to customize the recording parameters.

Adding Input Streams

Destination Type	Select the radio button for the desired storage type and then fill in the relevant parameters. • **Record to disk** – the recording is saved on the local disk. It is possible to record to an external destination by replacing the default storage location with a symbolic link. To learn more, see **Using an External Storage** section. • **Record to S3** – the file is saved to your AWS S3 Bucket.
Record to Disk Parameters	
File Name Template	Specify the file name pattern that ZEC will use to generate when saving the recorded content. A separate file will be generated for each recording up to the time specified in the Max recorded file duration parameter (see above). After this duration a new file will be generated. The file name pattern can include any string and up to five variables listed below. Only the %T=HH.MM.SS creation time is mandatory. You can change the order of these variables and add text as long as you maintain the legitimate structure of the file in Linux and Windows: • %S=stream id - optional. • %Y=year - optional • %M=month - optional • %D=day - optional • %T=HH.MM.SS creation time - mandatory For example, the following pattern %Y_recording%T.ts will generate the following file name 2017_recording15:32:35.ts.
Max recorded file duration [hours]	Specify the maximum time allotted for recording a video stream. Default: 2 hours
Keep recorded files for [hours]	Specify the maximum time for storing the recording. Default: 0 hours
Custom Path	Optionally specify a storage location for the recorded files that is relative to the root folder. This location bypasses the location specified as the root folder in the **Settings > General** screen.
Record to S3 Parameters	

Adding Input Streams

File Name Template	Specify the file name pattern that ZEC will use to generate when saving the recorded content. A separate file will be generated for each recording up to the time specified in the Max recorded file duration parameter (see above). After this duration a new file will be generated. The file name pattern can include any string and up to five variables listed below. Only the %T=HH.MM.SS creation time is mandatory. You can change the order of these variables and add text as long as you maintain the legitimate structure of the file in Linux and Windows: • %S=stream id - optional. • %Y=year - optional • %M=month - optional • %D=day - optional • %T=HH.MM.SS creation time - mandatory For example, the following pattern %Y_recording%T.ts will generate the following file name 2017_recording15:32:35.ts.
Max recorded file duration [hours]	Specify the maximum time allotted for recording a video stream. Default: 2 hours
URL	Specify the URL of the S3 bucket.
Ignore TLS certificate errors	TLS certificate for S3 bucket might be detected as faulty if bucket name contains dot[s]. When this option is selected, ZEC will ignore the TLS certificate errors and transmit the stream to its destination.
Access Key	The access key that is used for accessing the S3 bucket.
Secret Key	The secret key that is used for accessing the S3 bucket.

Adding RIST Streams

This enables ZEC to receive a RIST stream. RIST seeks to provide reliable, high performance media transport by using UDP at the transport layer to avoid the inefficiencies of TCP, then layering on top Forward Error Correction and Retransmits to add the reliability inherently absent from UDP. ZEC supports RIST streams from any compliant RIST device.
ZEC supports the following RIST profiles:

- **Simple Profile** - The RIST Simple Profile provides best-in-class packet protection, as well as support for multi-link bonding and seamless switching.
- **Main Profile** – The RIST Main Profile builds upon the features of the Simple Profile to provide backwards compatibility, while opening the door for additional features, including the use of industry-standard DTLS with a variety of available cyphers to ensure the most up-to-date protection, while being flexible to accommodate local legal regulations. Support for pre-shared keys is also included, which makes RIST Main Profile compatible with one-to-many environments such as satellite or multicast distribution

Contact your ZEC representative to learn more about interoperability testing between ZEC and 3rd party devices. More details about RIST can be found at www.rist.tv

➡ **To Add a RIST Stream:**

1. In the ZEC Navigation menu, click the **Inputs** tab.
2. In the Menu bar, click **New Input**. The **Add a new input stream** window is displayed.
3. Enter the unique **Stream ID.**

> Note this must be identical (case sensitive) to the stream name configured at the source (e.g. ZEC Feeder).

4. Select the maximum concurrent connections to this stream from the **Max. Outputs** drop-down list. Default: Unlimited.
5. Select the **Show in Matrix** check box to display this stream in the Matrix (see **Using the Matrix**). Default: Selected.

Adding Input Streams

6. Select **RIST** for the input stream.

7. Specify the **Stream Parameters** (see Input Stream Parameters Table).
8. If you want to **Enable time shift**, select this checkbox (see Input Stream Parameters Table).
9. If you want to **Transmit as multicast**, select this checkbox (see Input Stream Parameters Table).
10. If you want to configure the **Recording Parameters**, specify them in the respective fields (see Input Stream Parameters Table).
11. If you want to **Enable encryption**, select this checkbox (see Input Stream Parameters Table). For more information, see **Encrypting an Input Stream in .**
12. Click **OK**.
   The "Input added" message appears on the top of the screen. The RIST Stream f is added to the ZEC and now appears in the list of streams available in the ZEC inputs UI.

Input Stream Parameters Table

Parameter	Description
Stream Parameters	The general stream settings.

Adding Input Streams

Profile	Select one of the following RIST profiles that matches the input stream: • Simple Profile (default) • Main Profile
Simple Profile Parameters	
Local Port	Specify the port to listen on. This port must be open on all firewalls between the ZEC and other devices it is communicating with.
Multicast IP	If multicast, type the Multicast IP address (or leave blank in the case of Unicast).
SSM Source	Specify the source IP for a source-specific multicast.
Remote Port	Specify the remote port in the source RIST device. Default: 0 (any port)
Type	Select one of the following protocol types from the drop-down list: • RTP • RTP + SMPTE 2022 FEC
Bind to IP	Select from the drop-down list the local IP address to be used for this Input, OR select *Any* to enable any IP to be used.
Max. bitrate [kbps]	Specify the maximum expected bitrate for memory allocation. Recommended: 2X the actual bitrate, which will prevent buffer overruns (especially with VBR streams). Default: 8000. Note – Overflows will typically occur when the Max Bitrate isn't sufficient.
Max Latency [ms]	Specify the maximum latency of the stream in milliseconds. Default: 1000
Main Profile – Push Parameters	
Local Port	Specify the port to listen on. This port must be open on all firewalls between the ZEC and other devices it is communicating with.
Multicast IP	If multicast, type the Multicast IP address (or leave blank in the case of Unicast).
SSM Source	Specify the source IP for a source-specific multicast.
Remote Port	Specify the remote port in the source RIST device. Default: 0 (any port)
Type	Select one of the following protocol types from the drop-down list: • RTP • RTP + SMPTE 2022 FEC
Bind to IP	Select from the drop-down list the local IP address to be used for this Input, OR select *Any* to enable any IP to be used.

Adding Input Streams

Max. bitrate [kbps]	Specify the maximum expected bitrate for memory allocation. Recommended: 2X the actual bitrate, which will prevent buffer overruns (especially with VBR streams). Default: 8000. Note – Overflows will typically occur when the Max Bitrate isn't sufficient.
Max Latency [ms]	Specify the maximum latency of the stream in milliseconds. Default: 1000
Use DTLS	Select this checkbox to encrypt the stream dynamically using DTLS.
Main Profile – Pull Parameters	
Remote Host	Specify the IP Address of the remote RIST device from which the stream will be pulled.
Remote Port	Specify the port of the remote RIST device from which the stream will be pulled. Default: 0 (any port)
Local Port	Specify the local port to which the stream will be pulled. Default: 0 (any port)
Type	Select one of the following protocol types from the drop-down list: • RTP • RTP + SMPTE 2022 FEC
Bind to IP	Select from the drop-down list the local IP address to be used for this Input, OR select *Any* to enable any IP to be used.
Max. bitrate [kbps]	Specify the maximum expected bitrate for memory allocation. Recommended: 2X the actual bitrate, which will prevent buffer overruns (especially with VBR streams). Default: 8000. Note – Overflows will typically occur when the Max Bitrate isn't sufficient.
Max Latency [ms]	Specify the maximum latency of the stream in milliseconds. Default: 1000.
Use DTLS	Select this checkbox to encrypt the stream dynamically using DTLS.
Enable time shift	Select this checkbox to record the stream content and broadcast it after a specified delay. To deploy an input stream that uses the current stream's time shift, you need to configure a "Delayed" input stream. (See **Adding Delayed Streams**).
Maximum delay [hh:mm:ss] (for Time Shift enabled)	Specify the maximum time delay of this input.
Transmit as multicast	Select this checkbox to enable the transmission of this stream's outputs as multicast. A ZEC receiver that will pull the stream will receive it in multicast. By default ZEC is configured to allow transparent fallback to unicast if it is out of the LAN. Requires enabling Multicast Pull in the Settings.

Adding Input Streams

Multicast-Only (for multicast enabled)	Selecting this checkbox will force the transmission of this stream only in multicast.
Enable Encryption	Select this checkbox to encrypt the Input stream. For more information, see **Encrypting an Input Stream in .**
Encryption type (for Encryption enabled)	Specify the type of Encryption (AES 128/192/256).
Encryption key (for Encryption enabled)	Click **Generate** to generate an encryption key. The generated encryption key must be sent to the end-user to decipher the received encoded stream.
Recording parameters	Select this checkbox to customize the recording parameters.
Destination Type	Select the radio button for the desired storage type and then fill in the relevant parameters. • **Record to disk** – the recording is saved on the local disk. It is possible to record to an external destination by replacing the default storage location with a symbolic link. To learn more, see **Using an External Storage** section. • **Record to S3** – the file is saved to your AWS S3 Bucket.
Record to Disk Parameters	
File Name Template	Specify the file name pattern that ZEC will use to generate when saving the recorded content. A separate file will be generated for each recording up to the time specified in the Max recorded file duration parameter (see above). After this duration a new file will be generated. The file name pattern can include any string and up to five variables listed below. Only the %T=HH.MM.SS creation time is mandatory. You can change the order of these variables and add text as long as you maintain the legitimate structure of the file in Linux and Windows: • %S=stream id - optional. • %Y=year - optional • %M=month - optional • %D=day - optional • %T=HH.MM.SS creation time - mandatory For example, the following pattern %Y_recording%T.ts will generate the following file name 2017_recording15:32:35.ts.
Max recorded file duration [hours]	Specify the maximum time allotted for recording a video stream. Default: 2 hours

Adding Input Streams

Keep recorded files for [hours]	Specify the maximum time for storing the recording. Default: 0 hours
Custom Path	Optionally specify a storage location for the recorded files that is relative to the root folder. This location bypasses the location specified as the root folder in the **Settings** > **General** screen.
Record to S3 Parameters	
File Name Template	Specify the file name pattern that ZEC will use to generate when saving the recorded content. A separate file will be generated for each recording up to the time specified in the Max recorded file duration parameter (see above). After this duration a new file will be generated.
	The file name pattern can include any string and up to five variables listed below. Only the %T=HH.MM.SS creation time is mandatory. You can change the order of these variables and add text as long as you maintain the legitimate structure of the file in Linux and Windows:
	• %S=stream id - optional.
	• %Y=year - optional
	• %M=month - optional
	• %D=day - optional
	• %T=HH.MM.SS creation time - mandatory
	For example, the following pattern %Y_recording%T.ts will generate the following file name 2017_recording15:32:35.ts.
Max recorded file duration [hours]	Specify the maximum time allotted for recording a video stream. Default: 2 hours
URL	Specify the URL of the S3 bucket.
Ignore TLS certificate errors	TLS certificate for S3 bucket might be detected as faulty if bucket name contains dot[s]. When this option is selected, ZEC will ignore the TLS certificate errors and transmit the stream to its destination.
Access Key	The access key that is used for accessing the S3 bucket.
Secret Key	The secret key that is used for accessing the S3 bucket.

Viewing Existing Input Streams

The **Inputs** screen displays all the input streams that have been created. At the bottom of the screen you can also view accumulative utilization statistics for any connected streams selected. Hovering the cursor on the status indicator of a stream will provide you with the stream configuration information and basic utilization statistics, where applicable.

Any of the columns in the following table can be sorted in ascending/descending order by clicking on its heading. The Search text box in the upper left-hand side of the screen can be used to search for a specific input stream by entering the desired Stream ID.

Field	Description
Status	Displays the status of input stream. The following colored indicators are displayed: • Green = Connected

	• Yellow = Connecting
	• Red = Disconnected with an error condition
	• Blue = Offline with no connection attempts
	• Grey = Offline and stopped
ID	Displays the unique ID of the stream, as defined in ZEC.
Type	Displays the type of input stream.
Source	Displays the source host and port number.
Bitrate [kbps]	Displays bitrate of the connected input stream.
Uptime	Displays the amount of time the stream has been active.
TR 101 209	Displays if the Analyzer is active and the streams that are being analyzed according to the TR101 protocol. **P1** and **P2** are error priorities.
Error	Displays connection and transmission errors.
Outputs	Displays the amount of outputs currently configured for this input stream.
Actions	Provides access to various actions to be performed on this input stream (see **ZEC Actions on Input Streams**).

Viewing Stream Statistics

You can view all the accumulative statistics for a connected input stream in real-time. It is possible to reset the counters by clicking **Reset**. The statistics may differ between the various stream types.

➡ **To View Stream Statistics:**

1. On the Inputs page of ZEC, click the desired input stream for which you want to view statistics for. The stream's statistics are displayed on the bottom of the screen.

Field	Description
Bitrate (kbps)	Displays the current bitrate of the input stream.
Uptime	Displays the amount of time the stream has been active.
Reconnections	Displays the number of reconnection attempts.

Viewing Stream Statistics

Total Packets	Displays the total number of packets that have been transmitted.
Packet Rate	Displays the current number of packets per second.
Remuxing Resets	Remuxing resets can occur when remuxing to CBR (i.e value of 'Remux to bitrate' field is set). In this case, the value is not high enough to remux the video+audio+other PIDs data. A possible solution is to increase value of the 'Remux to bitrate' parameter.
Remuxing Overflows	This indicates that the multiplexer internal queues are full.
Smoothing Drops	The Smoothing feature uses a buffer to time packets according to the stream's clock. This is useful when there are bursts in the rate in which the stream arrives. The smoothing drops indicator indicates that the stream is too "bursty".
RTT (ms)	Displays the Round Trip Time (RTT) from the source (in milliseconds).
Jitter (ms)	Displays the current Jitter, measured in milliseconds.
Latency (ms)	Displays the stream latency configured on the source Feeder.
Total Packets	Displays the total number of packets that have been transmitted.
Packet Rate	Displays the current number of packets per second.
Packet Loss %	Displays current percentage of the packets that were dropped on route from the source.
Dropped Packets	Displays the total number of packets dropped between the Feeder and ZEC since the beginning of the stream.
Recovered Packets	Displays the number of dropped packets that have been recovered since the beginning of the stream.
Non Recovered Packets	Displays the number of non-recovered packets.
FEC Packets	Displays the number of FEC packets transmitted.
FEC Recovered	Displays the number of FEC packets recovered.
ARQ Requests	Displays the number of requests for retransmission of dropped packets made with ARQ.
ARQ Recovered	Displays the number of dropped packets recovered via ARQ.
ARQ Duplicates	Displays the number of duplicate recovery packets received via ARQ.
Overflows	The number of packets lost due to buffer overflow. **Note:** Overflow is usually the result of the Max Bitrate being too low.

ZEC Inputs

Searching for Input Streams

Searching for Input Streams

➡ **To Search for an Input Stream:**

1. In the **Inputs** page of ZEC, type in the specific input stream name in the search text box

   on the left- hand top of the screen and click [🔍] .

2. The **Input** screen displays the requested output stream(s).

ZEC Actions on Input Streams

Every stream has a shortcut button that can be used to perform relevant actions on the stream. The following actions can be performed through the Actions button:

- Adding Analysis to the Input Stream
- Recording the Input Stream
- Stopping/Starting the Input Stream
- Deleting Input Streams from ZEC
- Editing Input Settings or Duplicating Input Streams
- Playing Input Streams with Players
- Add Output
- Traceroute

Stopping/Starting the Input Stream

You can start or stop the input stream at any time.

➡ **To Stop/Start the Input Stream:**

1. On the **Inputs** page of ZEC, click the desired row of the input stream that you want to stop.

2. Click the [⚙▾] button on the right end of the selected row and then **Stop**. The selected row which was a Connected Input Stream is no longer displayed and appears below as **Offline**.
   To continue the Input Stream click **Start** from the same menu.

Editing Input Settings or Duplicating Input Streams

➡ **To Edit the Configuration of an Input Stream:**

1. In the ZEC **Inputs** page, click the desired input stream that you want to edit.

ZEC Actions on Input Streams

2. Click ⚙️▾ button on the right end of the selected row and then **Edit**. The Edit input stream name window is displayed. You can modify any of the settings.

Click **OK**. The new settings will take effect.

➡ **To Duplicate the Configuration of an Input Stream:**

1. In ZEC **Inputs** page, click the desired input stream that you want to duplicate.

2. Click ⚙️▾ button on the right end of the selected row and then **Duplicate**. The **Duplicate input stream name** window with the settings of the original input stream is displayed. You can modify any of these settings.

3. Click **OK**. The duplicate input stream with its new settings will be created.

Deleting Input Streams from ZEC

➡ **To Delete an Input Stream from ZEC:**

1. In the ZEC **Inputs** page, click the desired input stream that you want to delete.

2. Click the ⚙️▾ button on the right end of the selected row and then **Delete**. The message "Are you sure you want to delete input?" is displayed.

127.0.0.1:4444 says: ✕

Are you sure you want to delete input to_bx?

                                                OK   Cancel
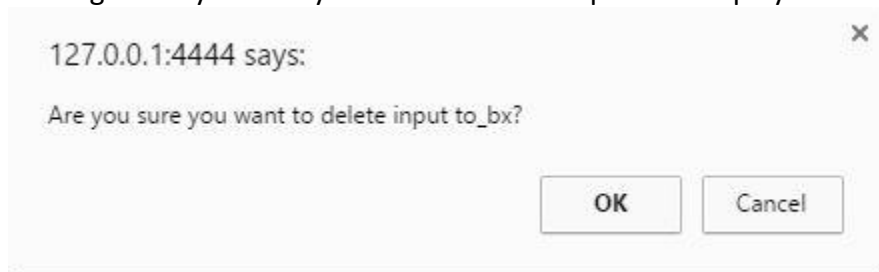
3. Click **OK**. The selected row which was a Connected Input Stream will be deleted.

Recording the Input Stream

You can record an input stream and store it as .TS file. The duration of the time the recording will be kept on the server is defined in the Input Stream configuration. It is possible to record to an external destination by replacing the default storage location with a symbolic link. To learn more, see **Using an External Storage** section.

➡ **To Record the Input Stream:**

1. In the ZEC **Inputs** page, click the desired input stream that you want to record.

2. Click the ⚙️▾ button on the selected row and then choose **Record**. A small red dot appears in the green circle at the left-hand side of the selected row indicating that the input stream is being recorded.
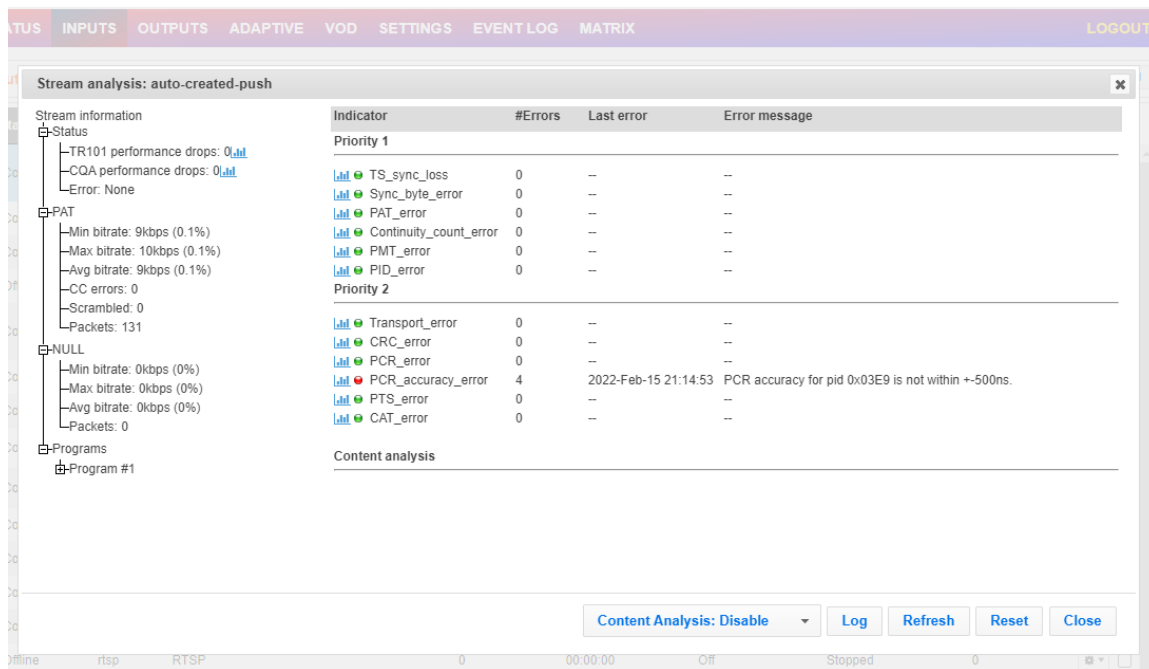
3. Clicking **Stop Recording** will stop the recording of the Input Stream and the newly recorded file will appear in the designated file directory in the **Files** page.

Adding TR101 Analysis to the Input Stream

A TR101 analysis can be added to the input stream for the monitoring of the TS while in operation. The analysis can be used to check the integrity of the TS and the most important elements of the stream. The analysis includes priority 1 and 2. To learn more about TR101 analysis see **TR 101 290 Technical Report**. For more information on ZEC's TR101 analysis, see **Viewing TR101 Analysis**.

➡ **To Add Analysis to the Input Stream:**

1. In the ZEC **Inputs** page, click the stream for which you want to analyze from the input streams UI.

2. Click the ![gear] button on the right end of the selected row and then select **Analyze**. The statuses of a **P1** (high priority error) and **P2** (low priority error) are indicated by an adjacent green or red button displayed in the *TR 101 290* column.
   You can view the detailed analysis of the P1 and P1 errors by clicking on the stethoscope icon ![stethoscope] shown in the TR 101 290 column. The **Stream Analysis** screen is displayed.

3. The following can be done from the **Stream Analysis** screen:
   - **Content Analysis** – shows errors in the audio and video content (i.e. Frozen video, Blank picture, Silent audio, Low video quality and Audio clipping)**.**
   - **Log**- start sending the events of this stream to the event log ('stop logging' will stop the reporting of events).
   - **Refresh** – refreshes the data that is displayed.
   - **Reset** – resets all the field's values to zero.

