

Keeping Time with Precision Time Protocol (PTP)

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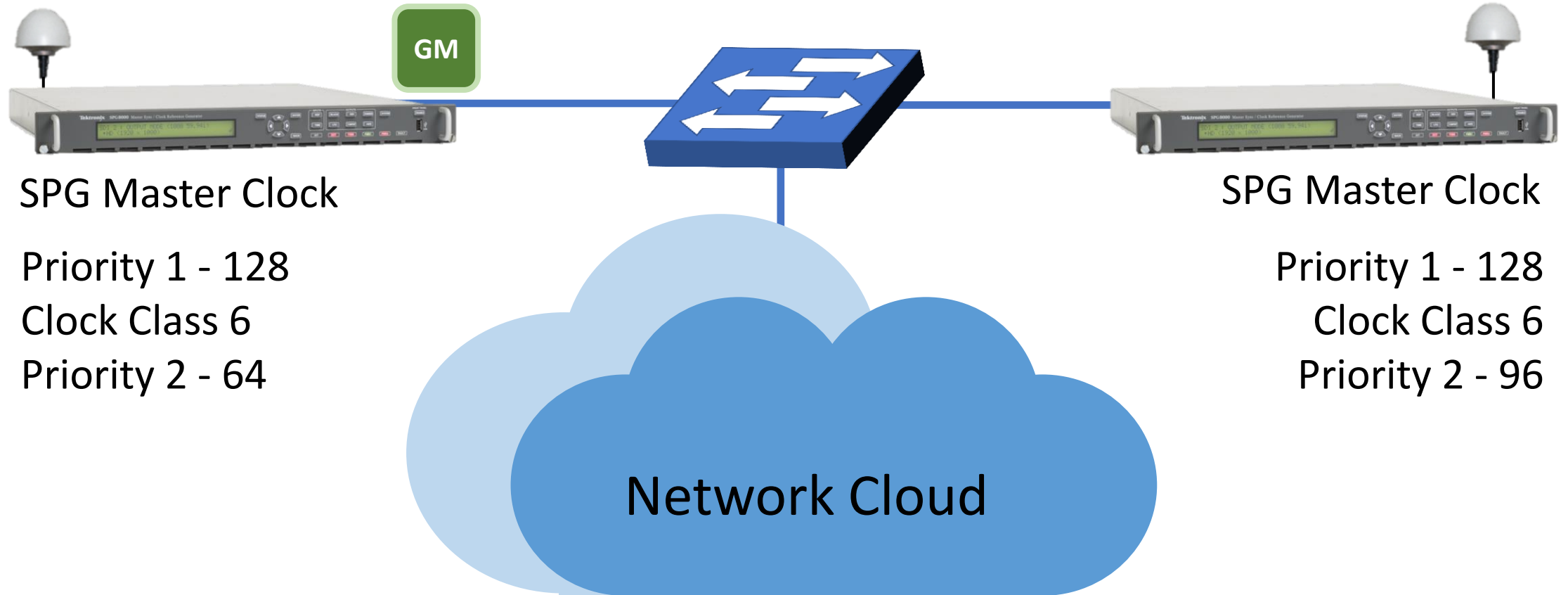
What time is it?

- What time is it now!
- Precision Time Protocol – IEEE 1588 -2008
 - Sends a Sync message periodic
 - How many seconds
 - How many nanoseconds
 - From the SMPTE Epoch
 - January 1st midnight, 1970

