

# Implementing AES67 and ST 2110-30 in Your Plant

Dominic Giambo, Development Engineer, Wheatstone



## What is AES67?

A Layer 3 protocol suite for transporting audio ratified by AES in 2013.

AES67 makes interoperability between AoIP networks such as Dante, WheatNet-IP and Livewire possible.

It has since become useful for more.



## Why AES67?

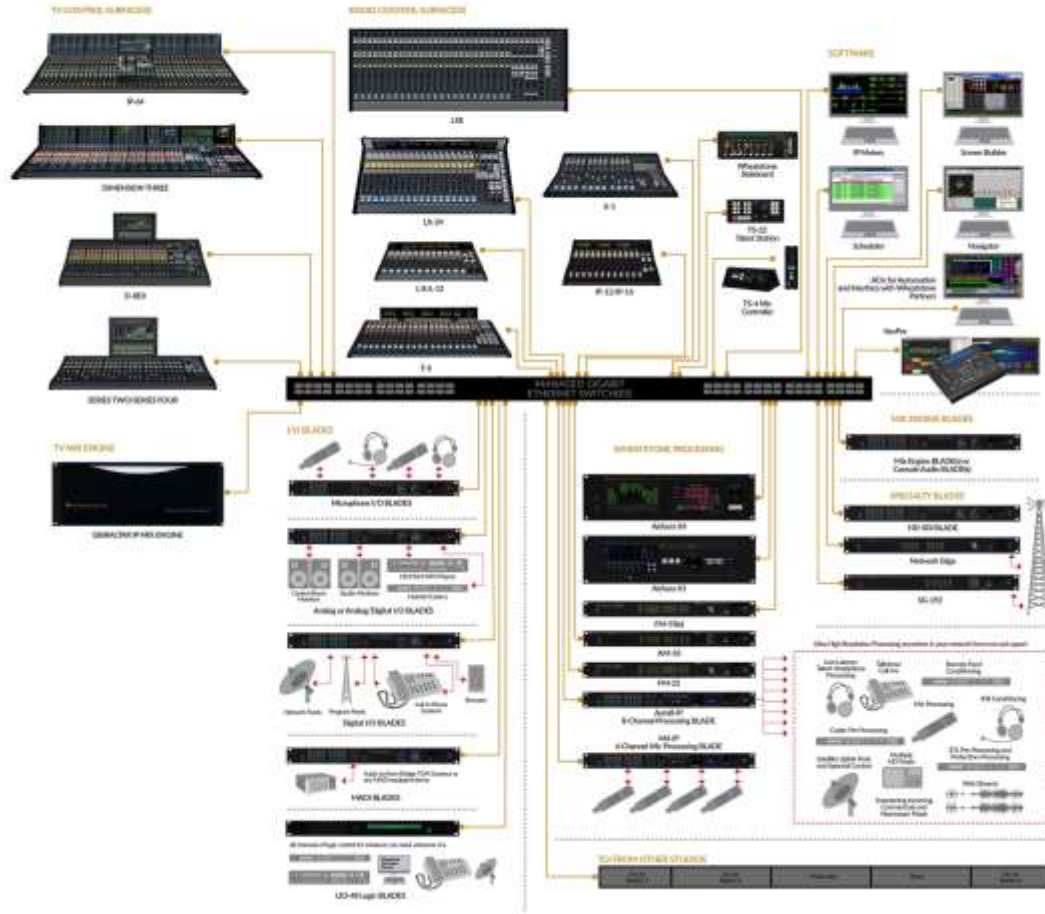
- Audio transport standard for SMPTE 2110-30
- Supported by most AoIP systems
- Key to transitioning to IP workflows
- AES67 will eventually find its way into every broadcast plant that includes audio.