ZEC Actions on Input Streams

> On the left-hand side of the screen is a stream information tree that displays accumulative statistics regarding the stream. Click the **+** icons to expand the tree.

4. Clicking **Stop Analysis** will discontinue the action.

Add Output

This is an alternative method (shortcut) to adding an output to a specific input stream instead of configuring it through the **Outputs** screen. The available types of outputs are:
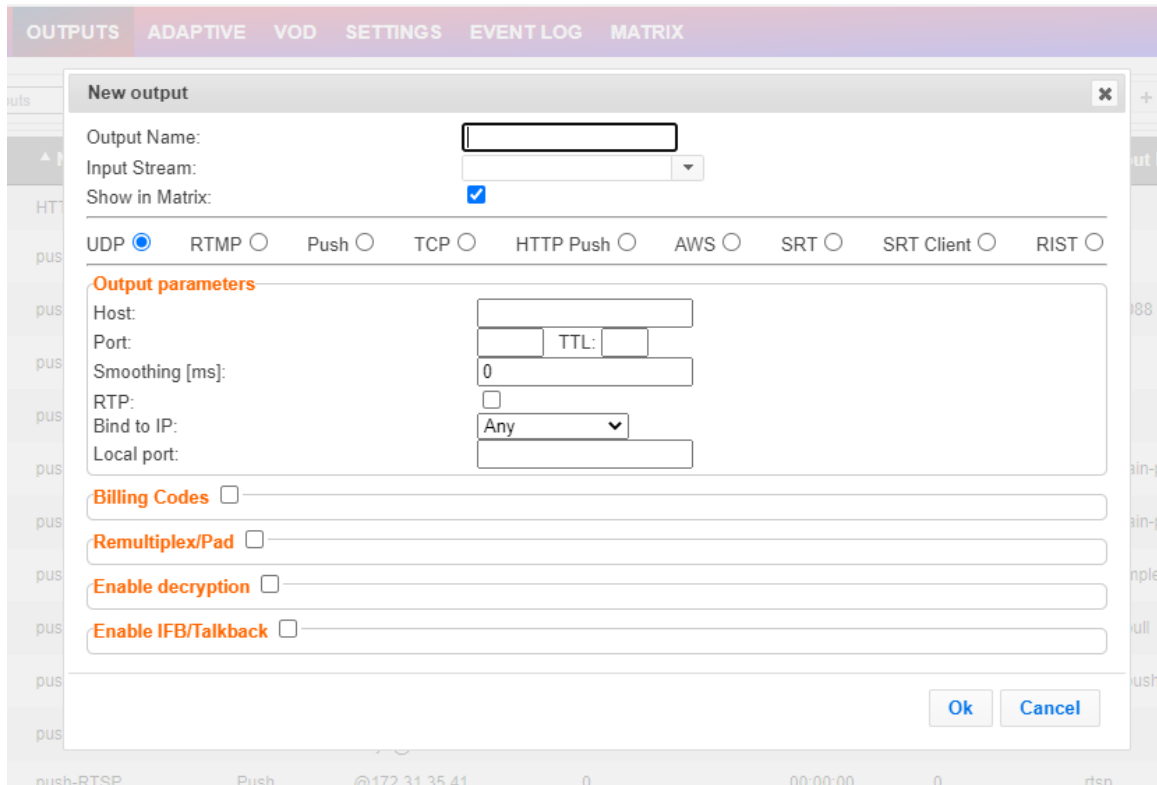
- **UDP** – Target is a UDP or RTP stream, over unicast or multicast.
- **RTMP** – Real Time Messaging Protocol streams can be played on systems that accept this protocol as input. Originally designed to enable Adobe® Flash® streams to be sent between a server and a client, RTMP has become a popular protocol for streaming into content-delivery networks (CDNs).
- **Pull** – Pull streams are Zixi protocol streams destined for ZEC Receivers. In this case, the ZEC can offer status and statistics for a stream that is being pulled from it by another device.
- **Push** – Push streams are Zixi protocol streams destined for other ZEC instances.
- **TCP** – The TCP output can push the stream directly to a TCP socket or to an HTTP server.
- **HTTP Push** – The HTTP Push output stream can be encapsulated in HLS or DASH. The source of the output stream is a predefined adaptive group that has been configured in the **Adaptive Groups** screen. The configuration of the stream includes the option to delete outdated stream fragments on the server. Output streams can be pushed to one ZEC instance.
- **AWS** – The HTTP output stream (HLS or DASH) can be pushed to an AWS S3 Bucket or too an Elemental MediStore. The native S3 support includes the ability to configure the S3 authentication credential, including the Region, Access Key, and Secret Key.
- **RIST** – The RIST output stream can be pushed to an external target using Simple or Main Profile over unicast or multicast. The output stream can include Forward Error Correction (SMPTE-2022 FEC).

ZEC Actions on Input Streams

➡ **To Add Output:**

1. In the ZEC Navigation menu, click the **Inputs** tab.

2. Click the Settings button ⚙▾, and then click **New Output**. The **New Output** window with the settings of the selected output stream is displayed.

3. Follow the specific instructions of each output type from one of the following sections:
    *   **Adding UDP Outputs**
    *   **Adding RTMP and RTMPS Outputs**
    *   **Adding Push Outputs**
    *   **Adding TCP Outputs**
    *   **Adding HTTP Push Outputs**
    *   **Adding AWS Outputs**
    *   **Adding RIST Outputs**

Playing Input Streams with Players

You can preview the input streams through the following video players:
- VLC Player
- Flash Player
- Shoutcast

In order to preview an input stream you must first configure its output. See **ZEC Outputs** section for more details.

➡ **To Play Input Streams with a VLC Player:**

1. In the ZEC **Inputs** page, click the desired input stream that you want to play with VLC.
2. Click the [button icon] button on the right end of the selected row and then **Play with VLC.** The **Link Description** window with the directory path for the desired file is displayed.
3. Click **Run VLC.** The selected file is downloaded to the computer.
4. Double-click on the newly downloaded file. This configured file runs using the VLC player and appears on a new output line on the **Output** screen wherein it can be monitored. Alternatively, copy the path and send it to the user so it can be entered in the Network URL of the VLC player.

➡ **To Play Input Streams with a Flash Player:**

Flash Player enables playing the stream on a native browser with the Flash player.
1. In the ZEC **Inputs** page, click the desired input stream that you want to play with Flash Player.
2. Click the [button icon] button on the right end of the selected row and then **Play with Flash.** The **Link Description** window with the directory path and proxy path for the desired file is displayed.
3. Click **Run** to view the .flv file that appears on the first line of the window or **Run Accelerated** to run the file from the proxy server with better results.

➡ **To Play Input Streams with Shoutcast:**

Shoutcast enables playing an audio file on a native browser.
1. In the ZEC **Inputs** page, click the desired input stream that you want to play with Shoutcast.
2. Click the [button icon] button on the right end of the selected row and then **Play with Shoutcast.** The **Link Description** window will open with the directory path for the desired file.

ZEC Actions on Multiple Inputs

Viewing Traceroutes

For streams sent from a ZEC Feeder (v13 and above) to a ZEC (v13 and above), you can view traceroute data for the stream.

➡ **To view traceroute data:**

1. On the **Inputs** page of ZEC, click on the row of the input stream for which you want to view traceroutes.

2. Click the button on the right end of the selected row and then select **Trace**.

3. The traceroute data for this stream is displayed.
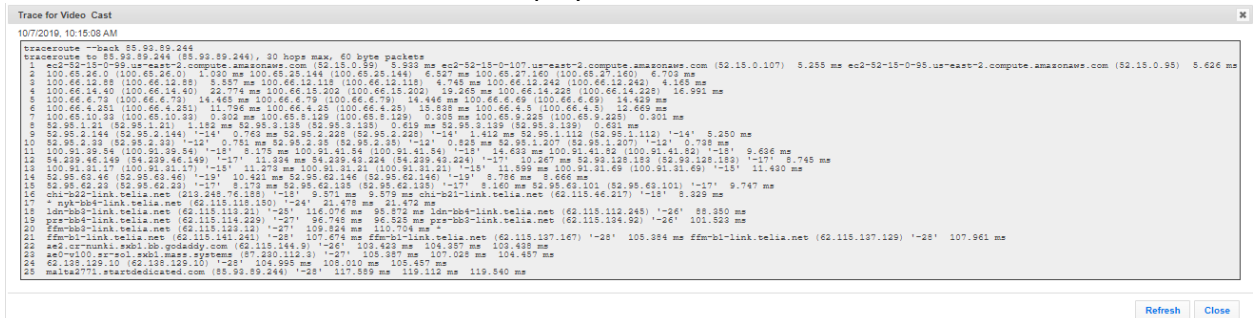
4. You can refresh the Traceroute data at any time by clicking the **Refresh** button.

ZEC Actions on Multiple Inputs

In the Inputs screen, you can perform actions on multiple or all input streams at once by selecting them using the check boxes and then clicking the Marked drop-down menu.
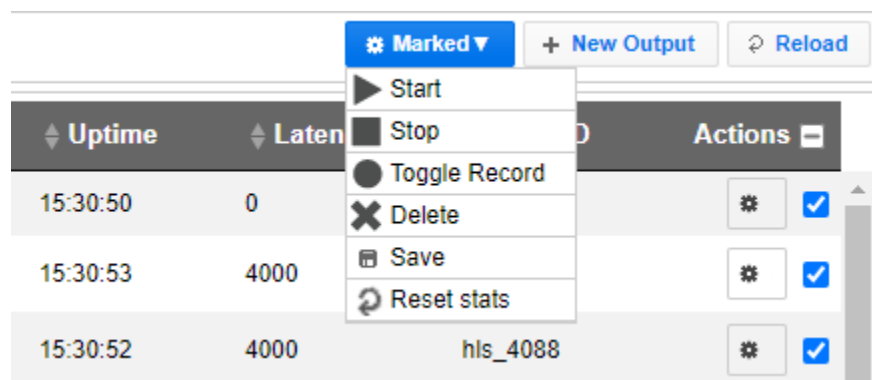
The actions include the following:

Starting and Stopping Multiple Input Streams

You can Start/Stop multiple streams.

ZEC Actions on Multiple Inputs

➡ **To Start/Stop multiple Input Streams:**

1. In the ZEC Inputs screen, select the relevant Inputs by selecting the checkboxes
2. Click the Marked drop-down menu and then click **Stop** or **Start**.
   The selected input streams will be started/stopped.

Deleting Multiple Input Streams

➡ **To Delete Multiple Input Streams:**

1. In the ZEC Inputs screen, select the relevant Inputs by selecting the checkboxes.
2. Click the **Marked** drop-down menu and then click **Delete**.
   The following notification appears:
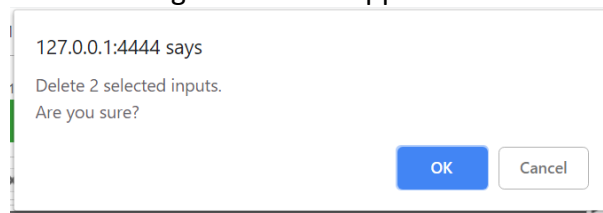
3. Click **OK**.

Saving Multiple Input Streams

➡ **To Save Multiple Input Streams:**

1. In the ZEC Inputs screen, select the relevant Inputs by selecting the checkboxes.
2. Click the **Marked** drop-down menu and then click **Save**.
3. All changes to the input streams are saved.

Resetting Stats for Multiple Input Streams

➡ **To Reset Stats for Multiple Input Streams:**

1. In the ZEC Inputs screen, select the relevant Inputs by selecting the checkboxes.
2. Click the **Marked** drop-down menu and then click **Reset Stats**.
   All accumulated stream statistics are reset.

Creating a Failover Group

ZEC supports failover based on TR-101, CQA, and unrecovered packet errors. The trigger for the failover includes TR-101 P1 and P2 errors, Frozen Video, Blank Picture, Audio Clipping, Bitrate below threshold, and unrecovered packets. Through ZEN Master and through the ZEC API it is possible to combine multiple triggers into a Boolean expression to determine when to the trigger the failover.

ZEC Actions on Multiple Inputs

In addition, ZEC features hitless failover for inputs, enabling undisrupted streaming when switching from one source to another. The hitless failover configuration involves grouping two or more inputs in a "Failover Group". If the inputs are identical (i.e. two or more binary-identical streams with synchronized RTP headers), whenever one of them is disrupted or interrupted completely, ZEC will seamlessly use the packets of the other input without any disruptions by "merging" the streams. The merging of the streams can be achieved using one of the following methods:

- **RTP headers (SMPTE 2022-7)** – if the sources are RTP and the RTP headers were maintained, ZEC will use the SMPTE 2022-7 to compare and merge the two streams in order to allow hitless failover. This option is the most recommended as it will use the sequence and the timestamp in the packets to compare which packets are missing. This method is more accurate than methods that compare the entire payload or methods that use sophisticated DNA sequencing algorithm, which are more error prone, as the payload may have multiple matches.
- **RTP headers or TS content** – if the sources do not have RTP headers, ZEC will try to merge using the MPEG-TS content itself.

> If the streams are not identical, the failover process will not be seamless and may take up to a second.

The following procedure describes how to configure inputs as a Failover Group in ZEC.

➡ **To create a Failover Group:**

1. On the Input screen of ZEC, select the checkboxes of the relevant identical input streams.
2. At the top of the inputs list, click the **Marked** drop-down menu and then click **Failover Group**.

3. The **Create a Failover Group** window opens:
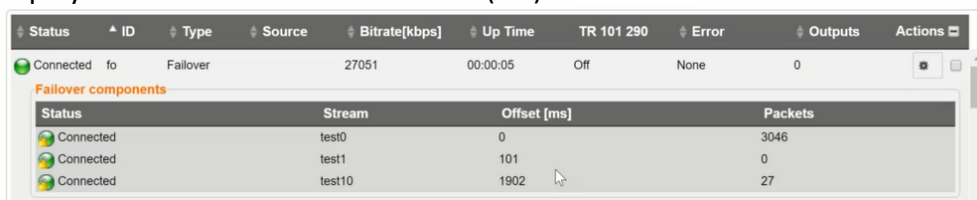
4. In the **Stream ID** field, type a new name for Failover Group. This name will appear in the list of Inputs.
5. In the **Max Outputs** field, type the number of desired concurrent outputs that can use the **Failover Group**. Default: Unlimited.
6. In the **Search Window** field, type the timeframe in which the system can search for the relevant packets in a matching stream. If there is a latency difference between the streams in the group, the **Search Window** value should be higher than the latency difference between the streams. In case the **Merge Mode** is set to **No Merge**, the **Search Window** time specifies how long the stream will wait for packets before attempting to switch between streams.
7. In the **Max Bitrate** field, specify the maximum bitrate of the stream. Default: 8000. This is used for internal memory allocation and will not affect the transmitted bitrate. Recommended: double the bitrate of the highest bitrate stream.
8. In the **Merge mode** field, select one of the following:
   - **No merge** – select this option if you want ZEC to treat the streams as different and not try to merge the streams. In this case, the time period specified in the

> **Search Window** field defines how long the stream will wait for packets before attempting to switch between streams.

- **RTP headers (SMPTE 2022-7)** – select this option if the sources are RTP and the RTP headers were maintained. In this case, ZEC will use the SMPTE 2022-7 to compare and merge the two streams in order to allow hitless failover. This option is the most recommended as it will use the sequence and the timestamp in the packets to compare which packets are missing. This method is more accurate than methods that compare the entire payload or methods that use sophisticated DNA sequencing algorithm, which are more error prone, as the payload may have multiple matches.
- **RTP headers or TS content** – select this option if you are not sure if the sources do have RTP headers. In this case, ZEC will try to merge using RTP and if not, using the MPEG-TS content itself.

9. Under **Candidates**, if you want to configure one or more of the streams as back up, select the checkbox next to the relevant stream. Backup streams will be used only when all the "Primary" streams are down.
10. Configure additional parameters as required.
11. Click **OK**.

    The Failover Group is added to the list of inputs, listing the sub-streams that are part of the group. The system will automatically detect the offset between the sub-streams and display it in milliseconds under Offset (ms).

Status	ID	Type	Source	Bitrate[kbps]	Up Time	TR 101 290	Error	Outputs	Actions
Connected	fo	Failover		27051	00:00:05	Off	None	0	⚙ ☐

Failover components

Status	Stream	Offset [ms]	Packets
Connected	test0	0	3046
Connected	test1	101	0
Connected	test10	1902	27

Encrypting an Input Stream in ZEC

You can encrypt a specific input stream using static key AES scrambling encryption (AES 128, AES 192, AES 256). If the stream has been encrypted at the source, it can be encrypted by ZEC only after its decryption (See: **Decrypting an Input Stream in**). The stream encryption prevents any further processing, such as analysis, transcoding, etc.

➡ **To encrypt an input stream in ZEC:**

1. In **Inputs** screen, click **+New Input**.
2. Select the relevant input type.
3. Fill in the stream parameters.
4. At the bottom, select the **Enable Encryption** checkbox.
5. In the **Encryption Type** field, select **AES 128**, **AES 192**, **AES 256** for fixed encryption.
6. In the **Encryption Key** field, enter your own key or click **Generate** to generate a key by the system. The exact key should be used to decrypt the stream on the other end.

7. Click **OK**.

Decrypting an Input Stream in ZEC

Any stream that has been encrypted using standard AES static key can be decrypted in ZEC. You can configure the decryption of a specific stream by entering the decryption key.

➡ **To decrypt an input stream in ZEC:**

1. In **Inputs** screen, click **+New Input**.
2. Select **Push** or **Pull**.
3. Fill in the input details.
4. At the bottom, select the **Decrypt Stream** checkbox.
5. In the **Decryption Type** field, select **AES 128**, **AES 192**, **AES 256** for fixed key.
6. In the **Decryption Key** field, enter the exact same key that was used to encrypt the stream.

Demuxing an MPTS Stream

7. Click **OK**.

Demuxing an MPTS Stream

MPTS (Multi Program Transport Streams) streams can be demuxed into single SPTS (Single Program Transport Streams) streams. MPTS demuxing is available for Pull, Push, UDP, and File input streams. From the various programs in the MPTS stream, you can select specific programs, which will be turned into induvial SPTS input streams.

➡ **To demux an MPTS stream:**

1. Create a Pull/Push/UDP/File input stream using an MPTS stream.
2. In the **Inputs** page, click the newly created input stream that you want to demux.
3. Click the action ⚙️▾ button on the right end of the selected row and then **Edit**. The Edit input stream name window is displayed.
4. Select the **Demux MPTS** checkbox.
   A list of included programs is displayed.

Demuxing an MPTS Stream

5. Click **Add Program** on the program that you want to create a separate SPTS input stream.
   An **Add Input** screen opens with the new SPTS input details, including a suggested **Stream ID**, the original MPTS as a Source Stream and the relevant **Program** number.

6. In the **Max Bitrate** field, specify the maximum bitrate of the stream. This is used for internal memory allocation and will not affect the transmitted bitrate. Recommended: double the bitrate of the highest bitrate stream.
7. Configure additional parameters as necessary.
8. Click **OK**.
   The channel is assigned an input:

Viewing TR101 Analysis

9. Repeat steps 5-8 to add more programs.
10. Click **OK**.
   The newly created MPTS input stream and the related SPTS input streams will appear in the Inputs list.

Viewing TR101 Analysis

TR101 analysis can be added to an input stream for the monitoring of the TS while in operation. The analysis can be used to check the integrity of the TS, as well as perform content analysis to identify frozen video, blank picture, silent audio, low video quality and audio clipping. The TR101 analysis covers priority 1 and 2 messages.

To enable the TR101 analysis follow the instructions in the **Adding TR101 Analysis to the Input Stream** section. After enabling the analysis, the stream will include the P1 (high priority error) and P2 (low priority error) status, indicating is there are P1 or P2 messages.

To open the analysis window, click the stethoscope ( ) icon.