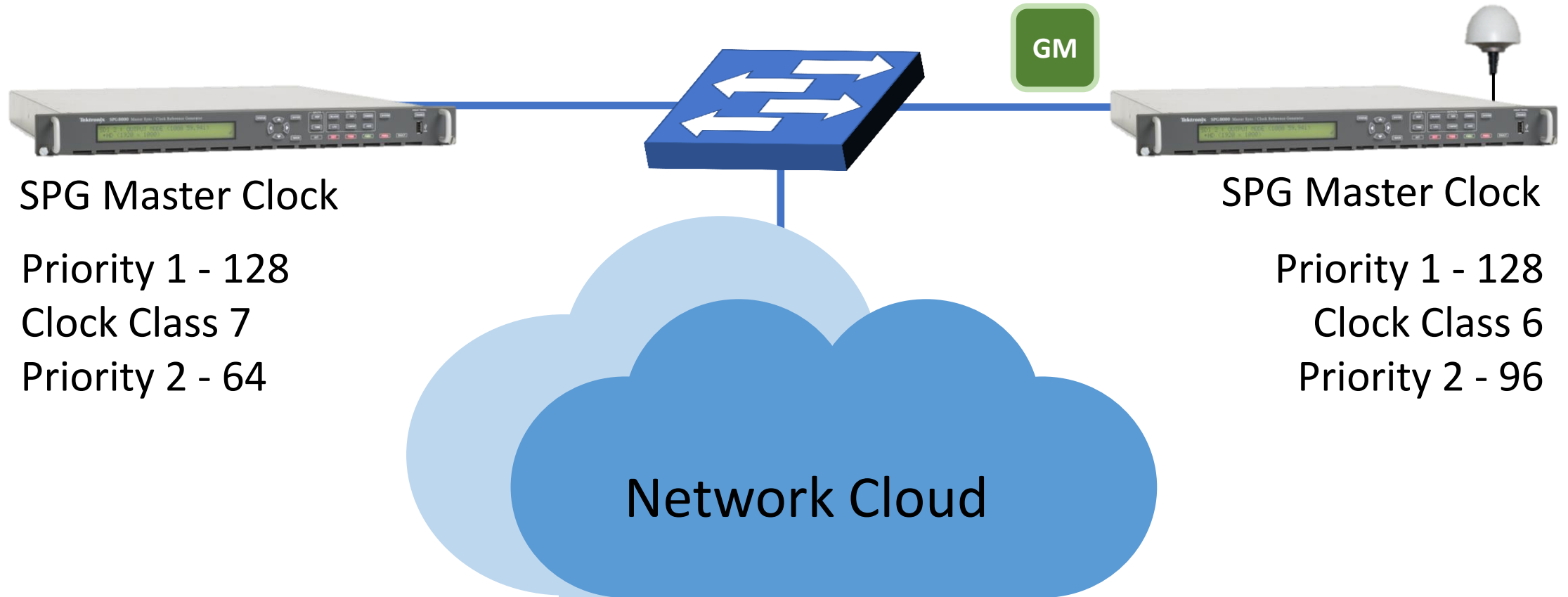
BMCA Best Master Clock Algorithm

- How to elect a Grandmaster Clock?
- Priority 1 (0-255) lowest number wins set by user
- Clock Class, Clock Accuracy, Clock Variance set by device
- Priority 2 (0-255) set by user
- MAC address of device

