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Precision Time Protocol - deep dive and use cases

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#CLUS



Agenda

Basics of PTP

- PTP Messaging
- PTP Profiles
- Grandmaster clock
- Boundary and Transparent Clocks

Configuring PTP on Cisco IE Switches

- Product support
- Profile, modes and changing the defaults

Troubleshooting: How to know its working?

- Show commands
- Debug commands
- Resolution to common issues

Close

New abstract

Precision Time Protocol (PTP) is used in many industries to synchronize time across network connected devices to sub-microsecond levels. This session will cover the details of how PTP works, how to configure PTP, and how to troubleshoot. This session focuses on the network Administrator persona, and will give the Network Administrator confidence to successfully deploy PTP in their network.

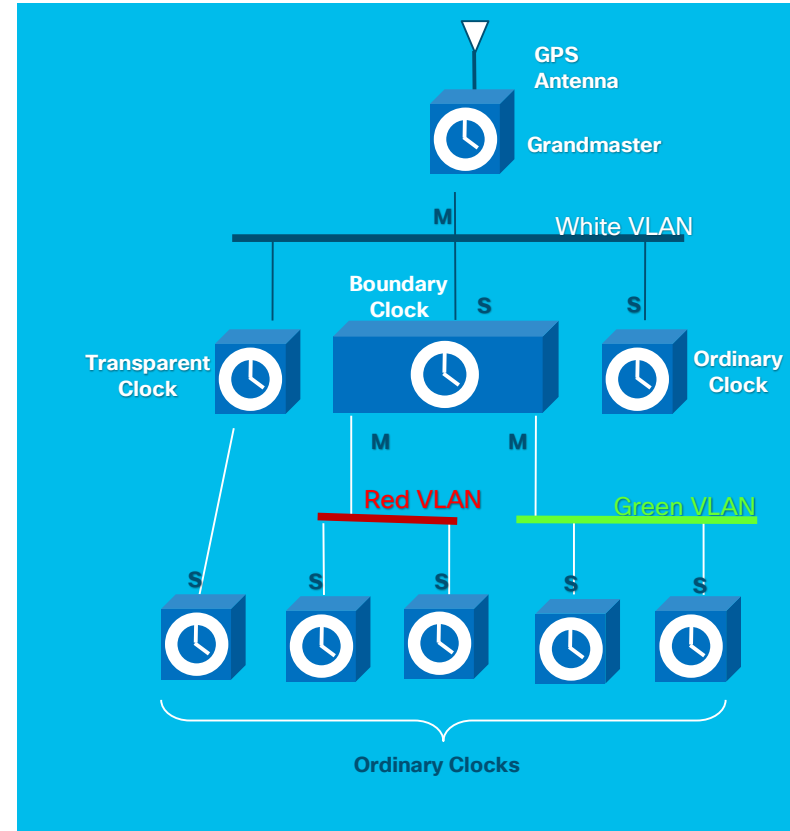
This session will focus on PTP use cases for the Power Utilities and Manufacturing verticals using Cisco Industrial Ethernet (IE) networking products. This session will not cover service provider PTP use cases.

Perspective for PTP Breakout session

- Oriented towards Network Administrator needing to configure PTP in the network.
- Not a PTP expert, yet responsible to implement
- The session covers
 - What is PTP
 - How to configure on the Cisco Industrial Ethernet Bridges
 - How to Troubleshoot problems

PTP Timing Distribution Architecture

- PTP uses a hierarchical master-slave architecture for clock distribution.
- **Grandmaster clock (GMC)** - root timing reference.
 - It transmits synchronization information to the clocks residing on its network segment.
- **Ordinary clock (OC)** - device with a single network (PTP) connection
 - either the source of time (GMC) or destination for time (slave).
- **Boundary clock (BC)** - has multiple network (PTP) connections
 - accurately bridges time synchronization from one network segment to another.
 - 'M' - interface in Master state
 - 'S' - interface in Slave State
- **Transparent Clocks in cascaded topologies:**
 - End-to-end transparent clock (E2E)
 - Peer-to-peer transparent clock (P2P)
- PTP epoch is the same as Unix time (Midnight, 1 January 1970).



PTP Timing Distribution Architecture

- PTP epoch is the same as Unix time (Midnight, 1 January 1970).
 - [Using UTC with PTP is subject to leap seconds.](#)
 - PTP uses TAI (Temps Atomique International) time scale and moves forward monotonically.
 - TAI is currently ahead of UTC by 35 seconds.
 - TAI is always ahead of GPS by 19 seconds.
 - The PTP grandmaster communicates the current offset between UTC and TAI so that UTC can be computed from the received PTP time.

PTP messages



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Position in presentation

You are here

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- PTP Profiles
- Grandmaster clock
- Boundary and Transparent Clocks

Configuring PTP on Cisco IE Switches

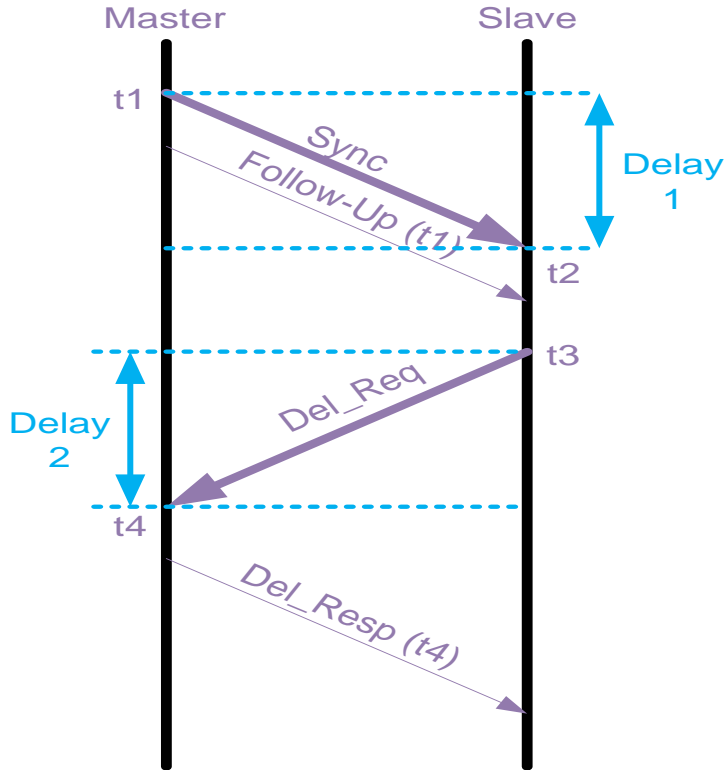
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Have you seen this diagram?



- What does this mean?
- How can I use this?

But first, Well used Terms in PTP

- Common terms used throughout the session.
- Good for a reference

PTP Terms

- PTP –precision time protocol
- GMC – Grand Master Clock (Master)
- BC – boundary clock
- TC – Transparent clock
- OC – Ordinary clock (eg: slave)
- E2E TC – End to End Transparent clock
- P2P TC – Peer to Peer transparent clock
- PDV – packet Delay Variation
- M – designates an interface is in Master mode
- S – designates an interface is in Slave Mode

Event Messaging in PTP master and slave

Event msgs are timed.

- **Sync** – master to all slaves, contains time
- **Announce** – used by BMCA to build clock hierarchy select GMC
- **Follow_Up** – master to all slaves, contains time t_1 ; only in two-step
- **Delay_Request (E2E only)**– Slave to master, requests delay time
- **Pdelay_Req (P2P only)** slave Peer asking for per hop delay from Master

PTP Protocol General messages

General messages are untimed

- **Follow_Up** master to all slaves, contains time t_1 ; only in two-step
- **Delay_Resp**, (E2E only) Master to Slave, responds with time t_4
- **Pdelay_Resp_Follow_Up** (P2P only)
- **Management**
- **Signaling**
- **Pdelay_Req**, **Pdelay_Resp** and **Pdelay_Resp_Follow_Up** are used by Peer-to-Peer Transparent Clocks to measure delays across the network so that they can be compensated for by the system.

PTP Synchronization Message Exchange

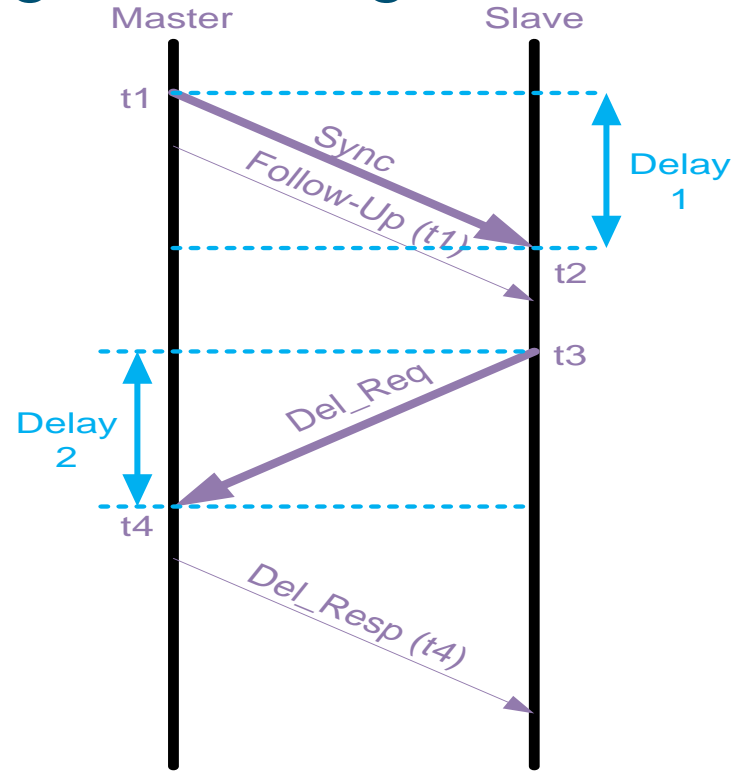
1. It starts when Master clock sends 'Sync' message.
 1. 't1' is timestamp when it leaves master
 2. In one-step 't1' in Sync message
 3. In two-step, 't1' in Follow-up message
2. Slave receives 'Sync' at 't2'.
3. Slave sends 'Delay_Req' message
 1. 't3' is timestamp when it leaves slave
4. Master receives 'Delay_Req' at 't4'
5. Master responds with 'Delay_Resp'
 1. contains 't4'

Slave needs t3 and t4 timestamps for delay

$$\text{MeanPathDelay} = ((t_2 - t_1) + (t_4 - t_3))/2$$

$$\text{Offset} = t_2 - t_1 - \text{MeanPathDelay}$$

Offset = difference between the master and slave clock



Calculating Delay

Mean path Delay = $((t_2 - t_1) + (t_4 - t_3)) / 2$

Mean path Delay is really an Average

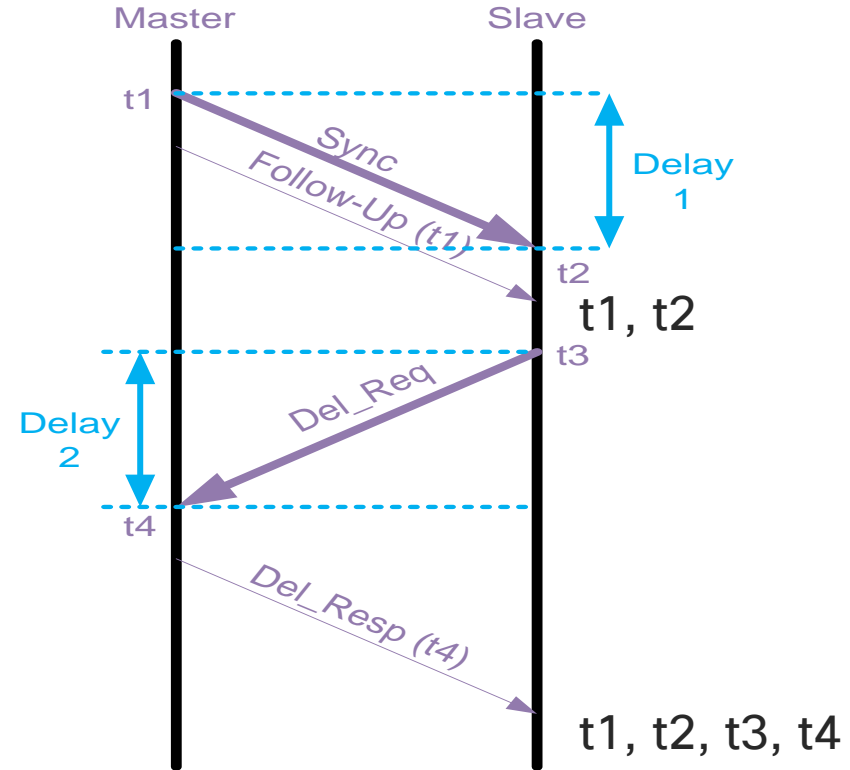
An **assumption** is made:

Delay 1 = Delay 2

Assumption is usually **wrong**
(to some degree)

