Tips for Successfully Commissioning and Monitoring an ST 2059/PTP System

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PTP/ST 2059 Systems – Facts and Fiction

Myth: PTP/2059 Systems are black magic or mystical

Fact: They are more complex that legacy analog black systems

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PTP/ST 2059 Systems – Facts and Fiction

Myth: PTP/2059 Systems never work well and always have issues

Fact: If designed, implemented and commissioned **POORLY**,
         they do **NOT** work well

Fact: If designed, implemented and commissioned **PROPERLY**,
         they work very well

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The Problem To Solve

- Now that you have designed and built your system, you need to verify that it is working properly
- PTP can seem to be working however it may not be working as designed/expected
- Issues can be
  - Design
  - Configuration
  - Device features or implementation bug

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Examples of Not Working As Expected

- GM actual announce rate varies from 1 to 3 seconds

- Delay Request rates incorrectly configured on the switch

- Delay Request not being received because of unicast configuration issue

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Design Sign-off

- Get Design sign-off from
    - GM vendor
    - Switches vendor
    - Media Nodes vendors

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Example Design
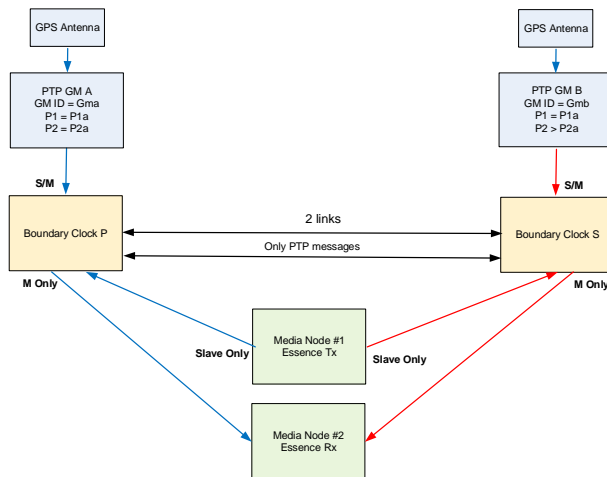
Recommended Values

- AES-R16 defaults
  - Will be the defaults in the new ST 2059-2 revision

- Announce Interval   0 or 1 message per sec
- Announce Timeout   3
- Sync rate   -3 or 8 messages per sec

Commissioning

- Need to understand the expected behavior
- Need to verify
  - GM
  - Switches
  - Media Nodes
- Checklist
- Tests

Commissioning Checklist

- Items to verify
  - There will be a lot

- Pass Criteria

Commissioning Checklist – GM

- Verify Master parameters configuration
  – Announce and Sync intervals
  – Priorities
  – Communication modes
  – Delay Request rate

- Verify Actual message rates

Commissioning Checklist – GM

Test #		Pass Criteria	Pass (P)/ Fail (F)	Notes
1	PTP Parameters			
1.1	PTP Domain (defaultDS.domainNumber)	Matches customer design Recommended not 0 or 128 E.g. 1		
1.2	Announce Receipt Timeout (portDS.announceReceiptTimeout)	3		
1.3	Announce Interval (portDS.logAnnounceInterval)	0 (1 Message per second)		
1.4	Sync Interval (portDS.logSyncInterval)	-3 (8 Messages per second)		
2	Other			
2.1	Parameter restore after power cycle	All parameters in section 1 are correct after power cycle.		

Commissioning Checklist – Switch

- Boundary clock mode

- Global settings
- Per port settings

- PTP state on each Slave interface
  - E.g. Counters
- PTP state on each Master interface

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Commissioning Checklist – Switch

Test #		Pass Criteria	Pass (P)/ Fail (F)	Notes
1	PTP Parameters - Global			
1.1	PTP Domain	Matches customer design		
1.2	PTP Source IP address	Matches customer design E.g. 192.168.2.1		
1.3	PTP mode	Boundary		
1.4	PTP Priority 1	Greater than the GM E.g. 128		
2	PTP Parameters - on each interface			
2.1	PTP Enable	Enable		
2.2	Announce Receipt Timeout	3		
2.3	Announce Interval	0 (1 Message per second)		
2.4	Sync interval	-3 (8 Messages per second)		
2.5	Master mode	For Media Node interfaces, "Master Only" For interfaces towards the GM, "Master/Slave"		
2.6	Delay Request interval	-3 (8 Messages per second)		

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Commissioning Checklist – Media Node

- Verify PTP Parameters
- Verify PTP Locking
- PTP Packets at the Media Node Interface

