EAN-Encoding

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Exports: Export Summary Sheet

EULA: End User License Agreement

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CAUTION: Alerts to a potential hazard that may result in personal injury, or an unsafe practice that causes damage to the equipment if not avoided.

IMPORTANT: Identifies crucial information that is important to setup and configuration procedures.

Used to emphasize points or reminds the user of something. Supplementary information that aids in the use or understanding of the equipment or subject that is not critical to system use.

1 Overview

This document outlines SightLine encoding capabilities and library support of motion imagery standards for streaming video and metadata. It also covers encoding options, compatible decoders, and encoding configuration settings.

1.1 Additional Support Documentation

Additional Engineering Application Notes (EANs) can be found on the Documentation page of the SightLine Applications website.

The Panel Plus User Guide provides a complete overview of settings and dialog windows. It can be accessed from the Help menu of the Panel Plus application.

The Interface Command and Control (IDD) describes the native communications protocol used by the SightLine Applications product line. The IDD is also available as a PDF download on the Software Downloads page.

1.2 SightLine Software Requirements

ⓘ **IMPORTANT:** The Panel Plus software version should match the firmware version running on the board. Firmware and Panel Plus software versions are available on the Software Download page.

1.3 Application Bit Requirements

The functions described in this EAN require Application Bits (app bits) purchased from SightLine. App bits are enabled with a license file provided by SightLine at initial unit purchase or during a license upgrade process. License files use a hardware ID that is applicable to a specific hardware serial number. For questions and upgrade support contact Sales.

Table 1: Application Bits Requirement Table

Function	Initial Software Release	Required Application Bit(s) v7 License
Encoding	2.22.xx	Encoding (H.264) 0x0000 0004 Optional add for H.265 (4000 only): Encoding (H.265) 0x0001 0000 HD bits as applicable for application.

2 Encoding Overview

2.1 Image Compression and Video Encoding Standards

SightLine has implemented both JPEG and PNG standards for capturing video frames. Snapshots of unprocessed frames from a connected camera, and processed frames (display) are supported.

Table 2: Support Digital Compression Standards

Snapshots	Supported Standard
JPEG - Joint Photographic Experts Group	ISO/IEC 10918
PNG - Portable Network Graphics	ISO/IEC 15948
Video	
SD-SDI	259M-C and 259M-D
NTSC/PAL	344M
HD-SDI	292M and 424M

2.2 Encoding Options

SightLine supports various configuration to tune encoder settings. Configurations include I-Frame interval setting, bit rate control mode setting (supporting constant and variable bit rate modes), and bit rate setting to support low bandwidth and high bandwidth streaming.

SightLine has implemented the following algorithms:

- MJPEG: The 1500-OEM supports this video compression format. Each video frame or interlaced field of a digital video sequence is compressed separately as a JPEG image. Client support includes most web browsers. While overall image quality is better, MJPEG requires more bandwidth.
- MPEG4: The 1500-OEM offers this video compression standard. It provides lower latency encoding. Higher output frame rates can be achieved because the algorithm compresses data content at a higher rate (payload of data is larger than H.264). This results in reduced bandwidth requirements, output frame rates, and overall lower latency, while delivering low robustness in the event of packet loss.
- H.264: The 1500-OEM, 3000-OEM, and 4000-OEM provide H.264 encoding utilizing part-10 compression techniques. The 1500-OEM supports the baseline profile. The 3000-OEM and 4000-OEM support the baseline, main and high profiles. Baseline is the default profile used for the 3000-OEM and high is the default profiled used for the 4000-OEM.

  H.264 is a block-oriented motion-compensation-based video compression standard. The two supported options for this algorithm are Standard Definition (SD) video and High Definition (HD) digital video. H.264 has become the industry standard providing excellent quality video with low bandwidth requirements.
- H.265: The 4000-OEM provides H.265 encoding, also known as High Efficiency Video Coding (HEVC). It provides better compression at the same quality level, however the resources to compress and decompress are significantly greater than H.264. Main is the default and only profile supported for H.265 on the 4000-OEM.

  Because H.265 requires additional resources to decode there may be additional lag in the video in Panel Plus or a reduced frame rate. This is with frame sizes of 1920x1080 or greater. If this happens, try the following options:

  - Use the hardware decoder in Panel Plus by checking the *Use HW Decoder* checkbox in the video tab.
  - The hardware decoder requires an Intel Integrated Graphics device that is Skylake or newer architecture. If one is not present Panel Plus may not be able to receive video or the video may be slow or delayed.
  - Reduce the output frame size.
  - Use a more powerful PC.

  For questions and additional support, contact Support.
- KLV Only: New in 3.3.x software. The 1500-OEM, 3000-OEM, and 4000-OEM support sending a KLV stream without accompanying video as part of an MPEG-2 transport stream. This may be useful in situations where the data contained in the KLV is important and bandwidth is extremely limited.

Table 3: Supported Display Resolutions

CODEC	1500-OEM
MJPEG	320x240, SD*, 960x720, 1280x720
MPEG4	
H.264	
CODEC	**3000-OEM**
H.264	320x240, 640x480, 768x576, 960 x 720, 1280x720, 1440x1080, 1920x1080
CODEC	**4000-OEM**
H.264	320x240, 640x480, 768x576, 960x720, 1280x720, 1280x960, 1440x1080,
H.265	1920x1080, 2560x1440, 3840x2160

**SD = 640 x 480 for NTSC cameras, 768 x 576 for PAL cameras.*

Table 4: Supported H.264 Profiles

Profile	1500-OEM	3000-OEM	4000-OEM
Baseline Profile (BP)	Yes	Yes	Yes
Main Profile (MP)	No	Yes	Yes
High Profile (HP)	No	Yes	Yes

Starting in 3.4.x software the maximum bit rate supported for each OEM is shown in Table 5. In previous software versions, the maximum bit rate supported for each OEM was 10 Mbps.

Actual bitrates may vary based on settings and video.