The TR101 Analysis window includes the following elements:

Viewing TR101 Analysis
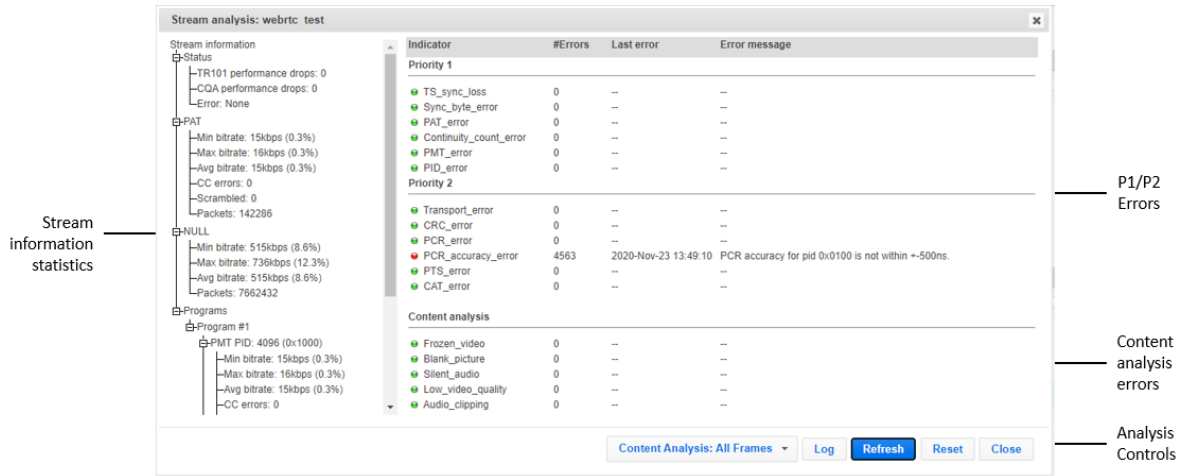
Stream Information Statistics Panel

The stream information statistics panel displays the following accumulative statistics about the stream:

Parameter	Description
Status	
TR101 performance drops	
CQA performance drops	Specify the UDP port to be used for streaming the video.
Error	Specify the UDP port to be used for streaming the audio.
PAT	The Program Association Table (PAT), which only appears in PID 0x0000 packets, tells the decoder what programs are in the TS and points to the Program Map Tables (PMT) which in turn point to the component video, audio and data streams that make up the program. If the PAT is missing then the decoder can do nothing, no program is decodable.
Min bitrate	The minimum bitrate of the PAT packets
Max bitrate	The maximum bitrate of the PAT packets

Viewing TR101 Analysis

Avg bitrate	The average bitrate of the PAT packets
CC errors	Indicates if continuity count errors were found. For this indicator three checks are combined. The preconditions "Incorrect packet order" and "Lost packet" could cause problems for IRD which are not equipped with additional buffer storage and intelligence. It is not necessary for the test equipment to distinguish between these two preconditions as they are logically OR-ed, together with the third precondition, into one indicator.
Scrambled	Indicates if the packet is encrypted.
Packets	The number of packets which are related to the PAT (with the same PID – 0)
NULL	Null (stuffing) packets. In order to ensure that the stream maintains a constant bitrate, a multiplexer may need to insert some additional packets. The PID 0x1FFF is reserved for this purpose. The payload of null packets is all zeroes, and the receiver is expected to ignore its contents. Null packets are indicated by PID 8191 (all 1s)
Min bitrate	The minimum bitrate of the NULL packets
Max bitrate	The maximum bitrate of the NULL packets
Avg bitrate	The average bitrate of the NULL packets
Packets	The number of packets which are related to NULL (with the same PID 8191)
Programs	The Transport Stream can include one program (SPTS) or multiple programs (MPTS). Every program is described by a program map table (PMT). The elementary streams associated with that program have PIDs listed in the PMT. Another PID is associated with the PMT itself.
PMT PID	Indicates the PID number of the program map table PMT
Min bitrate	The minimum bitrate of the packet which is related to the PMT PID
Max bitrate	The maximum bitrate of the packet which is related to the PMT PID
Avg bitrate	The average bitrate of the packet which is related to the PMT PID
CC errors	Indicates if continuity count errors were found in the packets that are related to the PMT PID. For this indicator three checks are combined. The preconditions "Incorrect packet order" and "Lost packet" could cause problems for IRD which are not equipped with additional buffer storage and intelligence. It is not necessary for the test equipment to distinguish between these two preconditions as they are logically OR-ed, together with the third precondition, into one indicator.
Packets	The number of packets which are related to the PMT PID

Viewing TR101 Analysis

PCR PID	Indicated the PID value that includes the program clock reference (PCR). The PCR is used to enable a decoder to present synchronized content, such as audio tracks matching the associated video.
PCR	Indicates the program clock reference (PCR) value.
Accuracy	Indicates the difference between the actual PCR value and the value it should have in the TS represented by the byte index for its actual position. For example, if the calculated PCR (derived from adding the value to the previous packet) is the same as the actual PCR value, the Accuracy value will be '0'.
Deviation	Indicates the frequency deviation.
Delay	Indicates the delay in delivery.
OJ max	Indicates the maximal Overall Jitter, which are variation in delays.
OJ Dev	Indicates the deviation in the overall jitter.
Bitrate	The bitrate of the specific PCR PID packets.
Elementary PIDs	*Below the Elementary PIDs level are all the different programs that are included in the stream.*
Type	The type of program.
Min Bitrate	The minimum bitrate of the packet which is related to the Elementary PID
Max Bitrate	The maximum bitrate of the packet which is related to the Elementary PID
Avg Bitrate	The average bitrate of the packet which is related to the Elementary PID
Declared Bitrate	The bitrate value which that was set on the encoder. (H264 streams only)
HDR Buffer Size	The HRD buffer size that was set on the encoder. (H264 streams only)
CC errors	Indicates if continuity count errors were found in the packets that are related to the Elementary PID.
Scrambled	Indicates if the packet is encrypted. Possible values include: Not scrambled, scrambled with even key, scrambled with odd key.
PIC Timing	Indicates the time as it is appears in the last PIC Timing SEI message. (H264 streams only)
PTS	The Presentation Time Stamp (PTS) that the analyzer has captured on the Element stream. The PTS is only accessible if the TS is not scrambled
DTS	The Decode Time Stamp (DTS) that the analyzer has captures on the Element stream. The Decode Time Stamp (DTS) indicates the time at which an access

Viewing TR101 Analysis

	unit should be instantaneously removed from the receiver buffer and decoded. It differs from the Presentation Time Stamp (PTS) only when picture reordering is used for B pictures. If DTS is used, PTS must also be provided in the bit stream. PTS (or DTS) is entered in the bitstream at intervals not exceeding 700 mS. ATSC further constrains PTS (or DTS) to be inserted at the beginning of each access unit.
Total Bytes	The total amount of bytes that has passed through the current elementary stream. This includes the Transport Stream Headers.
Packets	The total amount of packets that have passed through the current elementary stream.
Width	The frame resolution width setting.
Height	The frame resolution height setting.
FPS	The Frames Per Second setting.
Interlaced	Indicates whether the video is interlaced or not.
Chroma	Indicates the Chroma Subsampling.
CEA-608/708 captions	A counter that shows how many SEI messages with type 4 (user_data_registered_itu_t_t35) were detected so far. (H264 and HEVC streams only)
Frames	Indicates the number of frames. This indicator is enabled when content analysis is turned on.
Content	Indicates the status of the content. This indicator is enabled when content analysis is turned on. Possible values: • Live – indicates that there is a difference between two consecutive frames within a period of 30 seconds. • Frozen video – indicates that there is a single frame that is displayed (frozen). • Blank picture – the entire frame is in one color (e.g. black, white, etc.). • Unknown – this status is displayed during the first 30 seconds of the content analysis.
ePSNR	Estimated PSNR - an estimation of the video quality. values in dB
PSNR	Actual PSNR as calculate by the encoder. available on software transcoded H264 streams only (when user turned it on under the settings tab). values in dB.
Frames	Indicates the number of frames. This indicator is enabled when content analysis is turned on.
Frame Duration	Indicates the maximum, minimum, and average frame duration in milliseconds.

max/min/avg (ms)	
GOP Duration max/min/avg (ms)	Indicates the maximum, minimum, and average GOP duration in milliseconds.
GOP structure	Indicates the GOP structure, by showing the first 10 frame types in the last GOP. For the example, IPBBBPBBBP.

P1/P2 Errors

The P1/P2 errors panel displays data about Priority 1 and Priority 2 errors that were found in the stream during the analysis. The table displays the following information for each error:
- **Indicator** – the indicator for which the error was generated.
- **#Errors** – the total number of errors that were generated.
- **Last error** – the time in which the last error was generated.
- **Error message** – the message that was generated with the error.

The statistics regarding the following Priority 1 and Priority 2 errors are displayed.

Parameter	Description
Priority 1	
TS_sync_loss	Indicates a loss of synchronization with the TS. When 5 sync bytes have been acquired, the decoder is considered synched, but a loss of just 2 sync bytes indicates a loss of sync.
Sync_byte_error	If the sync byte is not equal to 47 hexidecimals, then a sync byte error occurs. The system then looks for the reoccurrence of the sync byte (which must be 47 hexadecimals) every 188 bytes.
PAT_error	The program association table (PAT) is the only packet with packet ID (PID) Hex 0000, and it must occur at least every 0.5s to keep this error from occurring. Every program within the TS is listed in the PAT; if it is missing, then no programs can be decoded
Continuity_count_error	This error occurs when any of the following faults happen — incorrect packet order, a packet occurs more than twice or a packet is lost.
PMT_error	This error can occur if the program map table (PMT) does not come up at least every 0.5s on the PID that is referred to in the PAT.

PID_error	When TSes are remultiplexed, this can occur if any PID doesn't refer to an actual data stream.
Priority 2	
Transport_error	This flag is set in the TS header by the demodulator if it can't correct errors in the stream.
CRC_error	This indicates that a CRC error (data corruption) occurred in any of the following tables — CAT, PAT, PMT, NIT, EIT, BAT, SDT or TOT.
PCR_error	This flag is raised if the primary clock reference (PCR) is not seen for more than 100ms. The time interval between two consecutive PCR values should be no more than 40ms. This type of error can cause the decoder to lose lock on the 27MHz clock.
PCR_accuracy_error	This error can occur when the PCR accuracy of the selected program is outside the range of ±500ns.
PTS_error	This occurs when the presentation time stamp (PTS) repetition is more than 700ms. The PTS is contained in the MPEG-2 program stream and is used to aid the decoder in presenting the program on time, at the correct speed and synchronized. The PTS is compared to the PCR.
CAT_error	This is used for conditional access programs (paid programming).

Content Analysis

The Content Analysis errors panel displays that were found in the stream as part of ZEC's content analysis. To see this table, you must enable the content analysis, by following the instructions in the **Enabling Content Analysis** section. The table displays the following information for each error:

- **Indicator** – the indicator for which the error was generated.
- **#Errors** – the total number of errors that were generated.
- **Last error** – the time in which the last error was generated.
- **Error message** – the message that was generated with the error.

Parameter	Description
Frozen_video	Occurrence of frozen video, i.e. no motion, for a duration of approximately 60s or longer.
Blank_picture	Occurrence of blank frames of any color for a duration of approximately 60s or longer.
Silent_audio	Occurrence of silence (dBFS < -90) on AAC or MPEG audio with a duration of about 30s or longer.

Low_video_quality	The estimated video quality, which is based on the Peak signal-to-noise ratio (PSNR) is below the 20dB threshold and therefore considered as poor.
Audio_clipping	Occurrence of clipped audio upon occurrence on AAC or MPEG audio.

Enabling Content Analysis

ZEC's content analysis can be enabled in two of the following modes:

- **Content Analysis: I-Frames** – The content analysis is performed on I-frames only. This option requires far less processing resources.
- **Content Analysis: All Frames** - The content analysis is performed on all frames. This may require more processing resources.

➡ **To enable content analysis:**

1. Add TR101 Analysis to an input stream. See **Adding TR101 Analysis to the Input Stream**
2. Click the stethoscope icon shown in the TR 101 290 column. The Stream Analysis screen is displayed.
3. On the Stream Analysis screen, select one of the following content analysis options from the Content Analysis drop-down menu:
   - **Content Analysis: I-Frames**
   - **Content Analysis: All Frames**

ZEC Outputs

ZEC supports the following output types:
- **UDP** – Target is a UDP or RTP stream, over unicast or multicast.
- **RTMP** – Real Time Messaging Protocol streams can be played on systems that accept this protocol as input. Originally designed to enable Adobe® Flash® streams to be sent between a server and a client, RTMP has become a popular protocol for streaming into content-delivery networks (CDNs).
- **RTMPS** – RTMP over a TLS/SSL connection.
- **Push Stream** – Push streams are Zixi protocol streams destined for other ZEC instances and "Accept mode" ZEC Receivers.
- **TCP** - TCP protocol provides reliable transmission guarantee for no loss of frame. Its bandwidth probing and congestion control will attempt to use all of the available bandwidth between the server and client, fetching content as quickly as possible while being friendly to other (TCP) traffic on the same links. Output streams can be pushed to one ZEC instance.
- **HTTP Push** - The HTTP Push output stream can be encapsulated in HLS or DASH. The source of the output stream is a predefined adaptive group that has been configured in the **Adaptive Groups** screen. The configuration of the stream includes the option to delete outdated stream fragments on the server. Output streams can be pushed to one ZEC instance.
- **S3 Bucket** - The HTTP output stream (HLS or DASH) can be pushed to an AWS S3 Bucket. The native S3 support includes the ability to configure the S3 authentication credential, including the Region, Access Key, and Secret Key.
- **RIST** - The RIST output can be pushed or have them pulled to/from a RIST-enabled device. RIST seeks to provide reliable, high performance media transport by using UDP at the transport layer to avoid the inefficiencies of TCP, then layering on top Forward Error Correction and Retransmits to add the reliability inherently absent from UDP.
- **SRT** – The SRT output can be pulled to/from an SRT-enabled device and is configured via Zen Master or ZEC API only. SRT stands for 'Secure Reliable Transport' and is an open-source video transport protocol and technology stack. SRT uses secure streams and easy firewall traversal to optimize streaming performance and deliver high-quality video over even the most unreliable networks.

When ZEC pulls a stream, a Pull stream definition is generated automatically in ZEC, the stream is identified in the Name and Destination columns of ZEC with the ID and IP address of the ZEC instance that pulls the stream.

Automated Output Configuration with Output Templates
Instead of manually creating an output and then connecting the output to an input, you can define output templates with rules for automatic creation of outputs with predefined settings. The template includes an Input pattern. When an input pattern matches the pattern of an

Adding Outputs

incoming input stream, the output is created automatically. For more information about Output Templates, see **Using Output Templates**.

Adding Outputs

ZEC enables you to add various types of outputs. When you create a new output, select the output type and then fill in the fields that are applicable for that output type.

Adding UDP Outputs

This enables ZEC to send a UDP stream. The UDP stream is not protected by the Zixi protocol. The UDP streams can be one of the following types:
- UDP – plain UDP
- RTP – Real-Time Transport Protocol
- RTP + SMPTE 2022 FEC - SMPTE 2022 standard with Forward Error Correction

➡ **To Create a UDP Output:**

1. In the ZEC **Outputs** page, click + New Output . The **New output** window is displayed.

2. Type in the unique identifier for this output in the **Output Name**.

Adding Outputs

3. Select an **Input Stream** to be made available on this output from the drop-down list.
4. Select the **Show in Matrix** check box to display this stream in the Matrix (see Using the Matrix). Default: Selected.
5. Select **UDP**.
6. Specify the **Output parameters** (see Output Stream Parameters Table).
7. In the **Host** field, specify the IP address or URL of the stream destination.
8. In the **Port** field, specify the port of the destination.
9. If you want to remux the stream to CBR (used for professional IRDs) in order to avoid bandwidth waste, select **Remuxing** and configure the respective parameters (see Output Stream Parameters Table).
10. Click **OK**.
    The new UDP Output with its settings is created and now appears on the **Outputs** screen.

Output Stream Parameters Table

Parameter	Description
Output Parameters	
Host	Specify the destination IP address or URL.
Port	Specify the target UDP port.
TTL	Specify the time-to-live (TTL). Used mainly to limit the range (or "scope") of a multicast transmission. Leaving it as blank uses the default value specified by the operating system.
Smoothing [mms]	Enables transmission of the output at the correct rate. Required when the receiving device is sensitive and can't lock on to the stream (in such a case, the recommended latency is 100 - 1000 ms).
RTP	Enables use of the Real-time Transport Protocol.
SMPTE 2022 FEC:	Disables the FEC or specify the type of FEC matrix to D1/ D2. This setting can be modified without interrupting an existing stream. In the SMPTE-2022 FEC standard, 1-D and 2-D parity codes are systematic FEC codes of decent complexity that provide protection against bursty or random losses. To enable SMPTE-2022 FEC (Forward Error Correction) select one of the following parity options from the drop-down menu: • **1D** (single dimension FEC) - SMPTE-2022 1D can fix a problem in ONE packet per row. This means that the number of rows specified should consider the

packet loss rate- the shorter the row, the more error resilience can be achieved on the expense of bitrate level. However, longer rows increase the delay that the FEC will add. It is recommended to select this option when the packet loss is sporadic.
The stream will occupy the source port and two ports above it (e.g. if the source port is 8988, it will occupy 8990).

- **2D** - SMPTE-2022 2D uses a table of packets, which includes rows and columns. This option is more error resilient, but it increases the delay by (row*column) packets and increases the bitrate with R+C packets per each table of R*C packets. It is recommended to select this option when packet loss is bursty. The stream it will occupy four ports above (e.g. if the source port is 8988, it will occupy 8992).

Bind to IP	Select from the drop-down list the local IP address to be used for this Output, OR select *Any* to enable any IP to be used.
Local Port	Specify from which local port to source the stream, if desired (instead of randomly chosen by the operating system).
ReMuxing	Select this checkbox to enable remuxing from VBR MPEG-TS to MPEG-TS CBR (used for professional IRDs).
Remux to bitrate [kbps]:	Specify the CBR bitrate to target for a remuxed stream.
Buffer Size [ms]	Specify the size of the buffer that will be used for the remixing. A larger buffer increases the quality, but also increases latency.
No NULL Packets	Select this option to re-multiplex the stream to CBR but remove the NULL packets in order to maintain low bitrate.
Enable Decryption	Select this checkbox to decrypt an encrypted stream.
Decryption type	If the stream has been encrypted, you can decrypt through the output by selecting this checkbox and specifying the type of encryption that was used. Select **Automatic** to decrypt a stream that has been encrypted using **Automatic** encryption. Only if the stream has not been encrypted, select **None** (default). **Important Notice: if the stream has been encrypted you must decrypt it in the output.**
Decryption key	If the decryption type includes a key, enter the key to decrypt the stream during output.

Adding Outputs

Enable IFB/Talkback	Select this checkbox to enable IFB/Talkback for one-way communication from the director or assistant director to on-air talent or a remote location. Selecting the checkbox allows the ZEC decoder to send audio back to the ZEC encoder. This offers the ability to, for example, give audio feedback to the camera operator.
Port	The port that will be used to send the audio feedback.

Adding RTMP and RTMPS Outputs

Real Time Messaging Protocol streams can be played on systems that accept this protocol as input. Originally designed to enable Adobe® Flash® streams to be sent between a server and a client, RTMP has become a popular protocol for streaming into content-delivery networks (CDNs).

To create an RTMPS output, select the RTMP output option but make sure rtmps:// url is used in the URL field.

SCTE-35 markers in MPEG-TS streams trigger OnCuePoint call function in RTMP.

➡ **To create an RTMP Output:**

1. In the ZEC **Outputs** page, click . The **New output** window is displayed.

Adding Outputs

2. Type the unique identifier for this output in the **Output Name**.
3. Select an **Input Stream** to be made available on this output from the drop-down list.
4. Select the **Show in Matrix** check box to display this stream in the Matrix (see **Using the Matrix**). Default: Selected.
5. Select **RTMP**.
6. Specify the **Output parameters** (see Output Stream Parameters Table).
7. Click **OK**.
8. The new RTMP Output with its settings is created and now appears on the screen.

Output Stream Parameters Table

Parameter	Description
Output Parameters	
URL	Specify the destination Stream URL according to the following format: rtmp://host:[port]/app.

	You can define RTMPS clients with the proven security of a secure socket layer (SSL), by using the rtmps:// url. Note that Facebook currently supports RTMPS streams only.
Backup URL	Enter a backup URL (fallback mode) – will be used in case the primary server is not responsive.
Stream Name	Specify the unique name for the stream that the RTMP server at the other end of the connection expects.
Username	Specify the Username to authenticate on the remote RTMP server
Password	Specify the string that is used for authorization on the remote RTMP server.
Bitrate (kbps)	Specify the actual bitrate in kbps or the maximum stream bitrate in case of a VBR stream.
Reconnect (sec)	If the stream drops, this value represents the time between reconnection attempts (in seconds). Default: 5.
Send Timecode	Converts the MPEG-TS SEI section to RTMP ONFI command (pass the encoder timecodes to the RTMP server)
Disconnect if inactive	Select this checkbox to disconnect if the stream is not active for 30 seconds.
Ignore TLS certificate errors	Select this option when streaming to a trusted server that does not have a valid certificate. When this option is selected, ZEC will ignore the TLS certificate errors and transmit the stream to its destination.
Enable Decryption	Select this checkbox to enable decryption of an encrypted stream.
Decryption type	If the stream has been encrypted, you can decrypt through the output by selecting this checkbox and specifying the type of encryption that was used. Select **Automatic** to decrypt a stream that has been encrypted using **Automatic** encryption. Only if the stream has not been encrypted, select **None** (default). **Important Notice: if the stream has been encrypted you must decrypt it in the output.**

Adding Push Outputs

Output streams can be pushed to one or ZEC instances. You can specify multiple destinations by adding them in the Links section. You can also split a single stream using multiple links and then bond them into a single stream in the target ZEC instance using the Bond Links feature. For each of these links, you can specify the max bitrate that can be used. In addition, some links
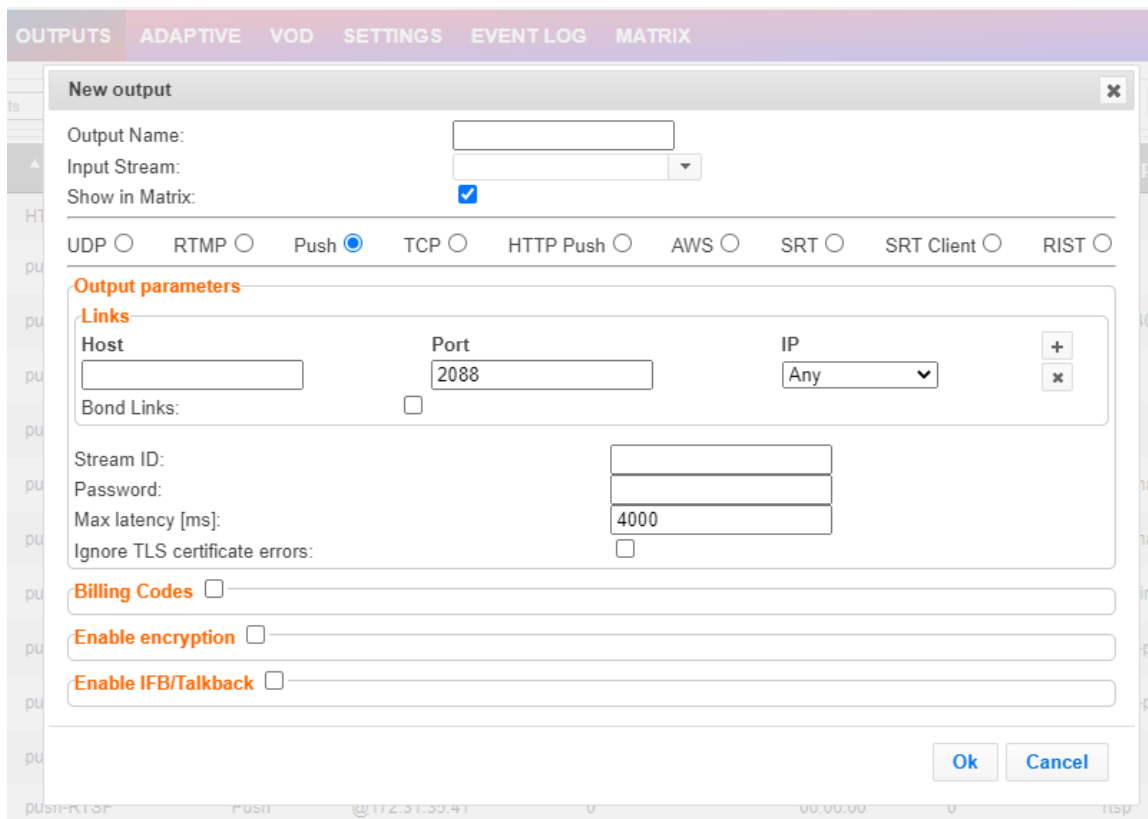
Adding Outputs

may be specified as backups. The backup links will be used if the bandwidth across all the non-backup links are not enough for the stream (i.e. if a non-backup link is not available, it will not use the backup). Only if the accumulated bandwidth of non-backup links is not enough, then ZEC will stream to a backup link.