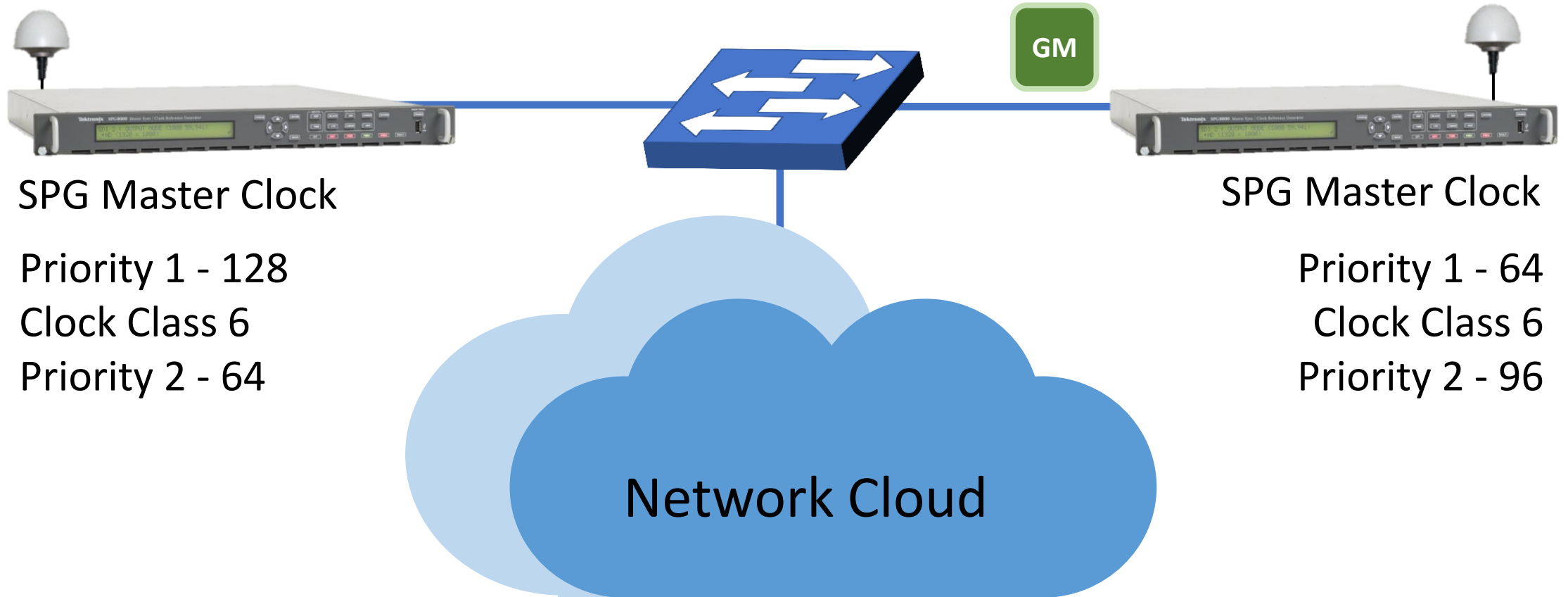
Hybrid Master Clock & SPG



Hybrid Master Clock & SPG

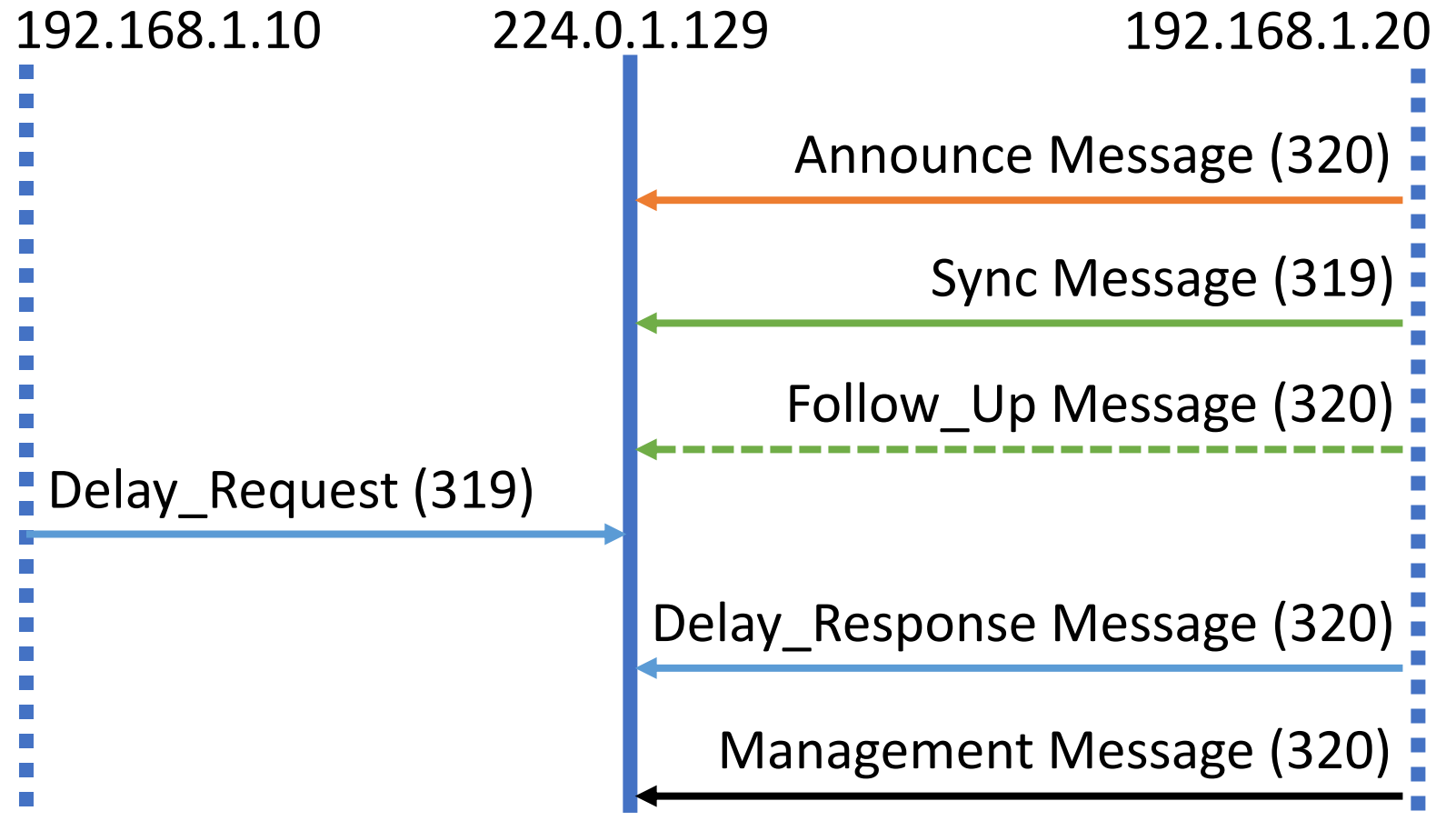


Hybrid Master Clock & SPG



Message Types

- Announce
- Sync
- Follow-Up
- Delay Request
- Delay Response
- Management
- Signaling



Troubleshooting PTP

- Check Domain Value
- Check Grandmaster ID
- Check Message Rates
- Check Communication Mode

IP Session		Run Time: 26d, 20:06:50	Running <input type="checkbox"/>
LAYER 1/2	VIDEO	PTP	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>			Unlocked
PTP Time			
Master/Slave Phase Lag		+ 0 ns	
Grandmaster ID		08:00:11:ff:fe:21:90:2b	
Steps Removed		1	
Domain		110	
Profile		ST 2059	
Delay Message Interval		Follow Master	
Grandmaster BMCA Values			
Priority 1		127	
Clock Class		6	
Clock Accuracy		< 100 ns	
Clock Variance		15652	
Priority 2		128	
Clock Source		GPS	
Communication Mode		Multicast	
Delay Mechanism		End to End	
Message Rates			
Announce		4 msg/sec	
Sync		8 msg/sec	
Delay Request		1 msg/sec	
Delay Response		inf msg/sec	

Ensuring PTP Lock

IP Session		Run Time: 26d, 20:57:46	Running <input type="checkbox"/>
LAYER 1/2	VIDEO	PTP	
✓	✗	✓	
✓	Lock Status	Locked	
	PTP Time	2017-12-06 23:43:59 (UTC)	
	Master/Slave Phase Lag	+ 0 ns	
	Grandmaster ID	08:00:11:ff:fe:21:90:2b	
	Steps Removed	1	
	Domain	110	
	Profile	ST 2059	
	Delay Message Interval	Follow Master	
	Grandmaster BMCA Values		
	Priority 1	127	
	Clock Class	6	
	Clock Accuracy	< 100 ns	
	Clock Variance	15652	
	Priority 2	128	
	Clock Source	GPS	
	Communication Mode	Multicast	
	Delay Mechanism	End to End	
	Message Rates		
	Announce	4 msg/sec	
	Sync	8 msg/sec	
	Delay Request	8 msg/sec	
	Delay Response	8 msg/sec	