Commissioning Checklist – Media Node

Test #		Pass Criteria	Pass (P)/ Fail (F)	Notes
1	Verify PTP Parameters – Common and Slave			
1.1	PTP Mode (defaultDS.slaveOnly)	"Slave Only"		
1.3	Manual PTP Domain (defaultDS.domainNumber)	Matches customer design Recommended not 0 or 127 E.g. 1		
1.4	Manual Announce Receipt Timeout (portDS.announceReceiptTimeout)	3		
1.5	Manual PTP Slave Communication Model	Multicast		
2	PTP Locking			
2.1	PTP State	Locked		
2.2	UTC Time	Matches correct UTC time		
2.3	Grandmaster ID	- Matches the ID of the GM E.g. 08 00 11 FF FE 22 0F 22 - GM-ID is not changing		
2.4	Grandmaster Traceable	Yes if the GM is GPS locked No if the GM is freerunning		
2.5	Sync/Follow-up Processing	Master Offset < +-5us and is non-zero		
2.6	One Way Delay Processing	Master Delay < 1us and is non-zero. It should be slowly changing		

Tools for Verifying

- Device GUI/API
  - Counters

- WireShark .pcap capture
  - Verify fields in the packets

- PTP TrackHound

WireShark Packet Analysis

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.169.101.2	224.0.1.129	PTPv2	86	Sync Message
2	0.004905	192.169.101.2	224.0.1.129	PTPv2	86	Follow_Up Message
3	0.120098	192.169.101.2	224.0.1.129	PTPv2	86	Sync Message
4	0.000706	192.169.101.2	224.0.1.129	PTPv2	86	Follow_Up Message
5	0.124319	192.169.101.2	224.0.1.129	PTPv2	86	Sync Message
6	0.002400	192.169.101.2	224.0.1.129	PTPv2	86	Follow_Up Message
7	0.009258	192.168.64.253	224.0.1.129	PTPv2	142	Management Message
8	0.039290	192.169.101.2	224.0.1.129	PTPv2	106	Announce Message
9	0.074027	192.169.101.2	224.0.1.129	PTPv2	86	Sync Message
10	0.000545	192.169.101.2	224.0.1.129	PTPv2	86	Follow_Up Message
11	0.124598	192.169.101.2	224.0.1.129	PTPv2	86	Sync Message
12	0.061578	192.169.101.2	224.0.1.129	PTPv2	86	Follow_Up Message
13	0.063295	192.169.101.2	224.0.1.129	PTPv2	86	Sync Message

```
> Ethernet II, Src: AristaNe_58:2a:e7 (74:83:ef:58:2a:e7), Dst: IPv4mcast_01:81 (01:00:5e:00:01:81)
> Internet Protocol Version 4, Src: 192.169.101.2, Dst: 224.0.1.129
> User Datagram Protocol, Src Port: 319, Dst Port: 319
v Precision Time Protocol (IEEE1588)
   > 0000 .... = transportSpecific: 0x0
     .... 0000 = messageId: Sync Message (0x0)
     .... 0010 = versionPTP: 2
     messageLength: 44
     subdomainNumber: 99
   > flags: 0x0200
   > correction: 0.000000 nanoseconds
     ClockIdentity: 0x7483efffff582ae7
     SourcePortID: 284
     sequenceId: 51835
     control: Sync Message (0)
     logMessagePeriod: -3
     originTimestamp (seconds): 0
     originTimestamp (nanoseconds): 0
```

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How to Check Actual Message Rates

- WireShark .pcap capture
  - Port mirror
  - Unused boundary clock port

- In WireShark
  - Filter on packet type
  - Set time to delta from previous packet
  - Sort by time