➡ **To Create a Push Output:**

1. In the ZEC **Outputs** page, click ➕ New Output .
   The **New Output** window is displayed.

2. Type in the unique identifier for this output in the **Output Name**.
3. Select an **Input Stream** to be made available on this output from the adjacent drop-down list.
4. Select the **Show in Matrix** check box to display this stream in the Matrix (see **Using the Matrix**). Default: Selected.
5. Select **Push**.
6. Do one of the following:
7. **Stream to multiple destinations** - you can stream the same identical stream to multiple destinations by entering the destination parameters and then clicking the **"+"** button to add another destination (see **Output Stream Parameters** Table).

Adding Outputs

8. **Bonded link to a single destination** - you can split the stream into multiple links, which will be forwarded to a single ZEC instance by selecting the **Bond Links** checkbox (see **Using Network Bonding for Hitless Failover**).
9. Enter additional parameters as necessary (see Output Stream Parameters Table)
10. Click **OK**. The new Push Output with its settings is created and now appears on the screen.

Output Stream Parameters Table

Parameter	Description
Output Parameters	
Links	
Host	The destination host for the push stream. **Note:** additional failover destinations can be added by clicking the adjacent "**+**" button.
Port	Specify the ports to listen on for Push streams. Default: 2088.
IP	Specify the local IP address.
Max Bitrate (for Bond Links enabled)	Relevant for **Bond Links** option. Specify the max bitrate in Kbps for the specific link.
Bond Links	Click this checkbox to split the stream into multiple links, which will be forwarded to a single ZEC instance.
Backup (for Bond Links enabled)	Relevant for Bond Links option. Select this checkbox to define the link as a backup. The backup will be used only if the accumulated bandwidth of the non-backup links is not sufficient.
Stream ID	Specify the unique Stream ID that the remote ZEC expects.
Password	Optional - Specify a string to be used at the receiving ZEC to authenticate that the pushing ZEC is allowed to push this stream.
Max Latency [ms]	Specify the buffer size that ZEC will keep for error correction. For example, 6000 milliseconds would ensure that the stream is protected for six seconds of errors in the network. Default:6000

Adding Outputs

Ignore TLS certificate errors	Select this option when streaming to a trusted server that does not have a valid certificate. When this option is selected, ZEC will ignore the TLS certificate errors and transmit the stream to its destination.
Enable Encryption	Select this checkbox to encrypt the Output stream.
Encryption type (for Encryption enabled)	Specify the type of Encryption (AES 128/192/256). Click **Generate** to generate an encryption key or enter another encryption key.
Enable IFB/Talkback	Select this checkbox to enable IFB/Talkback for one-way communication from the director or assistant director to on-air talent or a remote location. Selecting the checkbox allows the ZEC decoder to send audio back to the ZEC encoder. This offers the ability to, for example, give audio feedback to the camera operator.
Port	The port that will be used to send the audio feedback.

Adding Outputs

Adding TCP Outputs

TCP protocol provides reliable transmission guarantee for no loss of frame. Its bandwidth probing and congestion control will attempt to use all of the available bandwidth between the server and client, fetching content as quickly as possible while being friendly to other (TCP) traffic on the same links. The TCP output can push the stream directly to a TCP socket or to an HTTP server.

MultiPath TCP

Developed by the Internet Engineering Task Force's (IETF) Multipath TCP working group, MultiPath TCP (MPTCP) is an effort towards enabling the simultaneous use of several IP-addresses/interfaces by a modification of TCP that presents a regular TCP interface to applications, while in fact spreading data across several subflows. ZEC supports MultiPath TCP for Linux based on the OS Kernel support. This means that the Linux Kernel should be updated to support MPTCP. For detailed information on how to update the Kernel and use MPTCP, see **Configuring MultiPath TCP**.

The MPTCP functionality is similar to ZEC's "multi-link bonding" feature, which is available for UDP only. In this case MPTCP works on TCP.
If both the sending end and the receiving end support MultiPath TCP, ZEC can use this functionality to transmit a stream over TCP using multiple network interfaces (e.g. Wifi + mobile). The multiple links can be configured to:
- **Aggregate** - aggregate the bandwidth of the multiple links in order to use the total capacity of the links. In this case ZEC will use all available bandwidth among all available flows (if needed) to send the stream.
- **Duplicate** - enhance the path's resiliency by duplicating the stream and sending though multiple links in order to overcome errors and packet loss.

➡ **To Create a TCP Output:**

1. In the ZEC **Outputs** page, click ＋ New Output . The **New Output** window is displayed.

Adding Outputs

2. Type in the unique identifier for this output in the **Output Name**.
3. Select an **Input Stream** to be made available on this output from the adjacent drop-down list.
4. Select the **Show in Matrix** check box to display this stream in the Matrix (see **Using the Matrix**). Default: Selected.
5. Select **TCP**.
6. Specify the Output parameters (see **Output Stream Parameters** Table).
7. If the target is an HTTP server, select the **HTTP** checkbox. In this case, HTTP headers will be added to the stream.
8. Enter additional parameters as necessary (see Output Stream Parameters Table).
9. Click **OK**. The new TCP Output with its settings is created and now appears on the screen.

Output Stream Parameters Table

Parameter	Description
Output Parameters	
Host	The destination host for the stream.
Port	Specify the ports to listen on for TCP streams. Default: 7777.

Adding Outputs

HTTP	If the target is an HTTP server, select the **HTTP** checkbox. In this case, HTTP headers will be added to the stream.
Multi Path TCP	Select this checkbox to enable MultiPath TCP, which enables the transmission of a stream over TCP using two network interfaces (e.g. Wifi + mobile). Multi Path TCP is available for Linux only.
Mode	The multiple links can be configured to: • **Aggregate** - aggregate the bandwidth of the multiple links in order to use the total capacity of both links. In this case ZEC will use all available bandwidth among all available flows (if needed) to send the stream. • **Duplicate** - enhance the path's resiliency by duplicating the stream and sending through multiple links in order to overcome errors and packet loss.
Enable Decryption	Select this checkbox to enable decryption of an encrypted stream.
Decryption type	If the stream has been encrypted, you can decrypt through the output by selecting this checkbox and specifying the type of encryption that was used. Select **Automatic** to decrypt a stream that has been encrypted using Automatic encryption. Only if the stream has not been encrypted, select **None** (default). Important Notice: if the stream has been encrypted you must decrypt it in the output.
Decryption key	Enter the decryption key to decrypt the encrypted stream.

Adding HTTP Push Outputs
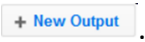
The HTTP Push output stream can be encapsulated in HLS or DASH. The source of the output stream is a predefined adaptive group that has been configured in the **Adaptive Groups** screen. The configuration of the stream includes the option to delete outdated stream fragments on the server. SCTE-35 markers in the source input will be preserved and used to segment the stream for both HLS and DASH encapsulation. Output streams can be pushed to one ZEC instance.

The path to the destination can be formed in one of the following ways:

- **Full path** – in this option the path would be constructed as follows: `<base url>/<path>/<file>?<aditional params may be also with path and file>`
- **Path in parameters** - in this option the path would be constructed as follows: `<base url>?<aditional params may be also with path and file>`
- **Flat path** - in this option the path would be constructed as follows: `<base url>/<path>_<file>?<aditional params may be also with path and file>`. Any "/" in path should be replaced with "_"

Low Latency HLS - ZEC supports low latency HLS delivery using chunked transfer encoding, which starts sending an HTTP response as chunks of data when they are ready before the complete response is available. Chunked transfer encoding can be used with transport stream (TS) segments and with fragmented MP4 (fMP4). For low latency HLS and DASH, ZEC must be used as an origin server. To enable low latency HLS and DASH, select **Enable HLS Fast playback** on **Settings > Live Protocols** screen.

➡ **To Create an HTTP Push Output:**

1. In the ZEC **Outputs** page, click   + New Output   .
   The **New Output** window is displayed.

Adding Outputs

2. Select the **HTTP Push** option (radio button).
3. Type in the unique identifier for this output stream in the **Output Name**.
4. Select an **Input Adaptive Group** to be made available on this output from the adjacent drop-down list. To create an Adaptive Group, see **Adaptive Groups**.
5. Select the **Show in Matrix** check box to display this stream in the Matrix (see **Using the Matrix)**. Default: not selected.
6. Enter the **Output Parameters** (see Output Stream Parameters Table).
7. Click **OK**.

Output Stream Parameters Table

Parameter	Description
Output Parameters	
Encapsulation Options	• HLS Encapsulation - the output stream, which includes all the streams in the selected Adaptive group, will be encapsulated in HTTP Live Streaming format. • Dash Encapsulation - the output stream, which includes all the streams in the selected Adaptive group, will be encapsulated in MPEG DASH format.

Adding Outputs

Target URL	Depending on the selection in the **Segment Path** field below, this field should include the following: • **Full path** – `<base url>/<path>/<file>` • **Path in parameters** - in this option the path would be constructed as follows: `<base url>` • **Flat path** - in this option the path would be constructed as follows: `<base url>/<path>_<file>`
Additional URL parameters	Depending on the selection in the **Segment Path** field below, this field should include the following: • **Full path** – `?<aditional params may be also with path and file>` • **Path in parameters** -`?<aditional params may be also with path and file>` • **Flat path** - `?<aditional params may be also with path and file>`. Any "/" in path should be replaced with "_" URL parameters support macros as follows: • %PATH% - file path as it appears in the playlist • %FILE% - file name
Delete outdated stream fragments on server	Select this checkbox to delete any outdated stream fragments from the server.
Upload DVR playlist	Select this checkbox if you are streaming a recorded/VOD stream and you want to upload a DVR playlist in addition to the live playlist.
Segment Path	Select one of the following path segmentation types: • **Full path** – in this option the path would be constructed as follows: `<base url>/<path>/<file>?<aditional params may be also with path and file>` • **Path in parameters** - in this option the path would be constructed as follows: `<base url>?<aditional params may be also with path and file>` • **Flat path** - in this option the path would be constructed as follows: `<base url>/<path>_<file>?<aditional params may be also with path and file>`. Any "/" in path should be replaced with "_"

Ignore TLS certificate errors	Select this option when streaming to a trusted server that does not have a valid certificate. When this option is selected, ZEC will ignore the TLS certificate errors and transmit the stream to its destination.
Authorization	Select this checkbox if your destination server requires authorization credentials to connect.
Method	Select one of the following authorization methods: • Basic authorization • Digest authorization • OAuth2 authorization
Username	Type the username
Password	Type the password

Adding AWS Outputs

The HTTP output stream, which is encapsulated in HLS or DASH/fMP4 HLS can be pushed to either an AWS S3 Bucket or to an AWS Elemental MediaStore. The native AWS support includes the ability to configure the S3 authentication credential, including the Region, Access Key, and Secret Key.

➡ **To Create an AWS Output:**

1. In the ZEC **Outputs** page, click [+ New Output]. The **New Output** window is displayed.

Adding Outputs

2. Select the **AWS** option (radio button).
3. Type in the unique identifier for this output stream in the **Output Name**.
4. Select an **Input Adaptive Group** to be made available on this output from the adjacent drop-down list. To create an Adaptive Group, see **Adaptive Groups**.
5. Select the **Show in Matrix** check box to display this stream in the Matrix (see **Using the Matrix**). Default: not selected.
6. Enter the **Output Parameters** (see Output Stream Parameters Table).
7. Click **OK**.

Output Stream Parameters Table

Parameter	Description
Output Parameters	
Service	Select one of the following options: • S3 Bucket - the output stream will be pushed to the specified S3 Bucket. • Elemental Media Store - the output stream will be pushed to the specified AWS Elemental MediaStore.

Adding Outputs

Encapsulation	• HLS Encapsulation - the output stream, which includes all the streams in the selected Adaptive group, will be encapsulated in HTTP Live Streaming format. • Dash Encapsulation - the output stream, which includes all the streams in the selected Adaptive group, will be encapsulated in MPEG DASH format.
URL	The URL address of the destination host for the S3 Bucket or the AWS Elemental MediaStore. The path to the destination can be formed in one of the following ways according to the option selected in the **Segment Path** field below: • **Full path** – in this option the path would be constructed as follows: `<base url>/<path>/<file>?<aditional params may be also with path and file>` • **Path in parameters** - in this option the path would be constructed as follows: `<base url>?<aditional params may be also with path and file>` • **Flat path** - in this option the path would be constructed as follows: `<base url>/<path>_<file>?<aditional params may be also with path and file>`. Any "/" in path should be replaced with "_"
Delete outdated stream fragments on server	Select this checkbox to send delete messages to S3/AWS Elemental MediaStore to delete the outdated stream fragments from the servers.
Ignore TLS certificate errors	Select this option when streaming to a trusted server that does not have a valid certificate. When this option is selected, ZEC will ignore the TLS certificate errors and transmit the stream to its destination.
Access key	Enter your AWS S3 or AWS Elemental MediaStore Access key.
Secret key	Enter your AWS S3 or AWS Elemental MediaStore Secret key.

Segment Path	Select one of the following path segmentation types: • **Full path** – in this option the path would be constructed as follows: `<base url>/<path>/<file>?<aditional params may be also with path and file>` • **Path in parameters** - in this option the path would be constructed as follows: `<base url>?<aditional params may be also with path and file>` • **Flat path** - in this option the path would be constructed as follows: `<base url>/<path>_<file>?<aditional params may be also with path and file>`. Any "/" in path should be replaced with "_"

Adding RIST Outputs

The RIST output can be push streams or have them pulled to/from a RIST-enabled device. RIST seeks to provide reliable, high performance media transport by using UDP at the transport layer to avoid the inefficiencies of TCP, then layering on top Forward Error Correction and Retransmits to add the reliability inherently absent from UDP.

ZEC supports the following RIST profiles:
- **Simple Profile (PUSH only)** - The RIST Simple Profile provides best-in-class packet protection, as well as support for multi-link bonding and seamless switching.
- **Main Profile (PUSH/PULL)** – The RIST Main Profile builds upon the features of the Simple Profile to provide backwards compatibility, while opening the door for additional features, including:
    - **Encryption and authentication** - RIST Main Profile uses industry-standard DTLS or PSK with a variety of available cyphers to ensure the most up-to-date protection, while being flexible to accommodate local legal regulations. Support for pre-shared keys is also included, which makes RIST Main Profile compatible with one-to-many environments such as satellite or multicast distribution.
    - **Native tunneling and multiplexing** - the ability to combine multiple Simple Profile RIST streams into one single connection, optionally with one single encryption and authentication step, using industry-standard GRE over UDP.
    - **Bandwidth optimization** - by deleting NULL packets at the source and re-inserting them at the destination.
    - **Support for high bit rate streams** - The RIST Main Profile includes an RTP header extension which increases the sequence number size to 32-bits, and therefore increases the maximum size of retransmission buffers, and thus opens the door for higher bitrate streams, such as lightly compressed (e.g. JPEG 2000, Tico) and uncompressed video.
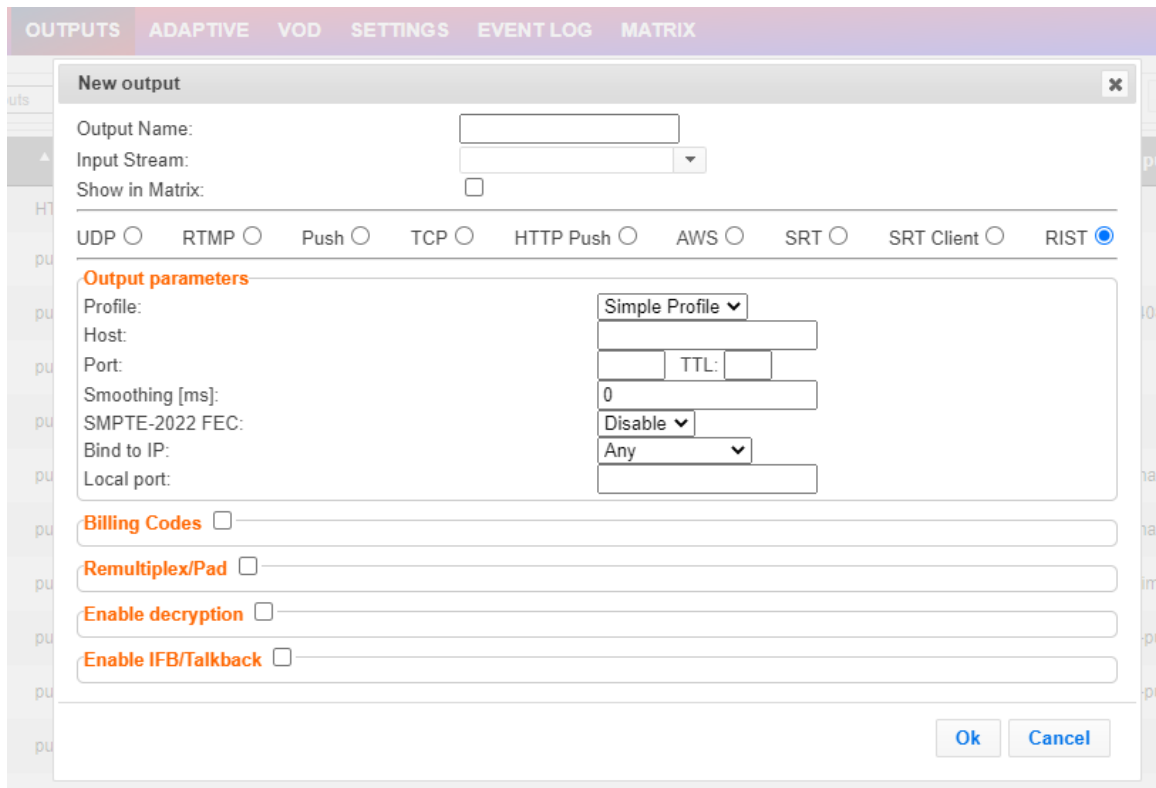
Adding Outputs

Contact your ZEC representative to learn more about interoperability testing between ZEC and 3rd party devices. More details about RIST can be found at www.rist.tv

➡ **To Add a RIST Output:**

1. In the ZEC **Outputs** page, click + New Output . The **New Output** window is displayed.

2. Select the **RIST** option (radio button).
3. Type in the unique identifier for this output stream in the **Output Name**.
4. Select an **Input Stream** to be made available on this output from the adjacent drop-down list.
5. Select the **Show in Matrix** check box to display this stream in the Matrix (see **Using the Matrix**). Default: not selected.
6. Enter the **Output Parameters** (see Output Stream Parameters Table).
7. Click **OK**.
The new RIST Output with its settings is created and now appears on the Outputs screen.

Output Stream Parameters Table

Parameter	Description

Adding Outputs

Output Parameters	
Profile	Select one of the following RIST profiles that matches the input stream: • Simple Profile (default) • Main Profile
Type (Main Profile)	Select the stream direction: • Push • Pull
Host	Specify the destination IP address or URL of the host to which the steam will be pushed.
Port	Specify the target UDP port.
TTL	Specify the time-to-live (TTL). Used mainly to limit the range (or "scope") of a multicast transmission. Leaving it as blank uses the default value specified by the operating system
Smoothing [ms]	Enables transmission of the output at the correct rate. Required when the receiving device is sensitive and can't lock on to the stream (in such a case, the recommended latency is 100 - 1000 ms)

Adding Outputs

SMPTE-2022 FEC	In the SMPTE-2022 FEC standard, 1-D and 2-D parity codes are systematic FEC codes of decent complexity that provide protection against bursty or random losses.
	This setting can be modified without interrupting an existing stream.
	To enable SMPTE-2022 FEC (Forward Error Correction) select one of the following parity options from the drop-down menu:
	• **1D** - SMPTE-2022 1D can fix a problem in ONE packet per row. This means that the number of rows specified should consider the packet loss rate- the shorter the row, the more error resilience can be achieved on the expense of bitrate level. However, longer rows increase the delay that the FEC will add. It is recommended to select this option when the packet loss is sporadic. The stream will occupy the source port and two ports above it (e.g. if the source port is 8988, it will occupy 8990).
	• **2D** - SMPTE-2022 2D uses a table of packets, which includes rows and columns. This option is more error resilient, but it increases the delay by (row*column) packets and increases the bitrate with R+C packets per each table of R*C packets. It is recommended to select this option when packet loss is bursty. The stream will occupy four ports above (e.g. if the source port is 8988, it will occupy 8992).
Bind to IP	Select from the drop-down list the local IP address to be used for this Input, OR select *Any* to enable any IP to be used.
Local Port	Specify from which local port to source the stream, if desired (instead of randomly chosen by the operating system).
RIST main profile parameters	
<mark>Use DTLS</mark>	
ReMuxing	Select this checkbox to enable remuxing from VBR MPEG-TS to MPEG-TS CBR (used for professional IRDs).
Remux to bitrate [kbps]:	Specify the CBR bitrate to target for a remuxed stream.
Buffer Size [ms]	Specify the size of the buffer that will be used for the remixing. A larger buffer increases the quality, but also increases latency.
No NULL Packets	Select this option to re-multiplex the stream to CBR but remove the NULL packets in order to maintain low bitrate.

Adding Outputs

Enable Decryption	Select this checkbox to decrypt an encrypted stream.
Decryption type	If the stream has been encrypted, you can decrypt through the output by selecting this checkbox and specifying the type of encryption that was used. Select **Automatic** to decrypt a stream that has been encrypted using **Automatic** encryption. Only if the stream has not been encrypted, select **None** (default). **Important Notice: if the stream has been encrypted you must decrypt it in the output.**
Decryption key	If the decryption type includes a key, enter the key to decrypt the stream during output.
Enable IFB/Talkback	Select this checkbox to enable IFB/Talkback for one-way communication from the director or assistant director to on-air talent or a remote location. Selecting the checkbox allows the ZEC decoder to send audio back to the ZEC encoder. This offers the ability to, for example, give audio feedback to the camera operator.
Port	The port that will be used to send the audio feedback.

Viewing Existing Outputs

The Outputs screen displays all the output streams that have been created.

Status	Name	Type	Destination	Bitrate[kbps]	Uptime	Latency	Input ID	Actions
Offline - None	dfdf	Pull	klkls@	0	00:00:00	0	bbb_1080p_5mbps	⚙▾ ☐
Offline - None	Live Broadcast	Facebook	rtmps://rtmp-api.facebook.com:443/rtmp	0	00:00:00	1000	bbb_1080p_5mbps	⚙▾ ☐

Hovering the cursor on the status indicator of a stream shows the stream configuration information and basic utilization statistics, where applicable.