## SMPTE 2110-30 Requirements

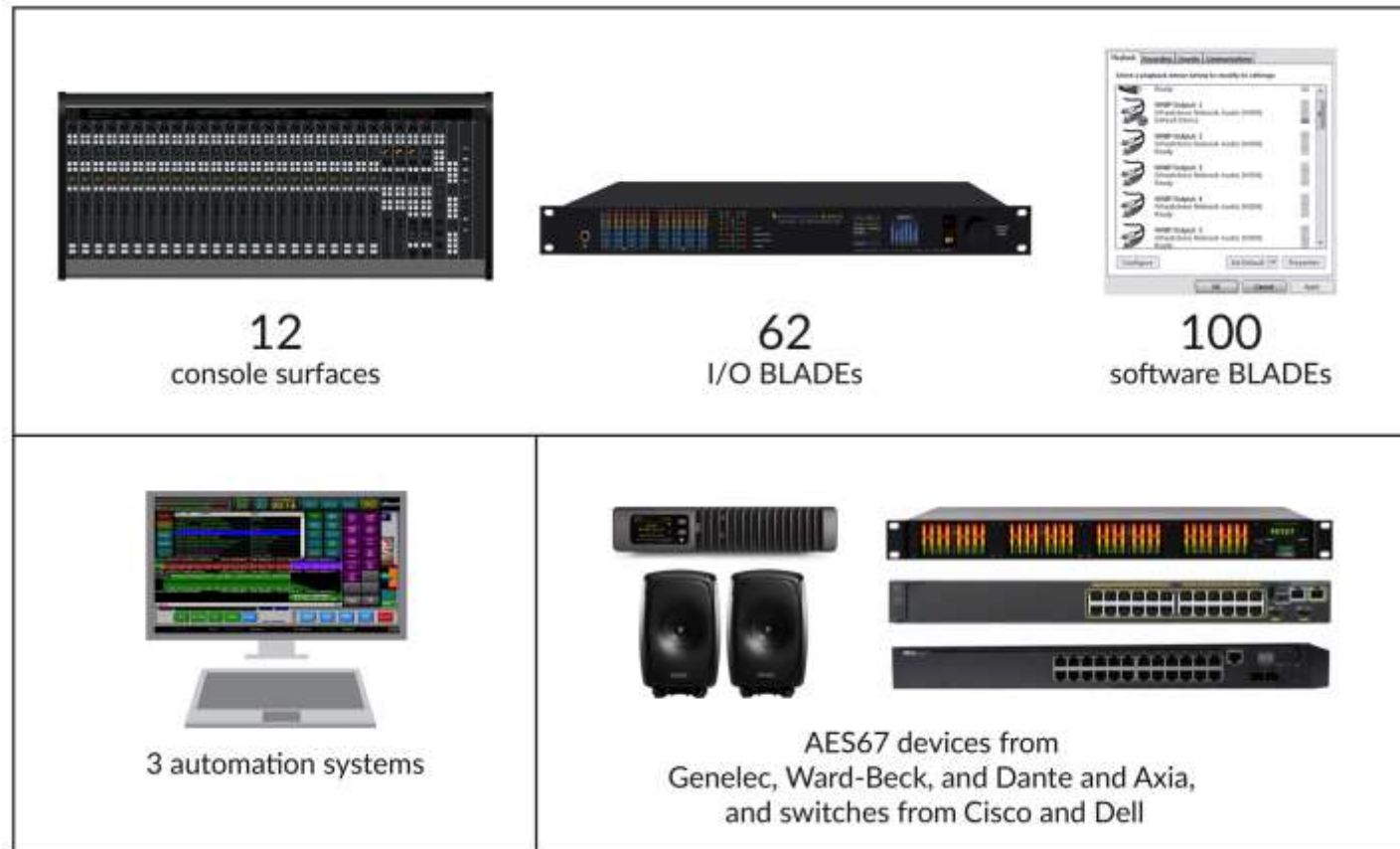
- 48kHz sampling is required for all devices
- 1ms packet time is required for all devices
- 1..8 channels per stream is required for all devices
- Slave-Only Mode PTP must be supported
- Media clock offset must be zero
- ST-2059-2: PTP Media Profile only (Message rates of 4/s)

## WheatNet-IP

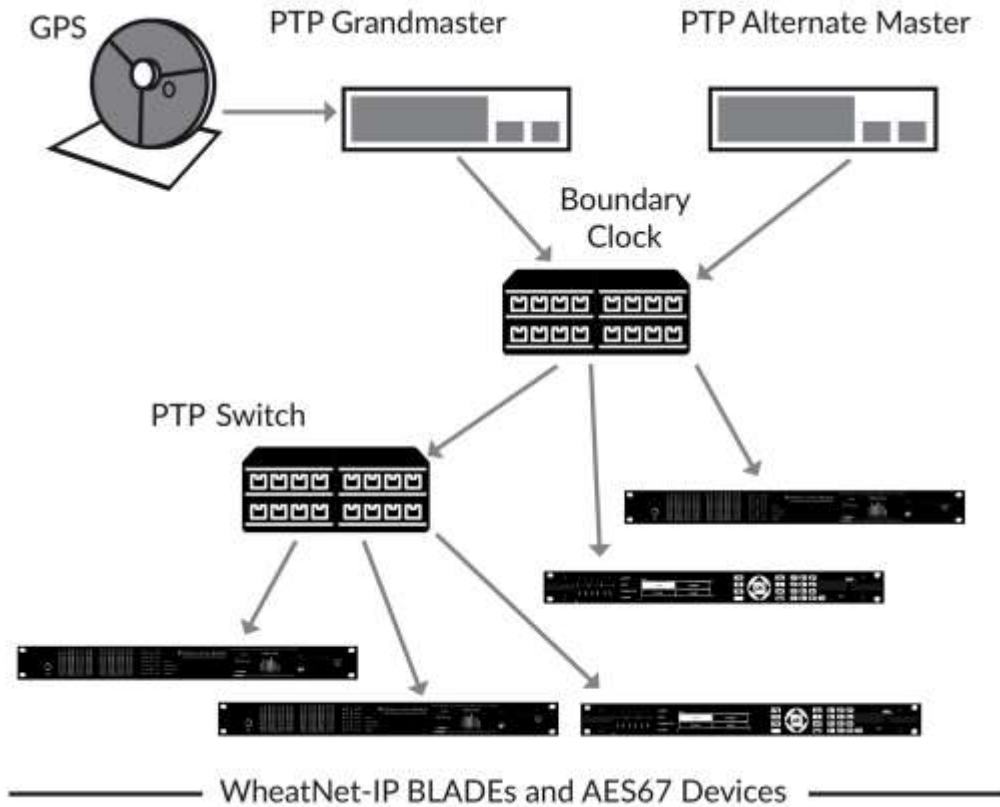


## Dante, etc

## Setting the stage: Simulated AES67 Studio



## AES67 Uses IEEE-1588 PTPv2



## PTPv2 timing and synchronization:

- Precise timing accuracy better than 1 microsecond
- Sub-microsecond timing accuracy not required
- PTPv2 devices found in most AoIP devices are not reliable





