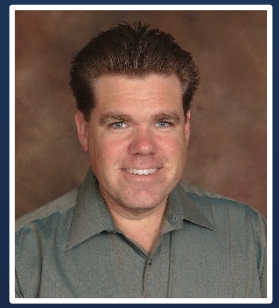


Patrick Killianey
Network Systems Applications Engineer
YAMAHA commercial audio

Terms & Tools to Know

- TCP vs UDP
- QoS (Quality of Service)
- Unicast, Broadcast & Multicast
- IGMP Snooping

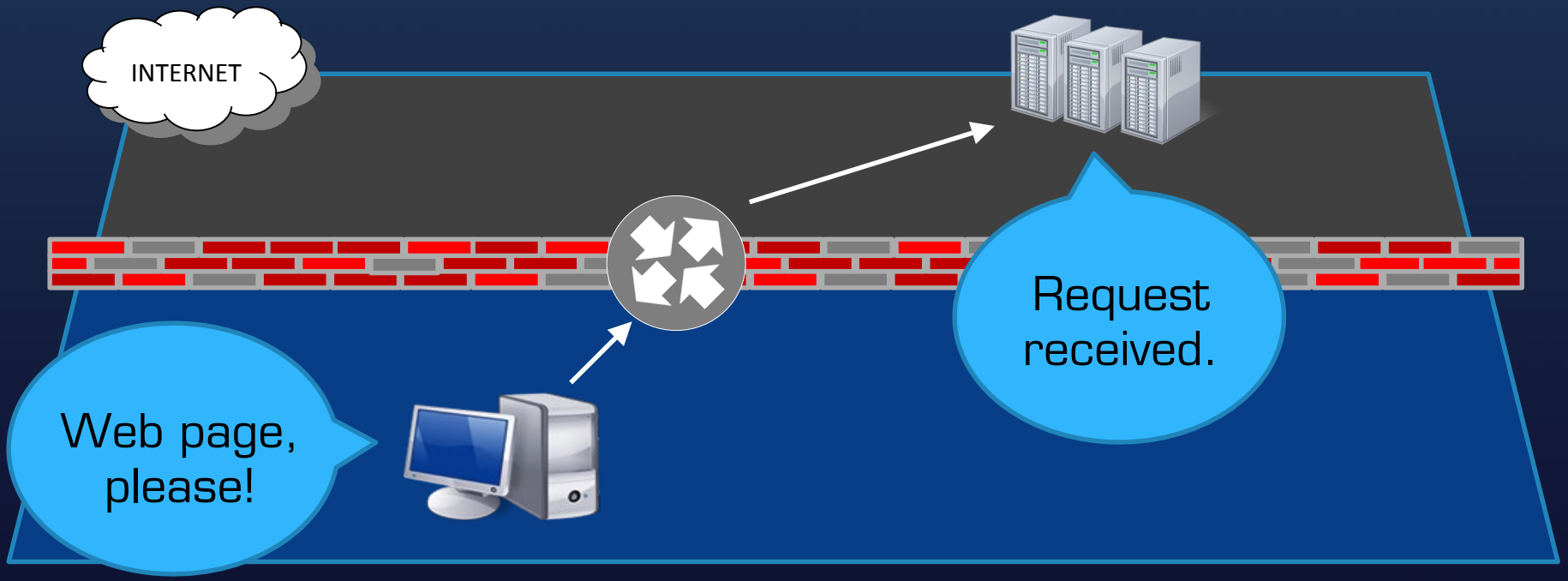
PTP Word Clock

- Review: Digital Audio
- Review: Clocking Architecture
- Real Scope Views of Clocks
- Application: Why does it matter?

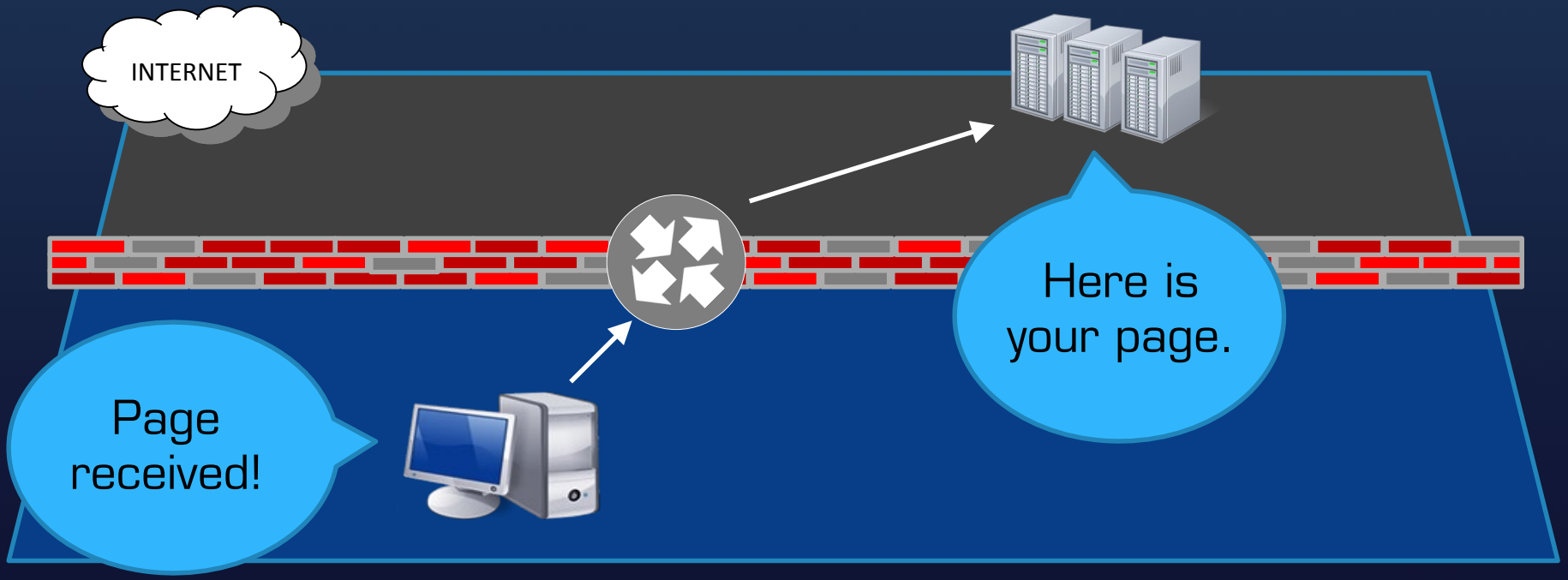
TCP vs. UDP

- TCP is akin to “Signature Required” delivery
  - System can slow down or retry a message
  - Configuration is received by sender
  - Typical for web browsing, email, “telnet” control
- UDP is more like “First Class Mail”
  - Sender trusts delivery occurs – no tracking/retries.
  - Streamlines delivery, reduces overhead.
  - Typical for time-sensitive content (streaming)

TCP Traffic



TCP Traffic



UDP Traffic

Traffic can occur both ways.
Data does not have to be verified.

Inputs

Mixes

QoS (Quality of Service)

Prioritizing Time-Sensitive Traffic

- Large deliveries are broken in to pieces, shipped, reassembled.
- Packet types can be prioritized.

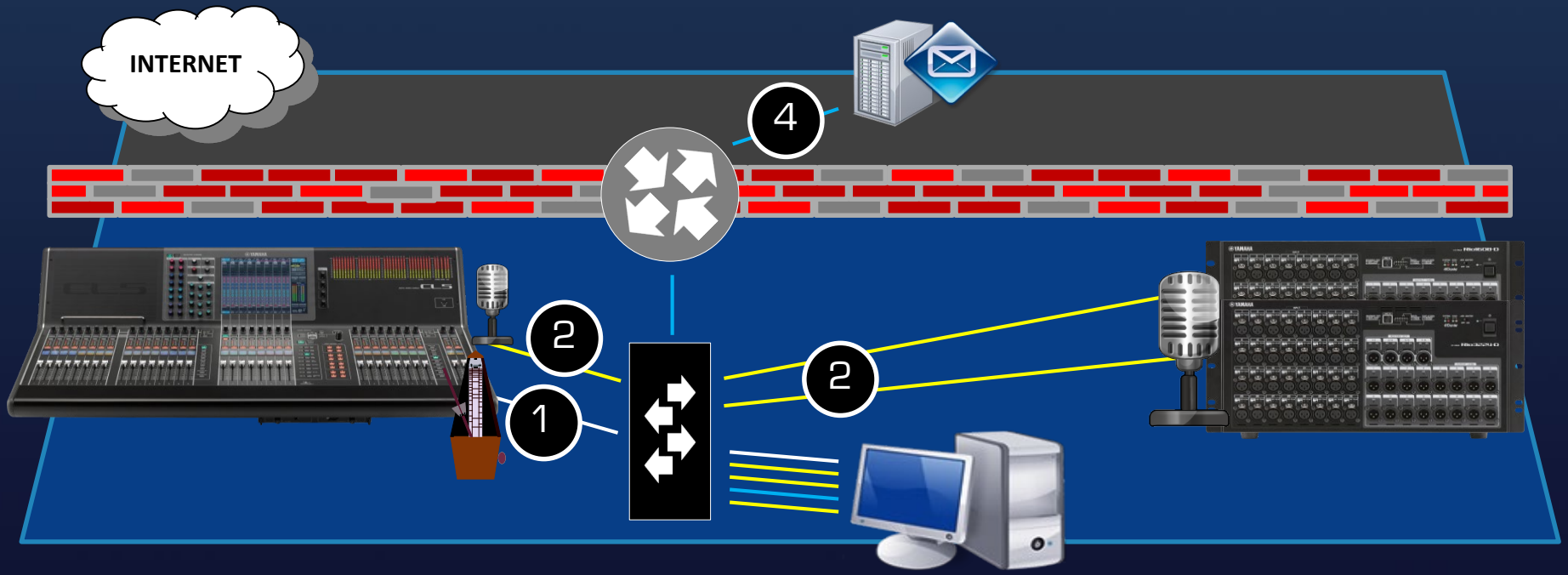
QoS (Quality of Service)

Prioritizing Time-Sensitive Traffic

1	2	3	4
Clock	Audio	Control	"Best Effort"
Dante 56 (CS7) AES67 46 (EF)	46 (EF) 34 (AF41)	8 (CS1)	

QoS (Quality of Service)

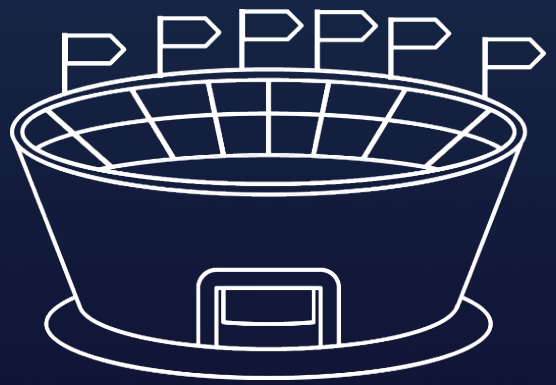
Prioritizing Time-Sensitive Traffic



QoS (Quality of Service)