- Grandmaster ID
- Domain
- Master/Slave Phase Lag should have low value for lock
- Messages Rates
 - SMPTE 2059
 - 4 Announce messages per second
 - 8 Sync, Delay Request, Delay Response
- Steps removed from Master

IP Status – Checking Domain

IP Status Run Time: 0d, 00:04:24

Port 1: OK
 Total: 1.319 Gb/s

ID	PORT	PROTOCOL	BITRATE	PAYLD	DEST IP	SOURCE IP	DEST MAC
✓ 1	1	S2110.20	1.309 Gb/s	96	239.27.8.76:50020	10.10.2.8:50020	01:00:5e:1b...
✓ 2	1	S2110.30	9.68 Mb/s	97	239.37.8.76:50030	10.10.2.8:50030	01:00:5e:25...
✓ 3	1	PTP_Gen	15.41 kb/s	--	224.0.1.129:320	2.2.2.2:320	01:00:5e:00...
✓ 4	1	PTP_Evt	5.759 kb/s	--	224.0.1.129:319	2.2.2.2:319	01:00:5e:00...
✓ 8	1	PTP_Gen	1.167 kb/s	--	224.0.1.129:320	192.168.40.4:320	01:00:5e:00...
--	--	Other Level 3	0b/s	--	--	--	--
✓ 5	2	PTP_Gen	9.278 kb/s	--	224.0.1.129:320	2.2.2.2:320	01:00:5e:00...
✓ 6	2	PTP_Evt	5.759 kb/s	--	224.0.1.129:319	2.2.2.2:319	01:00:5e:00...
✓ 7	2	PTP_Gen	1.167 kb/s	--	224.0.1.129:320	192.168.40.4:320	01:00:5e:00...
--	--	Other Level 3	0b/s	--	--	--	--

INPUT: 2110
1080i 59.94
REF: PTP:127 ✓
VID/REF: Locked

AUD: PPPP PPPP
RTC: 2018-10-30 14:12:21

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Messages

- Check Following
 - Domain Values
 - Data Rates of PTP messages
 - Check source IP & MAC

BMCA Keeps Toggling ID

- Check Configuration of Boundary Clock
- Check for loop of messages
- Check Messages Rates
- Check Announce Timeout

IP Session		Run Time: 26d, 20:57:46		Running <input type="checkbox"/>
LAYER 1/2	VIDEO	PTP		
				
	Lock Status	Locked		
	PTP Time	2017 - 12 - 06 23:44:00(UTC)		
	Master/Slave Phase Lag	+ 0 ns		
	Grandmaster ID	08:00:00:00:00:00		
	Steps Removed	1		
	Domain	110		
	Profile	ST 2059		
	Delay Message Interval	Follow Master		
	Grandmaster BMCA Values			
	Priority 1	127		
	Clock Class	6		
	Clock Accuracy	< 100 ns		
	Clock Variance	15652		
	Priority 2	128		

Monitoring PTP Graphs

- Check
 - Phase Lag
 - M-S Delay
 - S-M Delay

IP Session Run Time: 26d, 21:03:38 Running

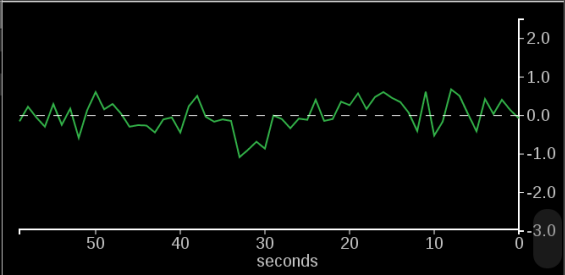
LAYER 1/2 VIDEO PTP

PTP Lock: Grandmaster ID: 08:00:11:ff:fe:21:90:2b Domain: 110 Profile: ST 2059
PTP Time: 2017-12-06 23:49:51 (UTC) Resolution: 1 second