Protocol Mechanisms can correct
for **known** Asymmetry

Asymmetry cannot be detected



Calculating Time Offset

$$\text{Delay} = ((t_2 - t_1) + (t_4 - t_3)) / 2$$

$$\text{Offset} = ((t_2 - t_1) - (t_4 - t_3)) / 2$$

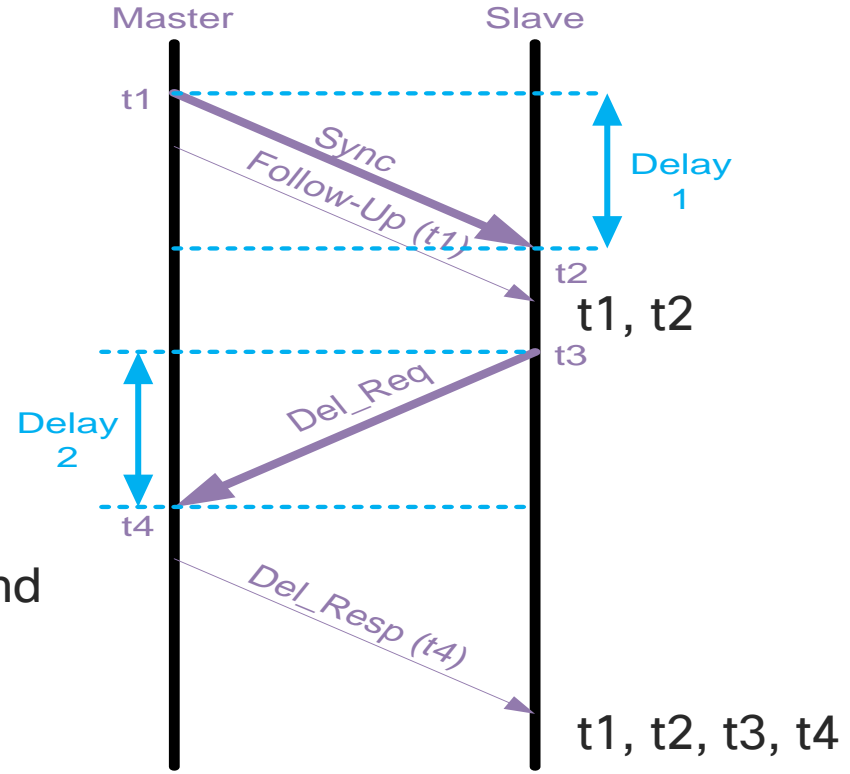
$$\text{Offset} = (\text{Delay}_1 - \text{Delay}_2) / 2$$

or

$$\text{Offset} = \text{Master Time} - \text{Slave Time} - \text{Delay}$$

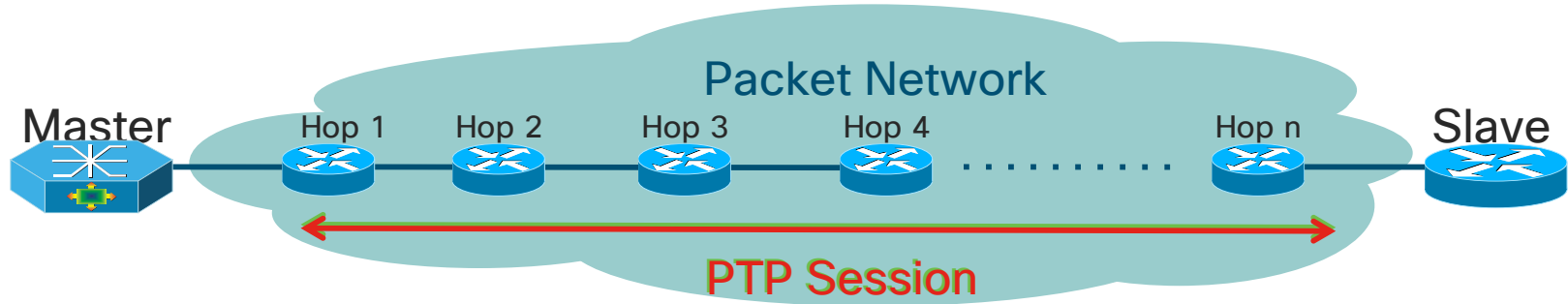
In other words:

When Ordinary clock is Frequency Locked and you assume $\text{Delay}_1 = \text{Delay}_2$, then any difference is due to error in **Time (Offset)**.



Packet Delay Variation (PDV)

PDV is primarily due to Varying Queue Delays at each hop...



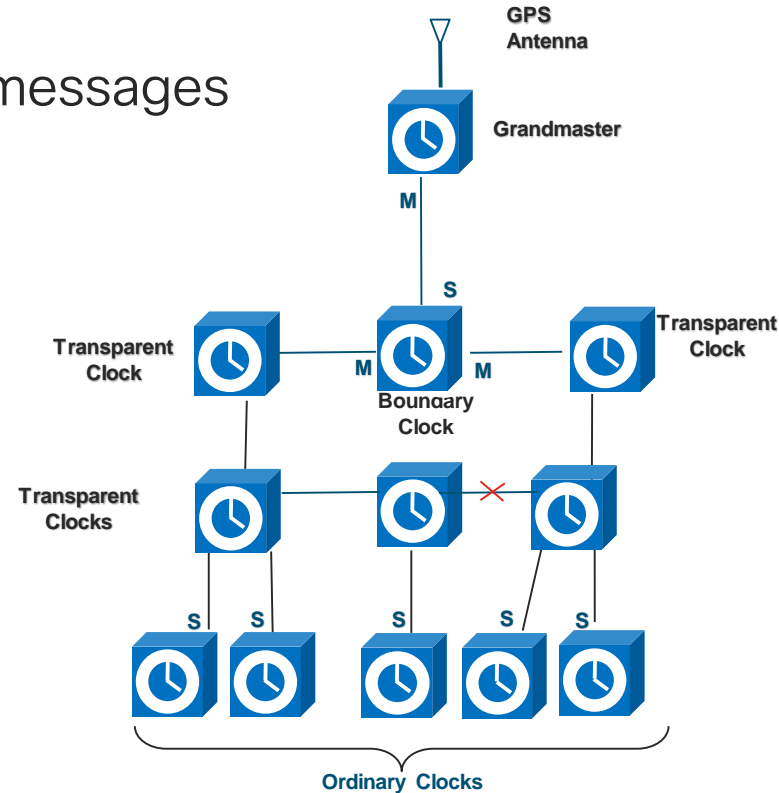
Even High Priority packets get behind a 1518 from time to time.

The variance comes from the fact that sometimes you do and sometimes you don't.

It's all statistics...

Time Synchronization across the network

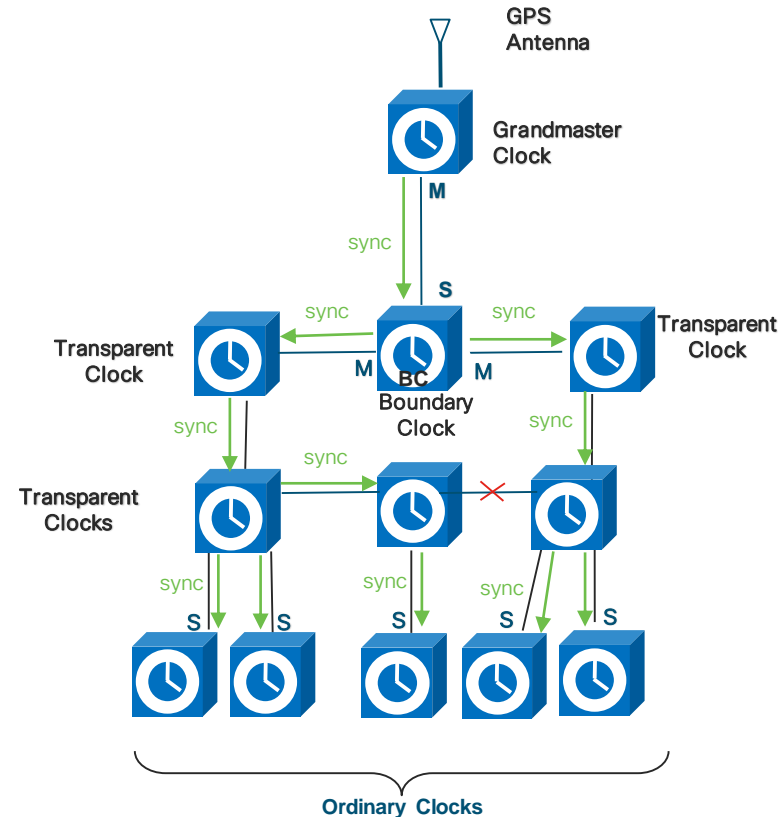
- How PTP works to distribute time using messages
- A 'typical' Ethernet network topology
- A single PTP Domain



Synchronization across the network - Sync

‘Sync’ from GMC to all Ordinary Clocks (slaves) throughout the PTP Domain

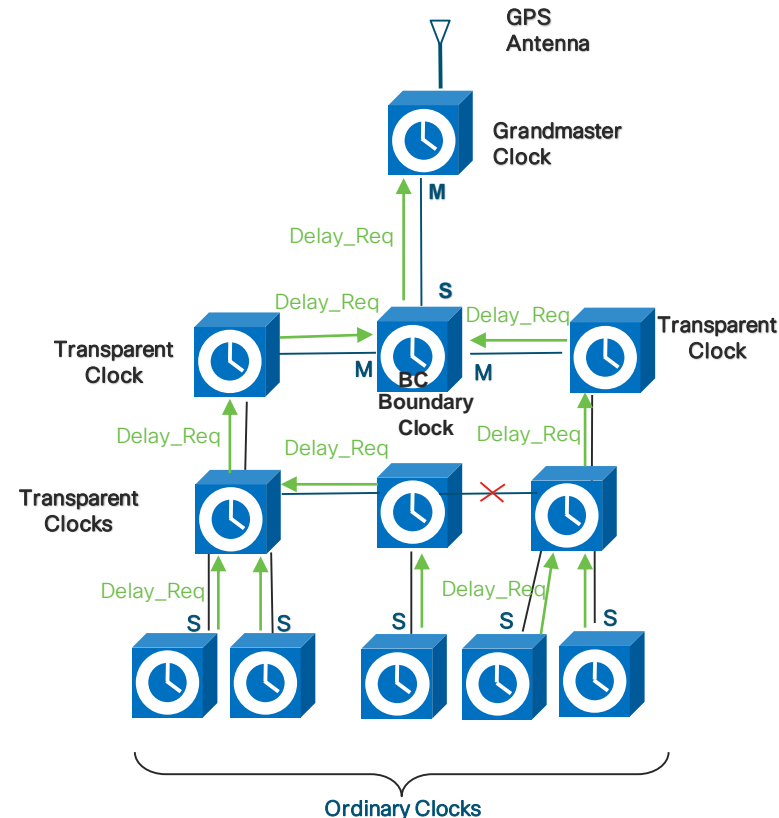
- Starts from GMC
- Passed to from Master Ports to Slave ports by network devices
- Arrives at Ordinary Clocks



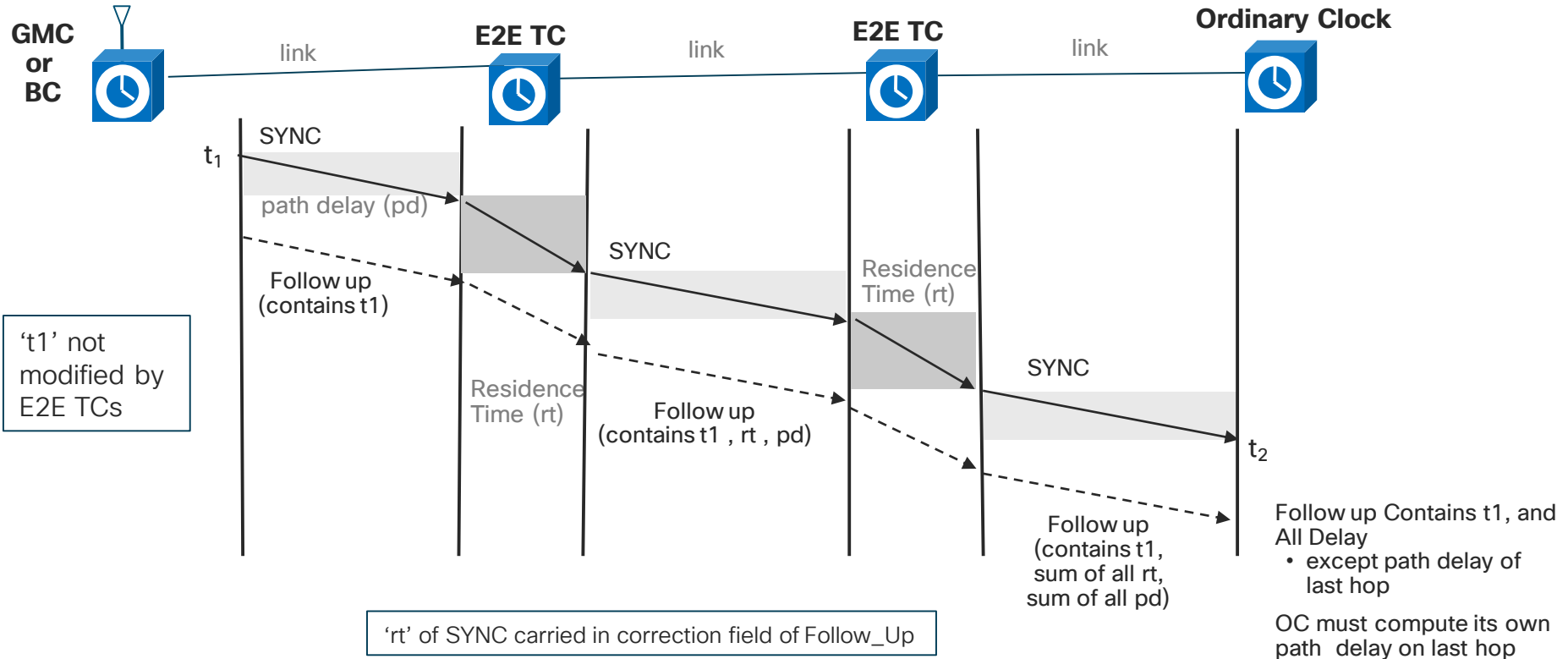
Synchronization across the network – Delay Req