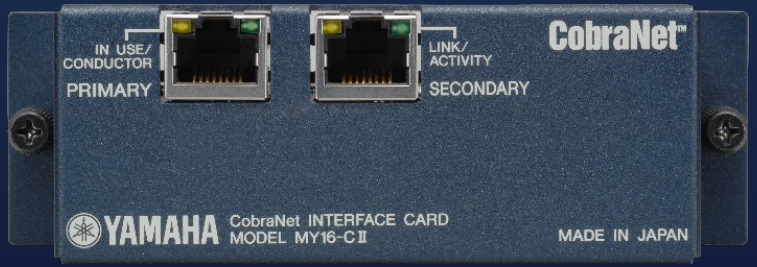
Prioritizing Time-Sensitive Traffic

2008 - CobraNet®

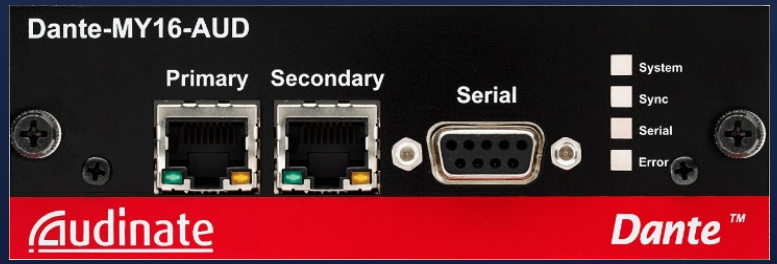


QoS (Quality of Service)

Prioritizing Time-Sensitive Traffic



CobraNet®

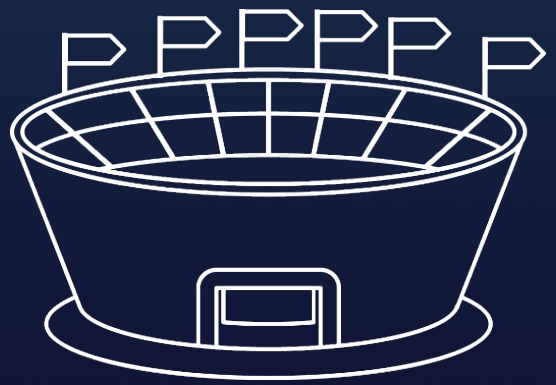


Dante™

QoS (Quality of Service)

Prioritizing Time-Sensitive Traffic

2014 - Dante™

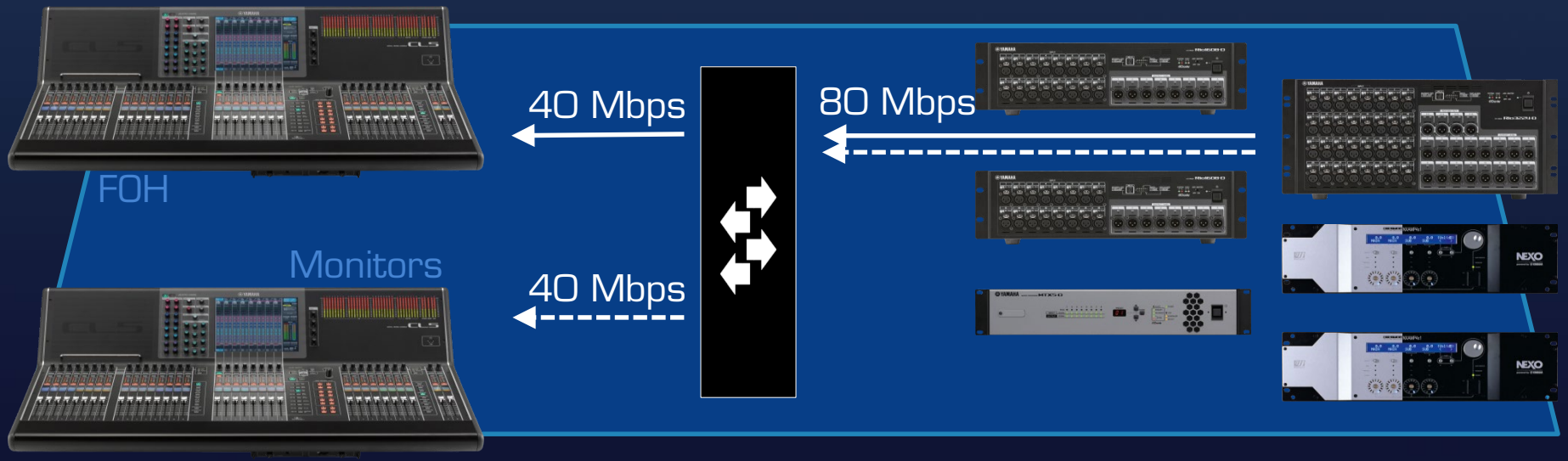


QoS (Quality of Service)