Lock Status	Locked
PTP Time	2017-12-06 23:49:51 (UTC)
Master/Slave Phase Lag	- 59 ns
Grandmaster ID	08:00:11:ff:fe:21:90:2b
Steps Removed	1
Domain	110
Profile	ST 2059
Delay Message Interval	Follow Master
Grandmaster BMCA Values	
Priority 1	127
Clock Class	6
Clock Accuracy	< 100 ns

PTP Phase Lag

Max:	68.0 ns
Mean:	-0.0 s
Min:	-108.0 ns

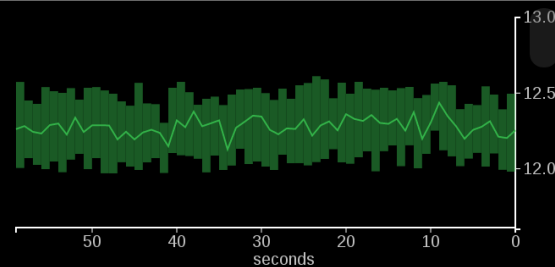


PTP Graphs

PTP Lock: Grandmaster ID: 08:00:11:ff:fe:21:90:2b Domain: 110 Profile: ST 2059
PTP Time: 2017-12-06 23:49:51 (UTC) Resolution: 1 second

Master-Slave Delay

Max:	12.6 μs
Mean:	12.3 μs
Min:	12.0 μs

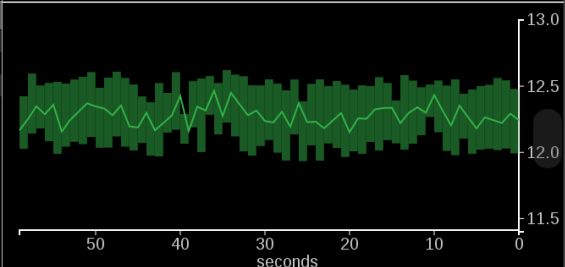


PTP Graphs

PTP Lock: Grandmaster ID: 08:00:11:ff:fe:21:90:2b Domain: 110 Profile: ST 2059
PTP Time: 2017-12-06 23:49:51 (UTC) Resolution: 1 second