## Key Finding

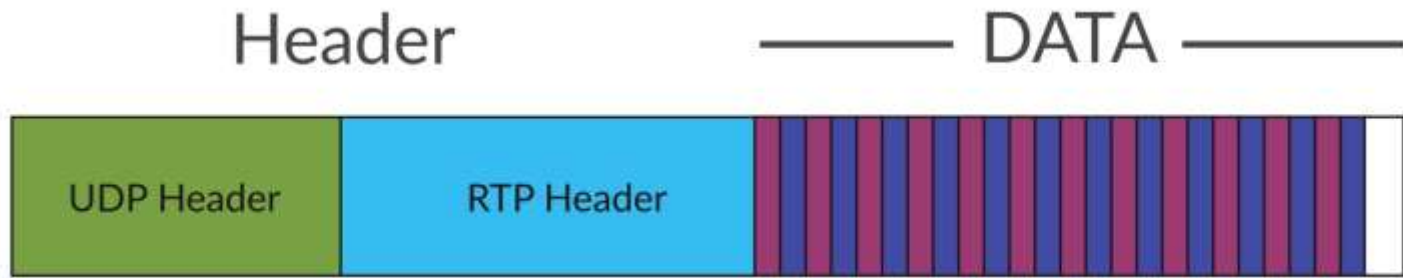
The PTPv2 synchronization role is best filled by a specialized PTP master clock device.



## Packet Structure:

Send device and receive device have to agree on header and payload information.

# Packet Structure:



source port	destination port	V	P	X	CSRC count	M	Payload Type	Sequence Number (16 bits)
length	checksum	Timestamp (32 bits)						
		Synchronization Source (SSRC) id. (32 bits)						

UDP Header Format

RTP Packet Format

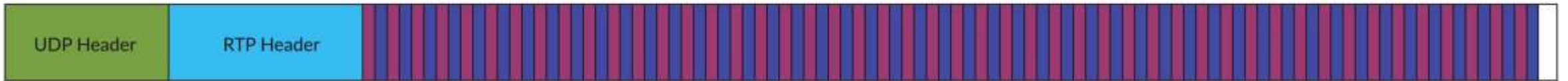
1/4 msec packet (WNIP)

12 Stereo audio samples, L-R Interleaved

# Packet Structure:

Header

DATA



source port	destination port	V	P	X	CSRC count	M	Payload Type	Sequence Number (16 bits)
length	checksum	Timestamp (32 bits)						
		Synchronization Source (SSRC) id. (32 bits)						

UDP Header Format

RTP Packet Format

1 msec packet (AES67)

48 Stereo audio samples, L-R Interleaved



## Key Finding

Unless you know the device sample rate, set the system sample rate to 48kHz as AES67 does not require devices to support 44.1kHz and many do not.

## Configuration Considerations:

- AES67 specifies a range of multicast addresses
- AES67 specifies a standard port (5004)



## Discovery and Control:

Since AES67 only specifies stream content parameters and does nothing to manage stream discovery and control, these functions must be managed manually.

This is the purpose of SDP specified in the AES67 standard.

## Mapping out an IP and multicast address plan:

- Determine how multicast stream addresses are allocated throughout.

Multicast addresses are in the form of 239.xxx.yyy.zzz.

Device	Signal	Multicast Addresses
WNIP Blades	Multiple Sources	239.192.192.0 - 239.192.239.255
XNode	SRC1	239.192.240.100
XNode	SRC2	239.192.240.101
XNode	SRC3	239.192.240.102
XNode	SRC4	239.192.240.103



## Mapping out an IP and multicast address plan:

- Determine how multicast stream addresses are allocated throughout.
- Isolate address ranges for each system. Start with less common devices. Change their addresses to an isolated address range.

Device	Signal	Multicast Addresses
WNIP Blades	Multiple Sources	239.192.192.0 - 239.192.239.255
XNode	SRC1	239.192.240.100
XNode	SRC2	239.192.240.101
XNode	SRC3	239.192.240.102
XNode	SRC4	239.192.240.103



## Key Finding

Assure all devices are on the same IP subnet as multicasting does not normally cross subnet boundaries.