Delay Request from all Ordinary Clocks toward GMC throughout the PTP Domain

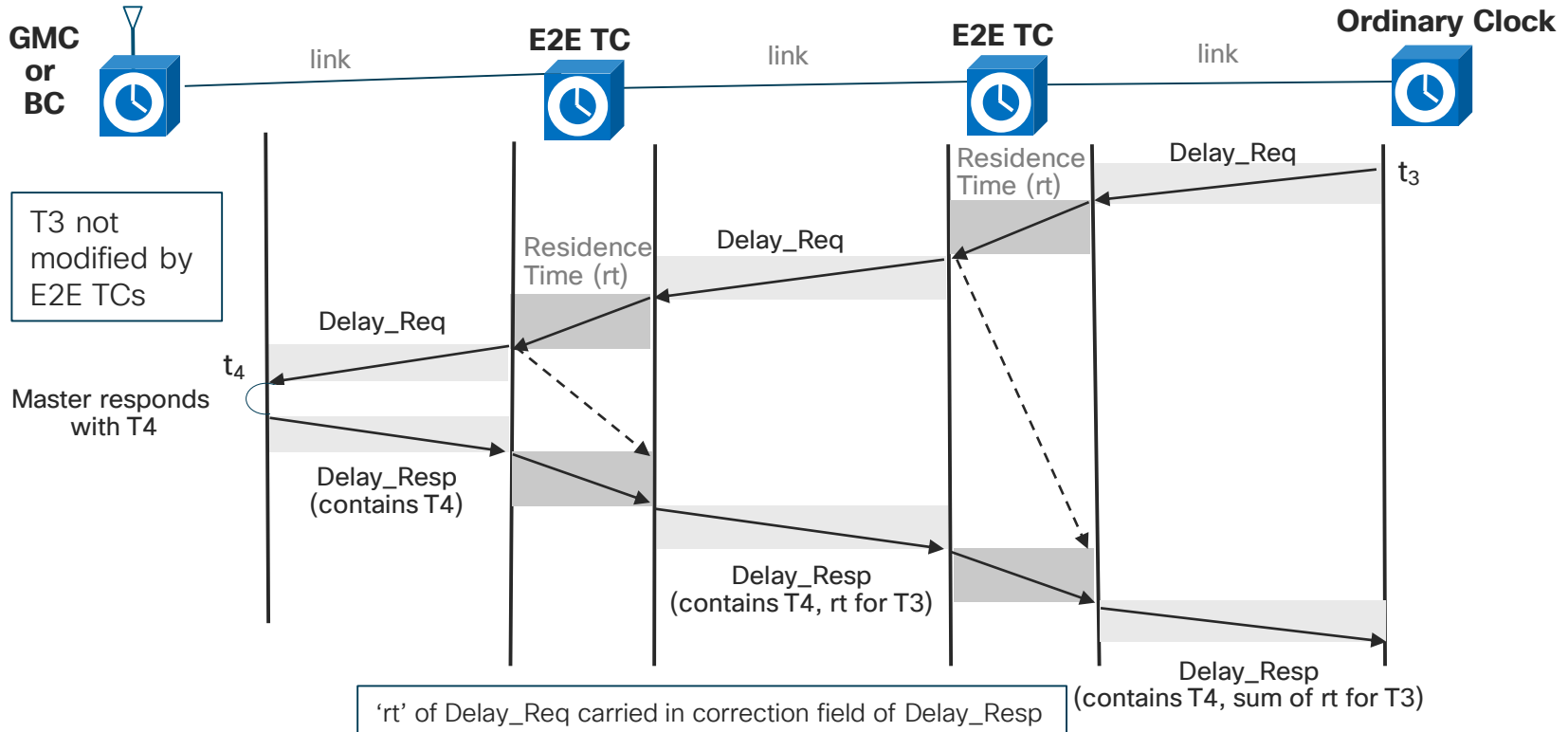
1. Starts at ordinary clocks
2. Passed to from Slave Ports to Master ports by network devices
3. Delay_Req stop at the Boundary Clock
 1. BC initiates its own Delay_Req



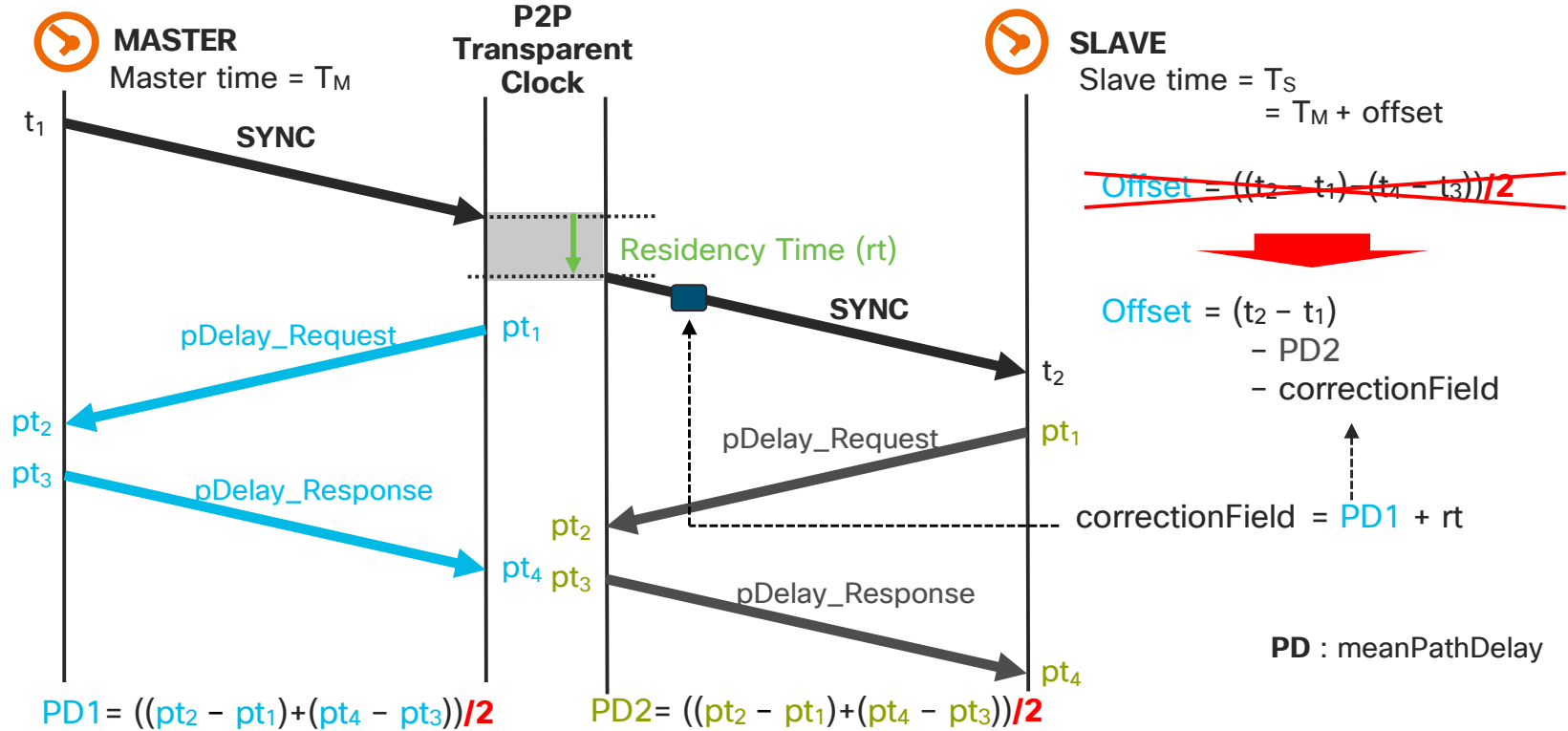
End to End Sync Msg - 2 Step



End to End Delay_Req and Delay_Resp - 2 Step

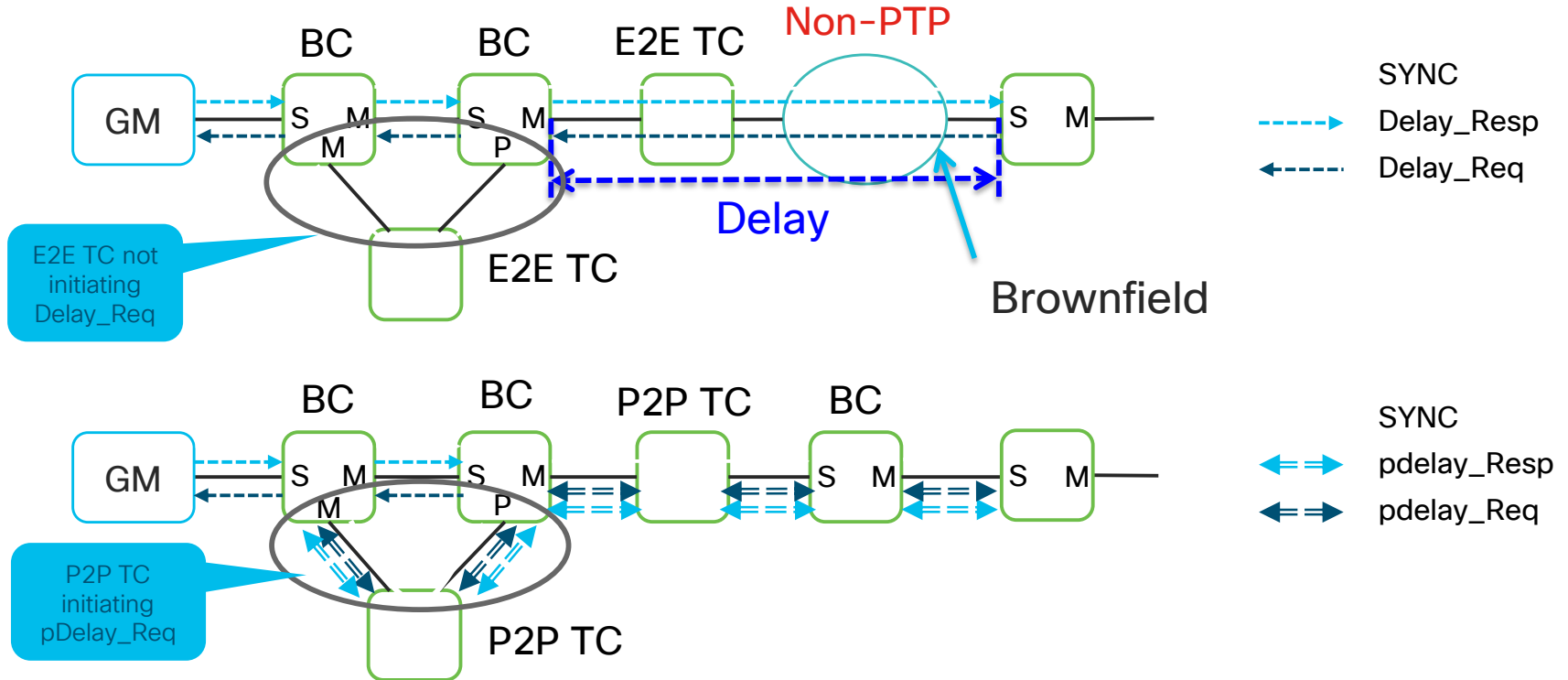


Peer to Peer Transparent Clock - Sync and Delay



Delay and pdelay Mechanisms

Side by side Types of TCs: End-to-End and Peer-to-Peer



PTP Message rates

Message	Power profile	Default profile
Announce	1 Second	2 second intervals
Sync	1 Second	1
Follow-up (two step only)	Triggered by Sync	Triggered by Sync
Delay Request	NA	32 seconds to slaves from BC/GMC*
Delay Response	NA	Triggered by Delay request
Peer Delay Request	1 second; 802.1AS = 8 / second	NA
Peer Delay Response	Triggered by Peer Delay request	NA

*' burst at beginning then fall back,path delay should not change

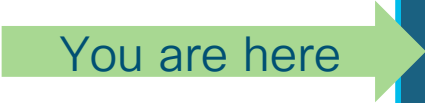
Difference between PTP Profiles and Power profile



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Position in presentation

You are here



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PTP Profile definitions

- Profiles – a set of rules defining PTP behavior, intended to meet the needs of a specific application.
- Supported by Cisco IE and Catalyst switches:
 - Default Profile – IEEE 1588-2008 standard – used by Industrial Automation
 - Also called PTPv2. second version of IEEE 1588
 - **Power Profile** – IEEE C37.238 (Power Profile) – used by Power Utilities and substations;
 - < 1us over 16 P2P hops
 - 802.1AS – IEEE 802.1AS – used by Audio Video Bridging (AVB) and Time Sensitive Networks (TSN)
 - Also called gPTP
- Other popular profiles
 - ITU-T G.82751 – Telecom and Mobile Backhaul

PTP Industrial Profile differences - summary

Profile	Default	Power	802.1AS
IEEE Standard	IEEE 1588 v2 (J.3)	IEEE C37.238	IEEE 802.1AS
Supported modes	Boundary & End-to-End transparent	Boundary & Peer-to-Peer Transparent	Not configurable.
Path Delay	Delay Request/Respond	Peer delay Request/respond	Peer delay Request/respond
Non-PTP device allowed	Yes	No	no
Transport	UDP over IP (multicast & Unicast); cross L2 boundary	L2 Multicast	L2 Multicast
Deployment cases	Industrial Automation Bridges and Wifi APs do not support PTP adding PDV	Power Utilities substations All Bridges support PTP	Enterprise networks deploying AVB Industrial Automation - TSN

Profile differences

Power Profile and Default Profile, 802.1AS

PTP property	Default Profile	Power Profile	802.1AS
Transparent Clock type	End to End	Peer to Peer	Peer to Peer
Transport	L2 and L3	L2	L2 only
L2 MAC Address		Mgs 01-80-C2-00-00-0E Pdelay - 01-1B-19-00-00-00-00	Mgs 01-80-C2-00-00-0E
IPv4 Addresses	224.0.1.129	Peer Delay 224.0.0.107	
Sync msg rate	32 second intervals*	1 / second	8 / second
Vlan Tagging	Untagged on Native	Mandatory or vlan 0	Prohibited

* - burst at beginning to get mean delay

IEEE1588-2008 Profiles

- Primary Profiles

	IEEE1588 Default Profiles	ITU G.8265.1 Telecom Profile / Frequency	IEEE C37.238 Power Profile
Segment	Industrial Solutions High Speed Trading	2G Mobile RAN 3G Mobile RAN	Smart Grid
Profile ID / Version	00-19-A7-00-01-00 / v1.0 00-19-A7-00-02-00 / v2.0	00-19-A7-00-01-00 / v1.0	1C-12-9D-00-00-00 / v1.0
PTP Modes	One-way & two-way One-step & two-step	One-way & two-way One-step & two-step	Two-way One-step & two-step
PTP Transport	IPv4 & Layer 2 Multicast	IPv4 Unicast Negotiation	Layer 2 Multicast
Master Selection	BMCA	Alternate BMCA <ul style="list-style-type: none"> • QL (Clock Class) • PTSF • Local Priority 	BMCA
Path Delay Mechanism	Delay request/response Peer-to-Peer	Delay request/response	Peer-to-Peer
Management Option	Mgmt Message per Clause 15	not specified	IEEE C37.238 MIB
Node Types	Ordinary Master/Slave, Boundary and Transparent	Ordinary Master and Slave	Ordinary Master/Slave, Boundary and Transparent