Slave-Master Delay

Max:	12.6 μs
Mean:	12.3 μs
Min:	11.9 μs

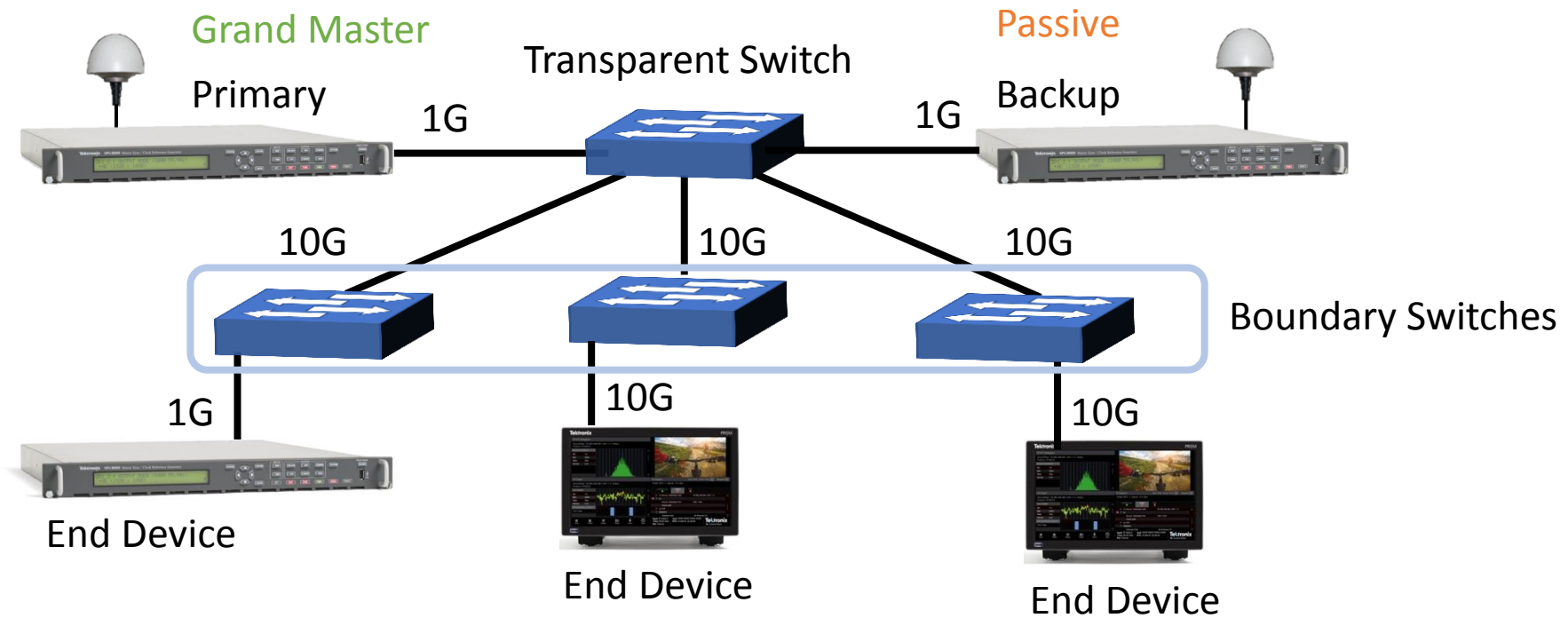


Home Volume 1-2 Presets Settings Capture Alarm Input

INPUT: 2110 loop 1 Missing AUD: PPPP PPPP RTC: 2017-12-06 15:51:11

Tektronix Messages

PTP Network Topology



Checking PTP at the Switch

- show ptp
- show ptp brief
- show ptp clock
- show ptp parent

```
Arista7280SE-2T# sh ptp
PTP Mode: Boundary Clock
Clock Identity: 0x44:4c:a8:ff:ff:d2:a1:49
Grandmaster Clock Identity: 0x08:00:11:ff:fe:21:90:2b
Number of slave ports: 1
Number of master ports: 6
Slave port: Ethernet47
Offset From Master: 273
Mean Path Delay (nanoseconds): 12140
Steps Removed: 1
Skew (estimated local-to-master clock frequency ratio): 1.00000637571
Last Sync Time: 21:18:23 UTC Apr 01 2019
Current PTP System Time: 21:18:23 UTC Apr 01 2019
```

Interface	State	Transport	Delay Mechanism
Et1	Disabled	ipv4	e2e
Et2	Disabled	ipv4	e2e
Et3	Disabled	ipv4	e2e
Et4	Disabled	ipv4	e2e
Et5	Disabled	ipv4	e2e
Et6	Disabled	ipv4	e2e
Et7	Master	ipv4	e2e
Et8	Disabled	ipv4	e2e
Et9	Disabled	ipv4	e2e
Et10	Disabled	ipv4	e2e
Et11	Master	ipv4	e2e
Et12	Disabled	ipv4	e2e
Et13	Disabled	ipv4	e2e
Et14	Disabled	ipv4	e2e
Et15	Disabled	ipv4	e2e
Et16	Disabled	ipv4	e2e
Et27	Disabled	ipv4	e2e
Et29	Master	ipv4	e2e
Et33	Master	ipv4	e2e
Et34	Disabled	ipv4	e2e
Et35	Disabled	ipv4	e2e
Et36	Disabled	ipv4	e2e
Et37	Disabled	ipv4	e2e
Et38	Disabled	ipv4	e2e
Et39	Disabled	ipv4	e2e
Et40	Disabled	ipv4	e2e
Et41	Disabled	ipv4	e2e
Et42	Disabled	ipv4	e2e
Et43	Master	ipv4	e2e
Et44	Master	ipv4	e2e
Et45	Disabled	ipv4	e2e
Et46	Disabled	ipv4	e2e
Et47	Slave	ipv4	e2e

```
Cisco-10G-3548# sh ptp br
```

```
PTP port status
-----
```