Table 5: OEM Maximum Supported Bit Rates

OEM	Bit Rates
4000-OEM	30 Mbps
3000-OEM	20 Mbps
1500-OEM	10 Mbps

2.3 Supported Networking Protocols

TCP: A connection-based error checking delivery stream that is dependable and ordered. Order checking significantly impacts delivery of video, which is apparent when frames are dropped.

UDP: A connectionless datagram service that emphasizes reduced latency over reliability. It is designed to deliver a faster stream of information. Dropped frames do not impact the video consistency and sequencing.

RTP: Designed for transfer of streaming data. Supports multiple destinations through multicasting and provides detection of out of sequence data. It is used in conjunction with UDP and helps sequencing.

2.4 Network Session Protocols

RTSP: Used to initiate and control streaming video and media sessions. Commonly used for establishing remote video streaming sessions that traverse firewalls. Ports which form a session are negotiated. It is used in tandem with RTP protocol to provide content to clients.

Client Support: Video Management Software (VMS) such as Milestone, ExacqVision, and Valerus use RTSP to view the content. Panel Plus can be used to start RTSP session and to receive the video stream.

2.5 MISB Compliance

SightLine has developed all motion imagery streams in accordance with the MISB standards. MISB standards referenced in SightLine documentation are available from the SightLine website.

Motion imagery describes a video stream that contains video and metadata encapsulated within an MPEG2 transport stream. The video stream is encoded as H.264 and the metadata is KLV. Both are encapsulated within the MPEG2 transport stream as a separate elementary stream. SightLine adheres to the following MISB guidelines: MISB ST 0102, MISB ST 0601, MISB ST 0603, MISB ST 0604, and MISB ST 0903.

2.6 Supported Libraries and SDKs

SightLine has developed a software decoder using the open-source product FFmpeg. This tool is a multimedia framework able to decode and play digital video. It is a cross-platform solution that compiles (and runs on) Linux, Microsoft Windows, and others.

SightLine offers a video decoder sample application using this FFmpeg library. Panel Plus utilizes this same decoder for receiving and processing network streamed video. Example applications can be found on the Software Download page.

Other video decoder SDKs include:

- GV2F Video: Par Government video framework kit. Commercial FMV software library for developers that require MPEG2 w/KLV, H.264 and MJPEG video support readily integrated within their core geospatial product offerings.
- GStreamer: Open source multimedia framework. A free tool for developing encoding and decoding applications. Supports simple playback, streaming both video and audio, as well as cross-platform support.

2.7 Decoding Hardware

The following is a list of known hardware decoders that can process the video stream:

- Delta Digital Video: Rugged mil-spec encoders and decoders (MISB compliant). Solid hardware and good integration options make this an excellent choice for larger platforms.
- Haivison: Video streaming solutions for encoding, recording, decoding (MISB compliant). Solid hardware and good integration options make this an excellent choice for larger platforms.
- VBrick: Video encoding, decoding, and management. Larger company/campus video distribution model with great software for managing and archiving streams.

2.8 Decoding SLA Streams

Most media players have a codec for decoding H.264 streams. Our output stream format is an MPEG2 transport stream with encapsulated elementary streams. The video elementary stream is H.264/H.265 and metadata is the other elementary stream (in KLV format). Detailed information on this second stream and KLV data elements is covered in EAN-KLV-Metadata document.

SightLine offers a video decoder sample application using the FFmpeg library. Panel Plus utilizes the same decoder for receiving and processing network streamed video.

Decoding software:

- Panel Plus: MISB compliant client for processing motion imagery. Notable example of a low latency example of using the FFmpeg library decoder.
- VLC: Video client for decoding video streams. Has significant lag in the on-screen-display side of decoding vs. the actual encoding. See the EAN-Performance-and-Latency document to measure system processing time and latency.
- GV3.0: MISB compliant client for processing motion imagery. Excellent tool for viewing KLV metadata and buffered video is an excellent feature.

2.9 Streaming and Snapshot

The snapshot function supports output for PNG and JPG formats (JPG snapshots support EXIF metadata). This data is embedded in the header section of the file and can be extracted after capture. This includes data values for location, GPS time, and/or geographic information.

The 1500-OEM allows snapshot exports of 16-bit raw camera data. This requires digital pixel output with full resolution (14 or 16-bits). This PNG option includes a header with metadata (no EXIF).

With HD inputs, the snapshot can be the entire HD frame, even if video streaming is a smaller frame size. Output destinations of the snapshots can be made to an SD card (local/onboard slot) or to a remote FTP server over a network connection. These can be either single snaps or a sequence of snapshots at a set interval. Live video stream can be captured to the local SD card or to a remote file on a host PC.

2.10 Digital Radio Support

SightLine has tested streaming video and serial communications over several IP based RF radio systems. The following network-based radios support SightLine video and serial communications:

Microhard Systems: Nano Digital Data Link (IPnDDL) radio support for both Ethernet and Serial communications. Can be tightly integrated on board a surveillance platform or vehicle with the 1500-OEM video processor and the 1500-RAB board.

Persistent Systems: Wave Relay MPU5 radio and their MANET architecture software. These radios are currently in wearable camera surveillance systems used by civilian and military personnel.

L3 Harris: Bandit is a miniature dual-band transceiver. Both L and S-bands are supported and provide AES encryption. It has standard network interfaces with a built-in router and is used on many unmanned systems.

3 Encoding Configuration Settings

This section describes the available settings for encoding and streaming video on the 1500-OEM, 3000-OEM, and 4000-OEM. Most problems with outbound streaming are related to setting/assigning IP addresses and ports. To stream to a local client, enter the destination IP address of the host and then a port for the receiving application. For Unicast destinations, this is the IP address of the remote host that wants to view the stream. For listening client applications, the protocol will be UDP. The port number to open will be a UDP port instead of a TCP port.

ⓘ **IMPORTANT***: Only use the Broadcast option if instructed to do so. This option can negatively impact network traffic.*

3.1 1500-OEM

Frame Step: Skips frames on the processing input prior to encoding. Down Sample drops frames on the output side.

These options relate to limited bandwidth.

Output Frame Size: Can be SD and HD (1280 or 960 x 720).