Any of the columns in the following table can be sorted in ascending/descending order by clicking on its heading. The **Search** text box in the upper left-hand side of the screen can be used to search for a specific input stream by entering the desired Stream ID.

Field	Description
Status	Displays the status of output stream. The following colored indicators are displayed: • Green = Connected • Yellow = Connecting • Red = Disconnected with an error condition • Blue = Offline with no connection attempts • Grey = Offline and stopped
Name	Displays the name of the output stream, as defined in ZEC.
Type	Displays the type of output stream.
Destination	Displays the IP address of the host that will be receiving the stream.
Bitrate [kbps]	Displays bitrate of the connected output stream.
Uptime	Displays the amount of time the stream has been active.
Latency	Displays the configured latency
Input ID	The ID of the related Input stream.
Actions	Provides access to various actions to be performed on this output stream (see **Performing Actions on Output Streams** below).

Viewing Existing Outputs

Stats Pane

The Stats pane on the bottom of the page shows data about the activity of the selected stream.

Click the ![icon] icon next to a parameter to show the graph of historical data for the specified parameter.

Field	Description
Bitrate (kbps)	Displays the current bitrate of the output stream
Last Connected	Displays the date and time in which the stream was connected.
Send Errors	Displays the number of errors generated after sending the stream.
Reconnections	Displays the number of reconnection attempts.
RTT (ms)	Displays the Round Trip Time (RTT) from the source (in milliseconds)
Jitter	Displays the current Jitter, measured in milliseconds.
Total Packets	Displays the total number of packets that have been transmitted.
Packet Rate	Displays the current number of packets per second.
Packet Loss %	Displays the packet loss rate (how many packets were lost out of the total number of packets).
Dropped Packets	Displays the total number of packets that were dropped since the beginning of the stream.
Recovered Packets	Displays the total number of dropped packets that have been recovered since the beginning of the stream.
Not Recovered Packets	Displays the number of non-recovered packets.
Failed Sends	Displays the number of failed attempts to send the stream.
FEC Packets	Displays the number of FEC packets transmitted.
FEC Recovered	Displays the number of FEC packets that were recovered.
ARQ Requests	Displays the number of requests for transmission of dropped packets made with ARQ.
ARQ Recovered	Displays the number of dropped packets recovered via ARQ.

Viewing Existing Outputs

ARQ Duplicates	Displays the number of duplicate recovery packets received via ARQ.
Overflows	Displays the number of packets lost due to buffer overflow. Note: overflow is usually the result of the Max Bitrate being too low.

Searching for Output Streams

➡ **To Search for an Output Stream:**

In the ZEC **Outputs** page, type in the specific output stream name in the search text box on the

left- hand top of the screen and click [🔍]. The **Output** screen displays the requested output stream(s).

Performing Actions on Output Streams

Every stream has a shortcut button that can be used to perform relevant actions on the stream. The following actions can be performed through the Actions button:

- **Deleting Output Streams from**
- **Switching Input**

Deleting Output Streams from ZEC

➡ **To Delete an Output Stream from the ZEC:**

1. In the ZEC **Outputs** page, select the output stream you want to delete, and then click
   [⚙ ▾].

2. Click **Delete** to the selected stream. The selected input stream was deleted and is not displayed anymore.

Switching Input

➡ **To change the input associated with the selected output:**

1. In the ZEC **Outputs** page, click [⚙ ▾] and select **Switch Input**. The **Switch source** window is displayed.
2. In the **New Input** drop-down, select the desired input, and click **OK**. The newly designated input is now associated with the selected output.

Viewing Traceroutes

You can view traceroute data for a stream sent from ZEC (v13 or above).

➡ **To view traceroute data:**

1. On the **Outputs** page of ZEC, click the desired row of the output stream for which you want to view traceroutes.

2. Click the [⚙ ▾] button on the right end of the selected row and then select **Trace**. The traceroute data for this stream is displayed.

Performing Actions on Output Streams

Performing Actions on Multiple Outputs

Delete Marked Individual and Multiple Outgoing Stream

➡ **To Delete Output Streams:**

1. In the ZEC Outputs page, select all outputs by selecting the checking the Actions checkbox at the header line, or select individual outputs by selecting their checkboxes. The Marked drop-down button is displayed.

2. Click the **Marked** drop-down menu and then click **Delete**. The selected Output Streams are deleted.

Start and Stop Marked Individual and Multiple Outgoing Streams

➡ **To Stop/Start Output Streams:**

1. In the ZEC Outputs page, select all outputs by selecting the **Actions** checkbox, located in the header line, or select individual outputs by selecting their checkboxes.
   The Marked drop-down button is displayed.
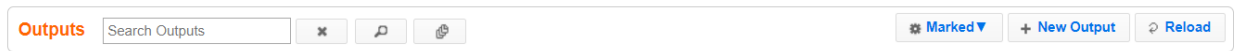
2. Click the **Marked** drop-down menu and then click **Start/Stop**.
   The selected Output Streams are started/stopped.

Save Marked Individual and Multiple Outgoing Streams

➡ **To Save Output Streams:**

1. In the ZEC Outputs page, select all outputs by selecting the **Actions** checkbox, located in the header line, or select individual outputs by selecting their checkboxes.
   The Marked drop-down button is displayed.
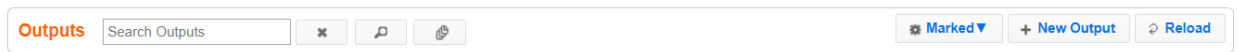
2. Click the **Marked** drop-down menu and then click **Save**.
   The selected Output Streams are saved.

Reset Stats for Individual and Multiple Outgoing Streams

➡ **To Reset Output Streams:**

1. In the ZEC Outputs page, select all outputs by selecting the **Actions** checkbox, located in the header line, or select individual outputs by selecting their checkboxes. The Marked drop-down button is displayed.

Using Output Templates

| Outputs | Search Outputs | ✕ | ⌕ | ⧉ | | ⚙ Marked ▾ | + New Output | ⟳ Reload |

2. Click the **Marked** drop-down menu and then click **Reset**.
   The selected Output Streams are reset.

Viewing Traceroutes

For streams sent from ZEC (v13 and above), you can view traceroute data for this stream.

➡ **To view traceroute data:**

1. On the **Outputs** page of ZEC, click on the row of the stream for which you want to view traceroutes.

2. Click the ⚙▾ button on the right end of the selected row and then select **Trace**.

3. The traceroute data for this stream is displayed.

```
Trace for 10.1.7.185:2118                                                          ✕

10/7/2019, 10:20:38 AM

traceroute 10.1.7.185
traceroute to 10.1.7.185 (10.1.7.185), 30 hops max, 60 byte packets
 1  ec2-52-15-0-107.us-east-2.compute.amazonaws.com (52.15.0.107)  33.471 ms ec2-52-15-0-97.us-east-2.compute.amazonaws.com (52.15.0.97)  163.996 ms  164.003 ms
 2  100.65.26.160 (100.65.26.160)  106.962 ms 100.65.27.16 (100.65.27.16)  7.212 ms 100.65.26.160 (100.65.26.160)  106.995 ms
 3  * * *
 4  * * *
 5  * * *
 6  * * *
 7  * * *
 8  * * *
 9  * * *
10  * * *
11  * * *
12  * * *
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23  * * *
24  * * *
25  * * *
26  * * *
27  * * *
28  * * *
29  * * *
30  * * *
```

Refresh   Close

You can refresh the Traceroute data at any time by clicking the **Refresh** button.

Using Output Templates

Instead of manually creating an output and then connecting the output to an input, you can define output templates with rules for automatic creation of outputs with predefined settings. The template includes an Input pattern. When an input pattern matches the pattern of an incoming input stream, the output is created automatically.

➡ **To create a new Output template:**

1. Click the **Outputs** tab at the top of the ZEC administrative screen.

2. In the **Menu** bar, click the **Templates** (⧉) button.
   The **Output Templates** window is displayed:

Using Output Templates

3. Under **Input ID Parameters**, click the **'+'** button.
    The **New Output Pattern Template** window is displayed:
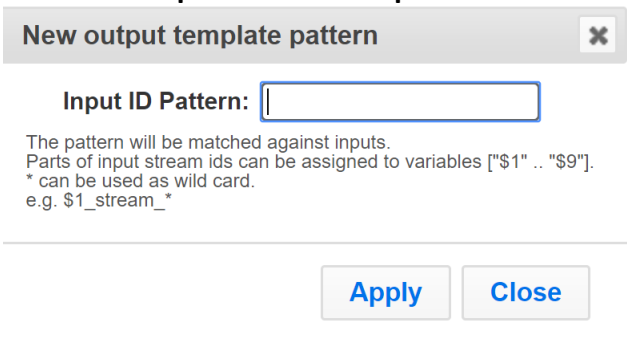
4. In the **Input ID Pattern** field, enter a pattern for the Stream ID of the input stream for which an output will be automatically created. This pattern will be used to identify the input stream and can include variables that are marked with the "$" sign followed by a number (e.g. $1, $2, etc.) and/or with an asterisk "*" wildcard.
    The patterns should also include a part of the string that requires an exact match.
    For example, the pattern "$1_stream_$2kbps" will match an input stream "talk_show_stream_600kbps".
5. Click **Apply**.
    The newly created input ID pattern is added to the **Input ID Patterns** list.
6. From the **Input ID Patterns** list, select a pattern for which you want to relate an output template.
7. In the **Output Template Description** section click the "**+**" button.

Using Output Templates
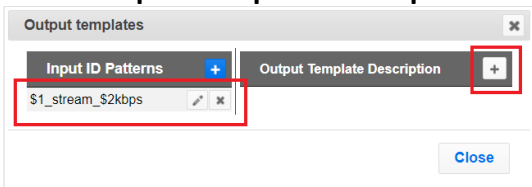
The **New Output Template** window is displayed:

8. In the **Output Name** field, enter a name for the output that will be created. The name can include variables used in the **Input Pattern** field. For example, the pattern *"$1_ouput_stream_$2kps"* will eventually create an output *"talk_show_output_stream_600kbps"*, as it uses the variables that were defined in the **Input Pattern** field.

9. Select the desired output type and fill-in the relevant Output parameters according to the instructions of the relevant section:

   - **UDP Output –** Follow the instructions in the **Adding UDP Outputs** section.
   - **RTMP Output –** Follow the instruction in the **Adding RTMP and RTMPS Outputs** section.
   - **Pull Output** - Follow the instruction in the Error! Reference source not found. s ection.
   - **Push Output** - Follow the instruction in the **Adding Push Outputs** section.
   - **TCP Output** - Follow the instruction in the **Adding TCP Outputs** section.

Using Output Templates

- **HTTP Push** - Follow the instructions in the **Adding HTTP Push Outputs** section. Note that the **Target URL** field can also use the same variables used in the **Input Pattern** field. For example, "*https://s3.amazon.com/zixi/$1_folder_$2kbps*".
- **AWS Output** - Follow the instructions in the **Adding AWS Outputs** section. Note that the **URL** field can also use the same variables used in the **Input Pattern** field. For example, *"https://s3.amazon.com/zixi/$1_folder_$2kbps"*.
- **RIST Output** – Follow the instruction in the **Adding RIST Outputs** section.

10. Click **OK**.

The template is added to the **Output Template Description** list. When an input pattern will match the pattern of an incoming input stream, the defined output will be created automatically.

ZEC Network Bonding

ZEC's Network Bonding feature enables you to divide a stream into several network channels by utilizing multiple NICs and links and then subsequently reuniting them at the Zixi Broadcaster side. For example, a 5 Mbps stream can be streamed using two links, one 2 Mbps link that uses a mobile network and another 3 Mbps Wifi network. The stream is automatically bonded at the Zixi Broadcaster side without any special configuration (as long as the Push input is defined and the two NICs are setup in the machine running the Zixi Broadcaster). Network Bonding can be used for load balancing between multiple links in the following configurations:

- **Zixi Feeder with Multiple NICs to a single Zixi Broadcaster NIC** - the stream is divided at the Zixi Feeder end and then bonded at the Zixi Broadcaster end. This configuration requires configuring Network Bonding in the Zixi Feeder.
- **Zixi Feeder with Multiple NICs to multiple Zixi Broadcaster NICs** - the stream is divided at the Zixi Feeder end, sent to multiple IP addresses (each Zixi Broadcaster NIC has a separate IP address), and then bonded at the Zixi Broadcaster end. This configuration requires configuring Network Bonding in the Zixi Feeder. Each destination (i.e. each Broadcaster NIC is configured in a separate network bonding link by using a different Host IP address).
- **Zixi Feeder with single NIC to Multiple Zixi Broadcaster NICs** - the stream is sent to multiple IP addresses (each Zixi Broadcaster NIC has a separate IP address), and then bonded at the Zixi Broadcaster end. This configuration requires configuring Network Bonding in the Zixi Feeder. Each destination (i.e. each Broadcaster NIC is configured in a separate network bonding link by using a different Host IP address).
- **Zixi Broadcaster with multiple NICs to another Zixi Broadcaster with a single/multiple NICs** - a Zixi Broadcaster can transfer a stream to another Zixi Broadcaster through multiple NICs at the source Broadcaster and single/multiple NICs at the destination Broadcaster. This configuration requires configuring Network Bonding in the Zixi Broadcaster (see Broadcaster Output with Network Bonding).

Using Network Bonding for Hitless Failover

The Network Bonding feature can be used to ensure high availability of the stream. The feature ensures hit-less failover between multiple networks and network cards (i.e. network and hardware protection). As part of the configuration of the network bonding feature it is possible to set a NIC (which may be connected to a separate network) as a "Backup". In this case, the backup link will only be utilized if the stream has used all other available capacity. For example, a stream can be configured to be transferred on a WiFi network as the main link and a mobile network as a backup. If the WiFi link is compromised (either completely unavailable or limited bandwidth), the stream will be transferred, in full or partially through the backup mobile link and then bonded at the ZEC end, enabling uninterrupted streaming and high availability.

ZEC Output with Network Bonding

ZEC can push a stream to another ZEC instance that has been divided into multiple network channels by utilizing multiple NICs. The ZEC at the destination will subsequently be reuniting them into a single input stream.

➡ **To add network bonding to a Push Output:**

1. Create a **Push Output**, by following the instructions in the **Adding Push Outputs** section.
2. In the **Output Parameters** section, select the **Bond Links** checkbox.

3. In the **Links** section, click the **+** button to add a second link:

4. In the **Host** field, type the IP address of the destination ZEC.
5. In the **Port** field, type the destination port number of the ZEC to which you want to stream. Default: 2088
6. In the **NIC** field, select the NIC in the ZEC (source) that you want to use to stream.
7. In the **Bitrate Limit** field, do one of the following:
   - If you want to limit the bitrate that will be used in this link, enter the limit value in Kbps.
   - If you DO NOT want to limit the bitrate, leave the default value - "0".
8. In the **Backup** field, do one of the following:
   - If you want to use this link only if there is not enough bandwidth in the other links, select the Backup checkbox.
   - If you want to use this link in parallel to other links, DO NOT select the Backup checkbox.
9. Configure additional parameters as required.
10. Click **OK** to save the ZEC Output.

Adaptive Groups

ZEC features the ability to create multiple bitrate profiles for a single input stream and set it as an adaptive group that can be used by a supporting client. The client will automatically switch between the various bitrate profiles of the stream according to the network conditions during playback.

After creating a group with different bitrates you can test them all out by playing them with the different 3rd party players (via the ⚙▾ Actions menu).
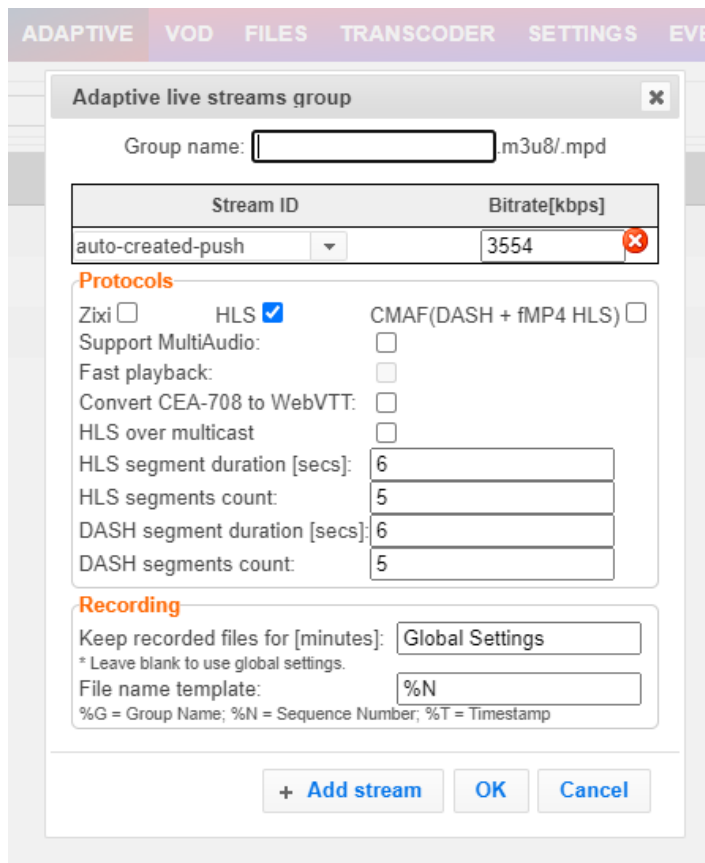
You can optionally create adaptive group templates that will automatically group streams in adaptive groups instead of defining groups in advance.

Creating New Adaptive Groups

➡ **To Create a New Adaptive Group:**

1. In the ZEC administrative screen, click the **Adaptive** tab.
2. Click **Add Group**.
   The **Adaptive live streams group** window is displayed:

Creating New Adaptive Groups

3. In the **Group Name** field, enter the unique string as the adaptive group's name.
4. Under **StreamID**, select an input stream from the drop-down list to create an adaptive bitrate.
5. Enter the desired **Bitrate[kbps]** for that stream in the adjacent field to **Stream ID**.
6. Click [+ Add stream] to add as many streams as you want to include in the group and repeat steps 4 and 5 for every stream that is added to the group.
7. Select one or more **Protocols** that will be supported for this adaptive group. The Zixi protocol option enables devices using the ZEC SDK to view the stream using the Zixi protocol.
8. Select **Support MultiAudio** if the input streams include multiple audio channels to enable multiple separate audio channels in the adaptive group.
9. Specify the HLS/Dash segment/chunk duration and count (See details in the table below).
10. Specify the duration to **Keep recorded files for [minutes]**. If the file is left as blank, the system will use the global settings, specified in the **Settings > Live Protocols** screen in the **HLS DVR Maximum Recording Duration** field.
11. In the **File name template** field, specify the file name pattern that ZEC will use to generate when saving the recorded content.
12. Click **OK**.
    The new Adaptive Group is created and appears on the Adaptive screen.

Parameter	Description
Group Name	Specify the unique identifier for this group.
Stream ID	Select an input stream from the drop-down list.
Bitrate [kbps]	Specify the bitrate for the selected stream.
Protocols	Select one or more **Protocols** that will be supported for this adaptive group - Zixi HLS (enables devices using the ZEC SDK to view the stream using the Zixi protocol), HLS, DASH/fMP4 HLS
Support MultiAudio	Select this checkbox to enable multiple separate audio channels in the adaptive group.
Fast playback	Select this setting to enable low latency HLS delivery. The **Enable HLS Fast playback** on the **Settings > Live Protocols** screen must be enabled. Only the TS segments version of the HLS stream will be available for adaptive streaming, not the fragmented MP4 (fMP4) version. When enabled, the following playback URLs will be available: • http://<server url>:7777/playback.m3u8?stream=<adaptive group name> • http://<server url>:7777/<adaptive group name>.m3u8

Creating New Adaptive Groups

Convert CEA-708 to WebVTT	Extracts closed caption from video elementary stream and converts it to WebVTT format.
	This feature is currently available for HLS only and there is no support to styling/placement, just text.
HLS Over Multicast	Select this checkbox to enable multicasting of the adaptive stream (requires multicast to be enabled in the **Settings**)
HLS Segment Duration [sec]	Specify the duration in seconds of each segment/chunk in the HLS playlist. You can specify sub-second durations (e.g. 0.5). (Default: 6 seconds)
HLS Segments Count	Specify the number of segments in the HLS playlist.
DASH Segment Duration [sec]	Specify the duration in seconds of each segment/chunk in the DASH adaptive group. You can specify sub-second durations (e.g. 0.5). (Default: 6 seconds)
DASH Segments Count	Specify the number of segments in the DASH adaptive group.
Recording	
Keep recorded files for [minutes]	Specify the maximum time for storing the recording. If the file is left as blank, the system will use the global settings specified in the **Settings > Live Protocols** screen in the **HLS DVR Maximum Recording Duration** field.
File name template	Specify the file name pattern that ZEC will use to generate when saving the recorded content. A separate file will be generated for each recording up to the time specified in the Max recorded file duration parameter (see above). After this duration a new file will be generated.
	The file name pattern can include any string and up to five variables listed below. Only the %T=HH.MM.SS creation time is mandatory. You can change the order of these variables and add text as long as you maintain the legitimate structure of the file in Linux and Windows:
	%S=stream id - optional.
	%Y=year - optional
	%M=month - optional
	%D=day - optional
	%T=HH.MM.SS creation time - mandatory
	For example, the following pattern %Y_recording%T.ts will generate the following file name 2017_recording15:32:35.ts.

Creating New Adaptive Groups

Adding Streams to Existing Adaptive Groups

You can add additional streams to existing adaptive groups.

➡ **To Add Streams to an Adaptive Group:**

1. In the ZEC administrative screen, click the **Adaptive** tab.

2. Select the Group to which you want to add a stream, and click [⚙▾] button, and then **Edit**. The **Adaptive live streams group** window is displayed.

3. Click [+ Add stream] button for as many streams as you want to include in the group. Another Stream row will be added in the above table to which a desired **Bitrate** must be specified. When clicking on the red ⊗ at the end of any of the stream rows, the stream will be deleted from the group.

4. Click **OK**. The group has been modified accordingly.

Adaptive Groups Templates

Instead of defining adaptive groups in advance and then relating specific input streams to these groups, you can define templates with rules for automatic grouping of streams in adaptive groups. Every time a new input stream, which matches the conditions of the template, is added, it will be automatically added to the adaptive group that was defined in the template. Specific streams are identified by naming patterns and added to the group by setting static naming patterns and bitrates or dynamic patters.