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How to Check Actual Message Rates


```
ptp.v2.messageid == 0xb

No.          Time          Source          Destination      Protocol   Length  Info
         418 1.002932      10.157.14.11    224.0.1.129      PTPv2        106 Announce Message
         444 1.006224      10.157.14.11    224.0.1.129      PTPv2        106 Announce Message
         192 1.998781      10.157.14.11    224.0.1.129      PTPv2        106 Announce Message
         257 1.998842      10.157.14.11    224.0.1.129      PTPv2        106 Announce Message
         405 1.998859      10.157.14.11    224.0.1.129      PTPv2        106 Announce Message
         213 1.998866      10.157.14.11    224.0.1.129      PTPv2        106 Announce Message
         567 1.998995      10.157.14.11    224.0.1.129      PTPv2        106 Announce Message
          89 1.999007      10.157.14.11    224.0.1.129      PTPv2        106 Announce Message
         297 1.999096      10.157.14.11    224.0.1.129      PTPv2        106 Announce Message
         131 1.999866      10.157.14.11    224.0.1.129      PTPv2        106 Announce Message
         173 1.999866      10.157.14.11    224.0.1.129      PTPv2        106 Announce Message
          48 1.999877      10.157.14.11    224.0.1.129      PTPv2        106 Announce Message
          27 1.999918      10.157.14.11    224.0.1.129      PTPv2        106 Announce Message
         278 1.999920      10.157.14.11    224.0.1.129      PTPv2        106 Announce Message
         361 1.999922      10.157.14.11    224.0.1.129      PTPv2        106 Announce Message
         467 1.999922      10.157.14.11    224.0.1.129      PTPv2        106 Announce Message
          71 1.999925      10.157.14.11    224.0.1.129      PTPv2        106 Announce Message
         487 1.999929      10.157.14.11    224.0.1.129      PTPv2        106 Announce Message
         151 1.999934      10.157.14.11    224.0.1.129      PTPv2        106 Announce Message
         547 1.999952      10.157.14.11    224.0.1.129      PTPv2        106 Announce Message
         528 2.000148      10.157.14.11    224.0.1.129      PTPv2        106 Announce Message
         317 2.000431      10.157.14.11    224.0.1.129      PTPv2        106 Announce Message
         110 2.000619      10.157.14.11    224.0.1.129      PTPv2        106 Announce Message
         447 2.000887      10.157.14.11    224.0.1.129      PTPv2        106 Announce Message
         426 2.999839      10.157.14.11    224.0.1.129      PTPv2        106 Announce Message

> Frame 426: 106 bytes on wire (848 bits), 106 bytes captured (848 bits) on interface 0
> Ethernet II, Src: EvertzMi_25:ee:f3 (00:02:c5:25:ee:f3), Dst: IPv4mcast_01:81 (01:00:5e:00:01:81)
> Internet Protocol Version 4, Src: 10.157.14.11, Dst: 224.0.1.129
> User Datagram Protocol, Src Port: 49154, Dst Port: 320
> Precision Time Protocol (IEEE1588)
```

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Commissioning Period

- Monitor for 24-48 hours

- pcap for monitoring period
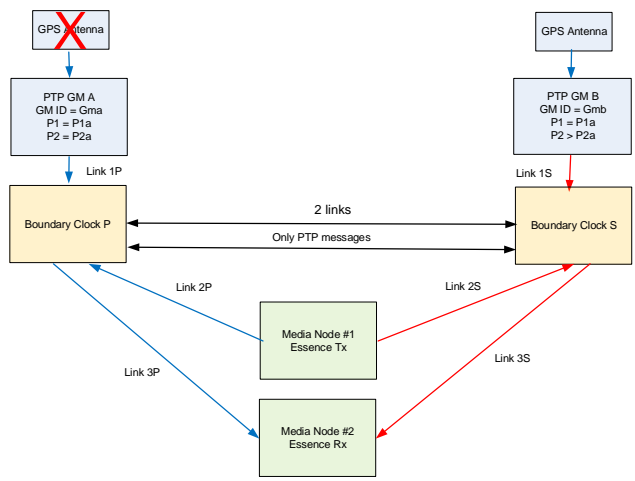
Redundancy/Failover

- Understand expected behavior
  - Detailed transient behavior. This includes
    - Port state change
    - Timing of the changes

- Change of GM should not impact the Media Node output
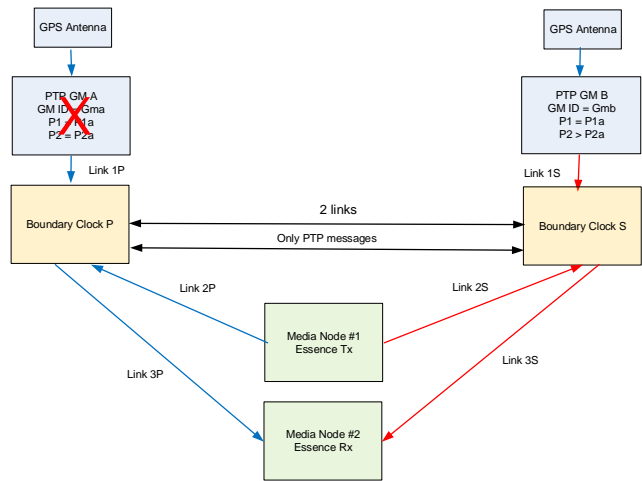 - Check for glitches at the Media Nodes

Redundancy/Failover

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Redundancy/Failover

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Monitoring

- Monitor critical parameters
  - GM ID
  - Locked status
- Detect changes in the system

- SMPTE has DG working on PTP Monitoring
  - Coming up with standardize parameters to monitor

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Conclusions

- PTP may seem like it is working however it may not
- Need to understand the expected behavior
- Commissioning Checklists
- Need to thoroughly test
  - GM, Switches and Media Nodes
- Need to test Redundancy/Failover
- If designed, implemented and commissioned **PROPERLY**, PTP works very well

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Thank you

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Thank you to our Media Partners

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