Bit Rate: The size of the payload packet. A low setting can result in reduced quality. A high setting could impact network traffic.

I-Frame Interval: The frame rate to receive an I-Frame

Deblocking: A smoothing filter. Use the default *Filter all edges* setting for most applications.

IP Address: IP destination can be set to Unicast or Multicast.

Port: UDP listening port of destination host.

Statistics: General Processing statistics.

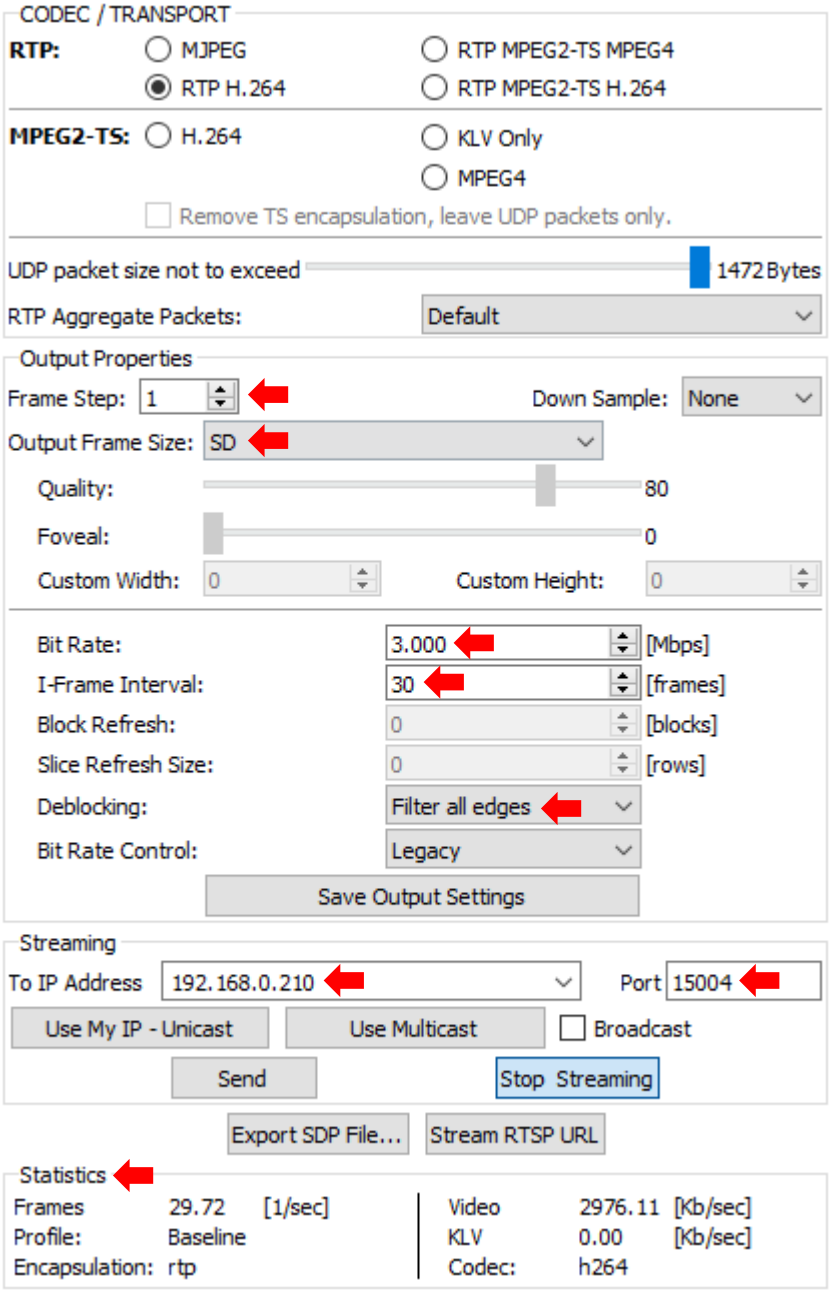


Figure 1: 1500-OEM Encoding Settings

3.1.1 Bit Rate Control Modes

The 1500-OEM encoder supports the following bit rate control modes:

Legacy: The encoder attempts to maintain a constant bit rate over time. It will not achieve an average constant bit rate when encoding extreme content. The encoder may exceed the target bit rate in scenes with high contrast and/or motion content. This mode is suitable for displaying static scenes.

Variable: The encoder attempts to maintain video quality by increasing the bit rate in complex scenes. If the receiver supports higher bit rates, this mode is suitable for maintaining the same quality throughout the video.

3.2 3000-OEM

Network: Select Network 0 or Network 1 setup.

Frame Step: Skips frames on the processing input prior to encoding.

These options relate to limited bandwidth.

Output Frame Size: Can be set to a variety of sizes. Use default Out=In for most applications.

Bit Rate: The size of the payload packet. A low setting can result in reduced quality. A high setting could impact network traffic.

I-Frame Interval: The frame rate to receive an I-Frame. Use a number equal to the frame rate in most applications.

Deblocking: A smoothing filter. Use the default *Filter all edges* setting for most applications.

IP Address: IP destination can be set to Unicast or Multicast.

Port: UDP listening port of destination host. Use an even port number if RTP codec is used.

Statistics: General Processing statistics.