4G Mobile RAN

PTP domains



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PTP domains and purpose

- A domain [\[note 9\]](#) is an interacting set of clocks that synchronize to one another using PTP. Clocks are assigned to a domain by virtue of the contents of the *Subdomain name* (IEEE 1588-2002) or the *domainNumber* (IEEE 1588-2008) fields in PTP messages they receive or generate. Domains allow multiple clock distribution systems to share the same communications medium.
- Default Domain – 0
- Cisco IE switches work with a single Domain.
- Power profile standard requires domain be configurable.
- BC drops packets with wrong domain

GrandMaster Clock Basics



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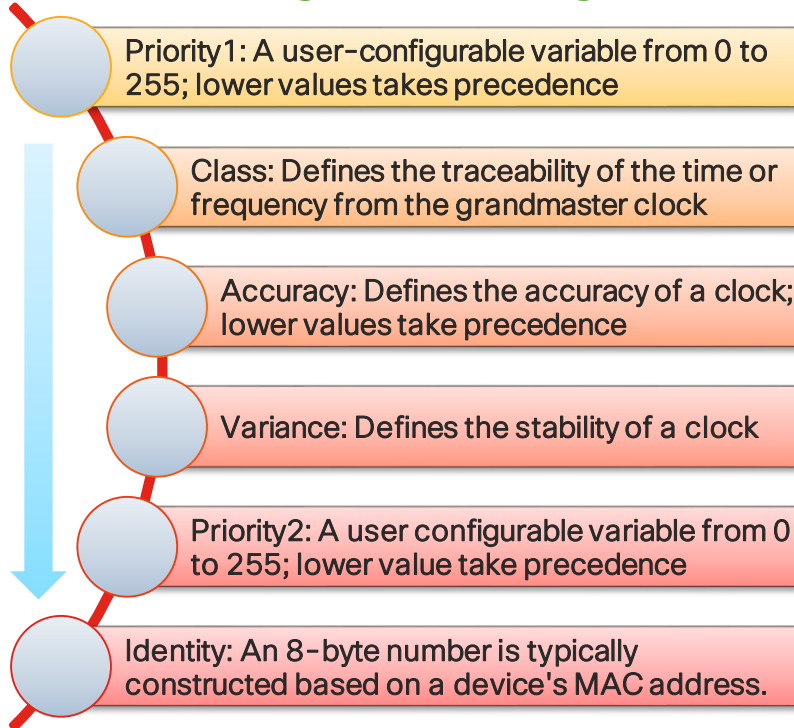
GMC and BMCA

'Announce' messages are used for BMCA

IE switches operate as Hybrid GMC+BC because they have multiple ports.

PTP Best Master Clock (BMC) Algorithm

BMC selects the best master clock according to the following order



- The BMC determines best master clock device.
- “Announce” messages are used.

PTP Best Master Clock (BMC) Algorithm

- The BMC is used to determine which device should be used as the master clock device.
 - This algorithm uses the clocks characteristics multicast on the network through “Announce” messages to determine which clock is the most accurate.
- Once the BMC algorithm has completed, the master clock starts sending synchronization messages at regular intervals.
- If the best grandmaster clock is removed from the network or is determined by the BMC algorithm to no longer be the highest quality clock, the algorithm then redefines what the new BMC is and adjusts all other clocks accordingly.
- No administrator input is needed for this readjustment because the algorithm provides a fault tolerant.

BMCA- clock Class

Class value	Definition
0	Reserved to enable compability with future versions
6	Clock synchronized to a primary reference (eg: GPS). Timescale distribution is PTP
7	Clock previously designated as Class 6, but lost the sync to primary reference.). Timescale distribution is PTP
13	Clock synchronized to a primary reference (eg: GPS). Timescale distribution is ARB
14	Clock previously designated as Class 13, but lost the sync to primary reference.). Timescale distribution is ARB
...	
248	Default

```
IE5000-2004# show ptp clock
PTP CLOCK INFO
PTP Device Type: Boundary clock
PTP Device Profile: Default Profile
Clock Identity: 0x18:8B:9D:FF:FE:75:EC:0
Clock Domain: 0
Number of PTP ports: 28
Time Transfer: Linear Filter
Priority1: 120
Priority2: 128
Clock Quality:
  Class: 248
  Accuracy: Unknown
  Offset (log variance): N/A
Offset From Master(ns): 0
Mean Path Delay(ns): 0
Steps Removed: 0
Local clock time: 17:05:15 UTC Dec 31 2018
```

- Class is 248 -free running on internal Oscillator

BMCA Clock Class with GPS input

- Grand Master with GPS
- Class = 6
- There's still a potential race condition even with one BC having class 6
 - 'flapping' GMC's
 - Configure priority1 to mitigate

• Class is 6 – clock sync'd to external primary source

```
v23-ie5000-12S12P-10G-2# show ptp clock
PTP CLOCK INFO
PTP Device Type: Grand Master clock - Boundary clock
PTP Device Profile: Power Profile
Clock Identity: 0x8:96:AD:FF:FE:A8:1:0
Clock Domain: 0
Number of PTP ports: 28
PTP Packet priority: 7
Time Transfer: Feedforward
Priority1: 128
Priority2: 128
Clock Quality:
  Class: 6
  Accuracy: Within 250ns
  Offset (log variance): N/A
Offset From Master(ns): 0
Mean Path Delay(ns): 0
Steps Removed: 0
Local clock time: 19:23:16 UTC Dec 21 2018
```

IE switching Oscillator

- The Oscillator matters when picking a GM with Class 248
 - when you do not have GPS or IRIG-B
- Temperature will impact Oscillator
- IE-5000 has Stratum 3e OCXO (oven Controlled Crystal Oscillators)
- IE-4010 has TCXO (Temperature compensated crystal oscillator)

Configure the GrandMaster

- When no External sources (eg: GPS, IRIG-B, ...) available.
- Configure priority1 or priority2 to sway the BMCA to a specific BC or OC
- The lower the priority the better the clock is represented in BMCA

```
IE5000-2004#conf t
IE5000-2004(config)#ptp priority?
priority1 priority2

IE5000-2004(config)#ptp priority1 ?
<0-255> clock priority1 number

IE5000-2004(config)#ptp priority1 120
IE5000-2004(config)#exit
```