➡ **To create a new adaptive group template:**

3. Click the **Adaptive** tab at the top of the ZEC administrative screen.

4. In the Menu bar, click the **Templates** (🔘) button.
   The Adaptive Groups Templates screen is displayed:

   Adaptive groups templates   ✖

Input ID Pattern	Adaptive Group Name	+

                                            Close
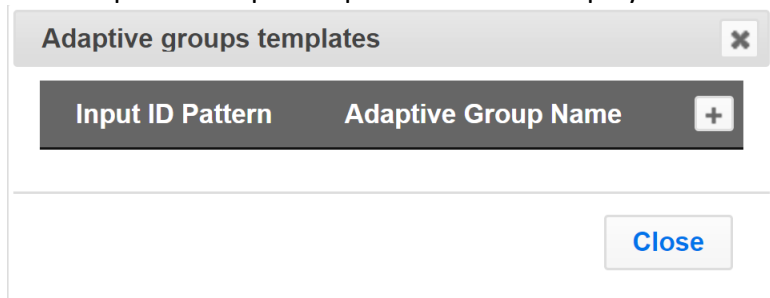
5. Click the **+** button.
   The **Adaptive Group Template** window is displayed:

6. In the **Input ID Pattern** field, enter a pattern for the Stream ID of the input stream that will be automatically added to newly created adaptive group. This pattern will be used to identify the input stream and can include variables that are marked with the "$" sign followed by a number (e.g. $1, $2, etc.) and/or with an asterisk "*" wildcard. The patterns should also include a part of the string that requires an exact match. For example, the pattern "$1_stream_$2kbps" will match an input stream "talk_show_stream_600kbps". String parts that were matched again $X variables, can be reused in other settings, however, string parts that were matched against an asterisk wildcard cannot be reused in other settings.

7. In the **Adaptive Group Name** field, enter a string that will be used as the name of the adaptive group. You can use the $X variables that were used in the Input ID Pattern field above. For example, based on the above example, if you write "$1_group", the group name will be "talk_show_group".

8. Under the **Adaptive Group Properties**, select the checkboxes of the protocols with which these streams will be transmitted (Zixi, HLS, DASH, HLS over multicast).

9. If you want to record an HLS stream, select the **Record** checkbox and in the **Keep recorded files for [minutes]**, specify the maximum time (in minutes) to record. Default:

the time defined in the global settings, specified in the **Settings > Live Protocols** screen in the **HLS DVR Maximum Recording Duration** field.

10. Under **Adaptive Group Stream Patterns**, select the method in which the streams in the adaptive group will be created:

- **Dynamic Streams Acquisition:** this method will automatically add input streams that match the defined **Input ID Pattern** and give them a bitrate value based on the **Bitrate Pattern**. This option is based on the assumption that the bitrate value is part of the input stream's ID. Based on the example above, by entering the value "$2" in the **Bitrate Pattern** field, the system will automatically add the incoming "talk_show_stream_600kbps" stream, while giving it a 600 Kbps Bitrate setting (according to the definition in the **Input ID Pattern** field, the $2 was assigned a value of 600kps). If another stream that matches the input ID patters comes in (e.g. talk_show_stream_700kbps") with a different bitrate, for example, 700kbps, this stream will be also added to the same adaptive groups, however the bitrate setting will be 700 kbps.

Adaptive group stream patterns

Streams expected in adaptive group may connect later.

Dynamic streams acquisition ⦿   Static streams set ⚪

Any stream matching 'Input ID Pattern' will be added.

Bitrate pattern: $2

To add a Dynamic Streams Acquisition bitrate pattern:

1. In the **Bitrate Pattern** field add the pattern as described above.
2. Click **Apply**.

   The new template is added to the **Adaptive Groups Templates** list:

Adaptive groups templates

Input ID Pattern	Adaptive Group Name	+
$1_stream_$2kbps	$1_adaptive_stream	✎ ✖

Close

- **Static Stream Set:** if the input streams do not have the bitrate value in their ID names, you can manually define the ID and the bitrate for each stream that will be included in the group. You can define streams that are not currently connected, but will be connected at a later stage.

Performing Actions on Adaptive Groups

Adaptive group stream patterns
Streams expected in adaptive group may connect later.

Dynamic streams acquisition ○   Static streams set ◉

Stream pattern	Bitrate [kbps]	+
comedy_HD	512	✖

To add a Static Steam Set:
1. Click the **+** button
2. In the **Steam Pattern** field, enter a pattern for the stream ID (you can use the variables used in the Input ID Pattern field and add additional variables as needed). This pattern will be used to identify the stream and add it to the group (e.g. "comedy_HD").
3. In the **Bitrate [Kbps]** field, enter the Bitrate value of the stream.
4. Click the **+** button for as many streams as you want to include in the group and repeat the steps above for every stream that is added to the group.
5. Click **Apply** to save all changes.
   The new template is added to the **Adaptive Groups Templates** list:

   Adaptive groups templates   ✖

Input ID Pattern	Adaptive Group Name	+
$1_stream_$2kbps	$1_adaptive_stream	✏ ✖

   Close

✎   the group will be active only when all the streams defined will be connected.

Performing Actions on Adaptive Groups

Every adaptive group has a shortcut button that can be used to perform relevant actions.

Stopping/Starting an Adaptive Group

You can start or stop the stream(s) in the adaptive group at any time.

Performing Actions on Adaptive Groups

➡ **To Stop/Start the Adaptive Group:**

1. In the ZEC **Adaptive Groups** page, click the adaptive group row that you want to start/stop.

2. Click the ⚙️ button on the right end of the selected row and then **Start/Stop**. The status will change to Connected/Stopped accordingly.

Editing an Existing Adaptive Group

➡ **To Edit the Configuration of an Adaptive Group:**

1. In the ZEC **Adaptive Groups** page, click the adaptive group row that you want to edit.

2. Click the ⚙️ button on the right end of the selected row and then **Edit**. The Adaptive live stream group screen is displayed. You can modify any of the settings.
3. Click **OK**. The new settings will take effect.

Deleting and Adaptive Group

➡ **To delete an Adaptive Group:**

1. In the ZEC **Adaptive Groups** page, click the adaptive group row that you want to delete.

2. Select the Group to which you want to add a stream, and click ⚙️ button, and then **Delete**. The message **"Are you sure you want to delete group <group_name>?"** is displayed.

localhost:4444 says:

Are you sure you want to delete group Test1?

OK   Cancel
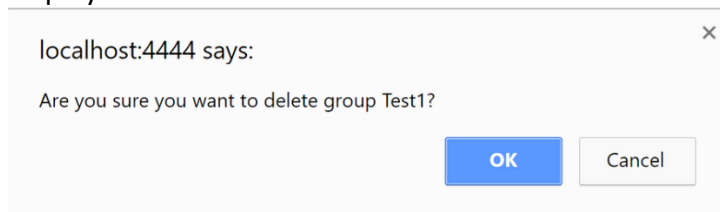
3. Click **OK**. The selected row adaptive group will be deleted.

Play Dash

ZEC can generate links to play the Adaptive Group stream in MPEG DASH format.

➡ **To Play MPEG DASH:**

1. In the ZEC **Adaptive Groups** page, click the adaptive group row that you want to playback.

2. Select the Group to which you want to add a stream, and click ⚙️ button, and then click **Play Dash**.

Performing Actions on Adaptive Groups

The following window is displayed:
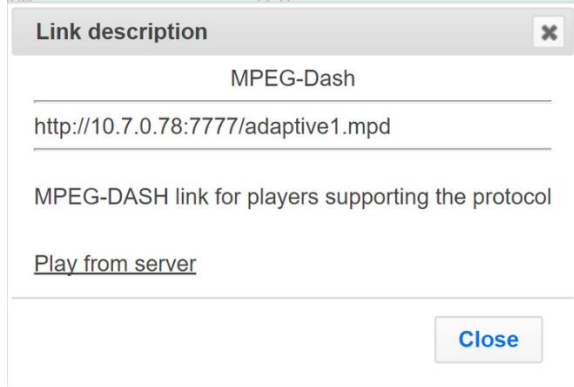
3. Do one of the following:
   - If you have a locally installed MPEG DASH compatible player - click the link to stream the data to your player.
   - If you DO NOT have a player - click **Play from server**. The stream will open in a web-based player.
4. Click **Close** when finished.

Play fMP4

ZEC can generate links to play the Adaptive Group stream in fMP4 HLS format.

➡ **To Play fMP4 HLS:**

1. In the ZEC **Adaptive Groups** page, click the adaptive group row that you want to playback.

2. Select the Group to which you want to add a stream, and click [⚙▾] button, and then click **Play fMP4**.
   The following window is displayed:
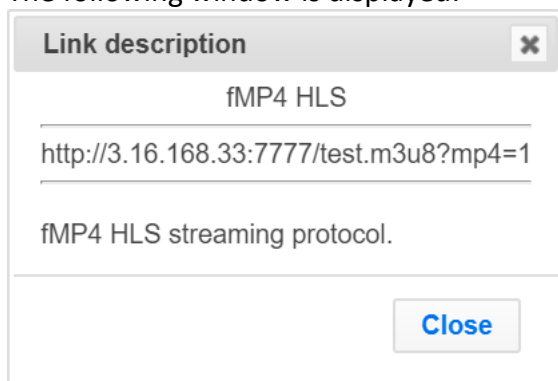
3. Copy the link that is generated at the bottom of the window and paste it into a player/browser for playback.
4. Click **Close** when finished.

Performing Actions on Adaptive Groups
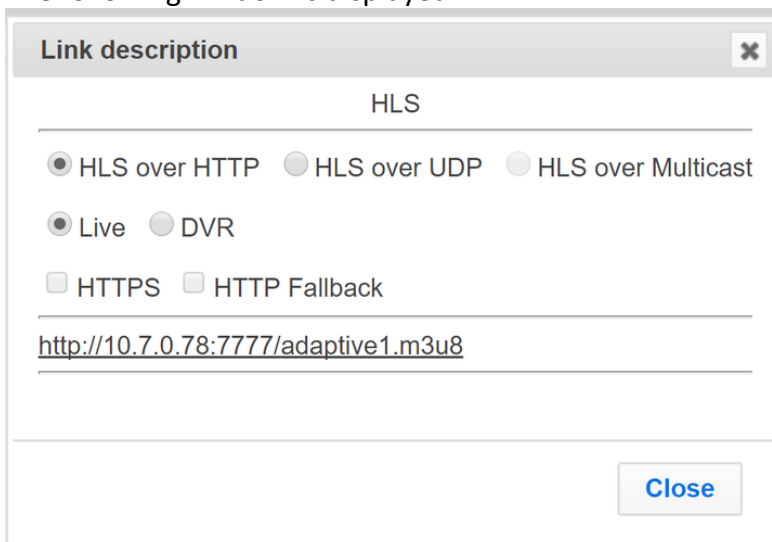
Play HLS

ZEC can generate links to play the Adaptive Group stream in HLS format over HTTP, UDP, or Multicast (requires Multicast enabled).

➡ **To Play HLS:**

1. In the ZEC **Adaptive Groups** page, click the adaptive group row that you want to playback.

2. Select the Group to which you want to add a stream, and click [⚙▾] button, and then click **Play HLS**.
   The following window is displayed:

3. Do one of the following:
   - **HLS over HTTP** - streams the adaptive stream over HTTP. Select **Live** to stream a live stream or select **DVR** to select a recorded stream. To stream from an encrypted HTTPS link, select the **HTTPS** checkbox. To stream from a secondary/backup server, select the **HTTP Fallback** checkbox.
   - **HLS over UDP** - streams the adaptive stream over UDP. Select **Live** to stream a live stream or select **DVR** to select a recorded stream. To stream from an encrypted HTTPS link, select the **HTTPS** checkbox. To stream from a secondary/backup server, select the **HTTP Fallback** checkbox.
   - **HLS over Multicast** - streams the adaptive stream over UDP. Select **Live** to stream a live stream or select **DVR** to select a recorded stream. To stream from an encrypted HTTPS link, select the **HTTPS** checkbox. To stream from a secondary/backup server, select the **HTTP Fallback** checkbox.
4. Copy the link that is generated at the bottom of the window and paste it into a player/browser for playback.
5. Click **Close** when finished.
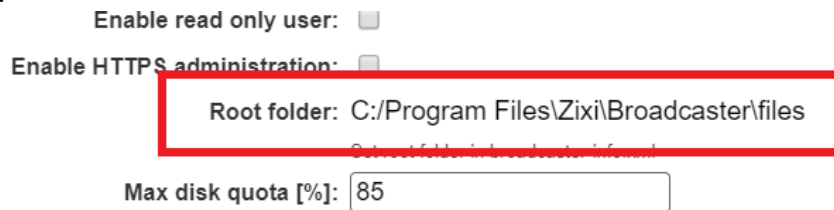
Performing Actions on Adaptive Groups

Set Preroll

A preroll transport stream file is a video/audio file that is played before the adaptive group video is played. Before setting the preroll, you should make sure that the file is available for VOD and that VOD is enabled in the File Transfer and VOD settings.

➡ **To set a Pre-roll:**

1. Upload the Pre-roll TS File to the designated Root folder on the ZEC server. To find your Root folder location, go to Settings > General. The Root path is specified in the Root Folder field.

    Enable read only user: ☐
    Enable HTTPS administration: ☐
    Root folder: C:/Program Files\Zixi\Broadcaster\files
    Max disk quota [%]: 85

2. In the **Settings > File Transfer & VOD** screen, select the **VOD** checkbox.
    The following window is displayed:

    HLS Indexing: ☐
    MPEG-DASH Indexing: ☐
    VOD: ☑
    Encrypt downloads: ☐
    Max download speed [kbps]: 100000   ~100.0 Mbit/s
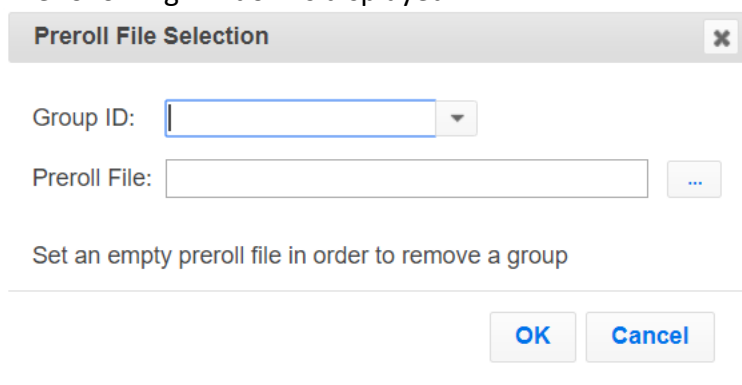
3. In the ZEC Adaptive Groups screen, click the desired adaptive group for which you want to add the preroll.

4. Click the ⚙▾ button on the selected row and then click **Set Preroll**.
    The following window is displayed:

    Preroll File Selection   ✖

    Group ID: [   ] ▾

    Preroll File: [   ] [...]

    Set an empty preroll file in order to remove a group

    OK   **Cancel**

5. In the **Group ID** field, select the adaptive group for which you want to add the preroll.
6. In the **Preroll File** field, click the **Browse** button and select the desired file.
7. Click **OK**.

Server Settings

ZEC is pre-configured with default settings, so generally there is no need to change the server settings. However, some users may want to change specific settings to meet their specific needs.

General

The General Settings screen includes basic configuration parameters for the server including the server's ID, access ports, authorizations, security, and storage.

Field	Description
General	

General

ID	The unique (alphanumeric) name of the ZEC server. Typically: host name. This field is editable.
Machine local time	Shows the current time for the machine.
Web Server Port	The port number of the web server administration. You can configure this parameter to any legal port number which is supported by your Firewall. Default: 4444
Admin User Name	The user name of the administrator. The administrator is authorized to modify all parameters in the system as well as manage all the outputs and inputs on the server.
Admin Password	The password of the administrator.
Enable read / write user - except for settings screen	Select this checkbox to enable an "Operator" user. This type of user can read and write throughout all of the screens, except for the screens under the Settings menu. You can modify the user name (i.e. enter another name instead of Operator) and password.
Enable read-only user +ability to switch streams	Select this checkbox to enable a "User" user. This type of user can read throughout all of the screens as well as the ability to switch between existing streams. You can modify the user name (i.e. enter another name instead of User) and password.
Username	The account Username.
Password	The account password.
Enable read only user	Select this checkbox to enable an "Observer" user. This type of user can read throughout all of the screens. You can modify the user name (i.e. enter another name instead of Observer) and password.
Enable HTTPS administration	Enables secure HTTPS connection to the server for administration. Enabling HTTPS requires the relevant certificates and private keys. To enable HTTPS, click on the checkbox and upload the required files.
HTTPS certificate uploaded (for HTTPS enabled)	If no certificate has been uploaded, click **Upload** and navigate to the file location.
HTTPS private key uploaded (for HTTPS enabled)	If no private key has been uploaded, click **Upload** and navigate to the file location.

Server Settings

General

HTTPS private key passphrase (for HTTPS enabled)	Enter the Private key passphrase for your HTTPS account.
SSL Setup Status	Displays the status of the SSL certificate upload process. Incomplete – the SSL setup process is incomplete. OK – the SSL setup process is complete.
Root folder	Displays the configured root folder. You can modify the root folder by modifying the broadcaster-info.xml, which is located in the ZEC installation folder (<ZEC_Installation_Folder>\Zixi\Broadcaster\)
TR101 analyzer mode	Select the mode in which the TR101 analyzer will operate: None – no TR101 analysis ATSC – based on the Advanced Television Systems Committee recommendations. DVB – based on the Digital Video Broadcasting specifications.
Enable audio levels in matrix	Select this option to enable audio in Matrix view. When not selected the audio will be turned off.
HTTPS and DTLS Streaming Certificate	
Certificate uploaded (for DTLS enabled)	If no certificate has been uploaded, click Upload and navigate to the file location. **Note:** This is the same certificate as the HTTPS certificate.
Private key uploaded (for DTLS enabled)	If no private key has been uploaded, click Upload and navigate to the file location.
Private key passphrase (for DTLS enabled)	Enter the Private key passphrase for your DTLS account.
Input ports	
Port	The port that is used for Input streams. You can modify the port number and/or add additional ports by adding a "," between them. Adding additional ports may be necessary when there is a chance that the ISP will block a certain port. Click '+' to add additional ports. Default: 2088
IP	Enter an IP address. The default enables **Any** IP address.
DTLS	Click the DTLS check box to activate DTLS automatic encryption of the streams.
+ (add ports)	Click + to add additional ports.

	Note: For each port you can select whether or not to activate DTLS encryption. This enables streaming of non-encrypted streams on one port and encrypted streams on a separate port.
Output ports	
Port	The port that is used for the Output streams. Displays the Output port(s). You can modify the port number and/or add additional ports by adding a "," between them. Adding additional ports may be necessary when there is a chance that the ISP will block a certain port. Click '+' to add additional ports. Default: 2077
IP	Enter an IP address. The default enables **Any** IP address.
DTLS	Click the DTLS check box to activate DTLS automatic encryption of the streams.
+ (add ports)	Click + to add additional ports. **Note:** For each port you can select whether or not to activate DTLS encryption. This enables streaming of non-encrypted streams on one port and encrypted streams on a separate port.
Limits	Select to configure thresholds for generating an alarm.
CPU [%]	The CPU utilization threshold. If this limit is exceeded, the CPU indicator at the top of the screen will appear in red, and an alarm will be generated in the event log. Default: 90
Memory [%]	The memory utilization threshold. If this limit is exceeded, the Memory indicator at the top of the screen will appear in red, and an alarm will be generated in the event log Default: 90
GPU [%]	The GPU utilization threshold. If this limit is exceeded, the GPU indicator at the top of the screen will appear in red, and an alarm will be generated in the event log. Default: 0
Input Bandwidth [kbps]	Bandwidth utilization threshold for input streams. Default: Unlimited.
Output Bandwidth [kbps]	Bandwidth utilization threshold for output streams. Default: Unlimited.

Network

The Network screen enables the configuration of the network settings of the ZEC. The screen includes the option to configuration multiple NICs, VLANs, and multiple DNS Servers.

Field	Description
Network Settings	
eth0	Click to configure the specified NIC. Displays the following parameters: • Speed – the network card speed • Duplex – whether the network card is full-duplex or half-duplex • MTU - the size of the largest protocol data unit (PDU) that can be communicated in a single network layer transaction.
Custom link settings	Select this checkbox to configure different link settings than the default settings.
Addresses	Displays the current IP address that is configured for the link. You edit these settings by clicking the Edit (pencil icon) button. Click the '**+**' button to add another link.
DNS Servers	
Use DHCP DNS settings	Select this option to use the DHCP settings instead of the DNS. If not selected, configure at least one DNS server.

Network

➡ **To Display Network Statistics:**

1. From the Settings page of the ZEC, click **Network** on the left-hand side.
   The various Network settings are displayed.

2. Click on the right-hand side.
   The **UDP statistics** window is displayed.

Field	Description
####Packets received	Number of packets on network received.
####packets to unknown port received	Number of packets to unknown port on network received.
####packet receive errors	Number of packets on network which received errors
####packets sent	Number of packets on network sent.
####SndbufErrors	Number of Sent buffer errors

Click the **Refresh** button to update the data or **Close** to close the window

Time

The Time screen enables the configuration of the system time synchronization for the system. The time can be synchronized with the machine local time or to an external NTP server.

Field	Description
NTP Settings	
Machine Time	Displays the current machine local time. To set the time click **Set** and modify the values.
Service	
NTP Servers	Configure external NTP servers for time synchronization. Click the + button to add an NTP server and specify the Host IP address.

Live Protocols

The Live Protocols screen enables the configuration of the HTTP/HTTPS/RTMP/WebSocket server that will broadcast the streams using live streaming protocols, particularly for adaptive streaming and internet protocols.

Field	Description
HTTP Server	
HTTP/HTTPS Server Public IP	Override the ZEC IP (e.g. download.Zixi.com) with a public IP.
Enable HTTP Server	Enable a non-secure connection over HTTP.
HTTP Server Port	Defines the HTTP Server Port. Default:7777
Enable HTTPS Server	Enable a secure connection over HTTPS.