Prioritizing Time-Sensitive Traffic

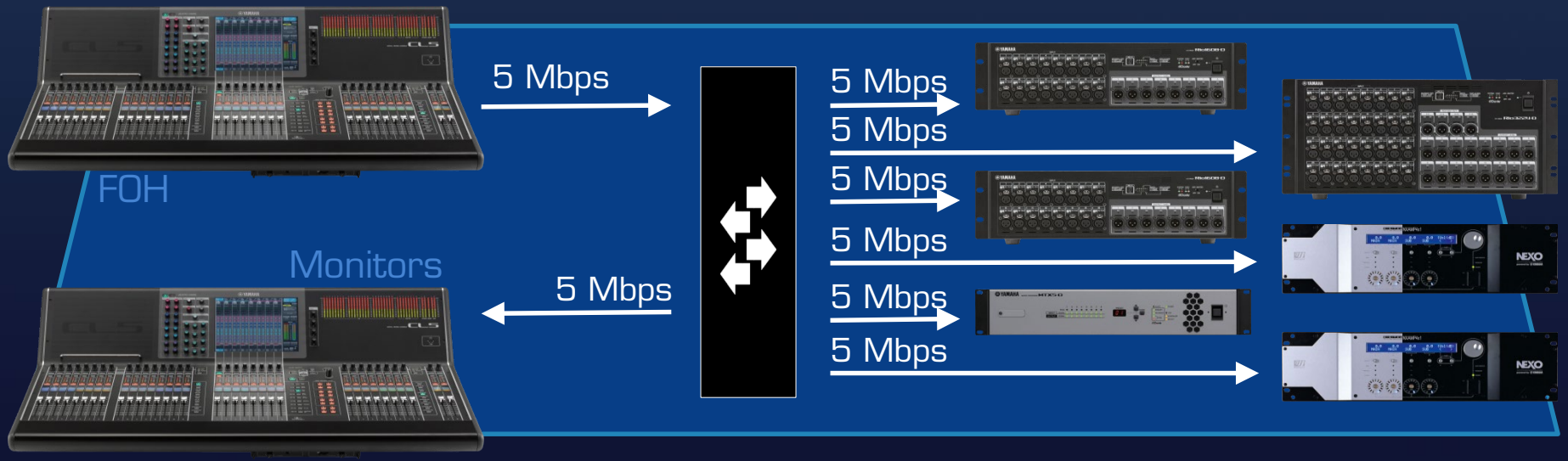
Unicast Distribution

1:1



Broadcast Distribution

1:All

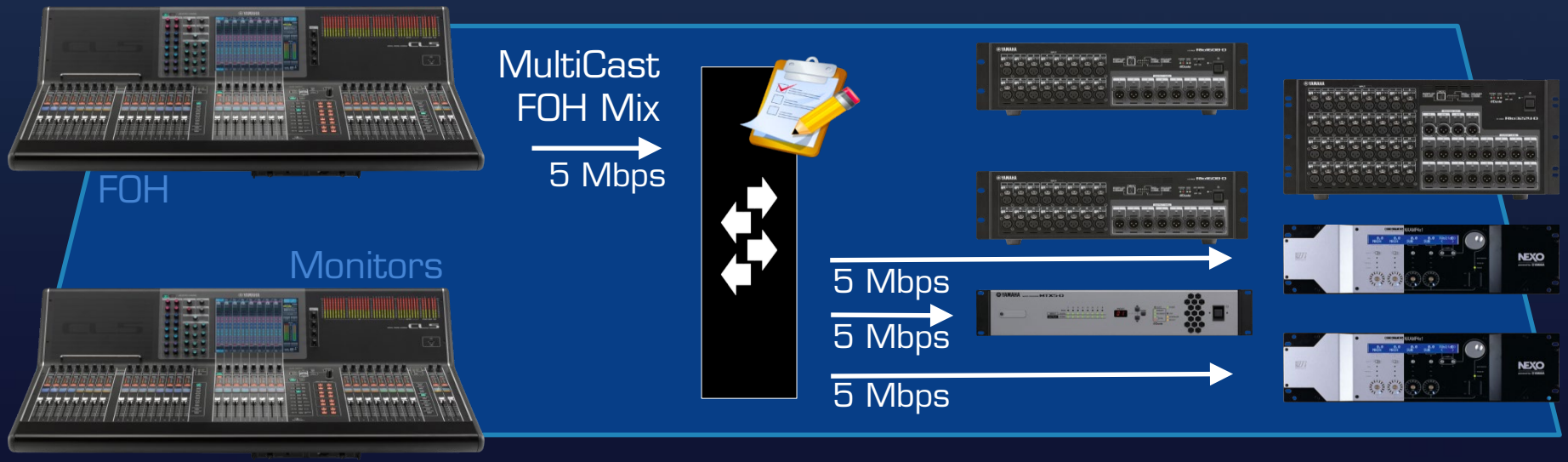


Multicast Distribution

1:Select List

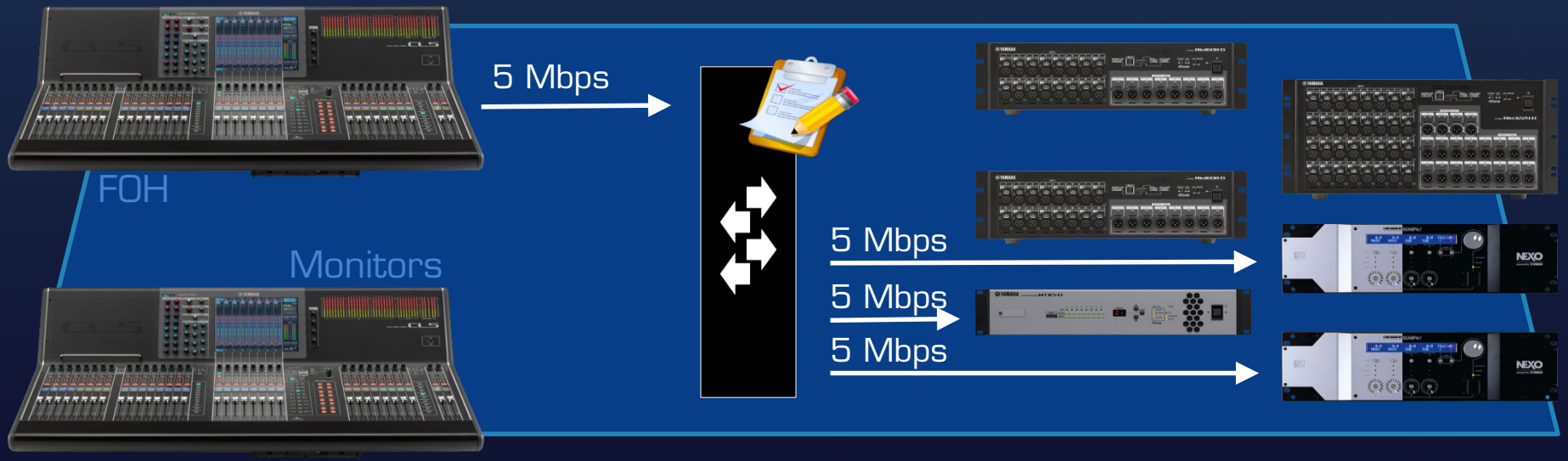
Multicast Distribution

1:Select List



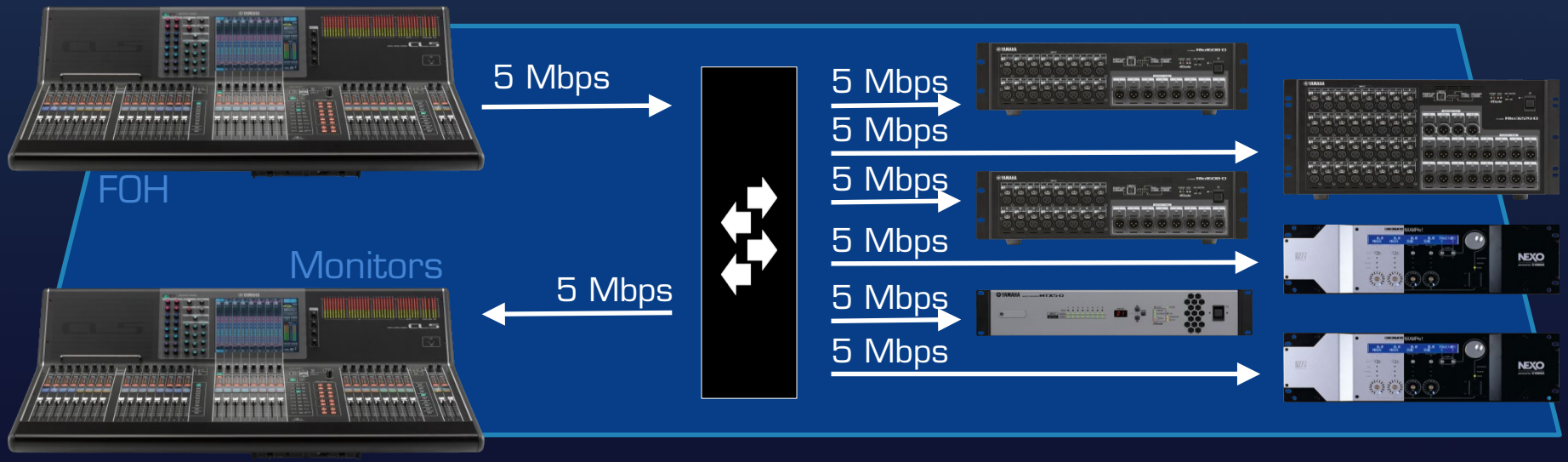
Multicast Distribution

w/ IGMP Snooping



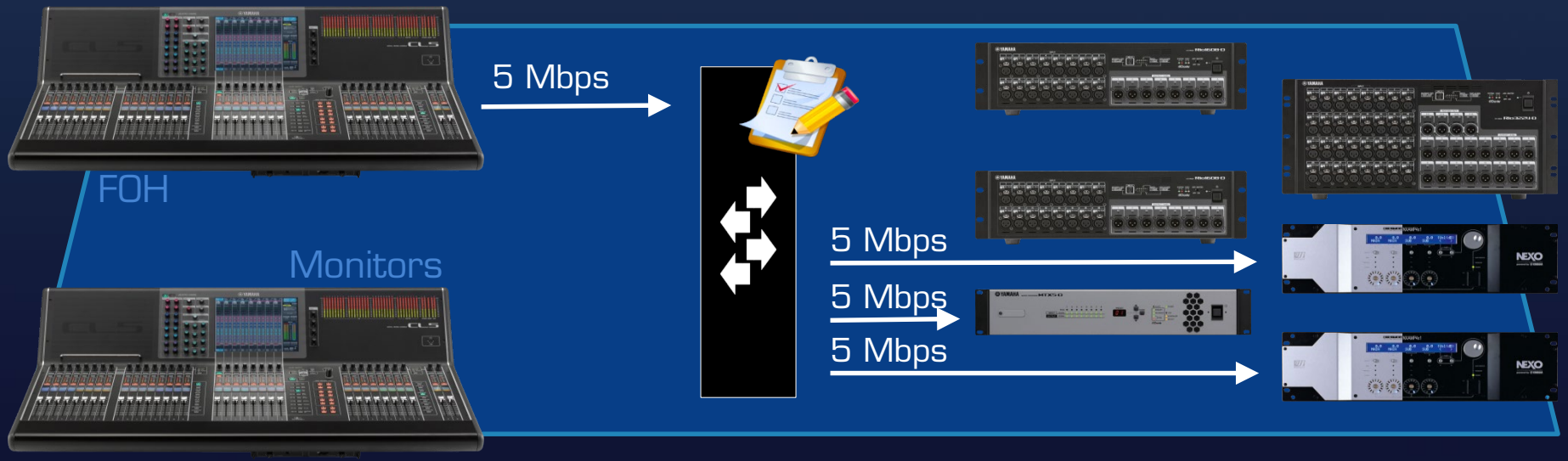
Multicast Distribution

w/o IGMP Snooping



Multicast Distribution

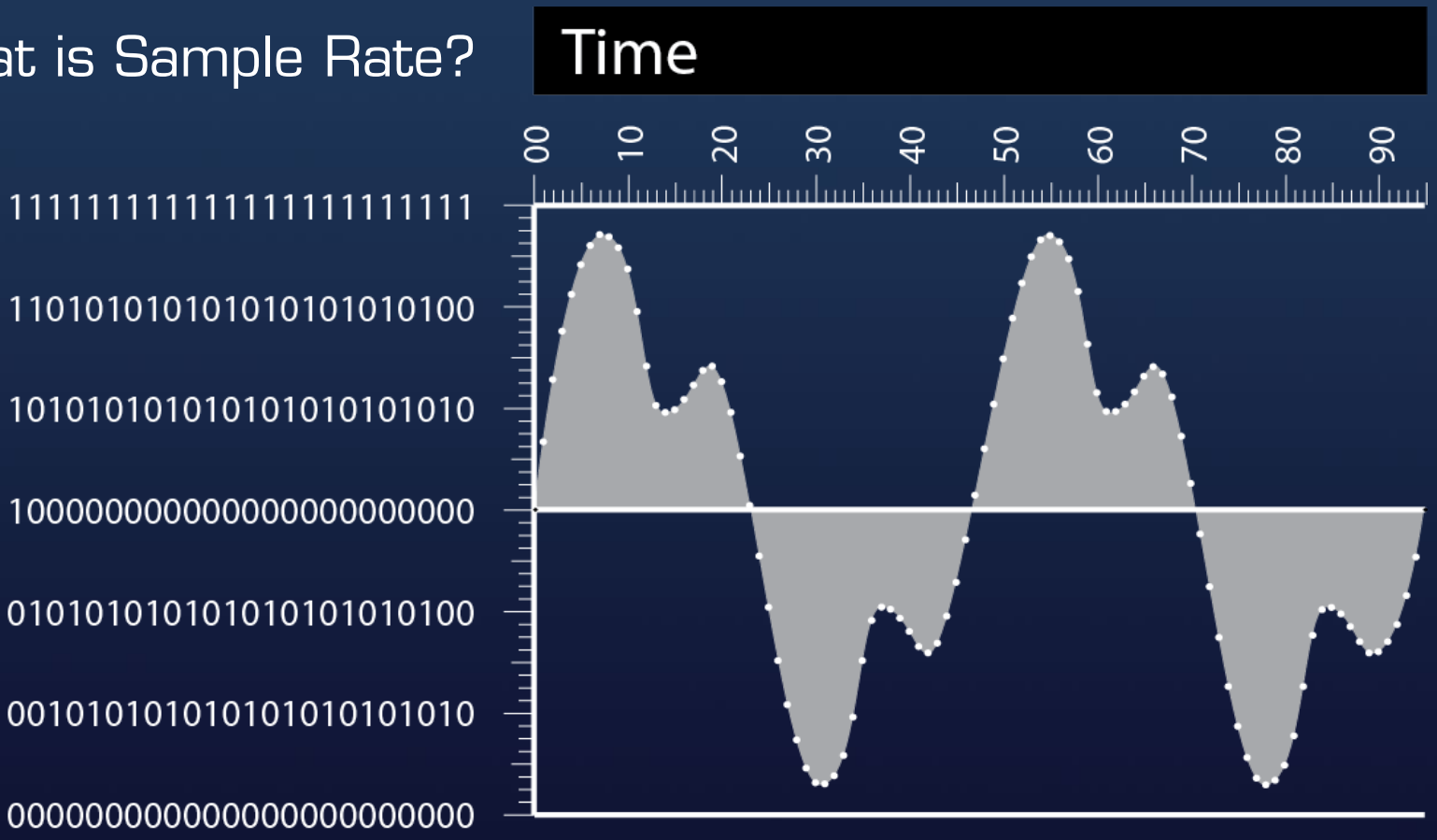
w/ IGMP Snooping

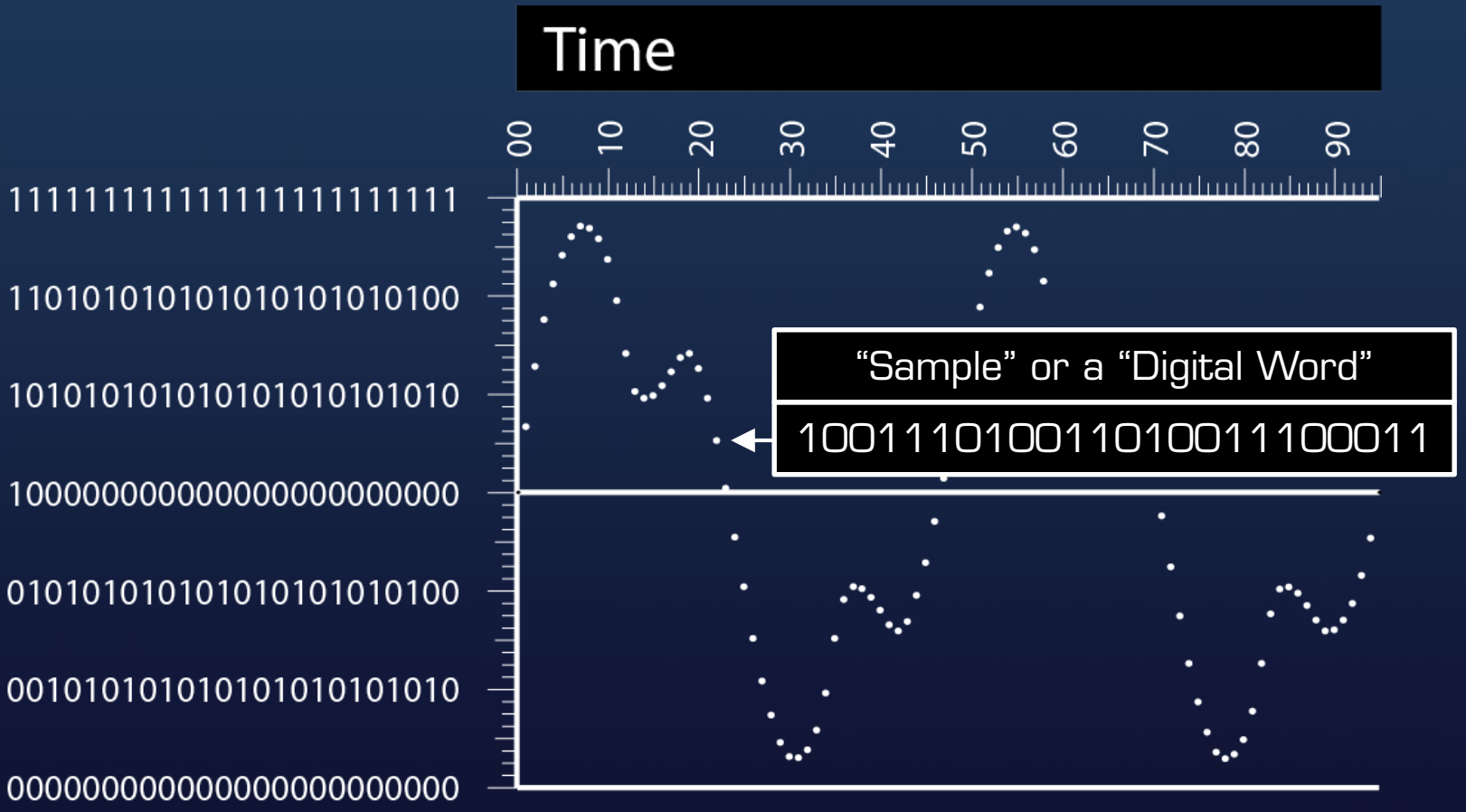


Dante Word Clock

But first, a *quick* introduction to
Digital Audio & Word Clock

What is Sample Rate?