## WheatNet-IP Navigator system information tab screen



## Navigator screen showing all available streams

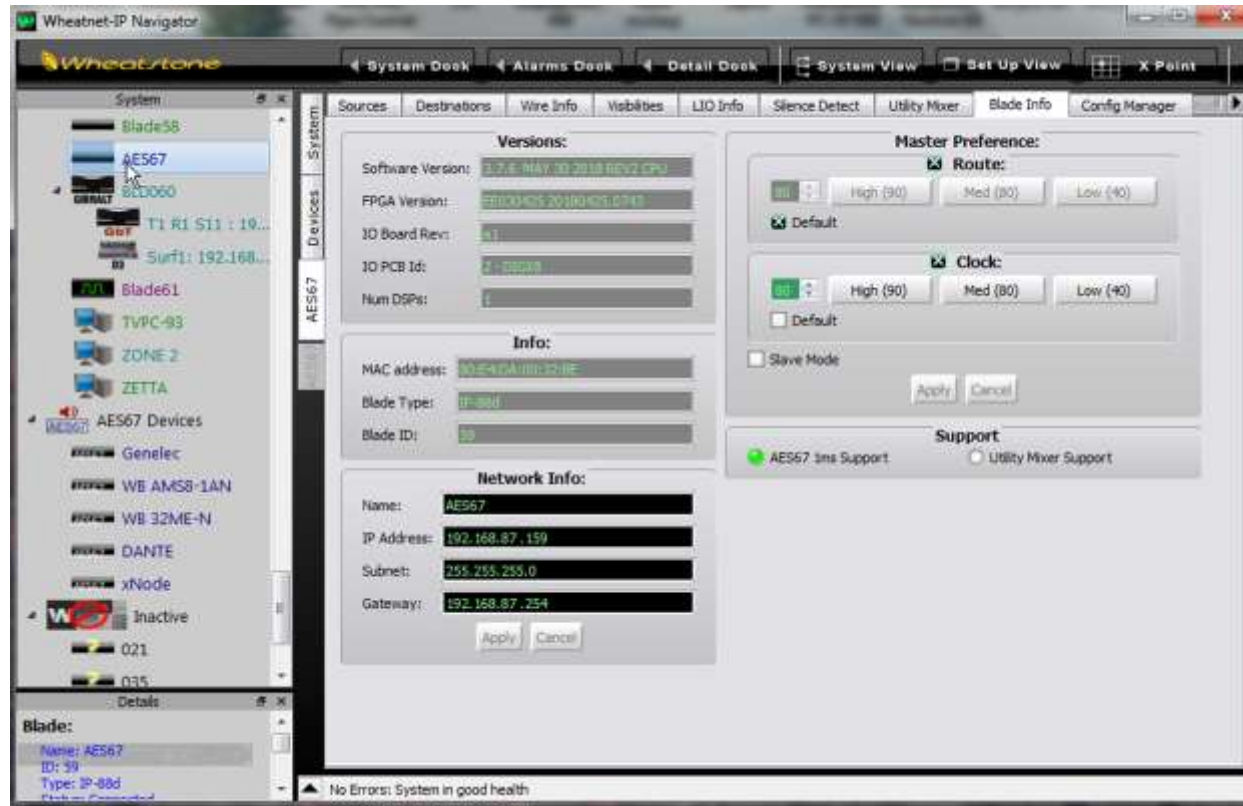
System View - Wheatnet-IP Navigator

Blades Sources Destinations Source Streams Destination Streams Latency Resources Devices

Source Streams

Sig Id	Name	Location	Index	Multicast Address	Offset	Width	Port	Payload Type	Packet Rate	Encoding Type	Clock Type	GMID
53.1.8.8	Spare09	Blade53	0	0.0.0.0	0	Stereo	50100	100	0.25ms	24 Bit Interleaved	Precision Time Protocol	00-50-c2-ff-fe-90-05-05 0
53.1.8.9	Spare10	Blade53	0	0.0.0.0	0	Stereo	50100	100	0.25ms	24 Bit Interleaved	Precision Time Protocol	00-50-c2-ff-fe-90-05-05 0
53.1.8.10	Spare11	Blade53	0	0.0.0.0	0	Stereo	50100	100	0.25ms	24 Bit Interleaved	Precision Time Protocol	00-50-c2-ff-fe-90-05-05 0
53.1.8.11	Spare12	Blade53	0	0.0.0.0	0	Stereo	50100	100	0.25ms	24 Bit Interleaved	Precision Time Protocol	00-50-c2-ff-fe-90-05-05 0
53.1.8.12	LXTIMER	Blade53	0	0.0.0.0	0	Stereo	50100	100	0.25ms	24 Bit Interleaved	Precision Time Protocol	00-50-c2-ff-fe-90-05-05 0
53.1.8.13	LXTALLY	Blade53	0	0.0.0.0	0	Stereo	50100	100	0.25ms	24 Bit Interleaved	Precision Time Protocol	00-50-c2-ff-fe-90-05-05 0
54.0.3.0	BL54UMXA	Blade54	0	239.192.217.144	0	Stereo	50100	100	0.25ms	24 Bit Interleaved	Precision Time Protocol	00-50-c2-ff-fe-90-05-05 0
54.0.3.1	BL54UMXB	Blade54	0	239.192.217.145	0	Stereo	50100	100	0.25ms	24 Bit Interleaved	Precision Time Protocol	00-50-c2-ff-fe-90-05-05 0
54.0.3.2	BL54UMYA	Blade54	0	239.192.217.146	0	Stereo	50100	100	0.25ms	24 Bit Interleaved	Precision Time Protocol	00-50-c2-ff-fe-90-05-05 0
54.0.3.3	BL54UMYB	Blade54	0	239.192.217.147	0	Stereo	50100	100	0.25ms	24 Bit Interleaved	Precision Time Protocol	00-50-c2-ff-fe-90-05-05 0
54.1.0.0	LX PGM	Blade54	0	239.192.217.148	0	Stereo	50100	100	0.25ms	24 Bit Interleaved	Precision Time Protocol	00-50-c2-ff-fe-90-05-05 0
54.1.0.1	LX AUD	Blade54	0	239.192.217.149	0	Stereo	50100	100	0.25ms	24 Bit Interleaved	Precision Time Protocol	00-50-c2-ff-fe-90-05-05 0
54.1.0.1	LX AUD	Blade54	1	239.192.219.36	0	Stereo	5004	100	1.00ms	24 Bit Interleaved	Precision Time Protocol	00-50-c2-ff-fe-90-05-05 0
54.1.0.2	LX AUX	Blade54	0	239.192.217.150	0	Stereo	50100	100	0.25ms	24 Bit Interleaved	Precision Time Protocol	00-50-c2-ff-fe-90-05-05 0
54.1.0.2	LX AUX	Blade54	1	239.192.219.38	0	Stereo	50100	100	1.00ms	24 Bit Interleaved	Precision Time Protocol	00-50-c2-ff-fe-90-05-05 0
54.1.0.3	LX OL	Blade54	0	239.192.217.151	0	Stereo	50100	100	0.25ms	24 Bit Interleaved	Precision Time Protocol	00-50-c2-ff-fe-90-05-05 0
54.1.0.3	LX OL	Blade54	1	239.192.219.40	0	Stereo	50100	100	1.00ms	24 Bit Interleaved	Precision Time Protocol	00-50-c2-ff-fe-90-05-05 0
54.1.2.0	LXAux1	Blade54	0	239.192.217.152	0	Stereo	50100	100	0.25ms	24 Bit Interleaved	Precision Time Protocol	00-50-c2-ff-fe-90-05-05 0
54.1.2.1	LXAux2	Blade54	0	239.192.217.153	0	Stereo	50100	100	0.25ms	24 Bit Interleaved	Precision Time Protocol	00-50-c2-ff-fe-90-05-05 0
54.1.2.2	LXAux3	Blade54	0	239.192.217.154	0	Stereo	50100	100	0.25ms	24 Bit Interleaved	Precision Time Protocol	00-50-c2-ff-fe-90-05-05 0
54.1.2.3	LXAux4	Blade54	0	239.192.217.155	0	Stereo	50100	100	0.25ms	24 Bit Interleaved	Precision Time Protocol	00-50-c2-ff-fe-90-05-05 0