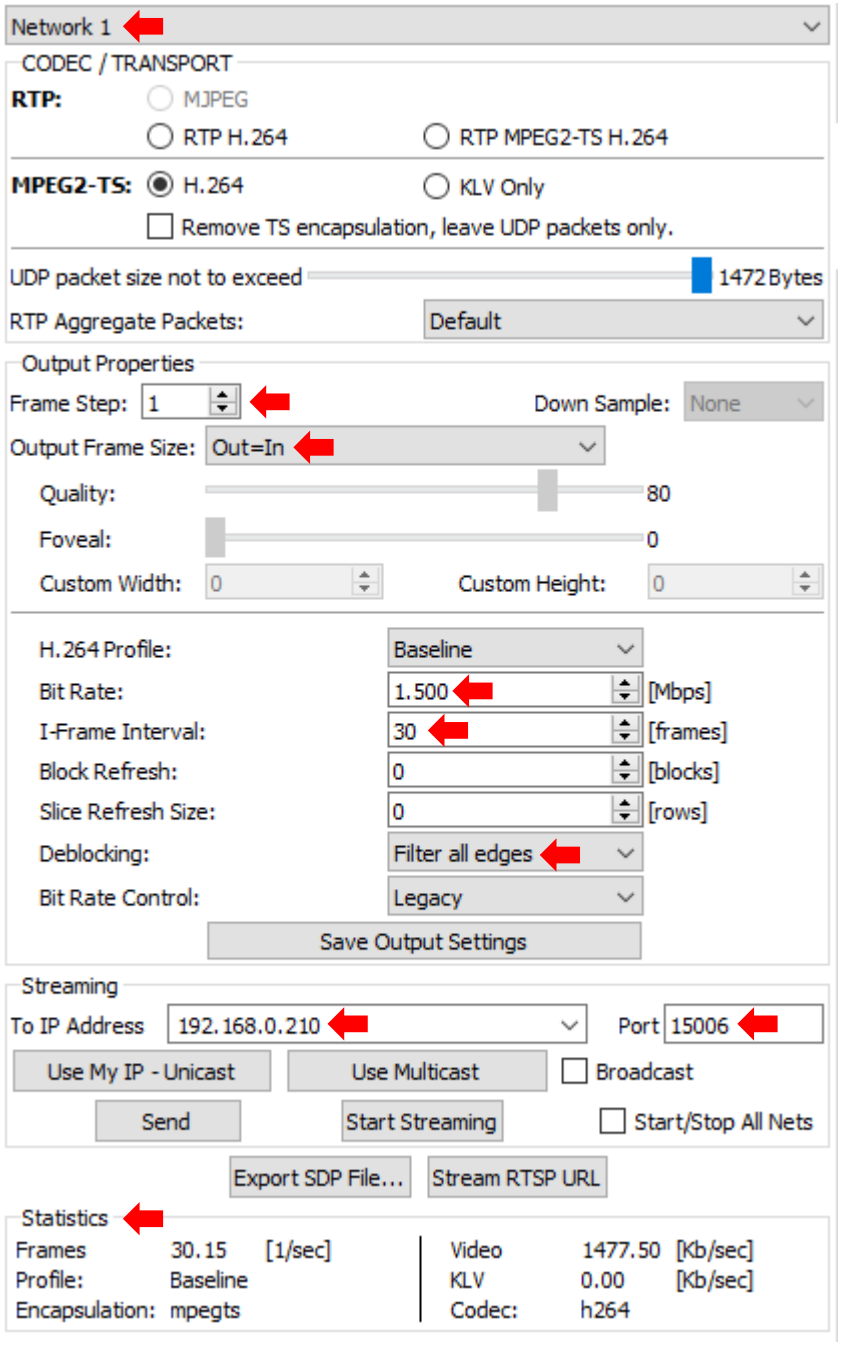


Figure 2: 3000-OEM Encoding Settings

3.2.1 Bit Rate Control Modes

The 3000-OEM encoder supports the following bit rate control modes:

Legacy: The encoder attempts to maintain a constant bit rate over time. It will not achieve an average constant bit rate when encoding extreme content. The encoder may significantly exceed the target bit rate in scenes with high contrast and/or motion content. This mode is suitable for displaying static scenes.

Variable: The encoder attempts to maintain video quality by increasing the bit rate in complex scenes. If the receiver supports higher bit rates, this mode is suitable for maintaining the same quality throughout the video.

Constrained: The encoder attempts to maintain an average constant bit rate with additional flexibility to adjust compression parameters. Trade-offs may include a perceived reduction in quality. This mode is suitable for encoding scenes with high contrast and/or motion content, radio transmission, and other limited bandwidth applications.

3.3 4000-OEM

Network: Select Network 0 or Network 1 setup.

Frame Step: Skips frames on the processing input prior to encoding.

These options relate to limited bandwidth.

Output Frame Size: Can be set to a variety of sizes. Use default *Out=In* for most applications.

Bit Rate: The size of the payload packet. A low setting can result in reduced quality. A high setting could impact network traffic.

I-Frame Interval: The frame rate to receive an I-Frame. Use a number equal to the frame rate in most applications.

Deblocking: A smoothing filter. Use the default *Filter all edges* setting for most applications.

IP Address: IP destination can be set to Unicast or Multicast.

Port: UDP listening port of destination host. Use an even port number if RTP codec is used.

Statistics: General Processing statistics.