Time
00
10
20
30
40
50
60
70
80
90
11111111111111111111111
11010101010101010101010
10101010101010101010101
10000000000000000000000
01010101010101010101010
00101010101010101010101
00000000000000000000000
"Sample" or a "Digital Word"
10011101001101001110001 1

Why Do We Cover Digital Audio Basics?

I enjoy working with the M7CL and PM5D. They are great analog consoles.

Why Do We Cover Digital Audio Basics?

- This means your whole system is connected digitally.
- This is the first time many will connect digitally.

Capture
#4

Transmit
#3

Process
#2

Transmit
#1

48kHz

Problem: Digital Connection, No Sync

48,000.3 Hz

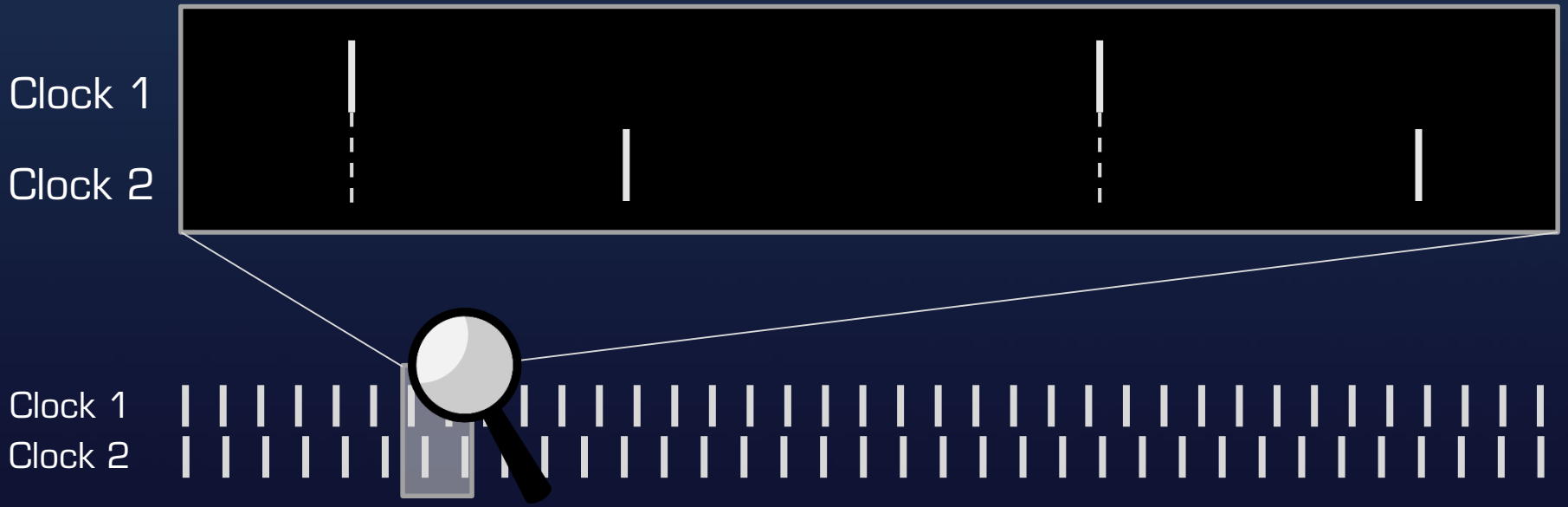
48,000.1 Hz

Clock 1

Clock 2

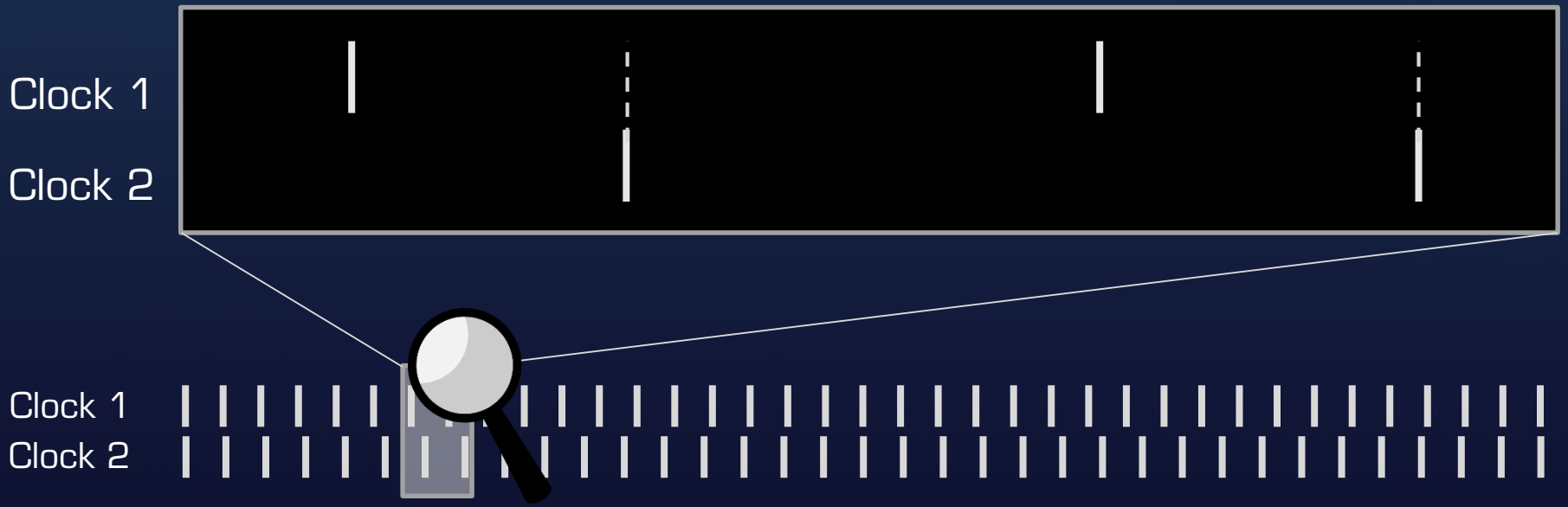
Problem: Digital Connection, No Sync

OK: Signal “out of phase”, but one sample appears per period.



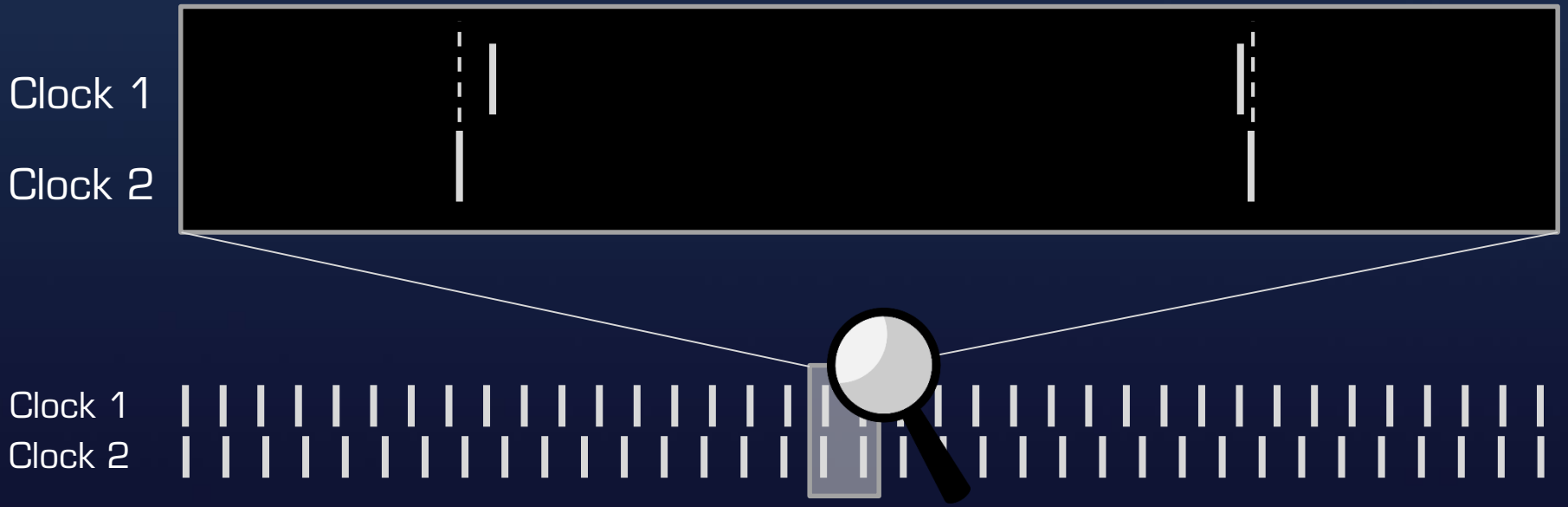
Problem: Digital Connection, No Sync

OK: Signal “out of phase”, but one sample appears per period.