## Navigator screen showing AES67 1 msec support functionality enabled

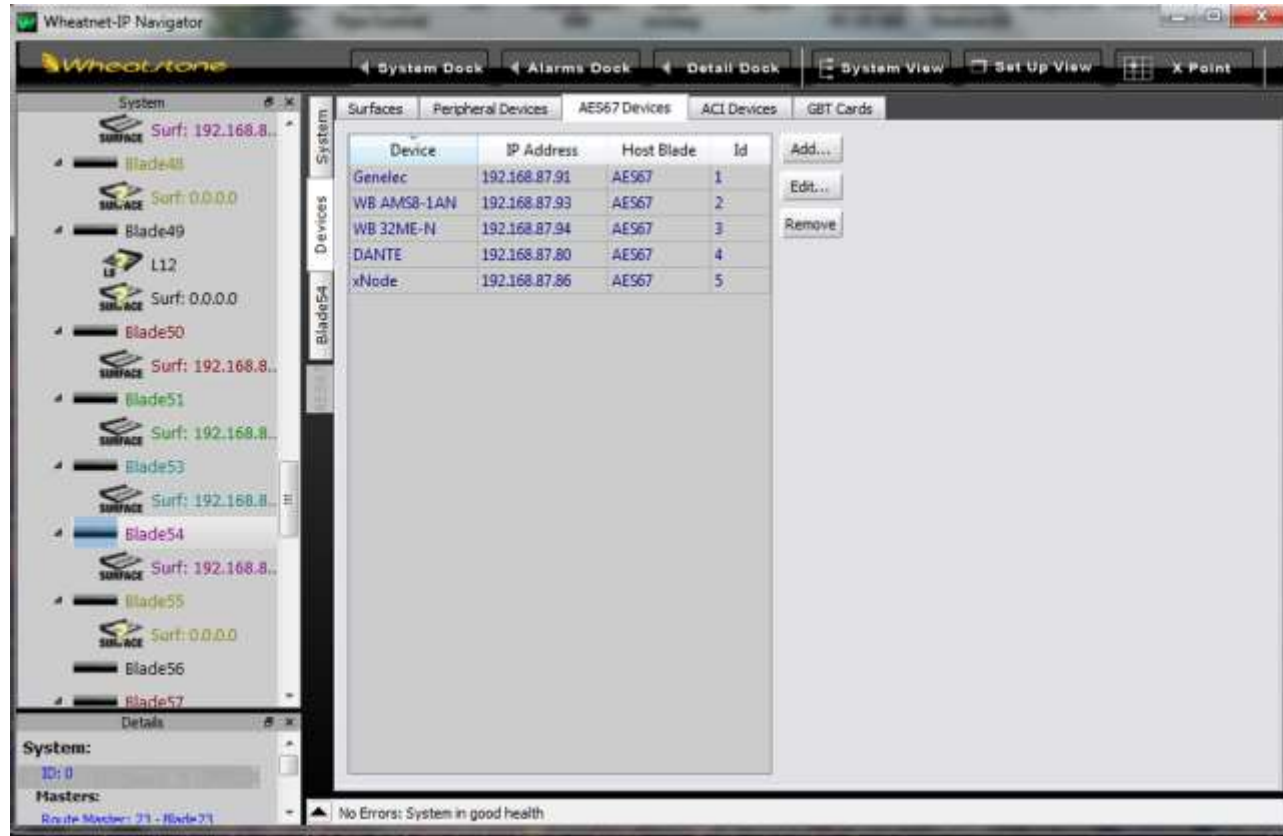


The screenshot displays the Wheatnet-IP Navigator interface. On the left, a tree view shows the system hierarchy, including Blade58, Blade61, and a group of AES67 Devices. The main panel is titled 'AES67' and contains several sections:

- Versions:** Software Version: 3.7.6 MAY 30 2018 REV2 CPU; FPGA Version: F8000K1S 201801S1.0741; IO Board Rev: v1; IO PCB Id: 2-0808; Num DSPs: 1.
- Info:** MAC address: 00:40:00:00:00:00; Blade Type: IP-88d; Blade ID: 39.
- Network Info:** Name: AES67; IP Address: 192.168.87.159; Subnet: 255.255.255.0; Gateway: 192.168.87.254.
- Master Preference:** Route: High (90), Med (80), Low (40); Clock: High (90), Med (80), Low (40); Default: ; Slave Mode: .
- Support:** AES67 1ms Support: ; Utility Mixer Support: .