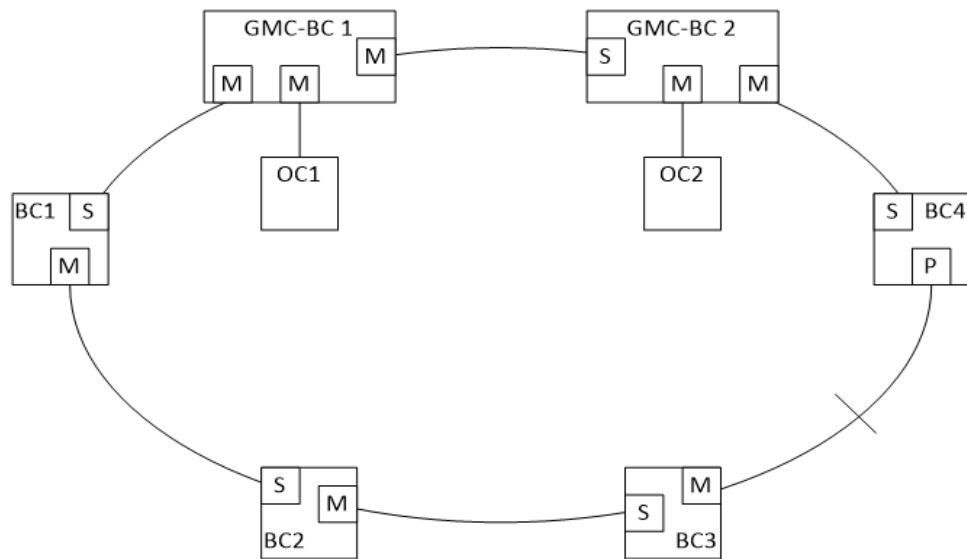
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    Offset (log variance): N/A
  Offset From Master(ns): 0
  Mean Path Delay(ns): 0
  Steps Removed: 0
```

Grandmaster – configure a backup

- Backup GMC considerations
 - Freerun oscillator or external clock source (eg: GPS, IRIG-B)
 - Oscillator matters if freerun (freerun means no external clock source)
 - Hops from Primary GMC
 - Limit PDV change to ordinary clocks in the network

Grandmaster – Primary and Backup

- How to connect and configure the two clocks.
- If GMC is IE, the two can be directly connected
- Use priority to impact BMCA electio
- Priority1 used to pick primary and b
- Priority2 is used to break ties



Cisco IE 5000 Timing Interfaces



External Timing Interfaces

GPS

NMEA 0183

IRIG-B In & Out Analog

IRIG-B122 and IRIG-B123

IRIG-B In & Out TTL

IRIG-B002 and IRIG-B003

Time of Day

“Cisco ToD” format

RS-422 and RS-232

IRIG-B TTL format (B002 and B003) Future

Boundary clocks and Transparent Clocks



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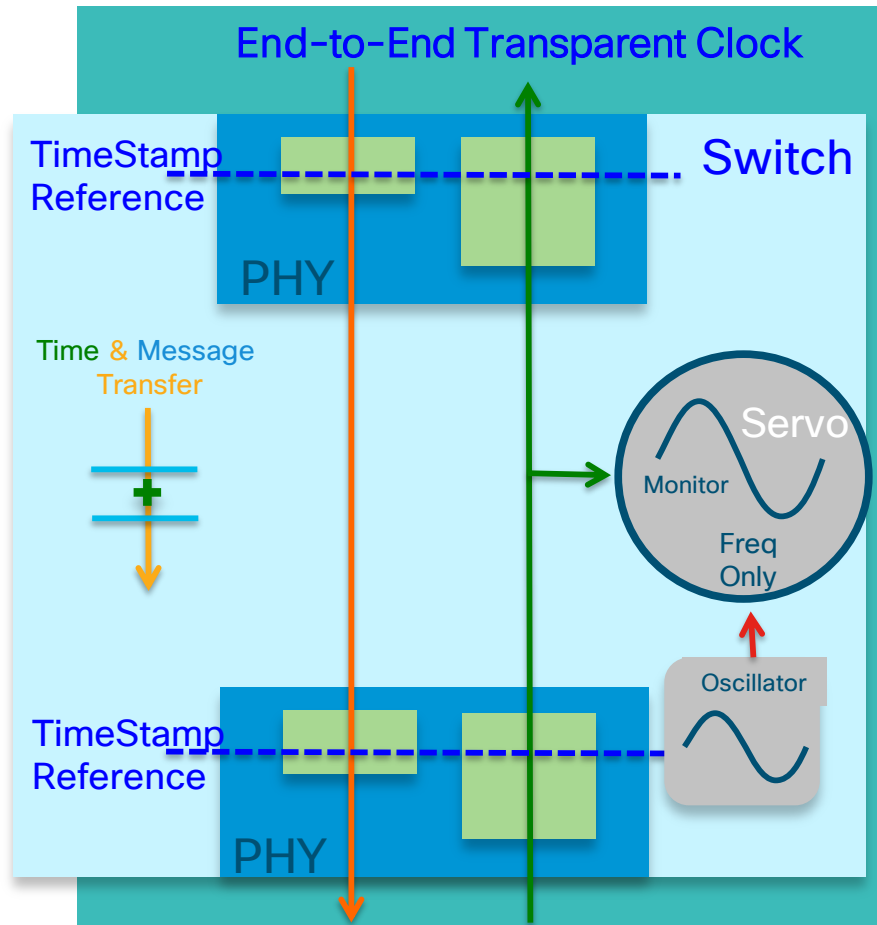
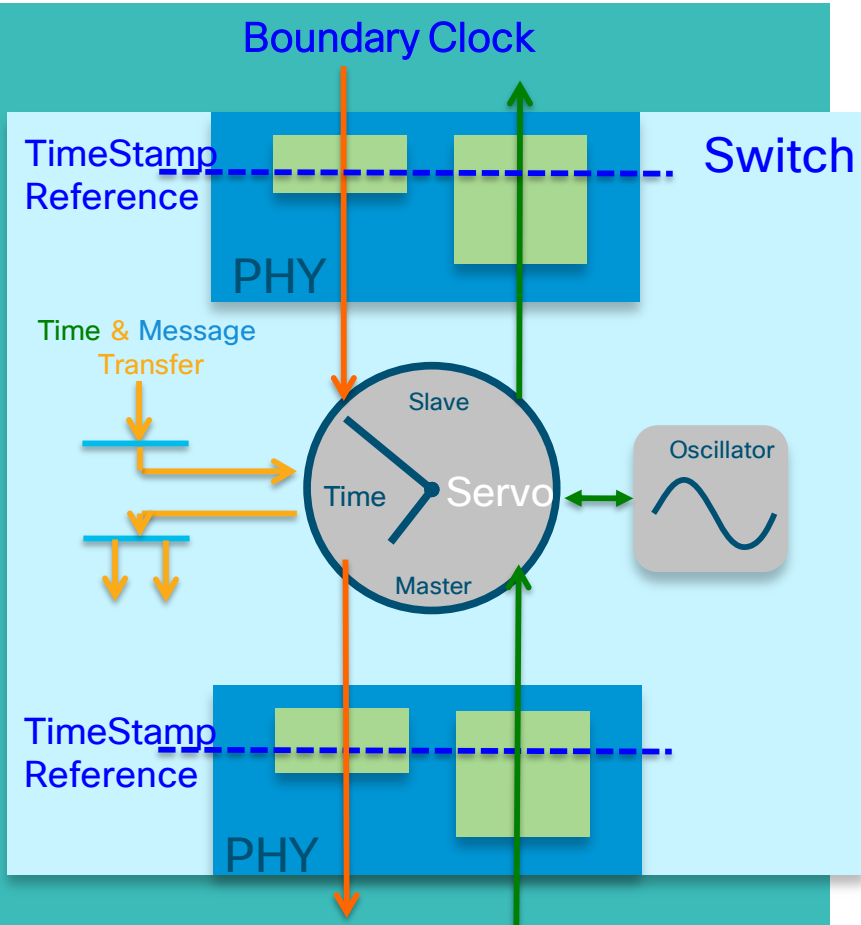
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Troubleshooting: How to know its working?

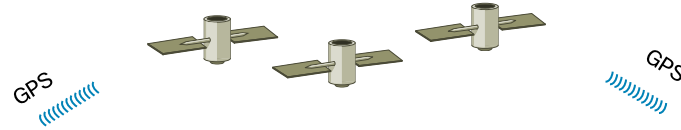
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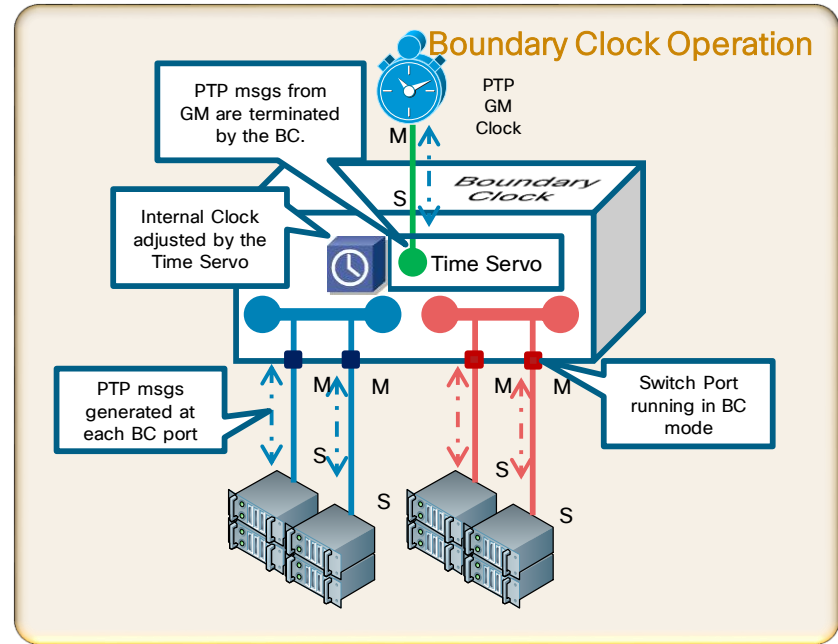
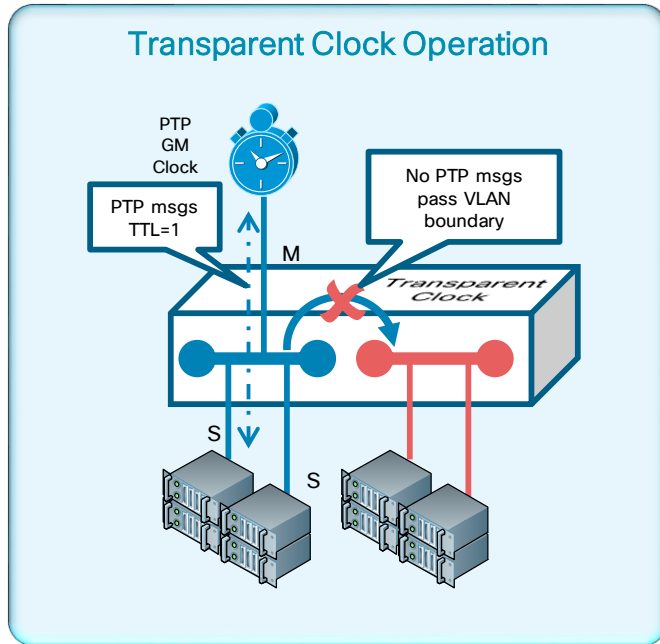
Boundary Clock v. Transparent Clock – Error Sources



Transparent Clock Operation vs. Boundary Clock Operation



S = Slave Mode
M = Master Mode



Boundary clock is master to Ordinary Clocks

- Boundary clock (BC) is not GMC.
- BC looks like master to slave clocks.
 - Source of Sync, and responds to delay_requests
- Slave clocks can be Ordinary clocks (end devices) or other Boundary Clocks (Switches)
- BCs transfer time by **recovering** time from a master then **regenerating** time to its slaves. Generally, BCs also **terminate** the messages from the master and **generate** messages to their slaves.

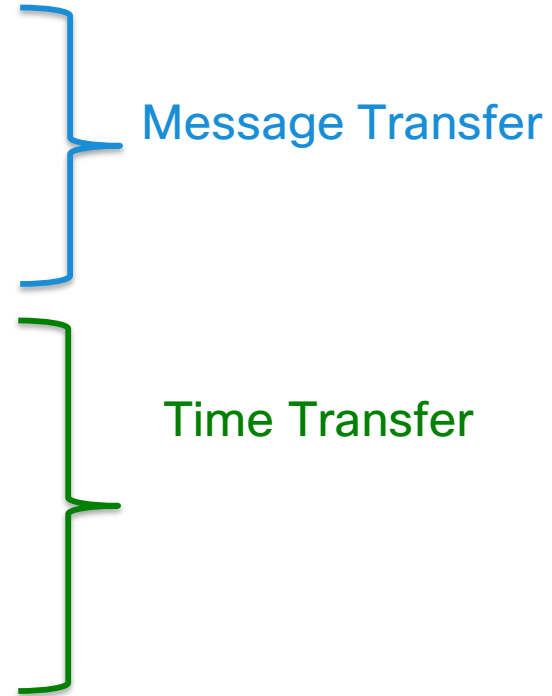
Pros and Cons of Boundary Clocks

Pros:

- Breaks up the PTP message domain
- Breaks up the PTP timing domain
- Spans across VLANs
- Shields Slaves from Transients due to hierarchy changes (BMCA)
- Filters PDV

Cons:

- Adds low frequency (wander) time error (hard to filter)
- Cumulative error: Limit to number of BCs in a row from GMC



Transparent Clocks (end to end, peer to peer)

- TC update the Correction Field with the Residence Time.
- End to End TC does not send Delay Requests
 - TC cannot know what true time is. that is OK
 - TC needs to get close to GM frequency to minimize the Residence Time Error.
- End to End – available in Default Profile
- Peer to Peer – available Power Profile and 802.1AS

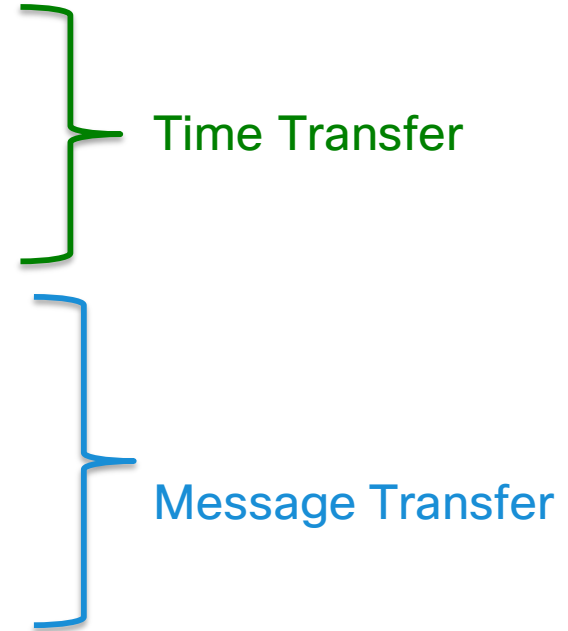
Pros and Cons of Transparent Clocks

Pros:

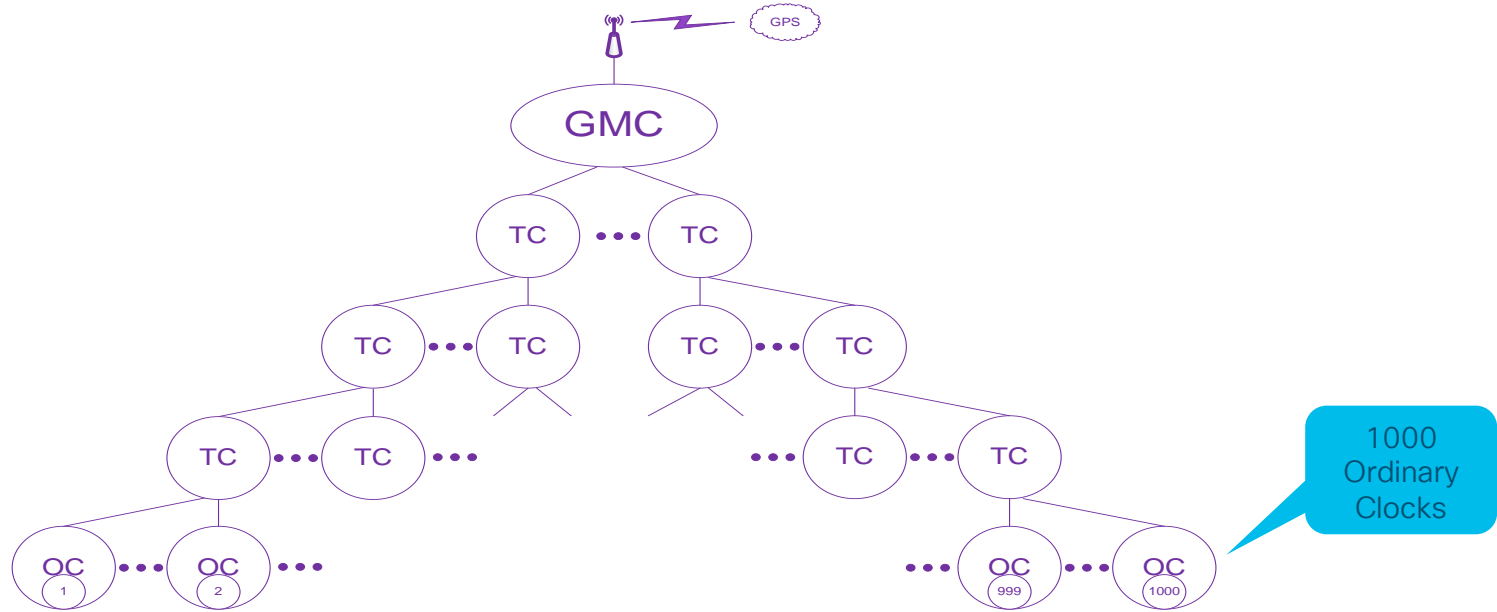
- Maintains tight timing throughout a domain
- Enables faster convergence in the network – less impact from GMC change
- Nothing to configure
- Peer-to-Peer TCs can converge faster after network topology changes

Cons:

- End-to-End TCs can have scalability issues with number of OCs
- PTP Limited to single vlan



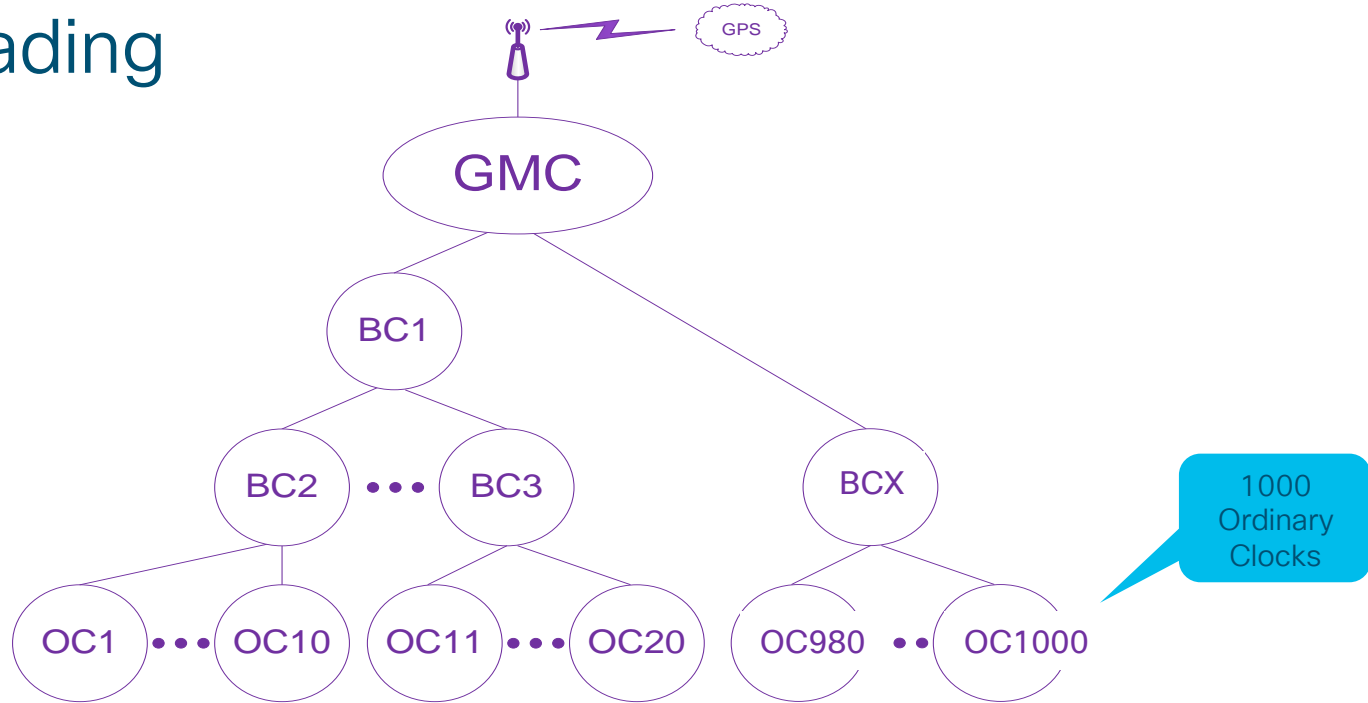
TC Scalability with End to End



Imagine a large hierarchy of TCs. If this were all E2E TCs, the GMC would be receiving Delay Request messages from all 1000 OCs (slaves).

With P2P TCs, however, each TC receives Pdel_Reqs from all of its subs, but only sends one to the device above it.

BC Cascading



Why not just make all the TCs into BCs?

- Precision error compounded at each BC (due to MTIE + MTIE)
- Cascading BCs is like cascading PLLs – instabilities can occur.

Guidance to choose BC or TC IE Bridge

Choose BC for IE Switch

- Change Vlans
- Need clock to be primary or backup GMC
- Device at head of ring (REP or STP)
- L3 Gateway (change vlans)

Choose TC for IE Switch

- Power utilities – mandate P2P Transparent Clock
- All devices support PTP and network is stable
- Use TC for devices on a ring

Cisco products supporting PTP



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Troubleshooting: How to know its working?

- Show commands
- Debug commands
- Resolution to common issues




Close

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IE3x00 platforms at a glance



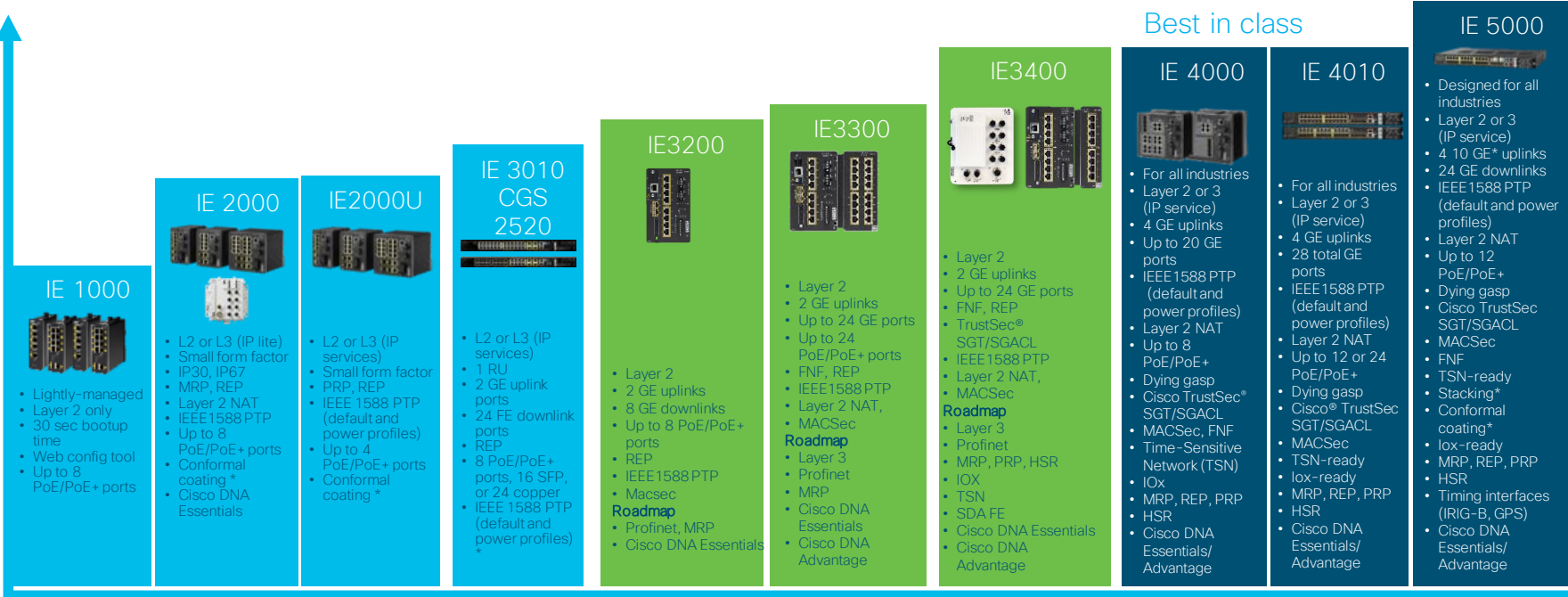
	 <p>IE3200 fixed basic</p>	 <p>IE3300 modular basic</p>	 <p>IE3400 modular advanced</p>
Positioning	Low port count, low power, Network Essentials features	IE 3000 transition High port count, Cisco DNA Essentials, or Cisco DNA Advantage features	Advanced features, high port count High port count
FCS features	<ul style="list-style-type: none"> • Layer 2 • Fixed: 10 x 1GE ports • PTP, REP • PoE/PoE+ 	<ul style="list-style-type: none"> • Layer 2 • Modular – 26 x1GE ports • PTP, NetFlow, REP • PoE/PoE+ 	<ul style="list-style-type: none"> • Layer 2 • Modular –26 x 1GE ports • PTP, NetFlow, REP • PoE/PoE+
Post-FCS features	<ul style="list-style-type: none"> • Profinet, MRP • Cisco DNA Essentials 	<ul style="list-style-type: none"> • Layer 3 • Profinet, MRP • Macsec • Cisco DNA Essentials, Cisco DNA Advantage • SDA Extended Node 	<ul style="list-style-type: none"> • Layer 3 • Profinet, MRP, HSR, PRP, L2NAT • Macsec, SGT, SGACL • Cisco DNA Essentials, Cisco DNA Advantage • SDA Extended Node, SDA Fabric Edge • TSN • Cisco® IOx

Cisco IoT Industrial Switching portfolio

Access

Aggregation

Feature



** -Selected Models



PTP support in Cisco IE Switches



PTP Feature	IE-2000 / IE-3000	IE-2000U / CGS-2520	IE-4000	IE-4010	IE-5000	IE-3x00
Profiles	<ul style="list-style-type: none"> • Default • Power 	<ul style="list-style-type: none"> • Power 	<ul style="list-style-type: none"> • Default, • Power • 802.1AS 	<ul style="list-style-type: none"> • Default • Power 	<ul style="list-style-type: none"> • Default • Power 	<ul style="list-style-type: none"> • Default • Power
Clock modes	<ul style="list-style-type: none"> • GMC • BC • E2E-TC • P2P-TC 	<ul style="list-style-type: none"> • GMC • BC • P2P-TC 	<ul style="list-style-type: none"> • GMC • BC • E2E-TC • P2P-TC 	<ul style="list-style-type: none"> • GMC • BC • E2E-TC • P2P-TC 	<ul style="list-style-type: none"> • GMC • BC • E2E-TC • P2P-TC 	<ul style="list-style-type: none"> • GMC • BC • E2E-TC • P2P-TC

- PTP 2-Step only
- Multicast PTP messages only

PTP topo: Industrial Network Director v1.7

PTP Support on Catalyst switches



PTP Feature	C3850 *	C3650 *	C9300	C9500 *
Profiles	<ul style="list-style-type: none"> • Default, • 802.1AS 	<ul style="list-style-type: none"> • Default, • 802.1AS 	<ul style="list-style-type: none"> • Default, • 802.1AS 	<ul style="list-style-type: none"> • Default • 802.1AS
Clock modes	<ul style="list-style-type: none"> • GMC • BC • E2E-TC • P2P-TC 	<ul style="list-style-type: none"> • GMC • BC • E2E-TC • P2P-TC 	<ul style="list-style-type: none"> • GMC • BC • E2E-TC • P2P-TC 	<ul style="list-style-type: none"> • GMC • BC • E2E-TC • P2P-TC

- PTP 2-Step only
- Multicast PTP messages only
- Minimum IOS-XE release 16.8.1

‘*’ – PTP on select models only

<https://www.cisco.com/c/en/us/products/switches/avb.html>

PTP support on Nexus switches

- Every Nexus 9K supports PTP

PTP Feature	N9K (first Gen)	N9300-EX, N9300-FX, N9300-FX2	N9500 with EX/FX line card, 9600-R line card
Profiles	<ul style="list-style-type: none">• Default	<ul style="list-style-type: none">• Default• AES67• SMPTE 2059-2	<ul style="list-style-type: none">• Default• AES67• SMPTE 2059-2
Clock modes	<ul style="list-style-type: none">• GMC• BC	<ul style="list-style-type: none">• GMC• BC	<ul style="list-style-type: none">• GMC• BC

PTP support on ASR Routers

PTP Feature	ASR9K	NCS 5500	NCS5xx	ASR9xx
Profiles	<ul style="list-style-type: none"> • Default • G.8265.1 • Multiprofile 	<ul style="list-style-type: none"> • SyncE • G.8265.1 • G.8275.1 • G.8275.2 • GNSS External 	<ul style="list-style-type: none"> • SyncE • G.8265.1 • G.8275.1 • G.8275.2 • GNSS External 	<ul style="list-style-type: none"> • SyncE • G.8265.1 • G.8275.1 • G.8275.2 • GNSS External
Clock modes	<ul style="list-style-type: none"> • GMC • BC 	<ul style="list-style-type: none"> • GMC • BC • OC 	<ul style="list-style-type: none"> • GMC • BC • OC 	<ul style="list-style-type: none"> • GMC • BC • OC

See ASR 9K series PTP config guide for detailed matrix

See NCS 5500 Series PTP config for detailed matrix

Configuring IE switches for PTP



You make networking **possible**

Position in presentation

Basics of PTP

- PTP Messaging
- PTP Profiles
- Grandmaster clock
- Boundary and Transparent Clocks

Configuring PTP on Cisco IE Switches

- Product support
- Profile, modes and changing the defaults

You are here



Troubleshooting: How to know its working?

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Close

IE Switch default PTP configuration

- Profile: Default profile (for IE Switches that support default profiles)
- Mode: end to end transparent – is always the default. Least impacting.
- Clock Domain – 0