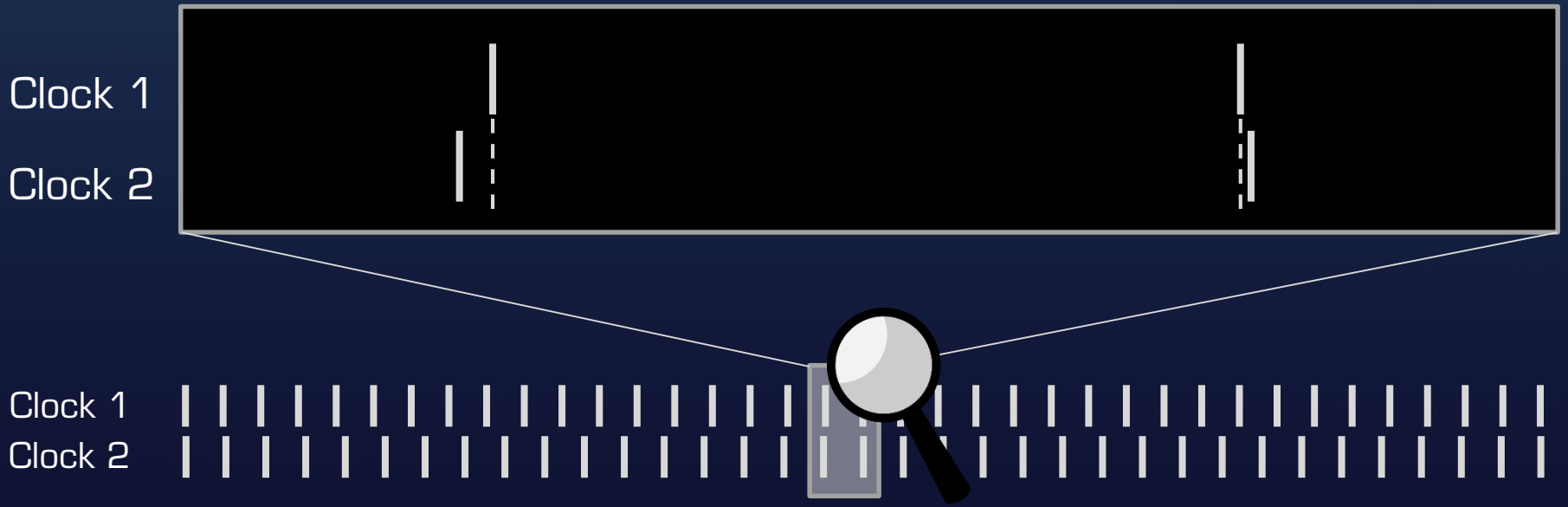
Problem: Digital Connection, No Sync

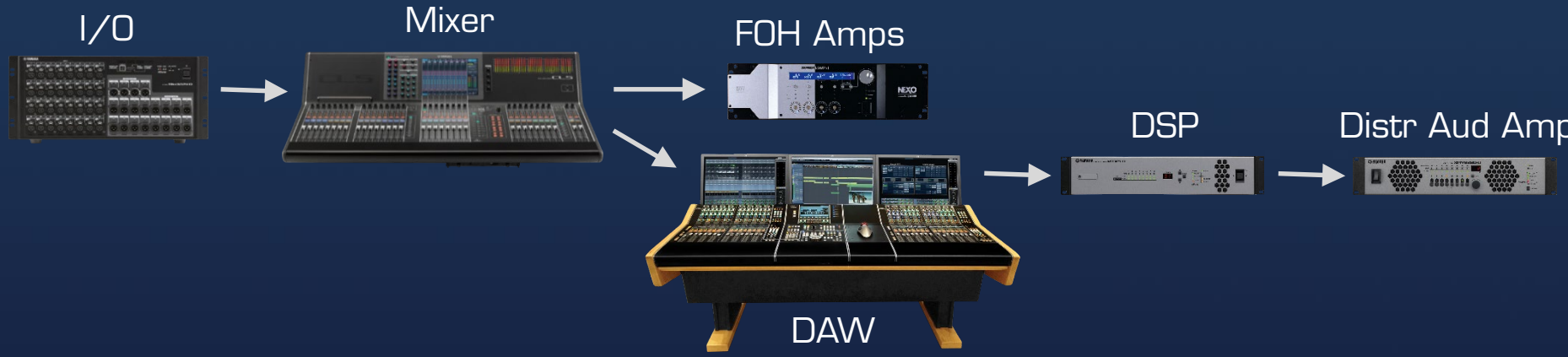
2 Samples Received in 1 Sample Period!
(Buffer Overrun)



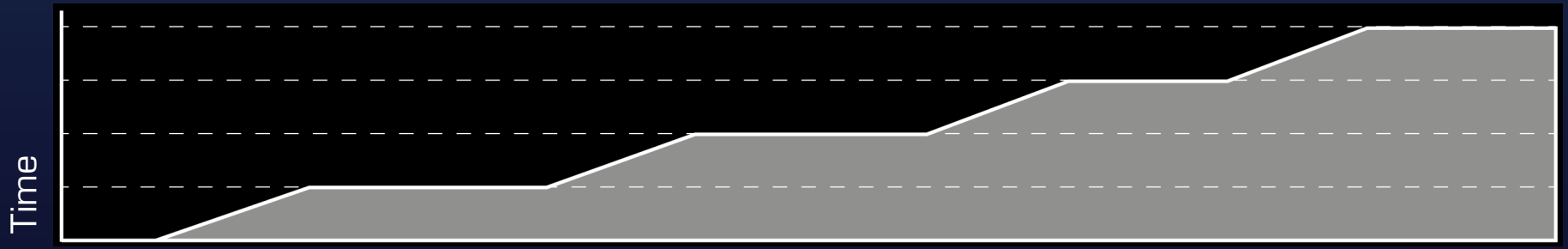
Problem: Digital Connection, No Sync

0 Samples Received in 1 Sample Period!
(Buffer Underrun)





Word Clock Variance (Propagation Delay)



I/O

Mixer

FOH Amps

DAW

DSP

Distr Aud Amp

Distribution Amp

I/O

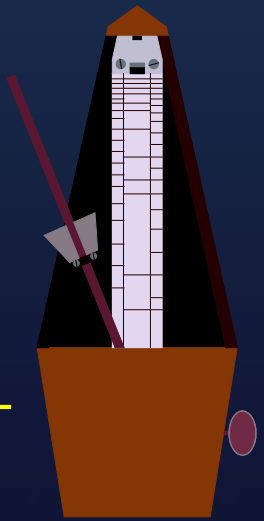
Mixer

FOH Amps

DAW

DSP

Distr Aud Amp



Word Clock Master

Dante PTP Word Clock

Simplifying Configuration
Not Just In Sync, but In Phase

I/O

Mixer

FOH Amps

DAW

DSP

Distr Aud Amp

Distribution Amp

I/O

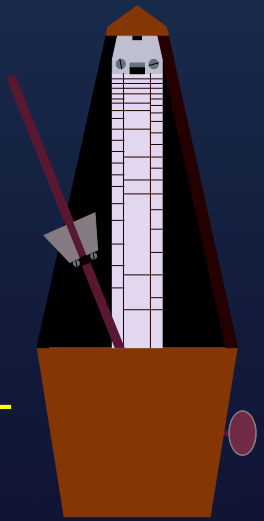
Mixer

FOH Amps

DAW

DSP

Distr Aud Amp

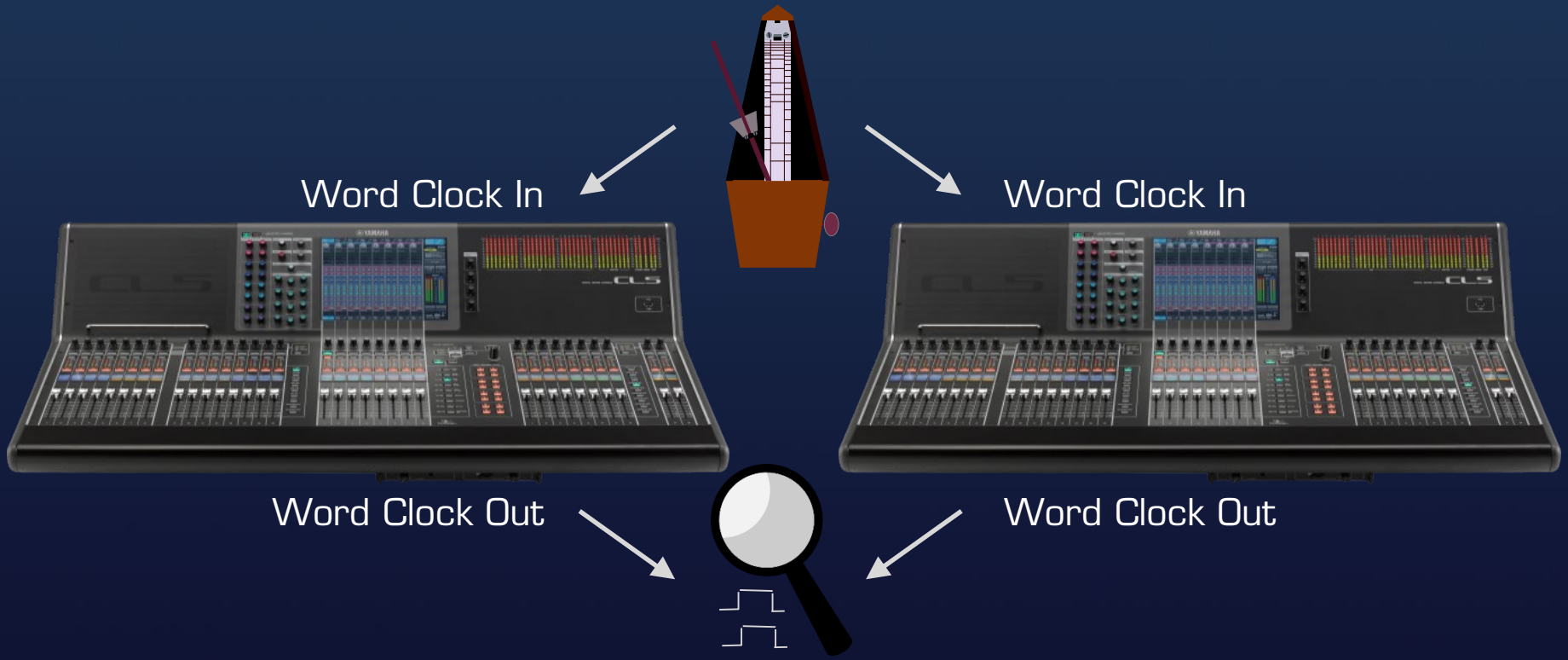


Word Clock Master

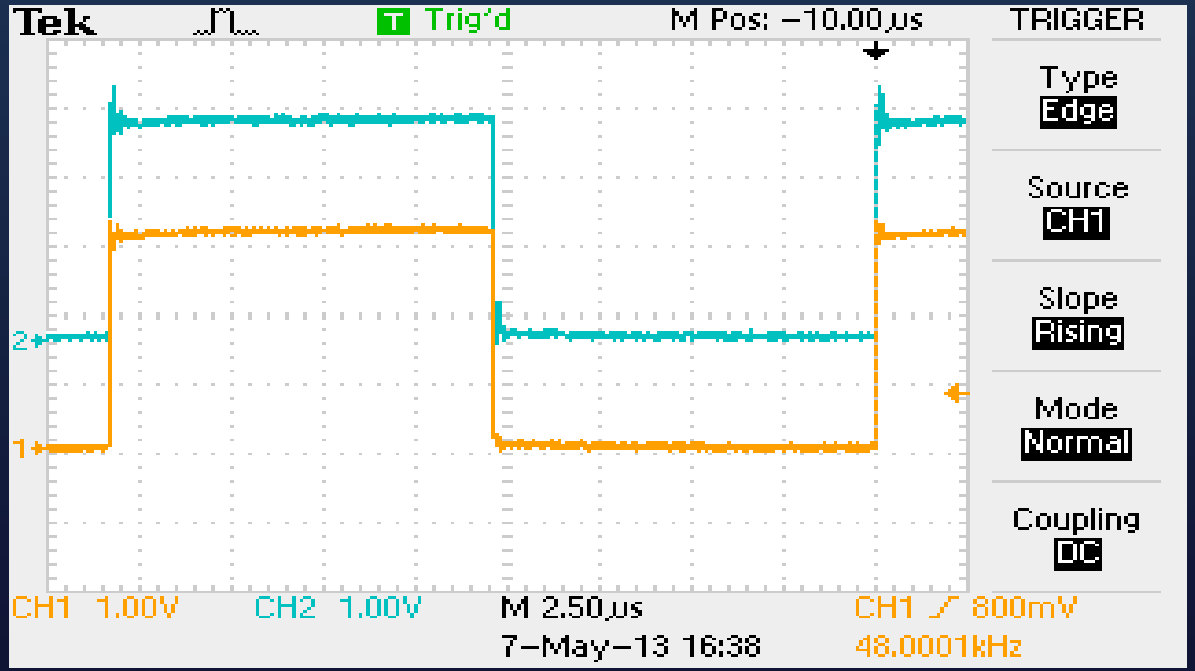
Word Clock Precision

- Digital Audio often uses Time Division Multiplexing (TDM)
  - TDM is typical for AES/EBU, MADI, CobraNet, EtherSound, etc.
  - Audio is sent in time, clock is derived from timing.
  - Each link down the chain is slightly later than its predecessor.
- Dante uses Precision Time Protocol (PTP)
  - IEEE1588, sub microsecond accuracy.
  - Sync packets are separate from audio packets.
  - Devices calculate delay in network transmission.
  - In Sync & In Phase