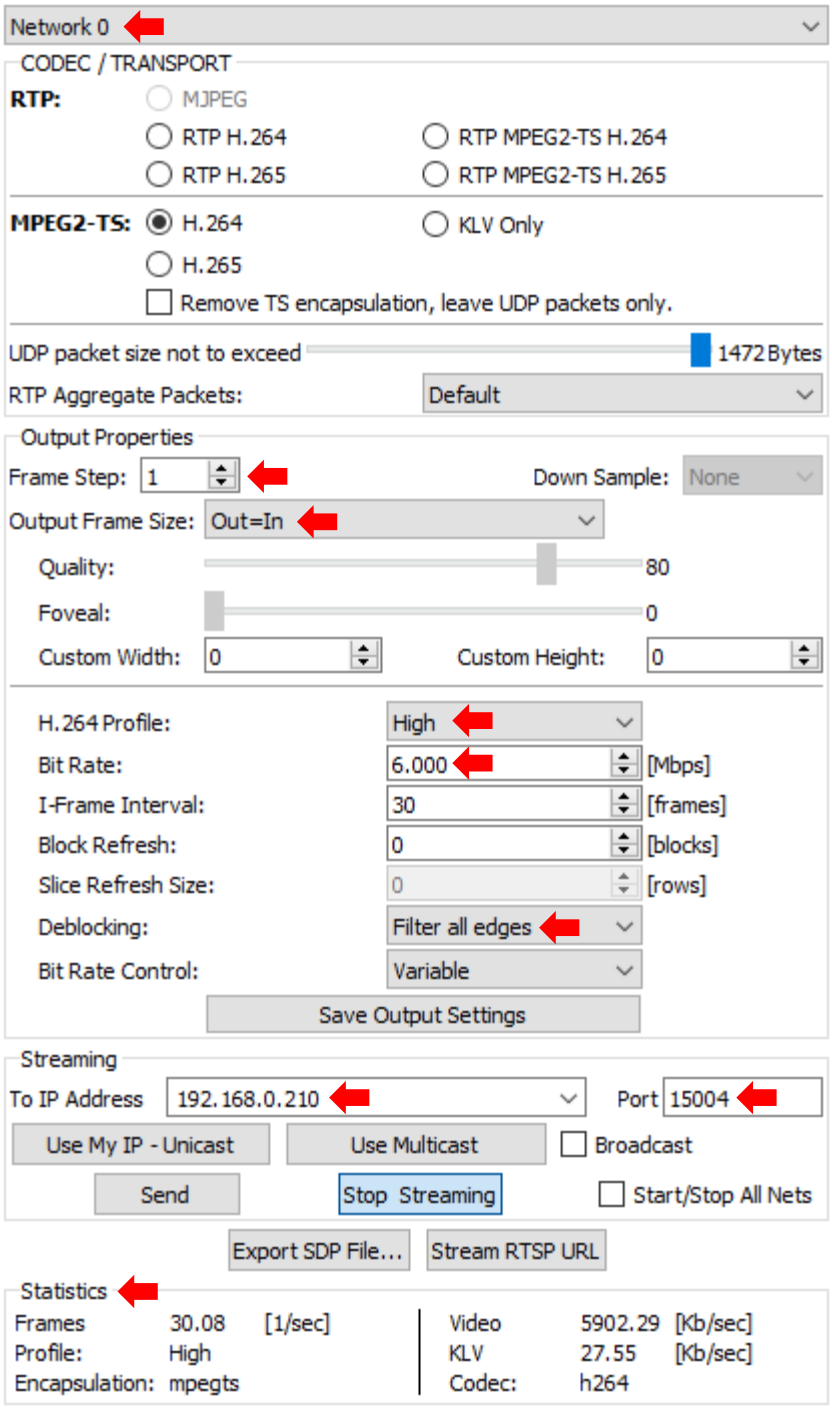


Figure 3: 4000-OEM Encoding Settings

3.3.1 Bit Rate Control Modes

The 4000-OEM encoder supports the following bit rate control modes:

- **Legacy:** The encoder attempts to maintain a constant bit rate over time. It will not achieve an average constant bit rate when encoding extreme content. The encoder may significantly exceed the target bit rate in scenes with high contrast and/or motion content. This mode is suitable for displaying static scenes.
- **Variable:** The encoder attempts to maintain video quality by increasing the bit rate in complex scenes. If the receiver supports higher bit rates, this mode is suitable for maintaining the same quality throughout the video. This mode is recommended on the 4000-OEM. The bit rate is kept constant under normal scenarios.
- **Constrained:** Not supported on the 4000-OEM. If this is set, Legacy mode will be used. To obtain a constant bit rate use an I-Frame interval of 0, to set Intra Refresh mode, and then set the Block Refresh parameter. Additionally, Linux traffic control (tc) can be used to further smooth the output data rate.

3.4 Output Separate Streams

New in 3.01.xx software for 4000-OEM.

The 3000-OEM and 4000-OEM can output two separate streams. These are logical network channels used to generate an outbound stream. The same rules apply for defining a destination address for either a single host or multiple hosts. If sending both streams to the same host, set a unique port address for each stream.

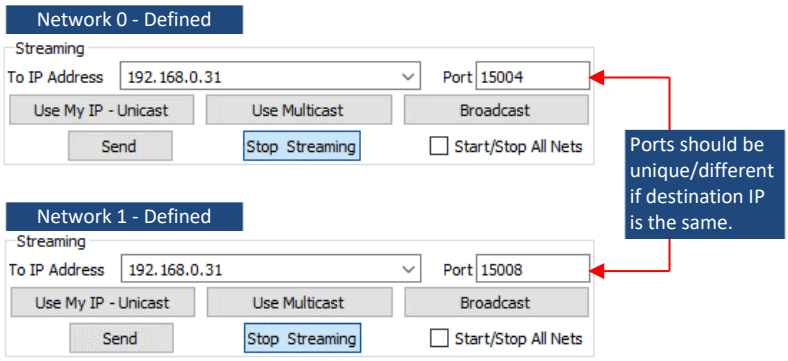


Figure 4: Output Separate Streams

The 4000-OEM requires version 3.01.xx software to output multiple streams.

3.4.1 Network Output Example

The diagram shown in Figure 5 outlines one possible configuration for streaming out both networks. Network 0 is defined to send to a single (Unicast) host. Network 1 is defined to send to many hosts (Multicast).

The single host (System1) can used as the control station that is monitoring and managing the video processing. Systems 2 and 3 are viewing stations. These systems could be used for exploitation services that record/collect video and metadata.