```
IE4K-8# show ptp clock
PTP CLOCK INFO
  PTP Device Type: End to End transparent clock
  PTP Device Profile: Default Profile
  Clock Identity: 0xF4:4E:5:FF:FE:E5:85:80
  Clock Domain: 0
  Number of PTP ports: 16
  Delay Mechanism: End to End
  Local clock time: 16:25:06 PDT Dec 31 2018
```

PTP – Configure Profile on IE switch

Desired Profile	CLI to configure
Default Profile	<ul style="list-style-type: none">- default*; nothing to configure- Negate current profile <pre>Switch(config)# no ptp profile power</pre> <p>* - unless Power Profile only</p>
Power Profile	<pre>Switch(config)# ptp profile power</pre>
802.1AS	<pre>Switch(config)# ptp profile 802.1as</pre>

PTP Modes per profile	Default Profile	Power Profile	802.1AS
Modes	<ul style="list-style-type: none">• Boundary Clock• E2E transparent,• Forward,• GMC-BC	<ul style="list-style-type: none">• Boundary Clock• E2E transparent,• Forward,• GMC-BC	<ul style="list-style-type: none">• GMC-BC• P2Ptransparent

IE Switching – Mode details

Mode name	details
Boundary Clock	Only peer delay mode is supported
GMC-BC	Automatically selects NTP as time source ('flywheel')
E2E transparent	Selects bridge to operate in transparent mode for Default Profile
P2p transparent	Selects bridge to operate in transparent mode for power profile
Forward	Forwards PTP without processing. – disables PTP No changes for resident time Treats PTP as normal Mcast traffic

IE Switching configuration table

- Possible configuration for different Modes/Profiles

Feature	Default Profile	Power Profile	802.1AS
Modes	Boundary Clock E2E transparent, Forward, GMC-BC	Boundary, P2P Transparent, Forward, GMC-BC	GMC-BC or P2Ptransparent
Transparent clock	End to End	Peer to Peer	Peer to Peer
Allow Announce without TLV	No	yes	no
Tune PTP Adaptive filters	No	Yes	no
Neighbor propagation delay threshold	No	No	yes
Persistence with previous GM's time property	Yes	Yes	no
Domain	Yes	Yes	yes

IE switch PTP configuration: all Profiles

Global Configuration parameters common to all Profiles

Feature CLI string	What it does	When to use
domain	Identifies the PTP domain	IE support single domain
Priority1, priority2	Influences BMCA to choose GMC, and also redundant GMC in case of primary failure	Identify on BC to be the GMC. Default and 802.1as profiles only. Not in power profile
Mode	Configure BC or TC	Default and Power profile only Not in 802.1as profile
Time-property persist <value>	Preserve time on the OC during a change in GMC	In Default and 802.1as. Only as BC. Prevent time jumps during BMCA on primary failover.

Interface level configuration common to all Profiles

Feature CLI string	What it does	When to use
Enable	Enable disable PTP at interface	Stop PTP processing on an interface. Possible to force PTP to use another

IE switch PTP configuration: Default Profile

Unique Global PTP config for Default Profile in Boundary clock mode

Feature CLI string	What it does	When to use
Transfer feedforward	BC sync algorithm that does not filter PDV	The BC internal clock will behave like a TC. If your organization believes this is better than 'linear filtering'. Best for networks where all Bridges support PTP, and PDV is minimal. Still terminates Delay_req. Minimizes cascading error effect of too many BC in a row. OCs will sync faster
Transfer filter adaptive	BC Sync algorithm that filters as much PDV as possible	For BCs in networks with lots of PDV. Bridges that do not support PTP or with wireless bridges.
Transfer filter linear	BC Sync algorithm provides a simple linear filter	This is the default setting. Use when you don't know the PDV in the network

IE switch PTP configuration Default Profile

Interface level PTP config for Default Profile

Feature CLI string	What it does	When to use
Announce interval	Interval time between announce msgs	When working with equipment that requires a different behavior other than default time intervals
Announce timeout	Time Interval to declare announce msg timeout	When working with equipment working correctly but could potentially miss announce msgs for more than 8 seconds (the default timeout)
delay-req interval	Interval to send delay-Req when ports is in Master state (device is slave)	Default is 1 second. Change when devices that need slower or faster delay-req msg intervals
Sync interval	Changes frequency of 'Sync' msgs transmits	The BC or GMC sends Sync msgs 1 per second. Faster Sync's converge faster cause more CPU cycles on OCs and BCs. Slower syncs converge slower, less CPU intense.
Sync limit	Max offset until attempt to resync	Only in BC mode. if there's significant drift being experienced, then shorten the sync limit to lessen the drift. The default is the max of 0.5 seconds.
vlan	PTP Vlan on Trunk port	For BC's, change the 802.1Q tagged Vlan for PTP messages. Needs to be same Vlan tag on both ends of Ethernet link.

IE switch PTP configuration Power Profile

Unique Global PTP config for Power Profile

Feature CLI string	What it does	When to use
Transfer filter adaptive	BC Sync algorithm that filters as much PDV as possible	For BCs in networks with lots of PDV. Bridges that do not support PTP or with wireless bridges.
Transfer filter linear	BC Sync algorithm provides a simple linear filter	This is the default setting. Use when you don't know the PDV in the network
Allow-without-TLV	Does not drop Announce msgs from non compliant GMC. Uses PTP from non compliant GMC	GMC not compliant, sends Announce msgs without specific TLVs

IE switch PTP configuration Power Profile

Interface level PTP config for power Profile

Feature CLI string	What it does	When to use
Announce interval	Interval time between announce msgs	Change default Faster or slower BMCA convergence. Default is 2 seconds
Announce timeout	Interval time to announce timeout msgs	Change default for Faster or slower BMCA convergence. Too Fast and wrong GMC wins BMCA, too slow and Servo drifts longer. Default is 8 seconds
Pdelay-req interval	Interval to send Pdelay-Req when ports is in Master state (device is slave)	Default is 1 second. Networks with lots of PDV, more msgs/sec better sync
Sync interval	Changes frequency of 'Sync' msgs transmits	
Sync limit	Max offset until attempt to resync	Only in BC mode if there's significant drift being experienced, then shorten the sync limit to lessen the drift. The default is the max of 0.5 seconds.
vlan	PTP Vlan on Trunk port	change the 802.1Q tagged Vlan for PTP messages. Needs to be same Vlan tag on both ends of Ethernet link.

IE switch PTP configuration 802.1AS Profile

Unique Global PTP config for 802.1AS profile

Feature CLI string	What it does	When to use
neighbor-propagation-delay-threshold	Limits the amount of time a neighbor can report as its delay.	some end devices are not fully compliant to 802.1AS and they do not calibrate their PTP timestamps correctly. Without calibration, IE switch mark good enough end devices as bad. This CLI adjusts the good/bad threshold.
adaptive-filter-params cost-function adaptive-filter-params group adaptive-filter-params merge adaptive-filter-params ptpdev adaptive-filter-params rate adaptive-filter-params training	Adjusts the internal working of the Servo	Only modify when you know what you're doing. Consult with Cisco AM/SE

Troubleshooting on the Cisco IE Switch



You make networking **possible**

Position in presentation

Basics of PTP

- PTP Messaging
- PTP Profiles
- Grandmaster clock
- Boundary and Transparent Clocks

Configuring PTP on Cisco IE Switches

- Product support
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Troubleshooting: How to know its working?

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Close

You are here



How to read 'show ptp clock' output on GM