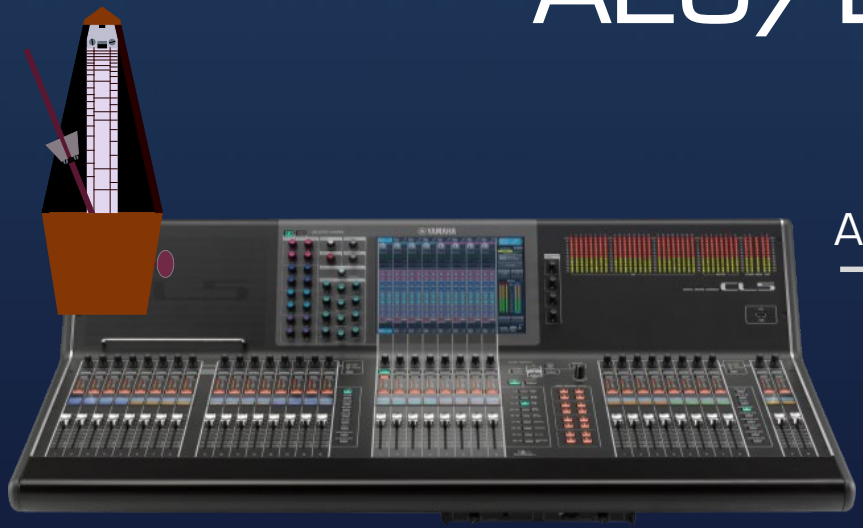
The “Control” Test



The “Control” Test



AES/EBU Test

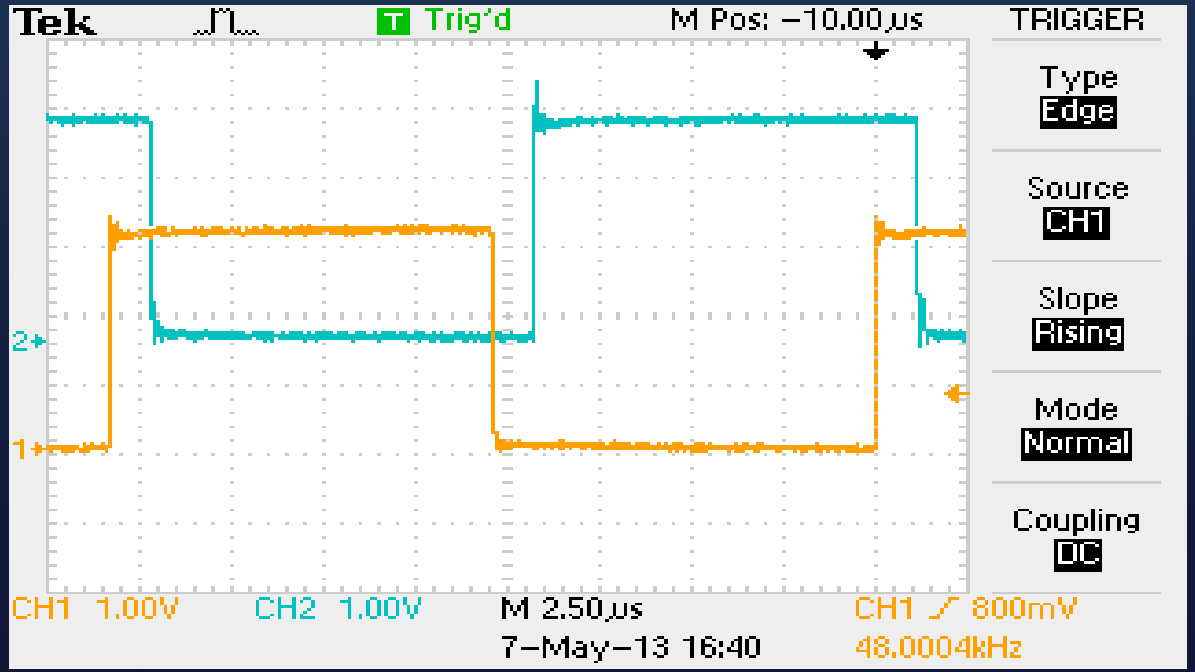


AES/EBU

Word Clock Out

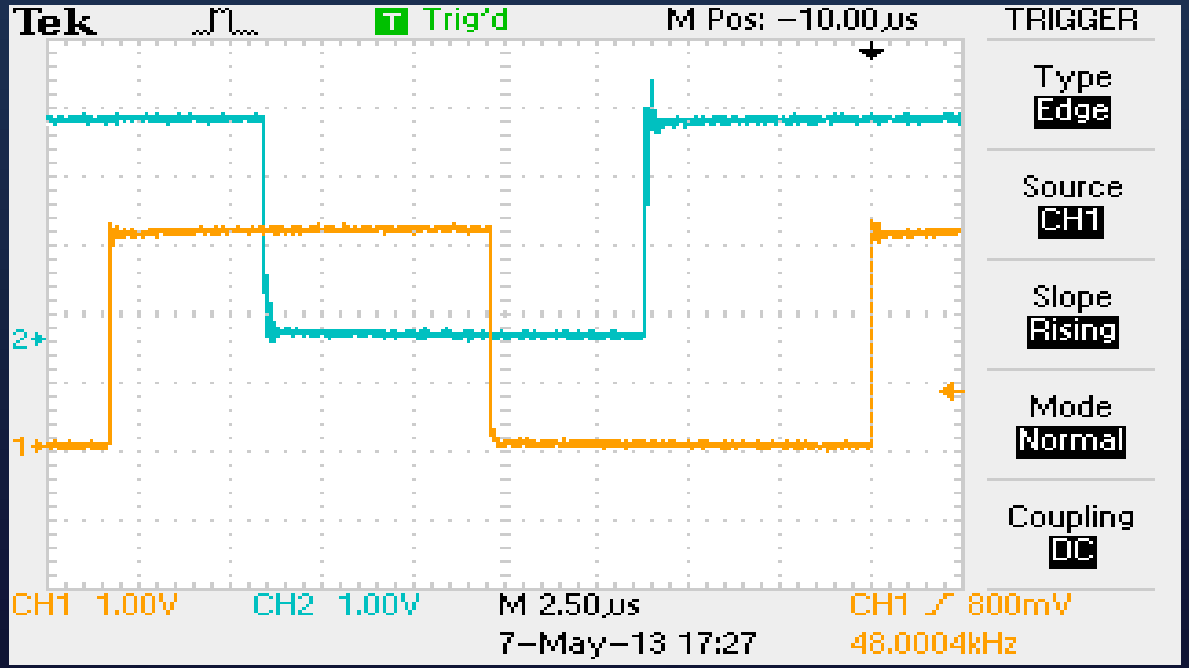
Word Clock Out

AES/EBU Test

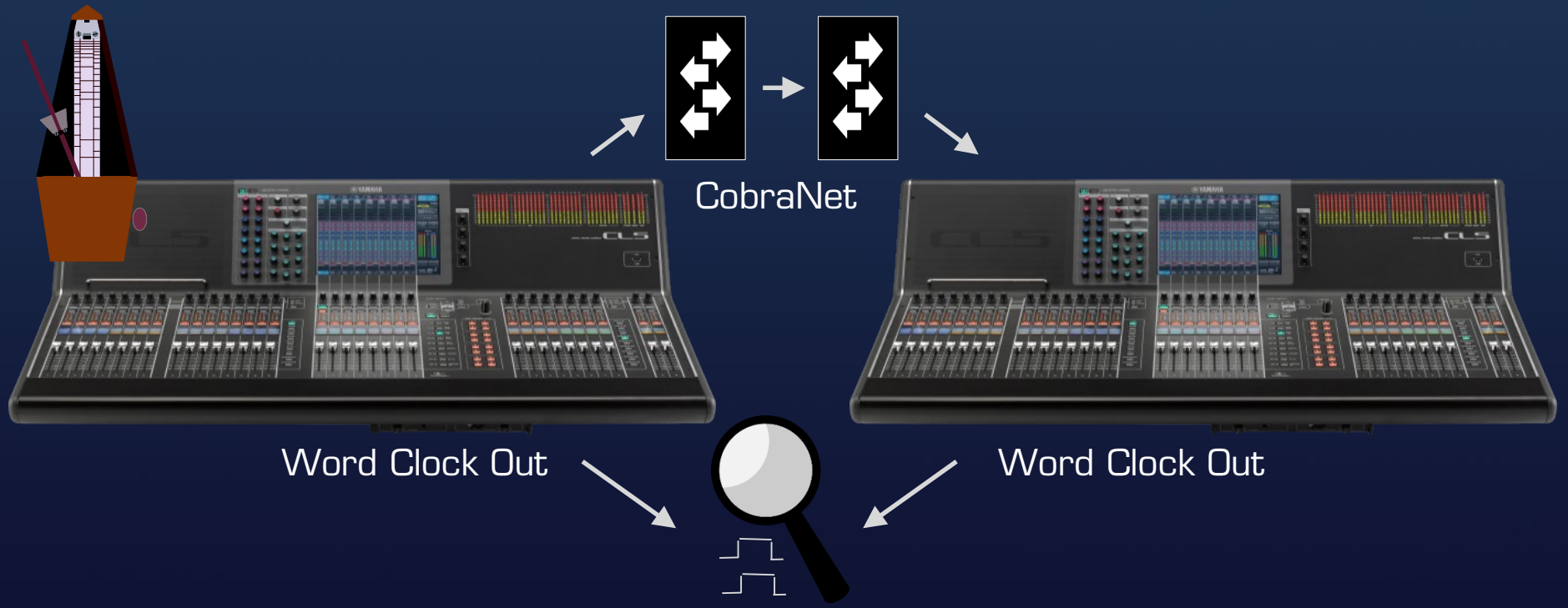

Tek
Trig'd
M Pos: −10.00µs
TRIGGER
Type
Edge
Source
CH1
Slope
Rising
Mode
Normal
Coupling
DC
CH1 1.00V
CH2 1.00V
M 2.50µs
7−May−13 16:40
CH1 800mV
48.0004kHz