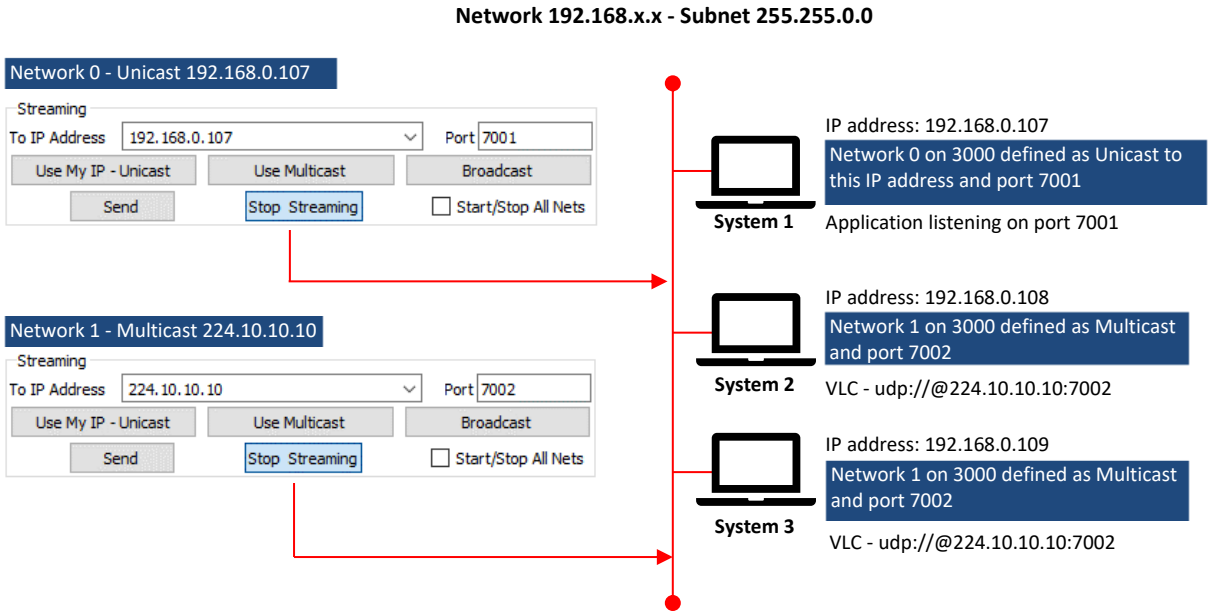


Figure 5: 3000-OEM/4000-OEM Example Network Output Diagram

3.5 Configuring Unicast and Multicast

This procedure describes how to use the Panel Plus application for configuring the 1500-OEM, 3000-OEM, and 4000-OEM boards to stream Unicast and Multicast video. General knowledge of IP addressing is recommended for implementing static IP addressing.

Unicast and Multicast are the two delivery methods used for sending out a network stream. Unicast refers to a one-to-one transmission from one point in the network to another point, i.e., one SLA board to one host PC, each identified by a network address.

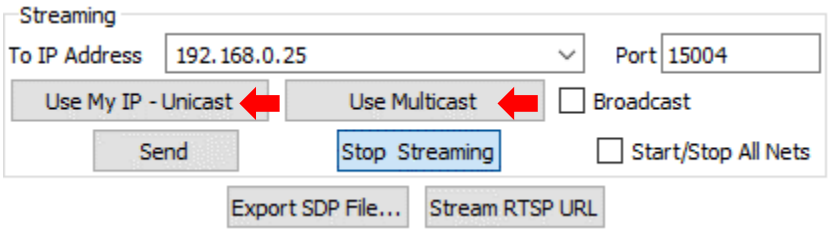
Multicast is addressed to a group of destination computers simultaneously, i.e., one SLA board to multiple host systems. There are specific ranges of IP addresses that determined the delivery method. Consult your network administrator when using the multicast option.

See the 1500, 3000, or 4000-OEM EAN startup guide to configure and connect the appropriate video processing board to stream video.

1. After starting Panel Plus and connecting to the video processing board, ensure that the status bar has properly updated.
2. Select the *Compress* tab and choose the desired CODEC.

3. In the *Streaming* section, type in the destination IP address and UDP port number. To stream to the same host that Panel Plus is currently running on, click *Use My IP*. To stream to multiple clients, click *Use Multicast*.

For RTP formats choose an even port number per section 11 RTP over Network and Transport Protocols in the RFC 3550 document. Odd number ports are used for RTCP, even ports are rejected.



4. Click *Send* and note the IP address and UDP port. Both the address and port assignments will be used to create the URL for VLC.
5. Click on *Start Streaming* button to commence streaming to the provided IP address and port if it is not already streaming.

See the EAN-Using-VLC for configuring VLC to start a streaming session. For more information about using VLC with RTP and RTSP see the EAN-RTSP document.

6. For VLC to work, the board must be streaming. Confirm that video is being displayed in VLC.

For more information about streaming video to Panel plus see the Panel Plus User Guide located in the Help menu of the Panel Plus application located in the Panel Plus application.

7. From the main menu » *Parameters* » *Save to board*.
8. Open the *Connect* tab and click *(click to disconnect).*
9. Exit Panel Plus. If Panel Plus is running the video stream and VLC may not work.

3.5.1 Multicast

The multicast option will replace the IP address with a multicast IP address (244.10.10.10 or similar). This allows the network video stream to display on multiple computers. The multicast address shown is this section is for example purposes only. Any valid multicast IP address can be used.

There are other issues regarding the transmission of multicast packets on a network. Consult your network administrator for advice regarding this and other networking issues.

3.6 Low Bandwidth Streaming

From the *Compress* tab moderate quality streaming can be obtained with a bit rate as low as 100kbps with the following settings shown in Figure 6:

- *MPEG2-TS: H.265* (4000-OEM only)
- *Output Frame Size: 720p* or less
- *Frame Step: 2* (15 fps) or *3* (10 fps) or more
- *Bit Rate: 0.100 Mbps*

Additionally, if color is not an issue, from the Enhance tab set False Color to White Hot.