Buttons for 'Apply' and 'Cancel' are present at the bottom of the 'Network Info' and 'Master Preference' sections. A status bar at the bottom indicates 'No Errors: System in good health'.

## Navigator screen showing AES67 devices added to the system



The screenshot displays the Wheatstone IP Navigator software interface. The main window is titled "Wheatstone" and features a navigation pane on the left with a tree view of system components including "System", "Blade48", "Blade49", "L12", "Blade50", "Blade51", "Blade53", "Blade54", "Blade55", and "Blade56". The "Blade54" component is selected, and the "AES67 Devices" tab is active. The main display area shows a table of AES67 devices with the following data:


Device	IP Address	Host Blade	Id
Genelec	192.168.87.91	AES67	1
WB AMS8-LAN	192.168.87.93	AES67	2
WB 32ME-N	192.168.87.94	AES67	3
DANTE	192.168.87.80	AES67	4
xNode	192.168.87.86	AES67	5

Buttons for "Add...", "Edit...", and "Remove" are visible to the right of the table. The status bar at the bottom indicates "No Errors: System in good health".

## Four xNode channels configured to make AES67 compatible streams

#	Source Name:	Channel/Address:	Stream Mode:	Input Gain [dB]:
Line 1	<input type="text" value="SRC 1"/>	<input type="text" value="239.192.240.100:50100"/>	<input type="text" value="Low Latency Stereo"/> ▾	<input type="text" value="0.0"/>
	AES67: <a href="#">Download stream description (SDP)</a> , RTSP: <a href="rtsp://192.168.87.86/by-id/1">rtsp://192.168.87.86/by-id/1</a>			
Line 2	<input type="text" value="SRC 2"/>	<input type="text" value="239.192.240.101:50100"/>	<input type="text" value="Low Latency Stereo"/> ▾	<input type="text" value="0.0"/>
	AES67: <a href="#">Download stream description (SDP)</a> , RTSP: <a href="rtsp://192.168.87.86/by-id/2">rtsp://192.168.87.86/by-id/2</a>			
Line 3	<input type="text" value="SRC 3"/>	<input type="text" value="239.192.240.102:5004"/>	<input type="text" value="Low Latency Stereo"/> ▾	<input type="text" value="0.0"/>
	AES67: <a href="#">Download stream description (SDP)</a> , RTSP: <a href="rtsp://192.168.87.86/by-id/3">rtsp://192.168.87.86/by-id/3</a>			
AES 4	<input type="text" value="SRC 4"/>	<input type="text" value="239.192.240.103:5004"/>	<input type="text" value="Low Latency Stereo"/> ▾	<input type="text" value="0.0"/>
	AES67: <a href="#">Download stream description (SDP)</a> , RTSP: <a href="rtsp://192.168.87.86/by-id/4">rtsp://192.168.87.86/by-id/4</a>			

## Defining the streams to match the xNode sources



The screenshot shows the 'xNode - Source AES67 Signal Wizard - Edit Signal - Wheatnet-IP Navigator' window. The 'Stream Info' tab is selected, displaying a table of stream parameters:

Multicast Address	Offset	Width	Port	Payload Type
239.192.240.100	0	Stereo	50100	100
239.192.218.214	0	Stereo	50100	100

A 'Stream Parameters' dialog box is open, showing the following configuration:

- Stream**
  - Multicast Addr: 239.192.240.100
  - Port: 50100
  - Payload Type: 100
  - Packet Rate: 1.00ms
  - Encoding Type: 24 Bit Interleaved
- Reference Clock**
  - Type: Precision Time Protocol
  - GMID: 00-00-00-00-00-00-00-00
  - Domain: 0

Buttons for 'Ok', 'Cancel', 'Edit...', and 'Finish' are visible. The status bar at the bottom indicates 'Signal is not connected' and 'Signal Name: xNode 1'.



Navigator screen after all the AES67 streams have been defined

The screenshot displays the Wheatstone IP Navigator software interface. The main window is titled "Wheatstone" and features a "System Dock" with tabs for "System View" and "Set Up View". The left sidebar shows a tree view of the system hierarchy, including "System", "Blade61", "TVPC-93", "ZONE 2", "ZETTA", "AES67 Devices", "Genelec", "WB AMS8-1AN", "WB 32ME-N", "DANTE", "xNode", "Inactive", "021", "035", "036", "052", and "068". The main area is divided into "Sources", "Destinations", and "Info" tabs. The "Sources" tab is active, showing a table of "AES67 Source Signals".

Name	Location
xNode 1	xNode
xNode 2	xNode
xNode 3	xNode
xNode 4	xNode

Buttons for "Add...", "Edit...", and "Delete" are visible next to the table. The "Details" panel on the right shows the configuration for the selected "xNode 1" source signal:

**Source Signal:**  
ID: 59.4.5.1 (DEC40A01)  
Name: xNode 1  
Location: xNode  
Width: 2 channels  
Card: 255 Circuits: 65535, 65535