```
IE5000-2004# show ptp clock
```

```
PTP CLOCK INFO
```

```
PTP Device Type: Grand Master clock - Boundary clock
```

```
PTP Device Profile: Power Profile
```

```
Clock Identity: 0x18:8B:9D:FF:FE:75:EC:0
```

```
Clock Domain: 0
```

```
Number of PTP ports: 28
```

```
PTP Packet priority: 4
```

```
Time Transfer: Linear Filter
```

```
Priority1: 128
```

```
Priority2: 128
```

```
Clock Quality:
```

```
Class: 13
```

```
Accuracy: Within 1s
```

```
Offset (log variance): N/A
```

```
Offset From Master(ns): 0
```

```
Mean Path Delay(ns): 0
```

```
Steps Removed: 0
```

```
Local clock time: 02:57:48 UTC Nov 15 2018
```

Role GMC, BC, or TC

Active PTP Profile

MAC Address of Bridge

Domain ID

BC clock transfers algorithm
This is default value

Path delay from GMC

Steps removed from GMC
0 = GMC

How to read 'show ptp clock' output on slave BC

```
IIE4010-16S12P# show ptp clock
```

```
PTP CLOCK INFO
```

```
PTP Device Type: Boundary clock
```

```
PTP Device Profile: Power Profile
```

```
Clock Identity: 0x50:1C:B0:FF:FE:23:14:80
```

```
Clock Domain: 0
```

```
Number of PTP ports: 28
```

```
PTP Packet priority: 4
```

```
Time Transfer: Linear Filter
```

```
Priority1: 128
```

```
Priority2: 128
```

```
Clock Quality:
```

```
Class: 248
```

```
Accuracy: Unknown
```

```
Offset (log variance): N/A
```

```
Offset From Master(ns): 5
```

```
Mean Path Delay(ns): 14
```

```
Steps Removed: 1
```

```
Local clock time: 02:58:56 UTC Nov 15 2018
```

Role GMC, BC, or TC

Active PTP Profile

MAC Address of Bridge

BC clock transfers algorithm

Path delay from GMC

Steps removed from GMC
1 = GMC is neighbor

How to read 'show ptp parent' output on GMC

When IE Bridge is GMC, Clock MACs are same

```
IE5000-2004# show ptp parent
```

```
PTP PARENT PROPERTIES
```

```
Parent Clock:
```

```
Parent Clock Identity: 0x18:8B:9D:FF:FE:75:EC:0
```

```
Parent Port Number: 0
```

```
Observed Parent Offset (log variance): N/A
```

```
Observed Parent Clock Phase Change Rate: N/A
```

```
Grandmaster Clock:
```

```
Grandmaster Clock Identity: 0x18:8B:9D:FF:FE:75:EC:0
```

```
Grandmaster Clock Quality:
```

```
Class: 13
```

```
Accuracy: Within 1s
```

```
Offset (log variance): N/A
```

```
Priority1: 128
```

```
Priority2: 128
```

MAC of this Bridge

Port is 0 on GMC

MAC of GMC

How to read 'show ptp parent' output on BC Slave

When IE Bridge is not GMC

```
IE4010-16S12P# show ptp parent
```

```
PTP PARENT PROPERTIES
```

```
Parent Clock:
```

```
Parent Clock Identity: 0x18:8B:9D:FF:FE:75:EC:0
```

```
Parent Port Number: 2
```

```
Observed Parent Offset (log variance): N/A
```

```
Observed Parent Clock Phase Change Rate: N/A
```

```
Grandmaster Clock:
```

```
Grandmaster Clock Identity: 0x18:8B:9D:FF:FE:75:EC:0
```

```
Grandmaster Clock Quality:
```

```
Class: 13
```

```
Accuracy: Within 1s
```

```
Offset (log variance): N/A
```

```
Priority1: 128
```

```
Priority2: 128
```

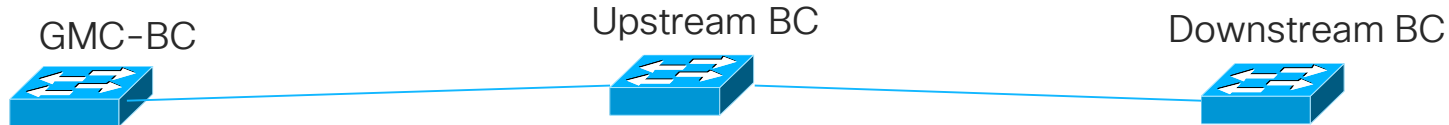
MAC of Parent
Same as GMC because GMC
is the next hop

Port is 2, not GMC

MAC of GMC

3 Boundary clocks topology

Clocks downstream from BC see upstream BC as GM (see steps removed)



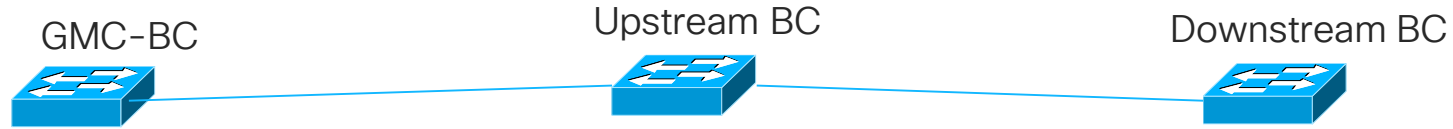
```
IE5000-2004# show ptp clock
PTP CLOCK INFO
  PTP Device Type: Grand Master clock -
  PTP Device Profile: Power Profile
  Clock Identity: 0x18:8B:9D:FF:FE:75:EC:0
  Clock Domain: 0
  Number of PTP ports: 28
Time Transfer: Linear Filter
Priority1: 128
Priority2: 128
Clock Quality:
  Class: 248
  Accuracy: unknown
  Offset (log variance): N/A
Offset From Master(ns): 0
Mean Path Delay(ns): 0
Steps Removed: 0
Local clock time: 02:57:48 UTC Nov 15
2018
```

```
IE4010-16S12P# show ptp clock
PTP CLOCK INFO
  PTP Device Type: Boundary clock
  PTP Device Profile: Power Profile
  Clock Identity: 0x50:1C:B0:FF:FE:23:14:80
  Clock Domain: 0
  Number of PTP ports: 28
Time Transfer: Linear Filter
Priority1: 128
Priority2: 128
Clock Quality:
  Class: 248
  Accuracy: Unknown
  Offset (log variance): N/A
Offset From Master(ns): 5
Mean Path Delay(ns): 14
Steps Removed: 1
Local clock time: 02:58:56 UTC Nov 15
2018
```

```
IE4010-24P# show ptp clock
PTP CLOCK INFO
  PTP Device Type: Boundary clock
  PTP Device Profile: Power Profile
  Clock Identity: 0x0:6B:F1:FF:FE:68:D2:0
  Clock Domain: 0
  Number of PTP ports: 28
  PTP Packet priority: 4
Time Transfer: Linear Filter
Priority1: 128
Priority2: 128
Clock Quality:
  Class: 248
  Accuracy: Unknown
  Offset (log variance): N/A
Offset From Master(ns): -4
Mean Path Delay(ns): 10
Steps Removed: 2
Local clock time: 14:37:34 UTC Apr 1 2000
```

BC - PTP Parent output debugging

Downstream BC, 2 hops from GMC: output of “show PTP Parent”



0x18:8B:9D:FF:FE:75:EC:0

0x50:1C:B0:FF:FE:23:14:80

Parent is upstream BC

GMC is not same as parent

```
IE4010-24P# show ptp parent
```

```
PTP PARENT PROPERTIES
```

```
Parent Clock:
```

```
Parent Clock Identity: 0x50:1C:B0:FF:FE:23:14:80
```

```
Parent Port Number: 1
```

```
Observed Parent Offset (log variance): N/A
```

```
Observed Parent Clock Phase Change Rate: N/A
```

```
Grandmaster Clock:
```

```
Grandmaster Clock Identity: 0x18:8B:9D:FF:FE:75:EC:0
```

```
Grandmaster Clock Quality:
```

```
Class: 248
```

```
Accuracy: Unknown
```

```
Offset (log variance): N/A
```

```
Priority1: 120
```

```
Priority2: 128
```

TC - PTP Parent output debugging

What happens to 'Downstream BC' when TC is inserted?

GMC-BC



0x18:8B:9D:FF:FE:75:EC:0

TC in Middle



0x50:1C:B0:FF:FE:23:14:80

Downstream BC



What is Parent?

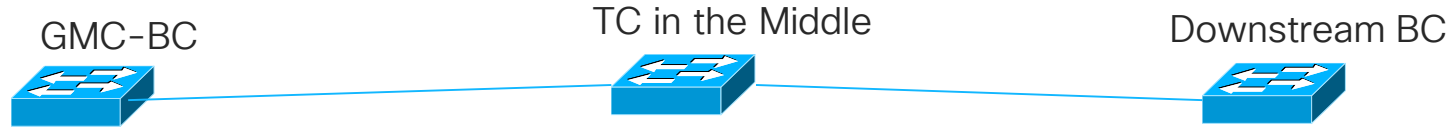
What is GMC?

```
IE4010-24P# show ptp parent
PTP PARENT PROPERTIES
Parent Clock:
Parent Clock Identity: ???
Parent Port Number: 1
Observed Parent Offset (log variance): N/A
Observed Parent Clock Phase Change Rate: N/A

Grandmaster Clock:
Grandmaster Clock Identity: ???
Grandmaster Clock Quality:
Class: 248
Accuracy: Unknown
Offset (log variance): N/A
Priority1: 120
Priority2: 128
```

TC - PTP Parent output debugging

'Downstream BC' sees GMC as parent and GMC. Why??



0x18:8B:9D:FF:FE:75:EC:0

0x50:1C:B0:FF:FE:23:14:80

Parent is upstream GMC-BC

GMC is same as parent

```
IE4010-24P# show ptp parent
PTP PARENT PROPERTIES
Parent Clock:
Parent Clock Identity: 0x18:8B:9D:FF:FE:75:EC:0
Parent Port Number: 1
Observed Parent Offset (log variance): N/A
Observed Parent Clock Phase Change Rate: N/A

Grandmaster Clock:
Grandmaster Clock Identity: 0x18:8B:9D:FF:FE:75:EC:0
Grandmaster Clock Quality:
  Class: 248
  Accuracy: Unknown
  Offset (log variance): N/A
  Priority1: 120
  Priority2: 128
```

PTP Messages through Layer 3 Gateway

- PTP messages can cross L3 devices within single domain
- L3 device must use Vlan interfaces
- Ethernet interfaces must be L2.
 - “no switchport” on Physical interface breaks PTP messages
- PTP messages have TTL = 1

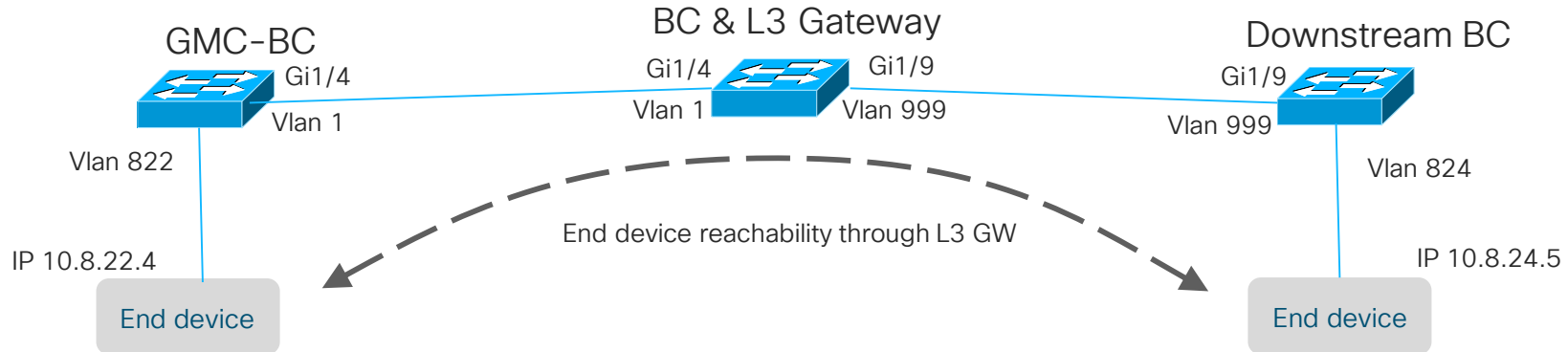
PTP through an Layer 3 BC as IP Gateway

- Changing the L2 Broadcast domain across an L3 Switch in BC mode
- Vlan as L3 interfaces. Not physical Ethernet ports (eg: not a 'no switchport')
- PTP msg can change Vlans, Native vlan same both sides of switch links