Server Settings

Live Protocols

HTTPS Server Port	Defined the HTTPS server port. Default: 443
HTTPS certificate uploaded (for HTTPS enabled)	If no certificate has been uploaded, click Upload and navigate to the file location.
HTTPS private key uploaded (for HTTPS enabled)	If no private key has been uploaded, click Upload and navigate to the file location.
HTTPS private key passphrase (for HTTPS enabled)	Enter the Private key passphrase for your HTTPS account.
SSL Setup Status	Displays the status of the SSL certificate upload process. Incomplete – the SSL setup process is incomplete. OK – the SSL setup process is complete.
Enable WebSocket server	Select checkbox to enable the WebSocket server. The WebSocket server uses the WebSocket protocol to stream content. The WebSocket protocol provides full-duplex communication channels over a single TCP connection.
WebSocket Server Port	If you have enabled WebSocket, enter a dedicated port for WebSocket. (Default: 8100)
Enable FLV	Enable the streaming via the FLV protocol.
Enable HLS	Enable the streaming via the HLS protocol.
Enable CMAF (DASH + fMP4 HLS)	Enable the streaming via the CMAF protocol.
Enable SHOUTcast	Enable the streaming via the SHOUTcast protocol.
Enable HLS Fast playback	Enables low latency HLS and DASH. When this setting is enabled, all input streams on the ZEC will be published to the origin server as HLS streams, so only enable this feature if it will be actually used.
Sub GOP HLS Fast playback	Select this option to enable publishing of HLS chunk before the response is complete. This means that ZEC will start sending the HTTP response as chunks of data when they are ready before the complete response is available.
HLS DVR maximum recording duration [HH:MM]:	Defines the maximum recording duration for HLS DVR. Default: 24 hours.

Live Protocols

Allow Automatic HTTP Push input	Automatically creates an HTTP Push input without the need to define it in the Input screen.
Allow Automatic HTTP Pull output	Automatically creates an HTTP Pull output without the need to define it in the Output screen. This works in tandem with Zixi Feeder (Remote HTTP Pull Output setting, which enables sending a Zixi-protected stream to ZEC and then ZEC automatically outputs the stream as HTTP Pull) and SDK (which includes a zixi_http_pull_out_config option). By enabling this option, the HTTP Pull streams will be automatically created as they arrive into ZEC and displayed in the Output screen.
RTMP Server	
Enable RTMP Server	Enables ZEC to handle incoming RTMP streams.
RTMP Server Port	The port through which the RTMP stream will be transmitted. Default: 1935
Allow Automatic RTMP Input	Automatically creates an RTMP input without the need to define it in the Input screen.
Allow Automatic RTMP Output	Automatically creates an RTMP output without the need to define it in the Output screen. This works in tandem with Zixi Feeder (**Remote RTMP Output** setting, which enables sending a Zixi-protected stream to ZEC and then ZEC automatically outputs the stream as RTMP) and SDK (which includes a **zixi_rtmp_out_config** option). By enabling this option, the RTMP streams will be automatically created as they arrive into EC and displayed in the Output screen.

Multicast Pool

Multicast pool is a collection of multicast IP addresses that automatically assign a multicast IP when an input is being pulled out of ZEC. When the "multicast pool" setting is enabled, you do not have to define a specific multicast IP address for every push stream. Instead, you simply enable the Multicast Only parameter and ZEC will assign the multicast IP automatically when it pulls the stream out. When the multicast stream is connected, it will appear in the Status table at the bottom of the screen.

Field	Description
Configuration	
Enabled	Enables multicast pool
Address	Specify the range of IP addresses (CIDR format).
Port	Specify the port that will be shared by all of the members of the pool.
NIC	Specify the network card to use for the outgoing multicast traffic.
TTL	Specify the Time To Live.

File Transfer & VOD

The File Transfer and VOD settings screen enables the download of files and the playback of VOD content and, in addition, specifies the speed limits (download/upload). The settings in this screen are related to the VOD and Files screens.

Field	Description
File Transfer & VOD	
Download	Enables download of files through the Files menu of ZEC.
Upload	Enables upload of files through the Files menu of ZEC.
Automatically index VOD files	Indexes the VOD files in the various VOD folders. In some cases, the indexing of VOD files can affect performance. Using this control, you can decide when to index the VOD files in order to ensure optimal performance during peak times.
Scan on startup	Indexes the files in the VOD folder that have not been indexed during startup of the ZEC.
HLS indexing	Enables indexing of HLS streams. The indexing creates an M3U8 playlist file.
MPEG-DASH indexing	Enables indexing of MPEG-DASH streams. The indexing creates a .mpd (MPEG-DASH Media Presentation Description) file.
VOD	Enables the VOD feature.
Encrypt downloads	Encrypts files that are downloaded.

File Transfer & VOD

Max download speed [kbps]	Limits the amount of bandwidth used to download files
Max upload speed [kbps]	Limits the amount of bandwidth used to upload files
Initial bitrate [kbps]	Limits the amount of bandwidth used during initial download/upload (before cache)
HTTP/Origin cache size [MB]	Limits the amount of cache memory that can be used for cache

Cluster

ZEC enables two types of configurations:

- **Cluster configuration** - a cluster of ZEC servers in a LAN for load balancing purposes. The different ZEC servers will communicate with each other and are "aware" of the Input/Output traffic of each node in order to redirect the streams to the least occupied ZEC instance. All ZECs should have a separate **Public IP** (NIC #1) and in addition, they all should have an internal IP on the LAN (**Cluster Internal IP**) to communicate over multicast (NIC #2). When a request received by ZEC, it accepts it, or transmit it internally to another ZEC that is less loaded and has the requested channel. The Cluster feature is currently supported for:
    - o Inputs - Zixi Push inputs
    - o Outputs - Zixi Pull outputs, HLS outputs

> If you want to use more advanced load balancing and high availability features, instead of configuring the cluster within each ZEC (as described below) it is recommended to configure the cluster within ZEN Master, which requires a single cluster configuration and then automatically manages the load balancing and high-availability, while enabling monitoring, reporting, and other advanced features. For more information, see: https://zixidocumentation.atlassian.net/wiki/spaces/ZMUG/pages/388005967/Adding+a+Broadcaster+Cluster+Automatic+Scaling.

- **Edge-Origin configuration** - the cluster may be used to forward the stream from one ZEC server (origin) to other ZEC servers (edge) which are closer to the user or is located in a less sensitive environment. When the end-user connects to the edge server to view a certain stream, the edge server will retrieve the stream from the origin server and will seamlessly deliver it to the end-user.

Server Settings

Cluster

Field	Description
Origin	
Enabled	Enables Edge-Origin configuration.
Host	The primary host IP address of the origin server.
Port	The port number in the origin server for transmitting the stream. Default: 2088
Alternative Host	The IP address for a secondary server. If the primary origin server is unavailable, the data will be retrieved from the secondary origin server.
Port	The port number for the secondary origin server. Default: 2088
HTTP/origin cache size [MB]	The size of the cache that will be used to serve multiple users. The edge server will retrieve the data from the origin and cache it for additional users in order to save bandwidth and increase performance.
Live Streams	
Latency [ms]	Specify the buffer size between the edge and the origin.
Timeout [s]	Specify the maximum amount of time in which the edge will attempt to connect to the origin. After the timeout period the edge server will attempt a connection with the secondary origin server.
Cluster	

Cluster

Enabled	Enables Cluster configuration.
Public IP	The public-facing IP address of this ZEC server for external access. A unique Public IP must be assigned to each ZEC in the cluster.
Cluster Internal IP	The internal IP (multi-cast) address for communication between the various servers in the cluster. This address is used to communicate load information forwarding the streams within the cluster. The same multicast IP address should be used across all instances in the cluster.
TTL	Specify the Time To Live parameter.
Port	Specify the port that are used in all the participating ZEC servers in the cluster.
Local IP	Specify the local IP address which the network employs for internal communication.
Balance Inputs	Enables the balancing of the inputs.
Balance Outputs	Enables the balancing of the outputs.
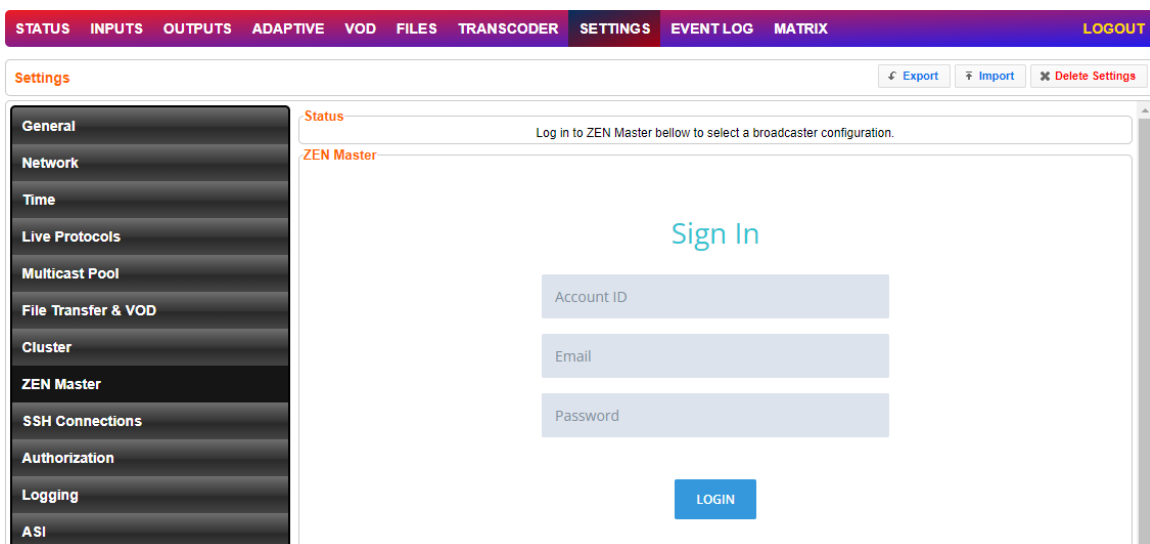
Zen Master

The ZEN Master screen is used to add the current ZEC to an existing ZEC Cluster in Zen Master that has been configured for "Manual Scaling". This process involves pre-configuring a "manual scaling" ZEC Cluster in ZEN Master, then, still in ZEN Master, creating a manual ZEC within this cluster, and then finally from the ZEN screen of the current ZEC UI, selecting the previously created ZEC Cluster and ZEC (that we had created though the ZEN Master UI). This process will generate a connection between the logical representation of the ZEC in ZEN Master and the ZEC system.

➡ **To connect the current ZEC to ZEN Master:**

1. In **ZEN Master**, create a "manual scaling" ZEC Cluster and add a ZEC entity to it by following the procedure described in the **Adding a ZEC Cluster – Manual Scaling** section in the **ZEN Master User Guide**.
2. In ZEN Master, in the main navigation, click **Settings**.
3. In the **SSH Keys** tab, click **Download** on the relevant SSH Key to download the key to your machine.
4. Login to the ZEC UI (it could be a locally installed ZEC, e.g. http://localhost:4444 or a remote ZEC).
   The ZEC UI opens.
5. Go to **Settings > ZEN Master**.
   The ZEN Master login fields are displayed:

6. In the **Account ID** field, enter the customer domain of your ZEN Master account (e.g. if you login to ZEN at *demo.zen.zixi.com* then your Account ID is *'demo'*).

> The user cannot be an SSO (Single Sign-On) user. If you are using an SSO account, you will have to create another user to sign in through this screen.

7. In the **Email** field, enter the username for your ZEN Master account.
8. In the **Password** field, enter the password from your ZEN Master account.
9. Click **Login**.
   A list of ZEC instances configured in ZEN Master is displayed.
10. For the ZEC that you are adding, which should currently be in **Pending** mode, click **Select**.
    Details about the ZEC are shown in the **Status**
11. Click **Refresh.**
    The connection is configured automatically.
12. In **ZEN Master**, in the main navigation, click **Broadcasters**.
13. Verify that the status of the newly configured ZEC cluster is *OK.*
14. Verify that the status of each ZEC that was added to the cluster has changed from *Pending* to *OK.*

SSH Connections

SSH (Secure Shell) is a network protocol that allows a secure access over an encrypted connection. Reverse SSH is a technique that can be used to access systems (that are behind a firewall) from the outside world. As part of the SSH configuration, you can configure a connection to the server and then configure any number of SSH tunnels to the same server.

➡ **To create an SSH connection to a server:**

1. Click the **Add Connections** button.
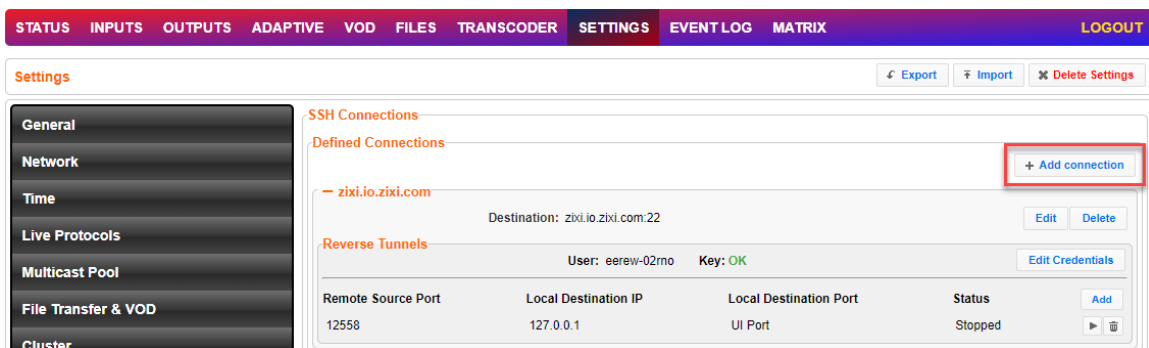
2. In the **Host** field, enter the IP address or host name of the host that you wish to access.
3. In the **Port** field, enter the port number to access the host.
4. Click **Apply**.
   The connection to the specified server is configured.

➡ **To create a reverse tunnel to the same server:**

1. Under the destination that you have configured, click **Edit Credentials**.
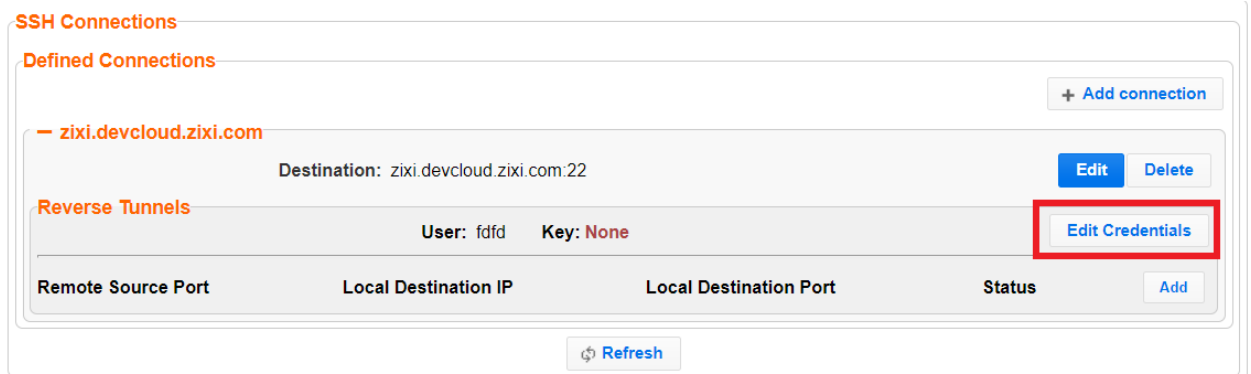
   The **Connection Credentials** dialog appears.
2. In the **User** field, enter the user name to access the tunnel.
3. Click **Private Key**, navigate to the file location and select the file.
4. Click **Apply**.

5. Click **Add** to add a reverse tunnel.

The **Tunnel details** dialog appears.

6. In the **Remote Source Port** field, enter the port number of the remote server.
7. In the **Local Destination IP** field, enter the IP address of the local server.
8. In the **Local Destination Port** field, enter the port number to connect the tunnel.
9. Click **OK**.
10. Repeat steps 5-9 to add additional tunnels.

Authorization

Authorization can be configured for any incoming or outgoing streams.

Field	Description
Authorization	
Type	**None (default)** - authorization will be defined in the Input and Output streams. In this case you will need to define the password in the Input and the Output streams. Unless you select the Allow automatic push inputs and/or Allow automatic pull outputs checkboxes (as described below). **Text File** – this option manages authorizations in a text file. This option is useful for large OTT operations, as it does not require configuration for every user. The text file contains pairs of stream name and password that are used for the input streams. For the outputs, it contains the stream name, user and password of the viewer. **Linux Users** – uses the built-in authorization of the Linux operating system. **Global Password** – a single password that will be used for all access requests. **Users Files** - **HTTP Server** – ZEC will generate an HTTP request to an external server on every connection. **Stream access** – access authorization on the stream level. The password needs to be the same as the password to access the stream**.** **Windows Users** – uses the built-in authorization of the Windows operating system. Other override authorization techniques are available. For more information contact Zixi support
Parameter	Specify the password that you would like to use for access

Authorization

Allow Automatic Push inputs	If this checkbox is selected, the ZEC will automatically create an input stream each time it receives a push stream from a source. However, if this checkbox is not selected, only predefined Push Input streams with the defined credentials will be allowed in (this is the default setting and the behavior in previous versions). Default: not selected.
Allow Automatic pull outputs	If this checkbox is selected, any ZEC that requests a Pull output will be granted access. In this case, a Pull output will be automatically created in ZEC (this is the default setting and the behavior in previous versions). However, if this checkbox is not selected, only predefined Pull output streams with the defined credentials will be pulled by ZEC. Default: selected.
Separate user folders	Select this checkbox to enable access by user folders
Logging	Select the checkbox to enable logging of the connections

Logging

The Logging screen defines the logs location and preferences for debugging purposes.
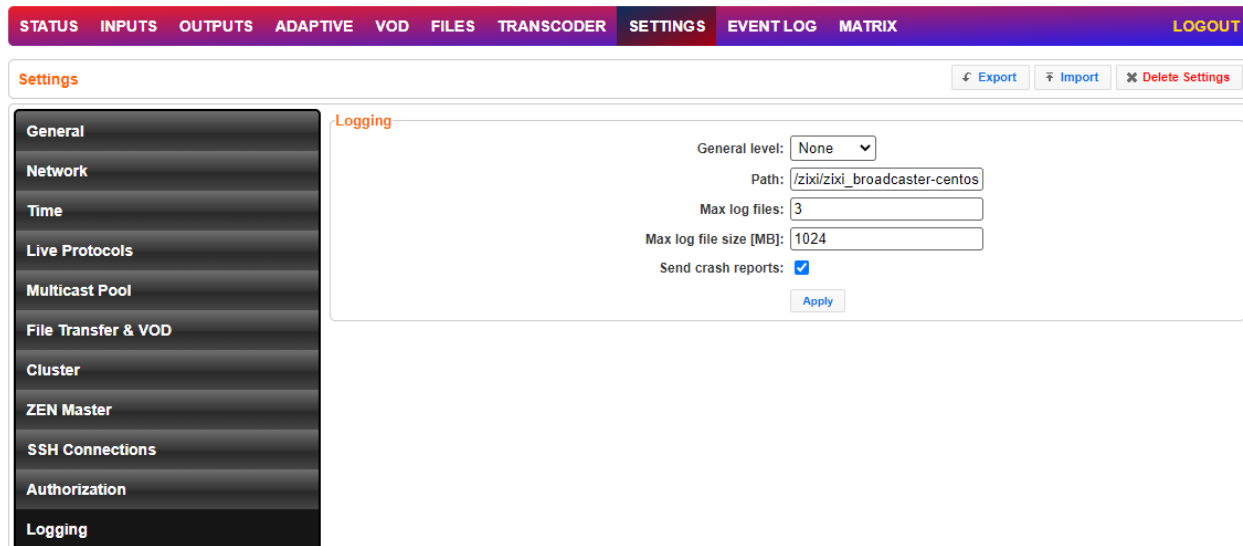
Field	Description
Logging	
General Level	The Severity Level that will be collected in the log, from Info, Warning, Error, to Fatal. Selection of lower severity levels will include all higher-level logs. Default: None, since Logging is resource-intensive and only enabled when necessary.
Path	The log file name and path where the collected event information will be stored.
Max log files	The maximal number of log files.
Max log file size (MB)	The maximal size of each log file.
Send crash reports	Select the checkbox to send a crash report to Zixi Support.

ASI

The ASI screen is used to configure the ASI interface when there is an ASI card in the machine. You can use this screen to reverse the direction of the ports on the ASI card. The port numbers should correspond to the port numbers on your ASI card.

Field	Description
ASI output stuffing	Select this checkbox to achieve CBR (constant bitrate) by padding the ASI stream with TS null packets.
ASI output PLL	Select this checkbox to enable a phase-locked loop. A phase-locked loop or phase lock loop (PLL) is a control system that generates an output signal whose phase is related to the phase of an input signal. When selecting this option, the system will adjust the bitrate that is sent according to the fullness rate of the output buffer.
ASI fix time	Select this checkbox to adjust input timestamps to local machine time.
Initial buffer time [ms]	To avoid underflows, specify the output buffer size that will be filled before starting the transmission.
Read buffer size [B]	Specify the input read buffer to fill, before passing data to the application. Larger buffer size should be specified for higher bitrates; Smaller buffer size will be more responsive and smoother in lower bitrate streams.

Reversing the directions of the ports

➡ **To Reverse the Direction of the Ports:**

1. From the **Settings** page of the ZEC, click **ASI** on the left-hand side. The various **ASI settings** are displayed.

2. Click the desired **RESET** button to the right of the port that you want to reverse. A confirmation window is displayed with the notification that the service must first be restarted before the direction is reversed.

Field	Description
Available ports	
Name	Displays the port number used by the ASI protocol.
Data Direction	Displays the direction of the data being transmitted by the ASI protocol.

Threads

The Threads screen enables the configuration of the maximal number of concurrent CPU threads allowed for each component/service. Enter -1 to limit the threads according to the number of cores.

The following elements can be configured:

- Input
- Output
- VOD
- Read
- Pool
- RTMP
- UDP In
- UDP Out
- HTTP In
- Transcoder
- Push Output Receive
- HTTP
- Authorization
- Analyzer

Threads

Viewing Events Log

The Event Log screen displays all the events (errors, connections, configuration changes, analysis events etc.) that occurred in the ZEC. The logs are displayed in the server time (not local time) and can be exported as a .cvs file.