**Connected to Destination:**  
ID: 54.1.0.1 (D0810001)  
Name: LXIn02  
Location: Blade54  
Width: Stereo

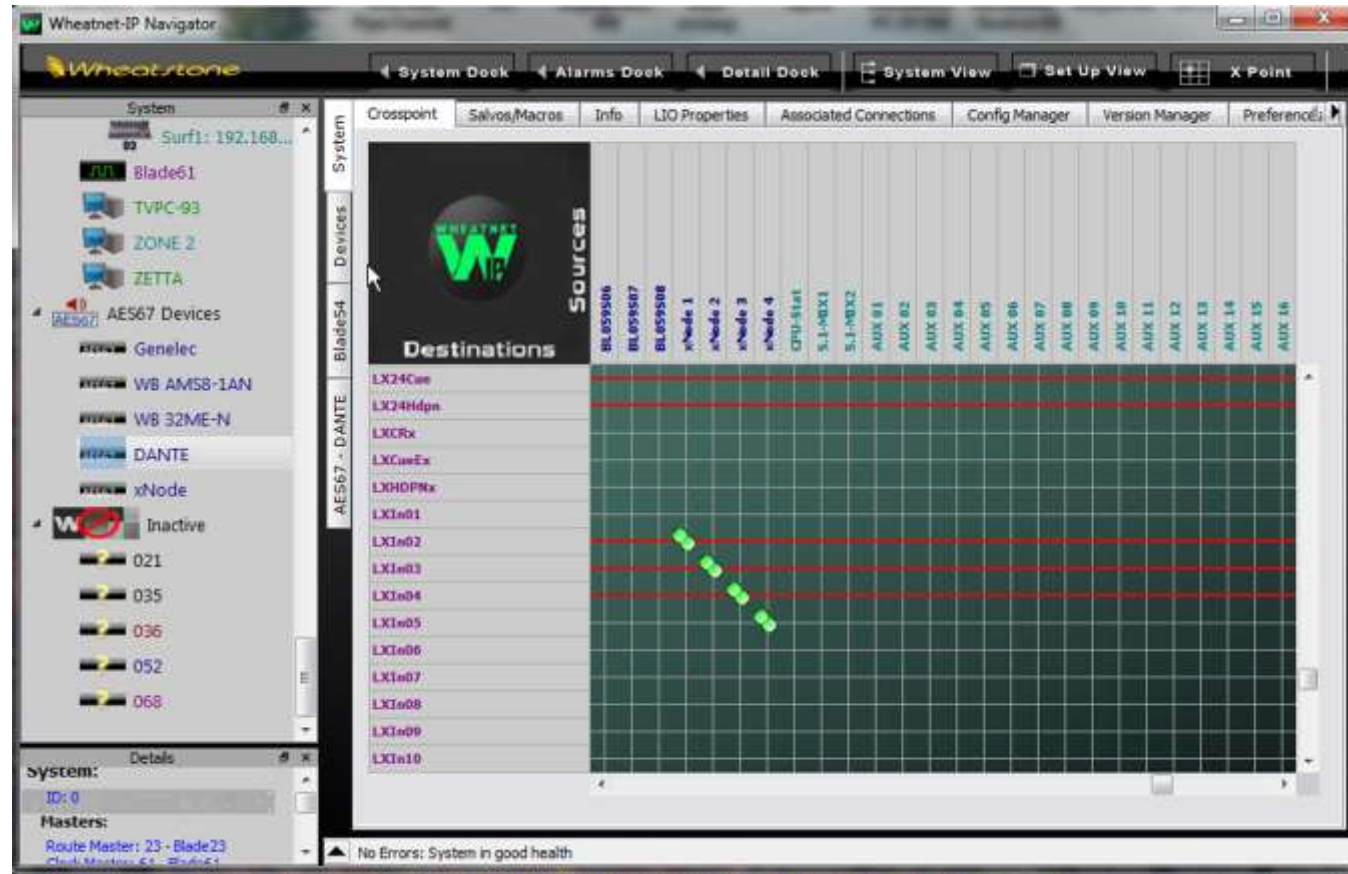
**Destination which has LIO control:**  
ID: 54.1.0.1 (D0810001)  
Name: LXIn02  
Location: Blade54  
Width: Stereo

**LIOS used:**  
None

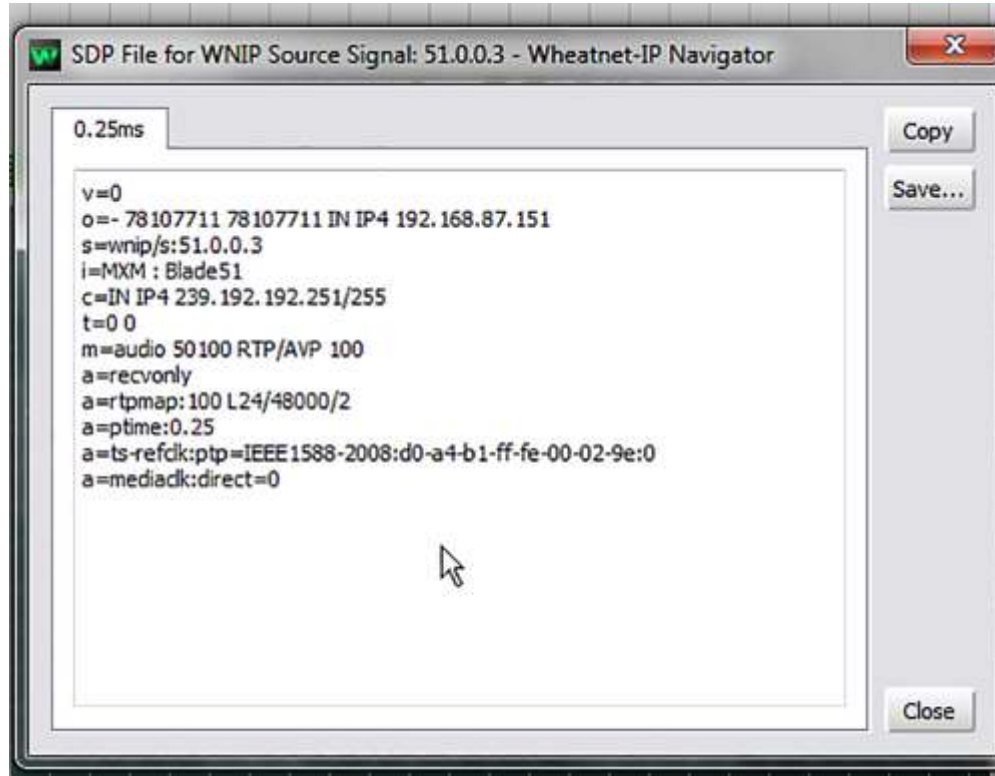
**Streams:**  
Multicast Address: 239.192.240.100  
Stream Offset: 0  
Stream Width: Stereo  
Port: 50100  
Payload Type: 100  
Packet Rate: 1.00ms  
Encoding Type: 24 Bit Interleaved  
Clock Type: Precision Time Protocol  
GMD: 00-00-00-00-00-00-00  
Domain: 0