CobraNet Test

CobraNet Test

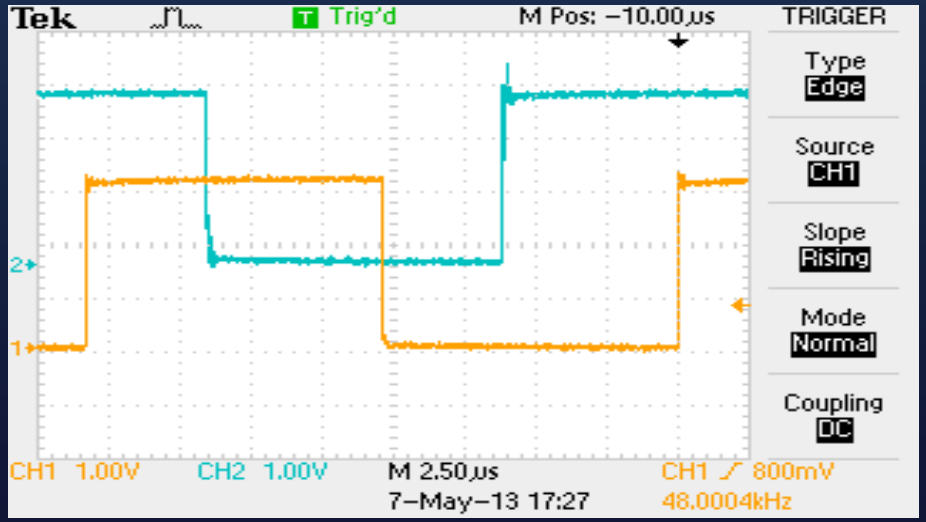


CobraNet Test

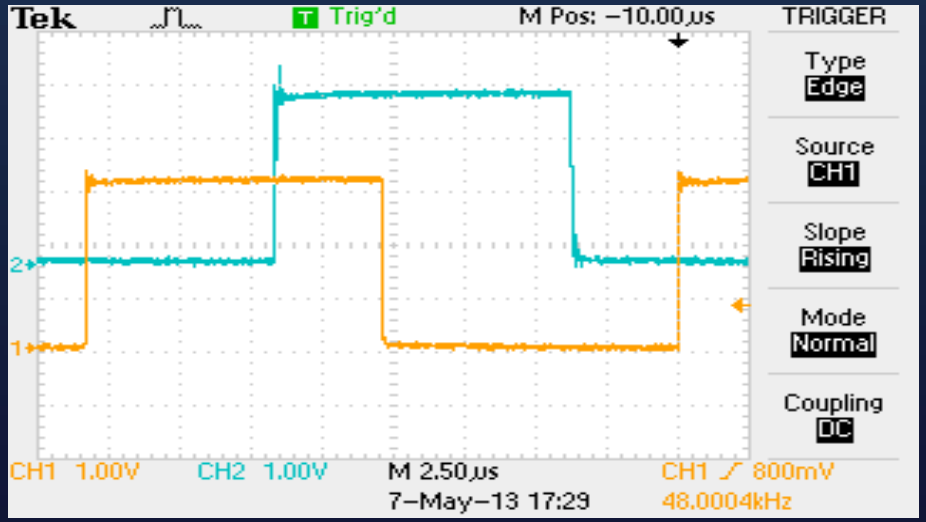


CobraNet Test

One Network Switch

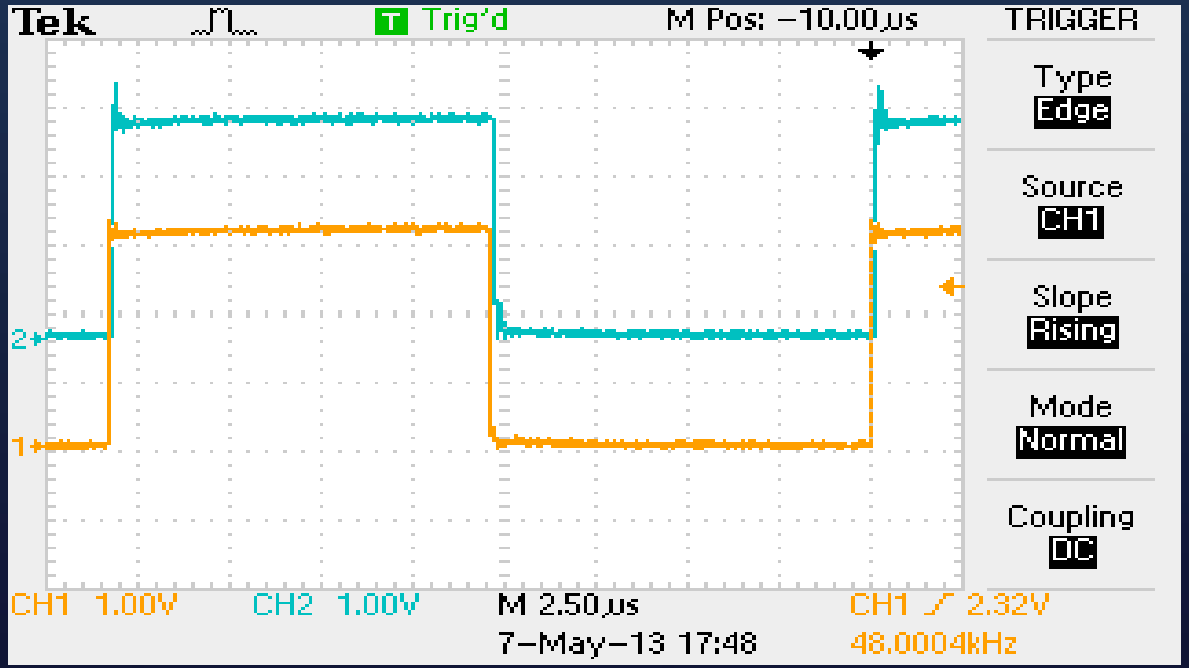


Two Network Switches

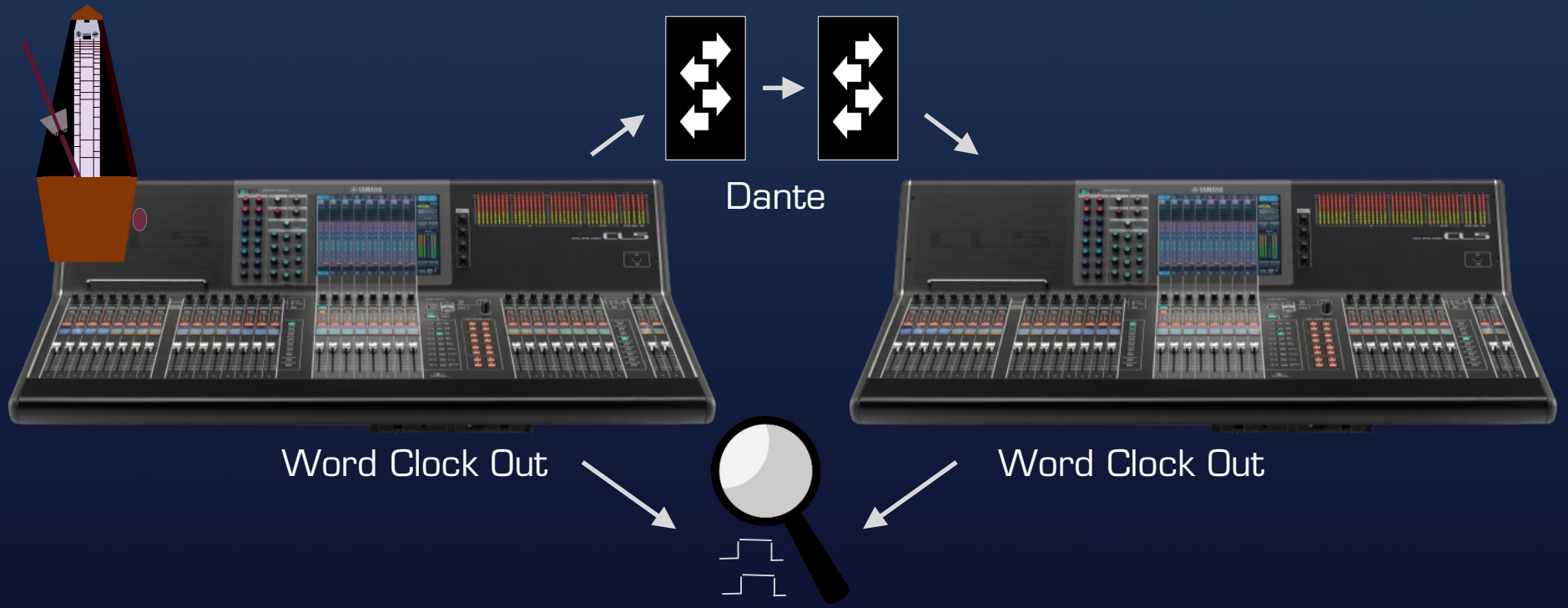


Dante Test

Dante Test

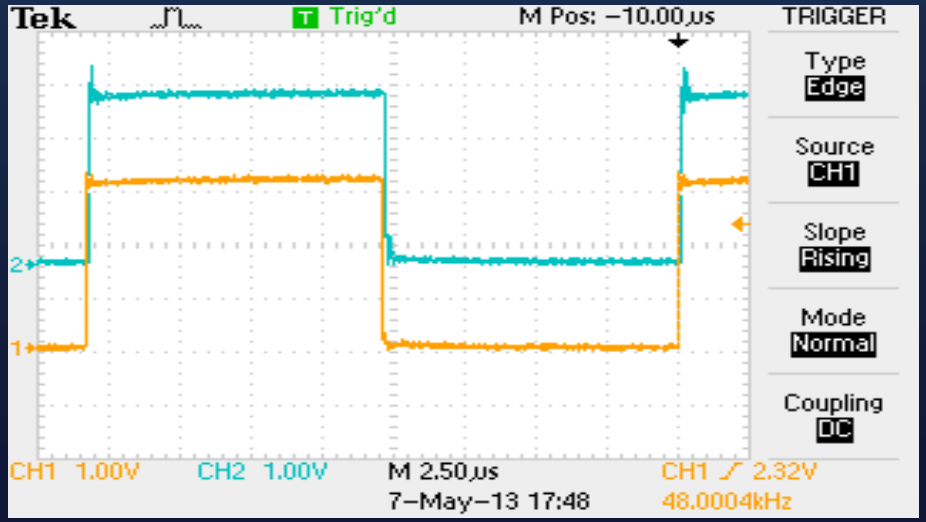

Tek
Trig'd
M Pos: -10.00µs
TRIGGER
Type
Edge
Source
CH1
Slope
Rising
Mode
Normal
Coupling
DC
2
1
CH1 1.00V
CH2 1.00V
M 2.50µs
7-May-13 17:48
CH1 2.32V
48.0004kHz