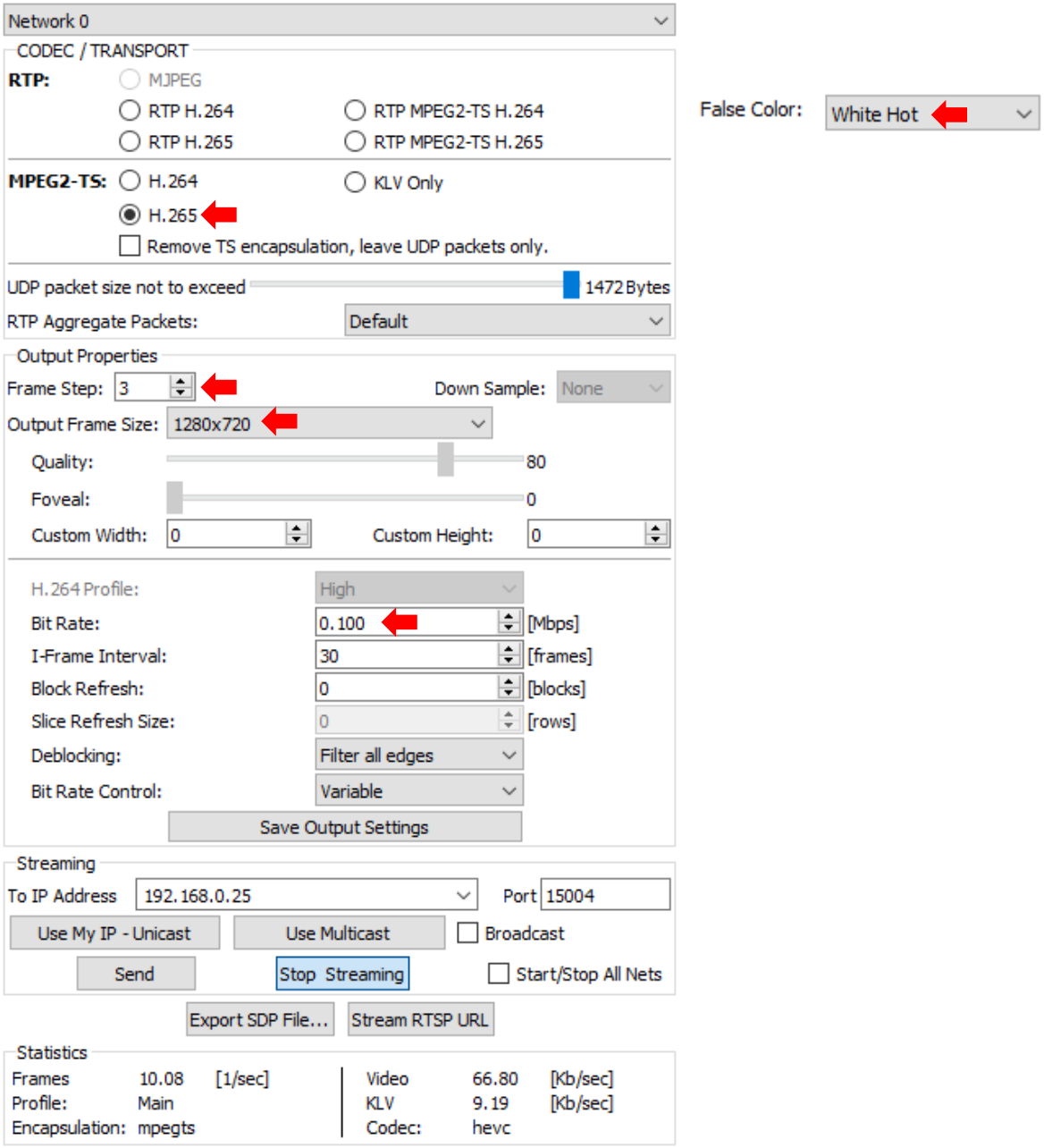


Figure 6: Low Bandwidth Streaming Settings

4 Troubleshooting

Issue	Possible Causes	Recommendations
When streaming video, the following problems may be caused by video enhancement settings that create high content images that do not compress well: • Video dropouts • Low frame rate video • No frames received	False color modes, such as Rainbow, can create high color content.	Do not use false color or use one of the smoother false color modes, such as Iron.
	Sharpen, CLAHE, LAP, and Histogram Equalization can amplify spatially noisy video to create high image content.	Do not use these modes with images that have a lot of noise. Use Denoise. See EAN-Enhancement for more information.
	High resolution. This issue is worse at 1080+ resolution.	Stream lower resolution.
	Bit rate. Video may not be able to compress into a low bit rate.	Set a higher bitrate.
Streamed video shows high latency, but good frame rate.	This may be caused by the video decoder, such as VLC.	Try using Panel Plus as the video decoder.
Is it possible to output a smaller frame size and then scale to the full video resolution?	NA	In Panel Plus go to the *Compress* tab. In the *Output Frame Size* drop-down menu select the frame size. Go to the *Video* tab and use the zoom slider to scale the video so the whole frame is in view.

4.1 Questions and Additional Support

For questions and additional support, please contact SightLine Support. Additional support documentation and Engineering Application Notes (EANs) can be found on the Documentation page of the SightLine Applications website.

Appendix - Configuring Bandwidth Limits

Configure compression:

1. From the *Compress* tab in Panel Plus set the *Bit Rate* to the value you want to transmit (e.g., 2.5 Mbps).
2. Set the *Bit Rate Control* to *Constrained*.
3. Click *Save Output* Settings.
4. Main menu » *Parameters* » *Save to Board*.
5. Main menu » *Reset* » *Board*. Wait for the system to boot, and then reconnect to the board.

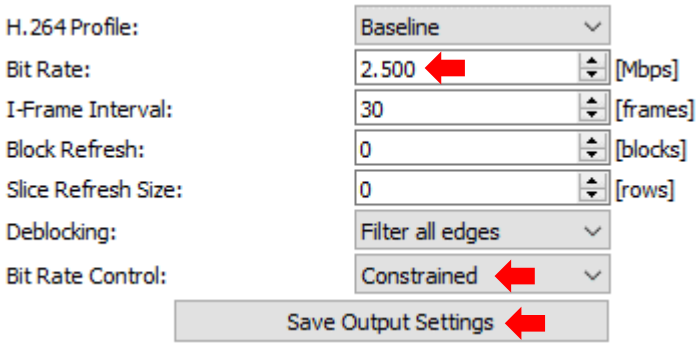


Figure A1: Configure Compression

Enable traffic control with set system value:

1. From the main menu in Panel Plus » *Configure* » *System Value*.
2. Set System Value to *13: TRAFFIC_CRTL*.
3. Set *Value0* to *2500* (This value changes megabits per second to kilobits per second.)
4. Click *Send*.