At the bottom of the interface, a status bar indicates "No Errors: System in good health".

## Crosspoint grid of AES67 source-to-destination connections



## About SDP Files...

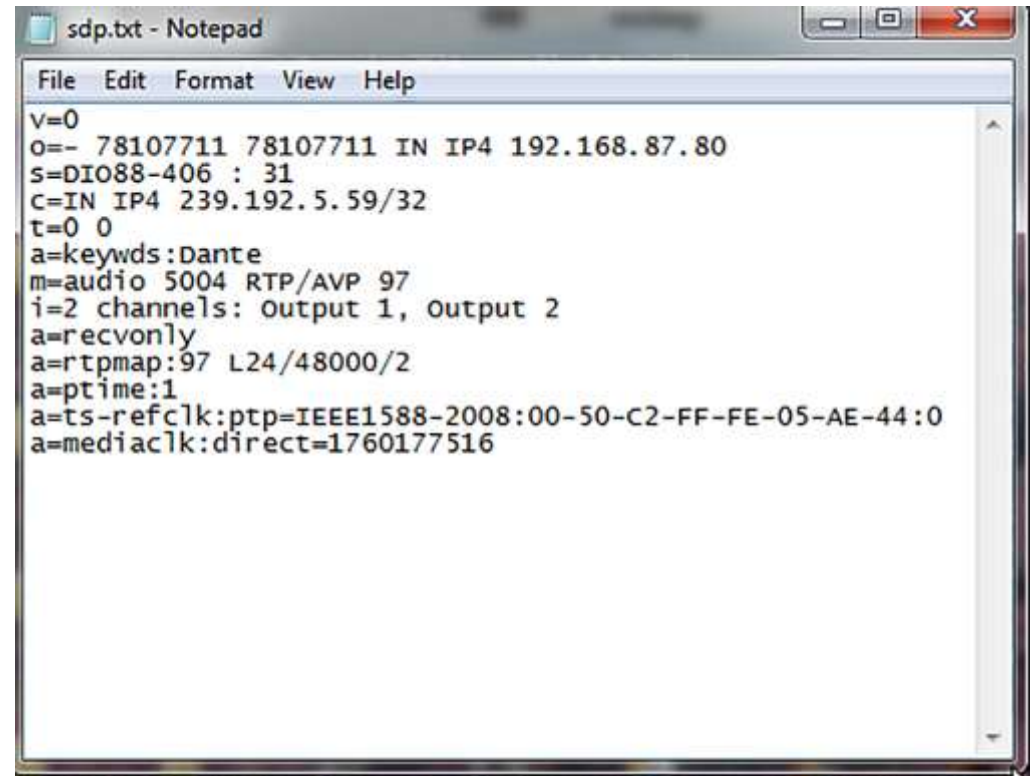


0.25ms

```
v=0
o=- 78107711 78107711 IN IP4 192.168.87.151
s=wnip/s:51.0.0.3
i=MXM : Blade51
c=IN IP4 239.192.192.251/255
t=0 0
m=audio 50100 RTP/AVP 100
a=recvonly
a=rtpmap:100 L24/48000/2
a=ptime:0.25
a=ts-refclk:ptp=IEEE1588-2008:d0-a4-b1-ff-fe-00-02-9e:0
a=mediadk:direct=0
```

Copy  
Save...  
Close

Sample WheatNet-IP SDP file



```
sdp.txt - Notepad
File Edit Format View Help
v=0
o=- 78107711 78107711 IN IP4 192.168.87.80
s=DIO88-406 : 31
c=IN IP4 239.192.5.59/32
t=0 0
a=keywds:Dante
m=audio 5004 RTP/AVP 97
i=2 channels: Output 1, Output 2
a=recvonly
a=rtpmap:97 L24/48000/2
a=ptime:1
a=ts-refclk:ptp=IEEE1588-2008:00-50-C2-FF-FE-05-AE-44:0
a=mediadk:direct=1760177516
```

Sample Dante SDP file

## In Closing

- Provide a PTPv2 master clock source.
- Assure all devices are on the same IP subnet as multicasting does not normally cross subnet boundaries.
- Configure the desired multicast addresses, port, packet timing, and payload type for Source streams.
- Configure Destinations with the stream details for the desired stream to receive.