Dante Test

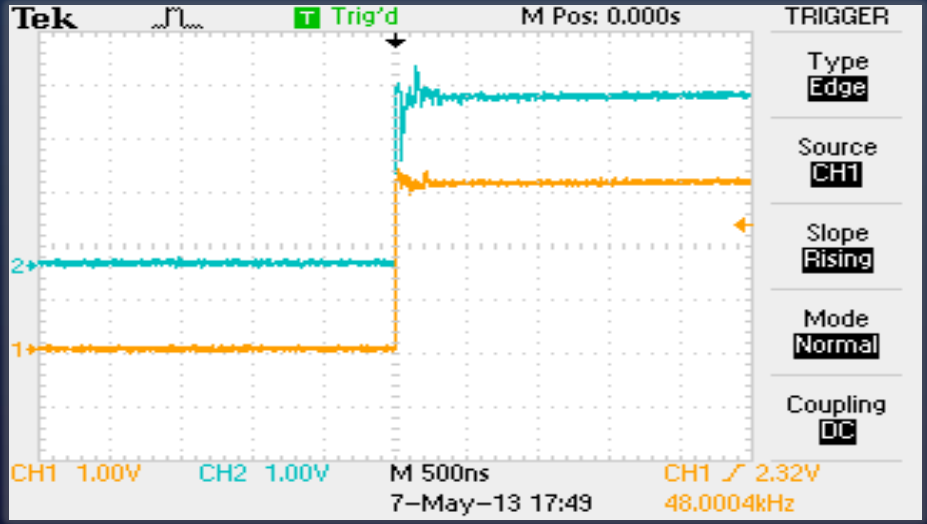


Dante Test

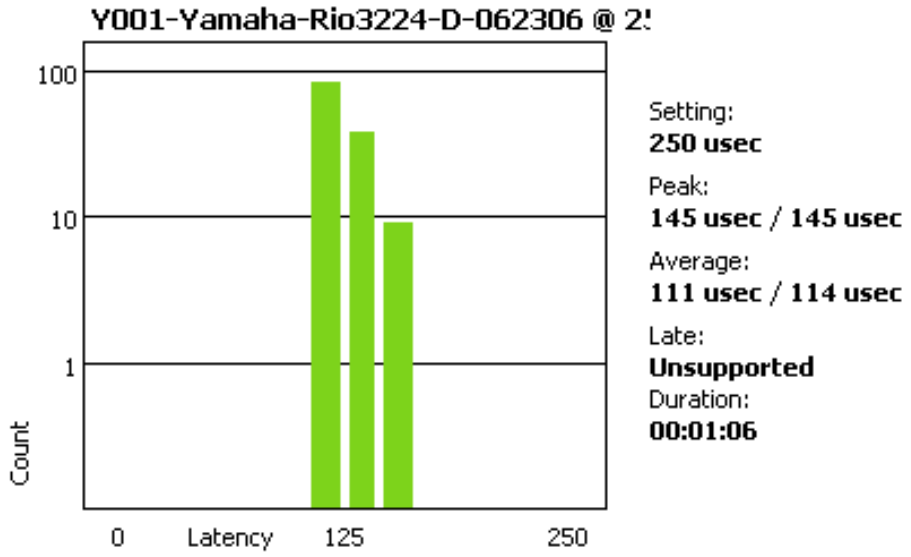
One Network Switch

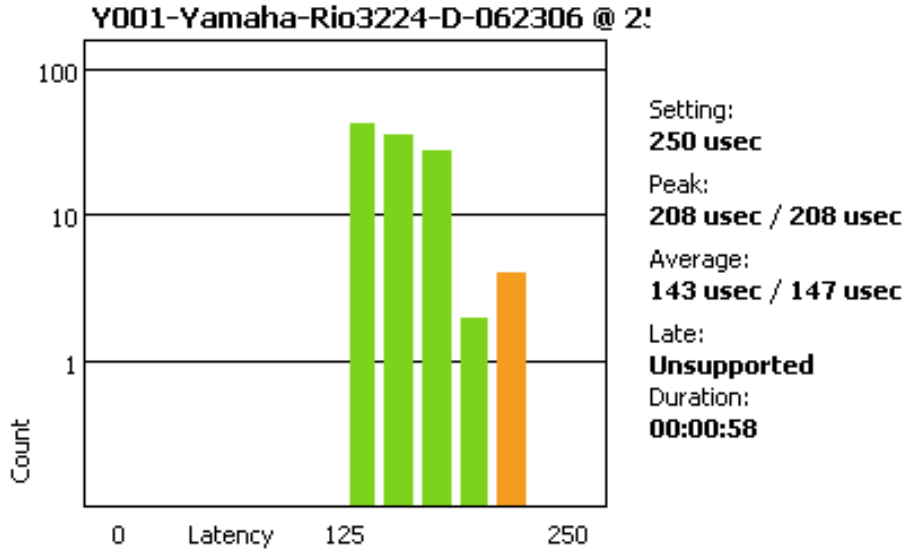


Two Network Switches



Dante Controller





1 Network Hop

6 Network Hops

Studio

Remote Feed

House Band

Recording

Nuendo

Guest Band

Sound FX

FOH

FOH

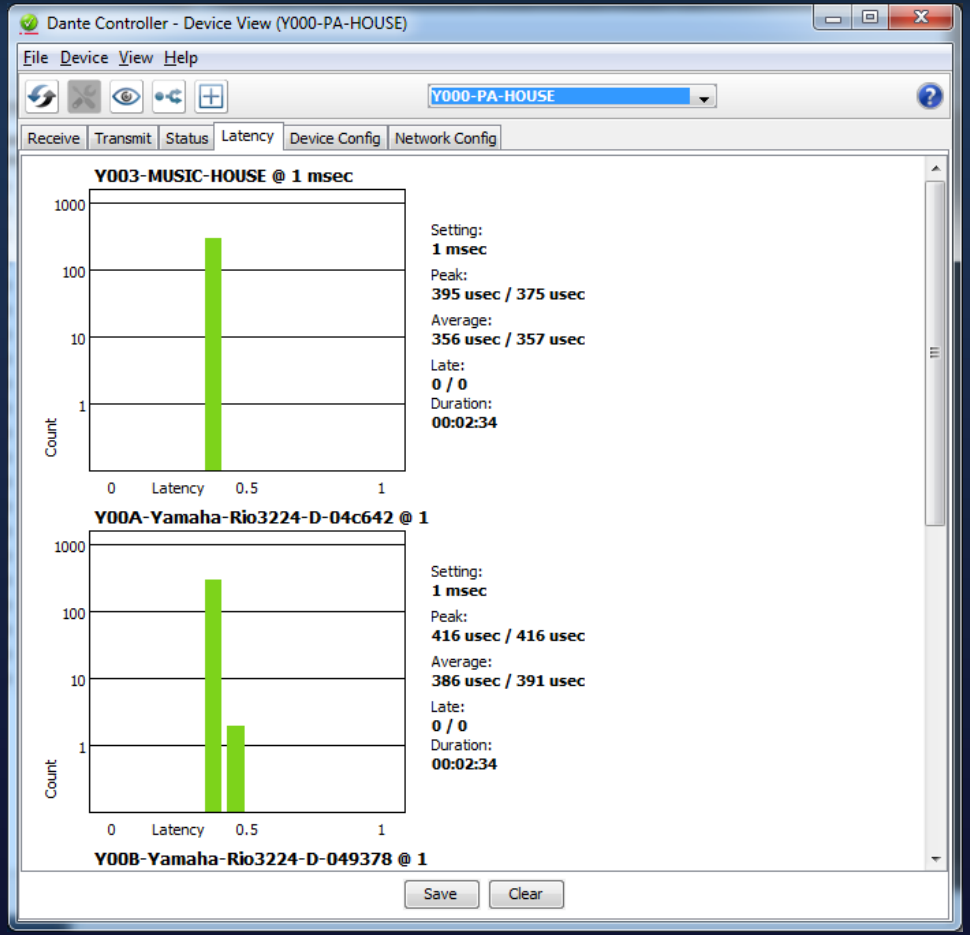
Monitors

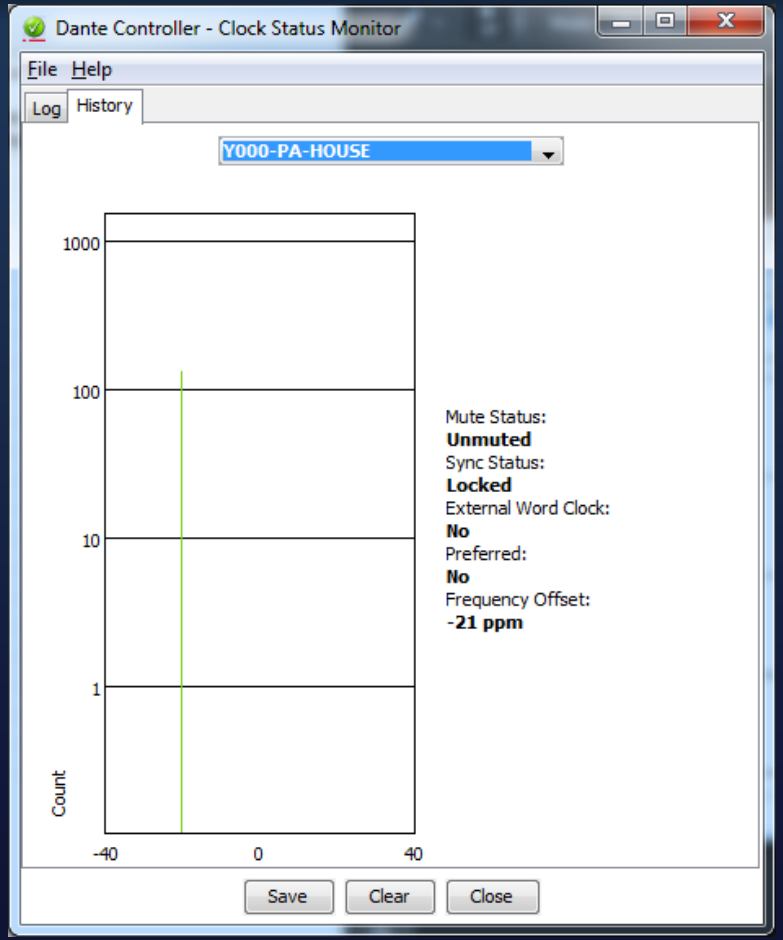
Monitors

160 Mic Ins (Studio)
64 Mic/Line Ins (Remote)
32 Guest Band “Tracks”
64 Monitor Mixes (32 stereo)
32 Stems
16 Communication Lines

256 Multicast Streams
112 Unicast Streams

500-1000 Patches


Dante Controller - Device View (Y000-PA-HOUSE)
File Device View Help
Y000-PA-HOUSE
Receive Transmit Status Latency Device Config Network Config
Y003-MUSIC-HOUSE @ 1 msec
1000
100
10
1
Count
0 Latency 0.5 1
Setting:
1 msec
Peak:
395 usec / 375 usec
Average:
356 usec / 357 usec
Late:
0 / 0
Duration:
00:02:34
Y00A-Yamaha-Rio3224-D-04c642 @ 1
1000
100
10
1
Count
0 Latency 0.5 1
Setting:
1 msec
Peak:
416 usec / 416 usec
Average:
386 usec / 391 usec
Late:
0 / 0
Duration:
00:02:34
Y00B-Yamaha-Rio3224-D-049378 @ 1
Save
Clear


Dante Controller - Clock Status Monitor
File Help
Log History
Y000-PA-HOUSE
1000
100
10
1
Count
-40 0 40
Mute Status:
Unmuted
Sync Status:
Locked
External Word Clock:
No
Preferred:
No
Frequency Offset:
-21 ppm
Save
Clear
Close

Studio

Remote Feed

House Band

Recording

Nuendo

Guest Band

Sound FX

FOH

FOH

Monitors

Monitors

160 Mic Ins (Studio)
64 Mic/Line Ins (Remote)
32 Guest Band “Tracks”
64 Monitor Mixes (32 stereo)
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112 Unicast Streams

500-1000 Patches

Thank You!

Patrick Killianey
Network Systems Applications Engineer

YAMAHA commercial audio