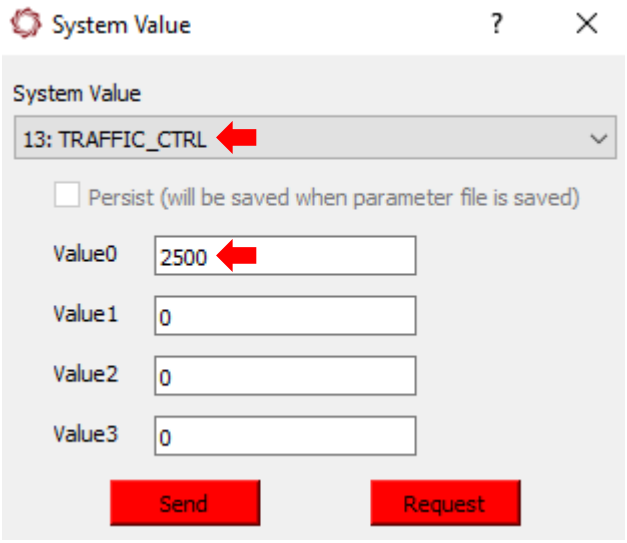


Figure A2: Configure System Value

Since this value may not be persisted between startups, it must be configured each time. It is possible that this parameter can be used to stop network traffic if the Value0 is set too low and is prevented from being saved to the parameter file.

A2 System Value Dialog

System values are primarily used by SightLine Engineering to customize or fine tune the behavior of the OEM systems.

The meaning of each system value may differ based on the platform. See the SetSystemValue (0x92) command for the list of available system value types and their meanings.

IMPORTANT: This is an advanced setting. Setting incorrect values can make the system unstable and or cause it to crash. If you are unsure how to proceed, contact Support before proceeding.

In this example SetSystemValue (0x92) command uses the system value type 13 (Linux traffic control). Value0 = kilobits per second. Send *0* to reset to no traffic control. Other values = reserved for further expansion.

A3 Traffic Control (tc)

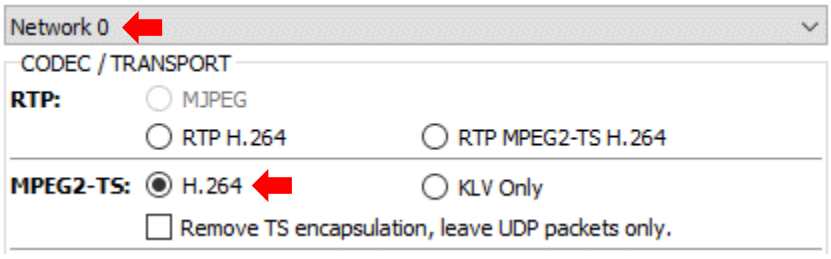
Traffic control (tc) can be used to normalize the rate that packets are transmitted preventing massive peaks when using IP radios or similar.

In this example the target will be configured to transmit video, and then the packet formation will be adjusted.

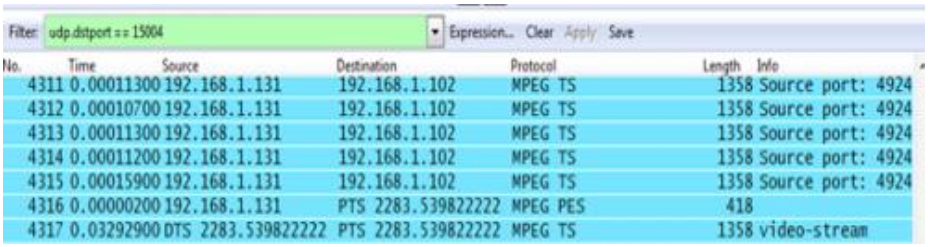
The following steps reference the Panel Plus software.

1. Connect to target using Panel Plus.
2. From the *Compress* tab set up for network output.

3. Configure MPEG2-TS + H.264 video streaming.
4. Click *Send*. The target should now be streaming video.



5. Start Wireshark.
6. From the main menu go to *Capture* » *Interfaces.* Filter the H.264 packets that are going to port 15004.



7. Configure the scale to view the base line data and periodic large data peaks:
   - *Menu* » *sStatistics* » *IO Graph*
   - *X Axis* » *Tick Interval = 0.1 sec*
   - *Y Axis* » *Unit: Bytes/Tick*
8. Use Tera Term (recommended) or another SSH client to connect to the OEM hardware.
9. To configure and run the traffic control (tc) binary, type:

```
tc qdisc replace dev eth0 handle 1:0 root tbf burst 3000 limit 300k rate 2000000
peakrate 3000000 mtu 3000
```

10. Edit parameters, as necessary.

In Wireshark there should be less peaks and more consistent output packet rate.

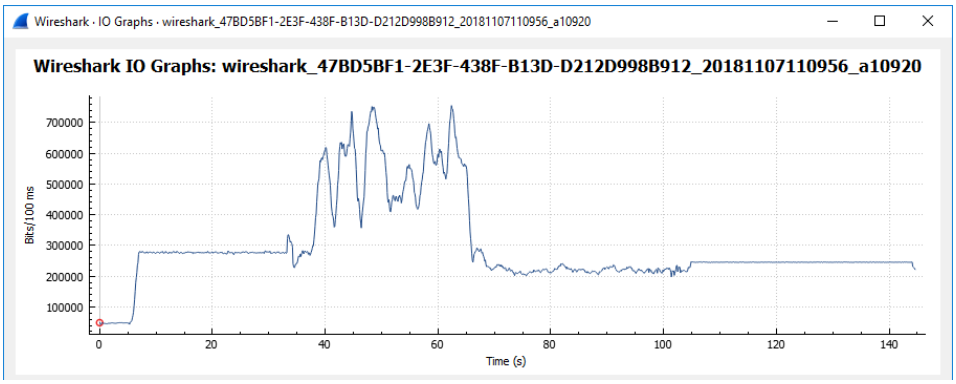


Figure A3: Wireshark IO Graphs

Alternate:

```
tc qdisc del dev eth0 root &> /dev/null
tc qdisc add dev eth0 root handle 1: htb default 1
tc class add dev eth0 parent 1: classid 1:1 htb rate 3mbit
```