Port	State
Eth1/1	Slave
Eth1/2	Master
Eth1/3	Master
Eth1/4	Master
Eth1/5	Master
Eth1/6	Master
Eth1/7	Master
Eth1/8	Master
Eth1/9	Master
Eth1/10	Master
Eth1/11	Master
Eth1/12	Master
Eth1/13	Disabled
Eth1/14	Master
Eth1/15	Master
Eth1/16	Master
Eth1/17	Master
Eth1/18	Master
Eth1/19	Disabled
Eth1/20	Master
Eth1/21	Disabled
Eth1/22	Master
Eth1/23	Master
Eth1/24	Master
Eth1/25	Master
Eth1/26	Disabled
Eth1/27	Master
Eth1/33	Disabled
Eth1/34	Disabled
Eth1/35	Disabled
Eth1/37	Master
Eth1/38	Master
Eth1/39	Disabled
Eth1/40	Master

Checking PTP Messages at the Switch Port

- watch 1 diff show ptp interface ethernet xx
- sh ptp port interface ethernet 1/x counters

```
Every 1.0s: CliShell -s ar -p 15 -c sh ptp int et47
```

```
Interface Ethernet47
PTP: Enabled
Port state: Slave
Sync interval: 0.125 seconds
Announce interval: 1.0 seconds
Announce interval timeout multiplier: 3
Delay mechanism: end to end
Delay request message interval: 0.125 seconds
Transport mode: ipv4
Announce messages sent: 23
Announce messages received: 3539
Sync messages sent: 191
Sync messages received: 7075
Follow up messages sent: 191
Follow up messages received: 7075
Delay request messages sent: 44290
Delay request messages received: 3
Delay response messages sent: 3
Delay response messages received: 44290
Peer delay request messages sent: 0
Peer delay request messages received: 0
Peer delay response messages sent: 0
Peer delay response messages received: 0
Peer delay response follow up messages sent: 0
Peer delay response follow up messages received: 0
Management messages sent: 0
Management messages received: 33675
```

Checking PTP Messages at the Switch Port

- sh ptp port interface ethernet 1/x counters

```
[Cisco-10G-3548# sh ptp counters interface ethernet 1/1
```

```
PTP Packet Counters of Interface Eth1/1:
```

Packet Type	TX	RX
Announce	0	52880863
Sync	0	105761733
FollowUp	0	105761733
Delay Request	92567417	105650942
Delay Response	0	198218364
PDelay Request	0	0
PDelay Response	0	0
PDelay Followup	0	0
Management	0	13220242

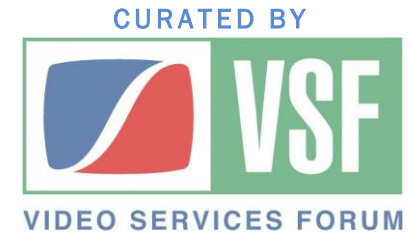
```
[Cisco-10G-3548# sh ptp counters interface ethernet 1/1
```

```
PTP Packet Counters of Interface Eth1/1:
```

Packet Type	TX	RX
Announce	0	52880869
Sync	0	105761745
FollowUp	0	105761745
Delay Request	92567427	105650954
Delay Response	0	198218385
PDelay Request	0	0
PDelay Response	0	0
PDelay Followup	0	0
Management	0	13220243

What time is it?

- What time is it now!
- Precision Time Protocol – IEEE 1588 -2008
- SMPTE 2059-1 & 2059-2
- Provides Timing Reference across a Media Network



Thank You

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IP SHOWCASE THEATER AT NAB – APRIL 8-11, 2019