In Linux, the event log is written to a file located in the following location on the disk: /log/var/messages

STATUS	INPUTS	OUTPUTS	ADAPTIVE	VOD	FILES	TRANSCODER	SETTINGS	EVENT LOG	MATRIX		LOGOUT

Event Log	Search Events	✖	🔍			⊘ Clear	🖫 Save	🗋 System Log	⟳ Refresh

▼ Time/Date	⇕ Event
2022-02-16 17:46:01	Output of hls_4088 to QA-Elena-SRT-1-3wyo cleared alert Low bitrate
2022-02-16 17:45:24	Output of hls_4088 to QA-Elena-SRT-1-3wyo raised alert Low bitrate
2022-02-16 17:42:36	Output of pull to ristMainPush-pull cleared alert High bitrate
2022-02-16 17:42:33	Output of pull to srt-pull cleared alert High bitrate
2022-02-16 17:42:33	Output of pull to srt2-pull cleared alert High bitrate
2022-02-16 17:42:33	Output of pull to tcp-pull cleared alert High bitrate
2022-02-16 17:42:33	Output of pull to QA-Elena-SRT-1-3wyo cleared alert High bitrate
2022-02-16 17:42:33	Output of pull to QA-Elena-SRT-1-3wyo cleared alert High bitrate
2022-02-16 17:42:30	Output of pull to ristMainPush-pull raised alert High bitrate
2022-02-16 17:42:28	Input srt-pull cleared alert High bitrate
2022-02-16 17:42:28	Output of pull to QA-Elena-SRT-1-3wyo raised alert High bitrate
2022-02-16 17:42:28	Output of pull to QA-Elena-SRT-1-3wyo raised alert High bitrate

➡ **To Clear the Log:**

1. In the **Event Log** screen, click **Clear** on the upper right-hand corner. The events on the log screen are deleted.

➡ **To Save the Log as a File:**

1. In the **Event Log** screen, click **Save** on the upper right-hand corner. A .cvs file is created and saved to the local destination.

➡ **To Refresh the Screen:**

1. In the **Event Log** screen, click **Refresh** on the upper right-hand corner. The data on the screen is updated.

Using the Matrix

The Zixi Matrix view provides a visual-based alternative to managing the streams, by previewing the input and output streams with their current status. Matrix offers drag and drop capabilities to connect input streams to outputs as well as some of the actions that were covered in the Performing Actions on Input Streams and Performing Actions on Output Streams sections above.

The following formats are supported in the Matrix:
* Video:

  * MPEG 1/2, 8bit 4:2:0 , interlaced/progressive, up to 60fps, up to Full HD (1080p)

  * H.264/AVC, 8/10 bit, 4:2:0, 4:2:2, 4:4:4, interlaced/progressive, up to 60fps, up to 4k (2160p)

  * H.265/HEVC, 8/10 bit, 4:2:0, 4:2:2, 4:4:4, interlaced/progressive, up to 60fps, up to 4k (2160p)

  * JPEG2000, 8/10 bit, 4:2:0, 4:2:2, interlaced/progressive, up to 60fps, , up to 4k (2160p)

* Audio (for audio levels meter overlay):

  * AAC (LC, HEv1, HEv2)

  * AC3 (downmix to stereo)

  * Opus

  * MPEG1/2 Layer 1/2/3

Connecting Input to Output

An easier method of connecting inputs to outputs.

➡ **To Connect an Input to an Output:**

1. Drag the desired input thumbnail and drop it over a specific output thumbnail. The desired input is connected to the selected output.

Disconnecting Output from Input

➡ **Disconnect an Input to an Output:**

1. Click on the **To connected stream** that you want to disconnect.
   The **Input stream data** window is displayed.
2. Click **Unlink**. A confirmation window is displayed.
3. Click **Confirm**. The Output is disconnected from the Input.

Matrix Interface Elements

The Matrix view displays preview thumbnails of the Input and Output streams. Preview thumbnails of input streams are presented in the Inputs pane and preview thumbnails of output streams are presented in the Outputs pane.

- If the stream is active - the live video will be shown in the preview thumbnail.
- If an input stream is not active – the preview thumbnail will include an "Offline" message.
- If an output stream has been created, but has not been connected to an input – the preview thumbnail will include the following message - "Drag Input Here".
- If a connected output stream does not receive a live stream - the preview thumbnail will include a "No Video" message.
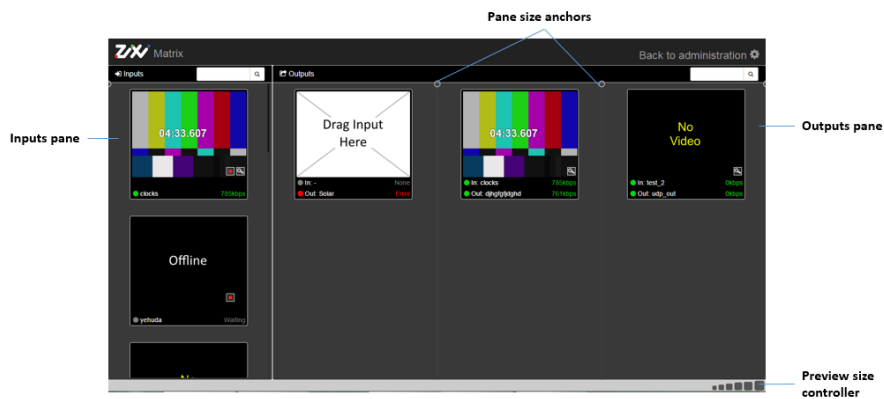
Changing Matrix View

You can modify the size of the panes, the size of the preview thumbnails, and re-arrange the order the preview thumbnails.

➡ **To modify the size of the panes:**

1. Click on one of the rounded **pane size anchors** (see screenshot above)

➡ **To modify the size of the preview thumbnails:**

1. Click on one of the sizes in the **preview size controller** (see screenshot above).

➡ **To re-arrange the order the preview thumbnails:**

1. Drag and drop the preview thumbnail to the desired position within the pane.

Searching for Specific Streams

➡ **To Search for a Specific Stream:**

1. Type in the specific stream name in the appropriate (Input or Output) search text box on the top of the console and click 🔍 .
2. The relevant stream will be the only one to be displayed in the pane.

Preview Thumbnail Elements

The following stream formats are supported for thumbnail preview:

- Scan Style: Interlaced and Progressive

- Codec: MPEG2, H.264/AVC

- Frame Size: SD, HD (720p), Full HD (1080p), 4K (2160p)

- Frame Rate: 24fps, 25fps, 29.97fps, 30fps, 59.94fps, 60fps

- Chroma Subsampling: 4:2:0

- Bit Depth: 8-bit (MPEG2, H.264/AVC), 10-bit (H.264/AVC)

Viewing Stream Details

The preview thumbnail includes the following elements:

Element	Description	Action
Status Indicator	Displays the unique identifier for this group.	
Stream ID	Displays the unique name for the stream.	
Bitrate [kbps]	Displays the bitrate of the active stream.	
Uptime	Displays the amount of time the stream has been active.	
Record	Stream recording	Click the record button to start recording. Click again to stop recording
Zoom	Opens the stream in a larger preview window with sound	Click the Zoom icon to open the larger preview screen.

Viewing Stream Details

➡ **To View Stream Details:**

Click anywhere on the preview thumbnail.
The Stream Details window opens:

Viewing Stream Details
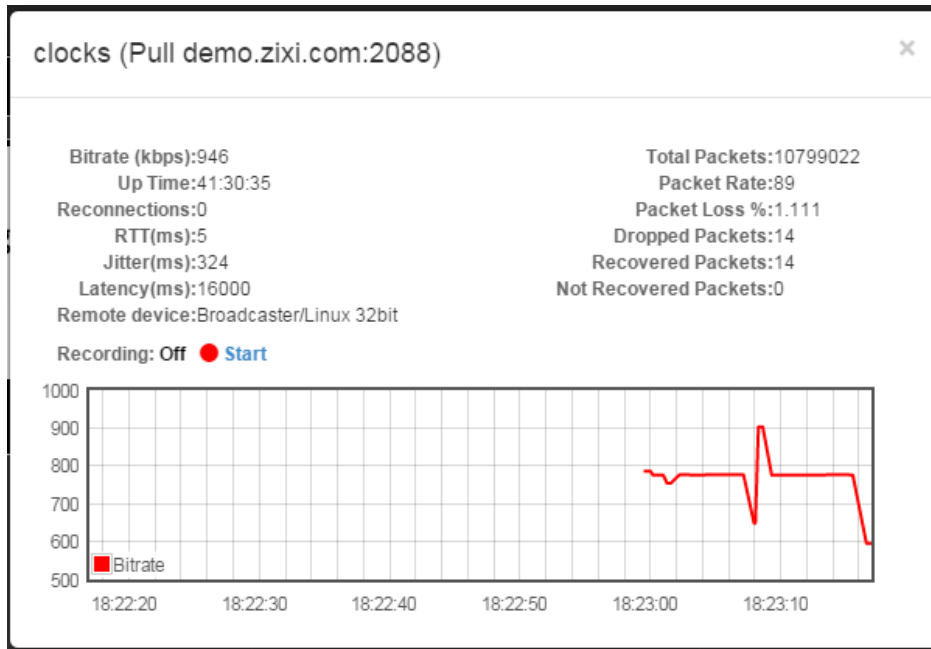
Configuring Hitless Failover

ZEC features hitless failover for inputs, enabling undisrupted streaming when switching from one source to another. The hitless failover feature is based on the SMPTE 2022-7 standard, which specifies "seamless" or hitless failover between binary-identical streams with synchronized RTP headers. ZEC's patent-pending hitless failover technology works by comparing the transport stream payload, without relying on sequences being synchronized. ZEC then applies a proprietary sequencing algorithm to identify missing parts and fill-in missing packets.
The Hitless Failover feature is supported in the inputs of ZEC.
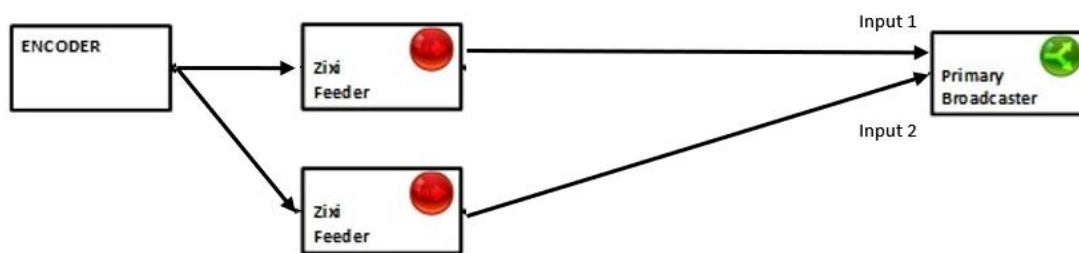
The hitless failover configuration involves grouping two inputs in a "Failover Group". The failover group includes the following configuration options for the merging of binary-identical steams:
The merging of the streams can be achieved using one of the following methods:

- **RTP headers (SMPTE 2022-7)** – if the sources are RTP and the RTP headers were maintained, ZEC will use the SMPTE 2022-7 to compare and merge the two streams in order to allow hitless failover. This option is the most recommended as it will use the sequence and the timestamp in the packets to compare which packets are missing. This method is more accurate than methods that compare the entire payload or methods that use sophisticated DNA sequencing algorithm, which are more error prone, as the payload may have multiple matches.
- **RTP headers or TS content** – if the sources do not have RTP headers, ZEC will try to merge using the MPEG-TS content itself.

In these cases, when one of the streams is disrupted or interrupted completely, ZEC will seamlessly use the packets of the other input without any disruptions.

> If the streams are not identical, the failover process will not be seamless and may take up to a second.

A Failover Group can comprise two or more inputs. In a group of three or more, you can define one or more streams as a "Backup". In this case the system will always try to recover packets from "Primary" streams first and only if there are no available primary streams, it will use the backup

streams. When one of the primary streams becomes available, the system will automatically jump to the primary stream.

While the ZEC GUI only enables configuration of primary streams at a single priority level, through the ZEC API it is possible to assign different priorities as follows:

- Priority 0 – means backup. It will be used only if all other streams are unavailable.

- Priority greater than 0 - means primary.

The Failover Group has its own Stream ID, just like an Input Stream, and will appear in the Inputs list. Although the topology above shows only one ZEC instance, it is also possible to have multiple targets (e.g. two or more ZEC instances), each with its own Failover Group of inputs to enable a more complete system-level redundancy.

To configure a Failover Group, follow the instructions in the **Creating a Failover Group** section.

Configuring HTTPS

ZEC supports HTTPS encryption based on OpenSSL. ZEC expects certificate files in X.509 textual format (sometimes called 'pem') with a full chain of certificates, each one starts with "----BEGIN CERTIFICATE----", and the associated private key file, that starts with "----BEGIN PRIVATE KEY----". The certificate can be provided by an SSL/TLS certificate provider (Certification Authority) where the domain is registered, such as VeriSign, Digicert, etc.. Alternatively, the certificate can be self-signed. A self-signed certificate is a certificate that is signed with its own private key. Self-signed certificates can be used to encrypt data just as well as CA-signed certificates, but your users will be displayed a warning that says that the certificate is not trusted by their computer or browser. Therefore, self-signed certificates should only be used if you do not need to prove your service's identity to its users (e.g. non-production or non-public servers).

Obtaining a CA-signed Certificate

Reach out to the hosting provider for instructions on how to obtain a CA-signed HTTPS certificate. As part of this process, you will be required to generate a certificate signing request (CSR). A CSR consists mainly of the public key of a key pair, and some additional information. Both of these components are inserted into the certificate when it is signed. To learn more about generating a CSR, go to - https://www.digitalocean.com/community/tutorials/openssl-essentials-working-with-ssl-certificates-private-keys-and-csrs.

Creating a Self-signed Certificate

Instead of obtaining a CA-signed certificate, you can create a self-signed certificate.

You can generate self-signed x.509 certs with OpenSSL by using the following command:
```
openssl req -x509 -newkey rsa:2048 -keyout selfsigned_key.pem -out selfsigned_cert.pem
```

To learn more about generating a self-signed certificate, go to: https://www.digitalocean.com/community/tutorials/openssl-essentials-working-with-ssl-certificates-private-keys-and-csrs.

Uploading the Certificate and Private Key

After obtaining a CA-signed certificate or creating a self-signed one, you will need to upload the certificate and private key to ZEC.

➡ **To upload the certificate and private key:**

1. In **ZEC UI**, go to **Settings > General**.

Uploading the Certificate and Private Key

2. Click + to expand the HTTPS and DTLS Streaming Certificate section
3. In the **Certificate Uploaded** field, click **Upload** and select the certificate file.
4. In the **Private Key Uploaded** field, click **Upload** and select the Private Key.
5. In the **Private Key Passphrase** field, type the passphrase or leave empty (Default passphrase is empty, ignore the '****').
6. Click **Apply**.
   If the process was successful, the **SSL setup status** field will turn to "**OK**".

Configuring MultiPath TCP

Developed by the Internet Engineering Task Force's (IETF) Multipath TCP working group, MultiPath TCP (MPTCP) is an effort towards enabling the simultaneous use of several IP-addresses/interfaces by a modification of TCP that presents a regular TCP interface to applications, while in fact spreading data across several subflows. This means that the Linux Kernel should be updated to support MPTCP.

The MPTCP functionality is similar to ZEC's "multi-link bonding" feature, which is available for UDP only, while MPTCP works on TCP.
If both the sending end and the receiving end support MultiPath TCP, ZEC can use this functionality to transmit a stream over TCP using multiple network interfaces (e.g. Wifi + mobile). The multiple links can be configured to:
- **Aggregate** - aggregates the bandwidth of the multiple links in order to use the total capacity of these links. In this case ZEC will use all available bandwidth among all available flows (if needed) to send the stream.
- **Duplicate** - enhance the path's resiliency by duplicating the stream and sending through all links in order to overcome errors and packet loss.

MultiPath Modes

MultiPath TCP can be used in two modes:
- **Pull** – when pulling the stream, the receiving-end has multiple network interfaces (e.g. two NIC) while the sending side has one network interface. When the stream is pulled by the receiving-end using the MultiPath feature, the client (receiving side / puller) creates the sub-flows, (one per nic) and connects to the "source" (the server). The definition of the NICs in the destination is done automatically at the OS socket level. To configure this mode:
  - **In the sending side** - In **Settings > Live Protocols** screen, enable the **Allow automatic Pull output option**. In this option the output will be created automatically when the Pull connection is established. Following the connection, the two links will be displayed as bonded links. When the connection is established, the two links will be displayed as bonded links as shown below.

o **In the receiving side** – Configure a **TS over HTTP Input as Pull**. When the connection is established, only one link is displayed as shown below.

- **Push** – when pushing the stream, the receiving-end has one or more network interfaces (e.g. two NICs) while the sending side can have one network interface. In this case, you should configure it in the following way:
    o **In the sending side** – you will need to configure a **TCP output** from the ZEC in the sending side. In this case you can configure the two links as **Aggregate** or **Duplicate**, as described above. When the connection is established, the two links will be displayed as bonded links as shown below.

   o **In the receiving side** - In the receiving-end, if this is also a ZEC, you have two options:
      - Configure a **TS over HTTP Input as Push**. In this option the Push input is ready in advance and will show the bitrates of both TCP connections when the connection has been established.
      - In **Settings > Live Protocols** screen, enable the **Allow automatic Push input option**. In this option the input will be created automatically when the Push connection is established.
         When the connection is established, the two links will be displayed as bonded links as shown below.

MultiPath TCP Setup

ZEC supports MultiPath TCP for Linux based on the OS Kernel support. This means that the Linux Kernel should be updated to support MPTCP.

➡ **To setup MultiPath TCP:**

- Follow the relevant instructions in - https://multipath-tcp.org/pmwiki.php/Users/HowToInstallMPTCP?

Using an External Storage

Modification of location of the ZEC 'cache' directory may be desired to minimize HDD used at the default location for recording streams. The default storage location (C:\Program Files\Zixi\Broadcaster\cache) can be replaced by using a symbolic link.

> ZEC will need to be in in a Maintenance Window to apply these steps as the service will be turned off and on.

➡ **To configure an external storage path in windows:**

1. On the ZEC Windows machine, stop the ZEC service, by going into the operating system **Services** screen.
2. Double click the ZEC service to open its configuration properties.
3. Under the **General** tab, in the **Startup type** drop-down menu, select the **Manual** option.
4. Click the **Stop** button and then click **OK**.
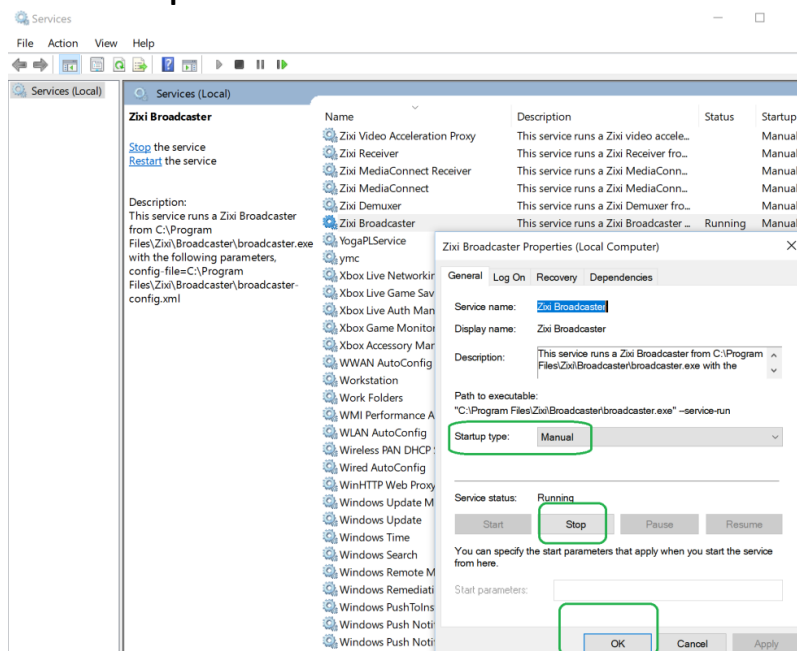
5. Delete the 'cache' file located at C:\Program Files\Zixi\Broadcaster\cache. This may require Administrator privileges depending on your environment.
6. On the planned new location create your new cache directory. In the example below the directory was created in d:_Zixi\Bx\cache.
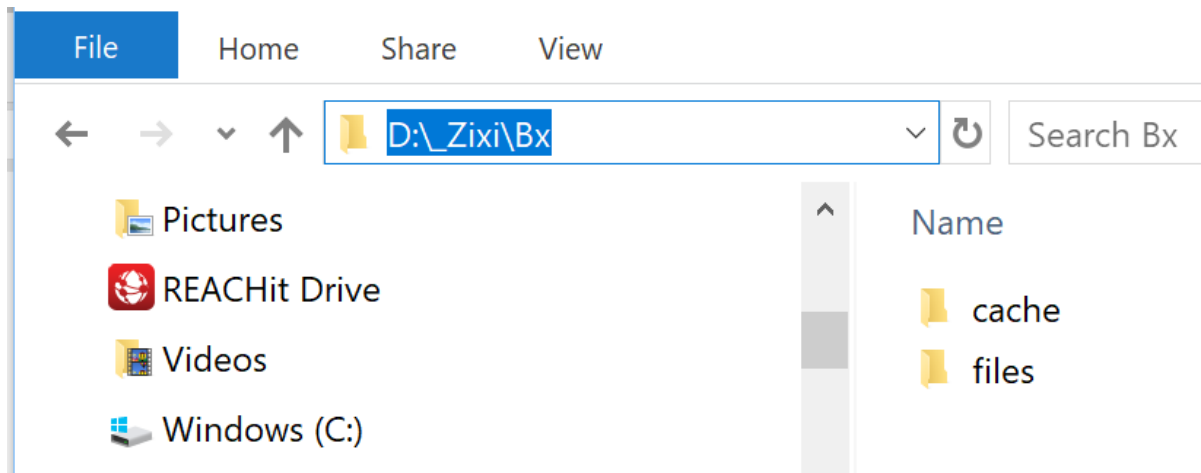
7. Go into the Windows Command line (cmd) as an Administrator.
8. Enter a makelink command to create a new Symbolic link from the original path to the newly created 'cache' folder. For example:
    mklink /D "c:\Program Files\Zixi\Broadcaster\cache" d:_Zixi\Bx\cache

    The newly created symbolic link for cache will be displayed in the following directory - C:\Program Files\Zixi\Broadcaster\
9. Go into the operating system **Services** screen.
10. Double click the ZEC service to open its configuration properties.
11. Under the **General** tab, in the **Startup type** drop-down menu, select the Automatic option.
12. Click the **Start** button and then click **OK**.
    The recording of input streams will be stored in the new directory.