```
IE5000-BC# show ip interface brief
Interface      IP-Address
Vlan822        10.8.22.2
Vlan823        172.23.223.23
```

```
IE-GW # show ip interface brief
Interface      IP-Address
Vlan822        10.8.22.1
Vlan823        172.23.223.108
Vlan824        10.8.24.1
```

```
IE4010-24P# show ip interface brief
Interface      IP-Address
Vlan823        172.23.223.23
Vlan824        10.8.24.2
```



Syslog for PTP master change

- IF PTP Master Frequent changes – issues with BMCA algorithms
- Example PTP master change syslog
- Easy fix – change priority1 or priority 2 value on desired GMC
- Harder fix – change the announce msg times

```
Switch# show logging
```

```
Jan 21 20:10:59.969: %PTP-6-GRANDMASTER_CLOCK_CHANGE_TO_LOCAL:
```

```
Old grandmaster clock identity: 0x18:8B:9D:FF:FE:75:EC:0,
```

```
New grandmaster clock identity: 0x50:1C:B0:FF:FE:23:14:80 (local system)
```

Troubleshooting –
use Debug
commands



You make networking **possible**

Position in presentation

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- Grandmaster clock
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Configuring PTP on Cisco IE Switches

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Troubleshooting: How to know its working?

- Show commands
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You are here



Close

Debug commands overview

IE4010-16S12P# **debug ptp ?**

bmc	PTP Best Master Clock Algorithm
clock-correction	PTP Clock correction
collision	PTP source collision
error	PTP errors
event	PTP state event
messages	PTP messages
platform	PTP platform
transparent-clock	PTP transparent clock

Really Chatty with lots of details. useful to SW Engr only

State machine of port (M,S), announce msgs, errors in Sync time stamps
No output – no errors perceived by IE switch

No significant benefit to end user

Sync msg tracking

IE4010-16S12P# **undebug all**

Debug PTP BMC

IE4010-16S12P#

IE4010-16S12P#

```
Jan 21 20:29:37.915: Compare: clock-A: GM Id: 0x50:1C:B0:FF:FE:23:14:80, FM port num: 0, Rx port num: 0
Jan 21 20:29:37.915: with clock-B: GM Id: 0x18:8B:9D:FF:FE:75:EC:0, FM port num: 2, Rx port num: 2
Jan 21 20:29:37.915: B is better for lower Priority1 value (128:120)
Jan 21 20:29:37.915: Compare: clock-A: GM Id: 0x50:1C:B0:FF:FE:23:14:80, FM port num: 0, Rx port num: 0
Jan 21 20:29:37.915: with clock-B: GM Id: 0x18:8B:9D:FF:FE:75:EC:0, FM port num: 2, Rx port num: 2
Jan 21 20:29:37.915: B is better for lower Priority1 value (128:120)
Jan 21 20:29:37.915: Ebest = 0x21A0DA68, Er_best = 0x21A0C4CC
Jan 21 20:29:37.915: Ebest->received_port = 2 , Er_best->received_port = 2
Jan 21 20:29:37.915: Compare: clock-A: GM Id: 0x50:1C:B0:FF:FE:23:14:80, FM port num: 0, Rx port num: 0
Jan 21 20:29:37.915: with clock-B: GM Id: 0x18:8B:9D:FF:FE:75:EC:0, FM port num: 2, Rx port num: 2
Jan 21 20:29:37.915: B is better for lower Priority1 value (128:120)

Jan 21 20:29:39.914: Compare: clock-A: GM Id: 0x50:1C:B0:FF:FE:23:14:80, FM port num: 0, Rx port num: 0
Jan 21 20:29:39.914: with clock-B: GM Id: 0x18:8B:9D:FF:FE:75:EC:0, FM port num: 2, Rx port num: 2
Jan 21 20:29:39.914: B is better for lower Priority1 value (128:120)
```

Announce msgs every 2
seconds by default

Debug PTP Messages – Ports and messages

```
IE4010-16S12P#debug ptp messages
```

```
PTP Messages debugging is on
```

```
IE4010-16S12P#
```

```
Jan 21 20:37:33.358: PTP message sent: intf: GigabitEthernet1/1, type: SYNC
Jan 21 20:37:33.781: PTP message received, intf: GigabitEthernet1/2, vlan_id: 1, type: SYNC, seq_id: 18109
Jan 21 20:37:33.781: PTP message received, intf: GigabitEthernet1/2, vlan_id: 1, type: FOLLOWUP, seq_id: 18109
Jan 21 20:37:33.872: PTP message received, intf: GigabitEthernet1/2, vlan_id: 1, type: ANNOUNCE, seq_id: 11037
Jan 21 20:37:34.295: PTP message sent: intf: GigabitEthernet1/1, type: ANNOUNCE
Jan 21 20:37:34.312: PTP message sent: intf: GigabitEthernet1/3, type: SYNC
Jan 21 20:37:34.361: PTP message sent: intf: GigabitEthernet1/1, type: SYNC
Jan 21 20:37:34.787: PTP message received, intf: GigabitEthernet1/2, vlan_id: 1, type: SYNC, seq_id: 18110
Jan 21 20:37:34.791: PTP message received, intf: GigabitEthernet1/2, vlan_id: 1, type: FOLLOWUP, seq_id: 18110
Jan 21 20:37:35.284: PTP message sent: intf: GigabitEthernet1/3, type: ANNOUNCE
Jan 21 20:37:35.312: PTP message sent: intf: GigabitEthernet1/3, type: SYNC
Jan 21 20:37:35.361: PTP message sent: intf: GigabitEthernet1/1, type: SYNC
Jan 21 20:37:35.787: PTP message received, intf: GigabitEthernet1/2, vlan_id: 1, type: SYNC, seq_id: 18111
Jan 21 20:37:35.791: PTP message received, intf: GigabitEthernet1/2, vlan_id: 1, type: FOLLOWUP, seq_id: 18111
Jan 21 20:37:35.871: PTP message received, intf: GigabitEthernet1/2, vlan_id: 1, type: ANNOUNCE, seq_id: 11038
Jan 21 20:37:36.294: PTP message sent: intf: GigabitEthernet1/1, type: ANNOUNCE
Jan 21 20:37:36.315: PTP message sent: intf: GigabitEthernet1/3, type: SYNC
Jan 21 20:37:36.364: PTP message sent: intf: GigabitEthernet1/1, type: SYNC
Jan 21 20:37:36.790: PTP message received, intf: GigabitEthernet1/2, vlan_id: 1, type: SYNC, seq_id: 18112
Jan 21 20:37:36.790: PTP message received, intf: GigabitEthernet1/2, vlan_id: 1, type: FOLLOWUP, seq_id: 18112
```

Troubleshooting – common issues



You make networking **possible**

Position in presentation

Basics of PTP

- PTP Messaging
- PTP Profiles
- Grandmaster clock
- Boundary and Transparent Clocks

Configuring PTP on Cisco IE Switches

- Product support
- Profile, modes and changing the defaults

Troubleshooting: How to know its working?

- Show commands
- Debug commands
- Resolution to common issues

You are here

Close

Issues with Vlan tagging

Switch Port Mode	Configuration	Power Profile Mode		Default Profile Mode	
		Behavior	Priority	Behavior	Priority
Trunk Port	vlan dot1q tag native enabled	Switch tags packets	7	Switch tags packets	7
Trunk Port	vlan dot1q tag native disabled	PTP software tags packets	4	Untagged	None
Access Port	N/A	Untagged	None	Untagged	None

Power Profile & 802.1AS mode

- interface is configured as an access port, PTP messages are sent as untagged, Layer 2 packets
- interface is configured as a trunk port, PTP packets are sent as 802.1q tagged Layer 2 packets on port native VLAN

Default Profile mode

- interface is configured as an trunk port, PTP messages are sent as untagged, Layer 2 packets on native
 - use 'vlan dot1q tag native' to tag PTP on Native vlan.

End Device requires Vlan Tagged PTP – power profile (1)

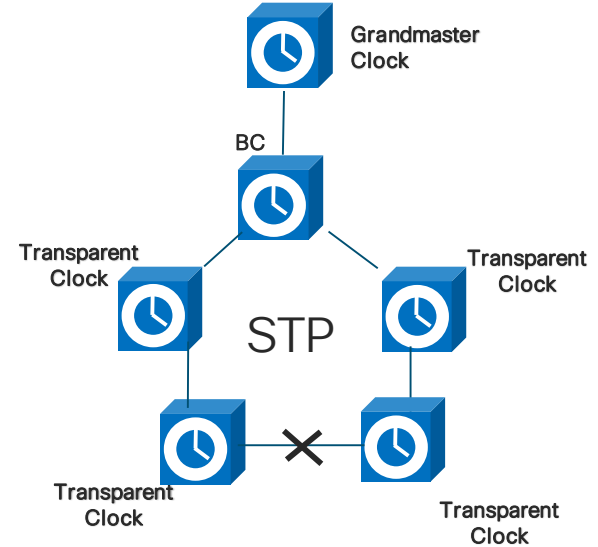
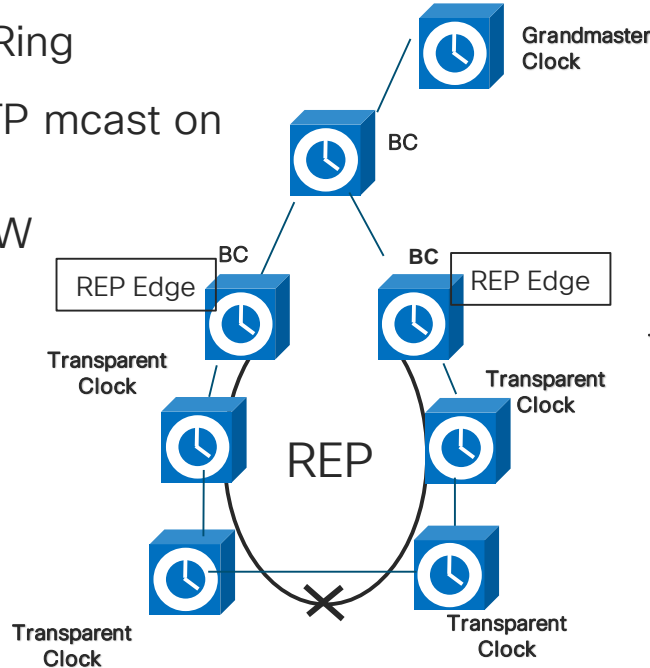
- On Cisco IE – Announce and Sync msgs
 - Received accepted on any Vlan.
 - FWD on same Vlan
- On Cisco IE Switches as P2P TC P2P–Prior to 15.2(6)x and earlier
 - Peer delay msgs sent tagged on native vlan on Trunk interfaces
 - Interface toward GMC
 - Configure Native Vlan to match expected Vlan from GMC
 - Configure as Trunk “switchport mode trunk”
 - “Vlan tag dot1q native” just in case.
 - This will ensure that Sync, Announce, Peer Delay, Peer Delay Request on same vlan

End Device requires Vlan Tagged PTP – power profile (2)

- When GMC configures VLAN for PTP Announce and Sync
- On Cisco IE Switches as P2P TC - 15.2(7)E (Feb/Mar 2019) and later
 - Configure ‘PTP vlan x’ to match Vlan used by GMC
 - PTP Vlan configured per interface for Delay msgs
 - PTP Vlan different than Native vlan
 - All announce, sync, Pdelay_req, Pdelay-resp on same Vlan
 - Default : PTP uses native vlan – when PTP Vlan not configured.
- “Vlan tag dot1q native” as work around

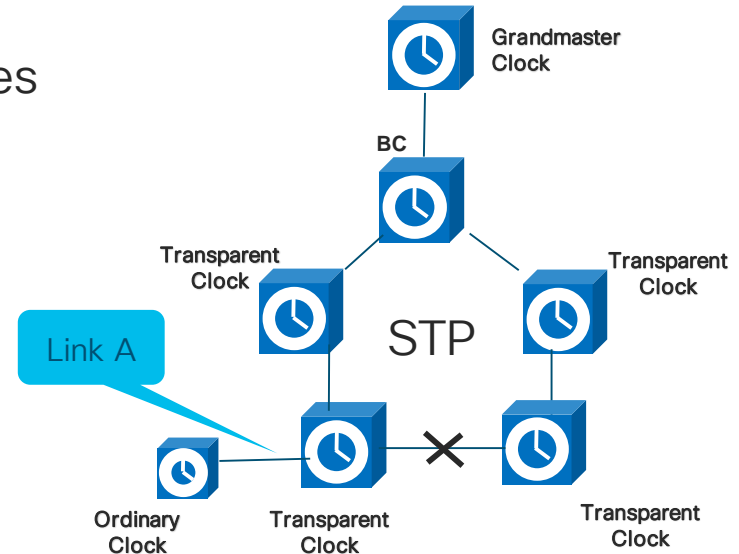
PTP in ring topologies

- Concerned for Topo change
 - BC configured on Gateway Bridges
 - TC's on Bridges inside Ring
- STP issue not blocking PTP mcast on STP Blk Link
 - Fixed in 15.2(7)E IOS SW
- Not an issue with REP



PTP not working - Spanning tree PortFast

- Issue: STP Topology change in Network causing PTP sync loss downstream
 - Tough to debug because Topo change not near the impacted OC
- STP topo change causes links from Bridges to BLK pending reconvergence
 - 1 second with RSTP/MSTP, 30 seconds STP
- Configure STP Portfast on links to non-Bridges
 - Does not stop FWD on STP topo change
- **Link A** to an Ordinary Clock
 - With Portfast - not impacted by Topo change
 - Without Portfast - loses PTP sync



Mismatch profiles

- IE4K running power profile – OC running default profile
- Client not syncing

```
IE4010-24P#show ptp port gi1/22
PTP PORT DATASET: GigabitEthernet1/22
Port identity: clock identity: 0x0:6B:F1:FF:FE:68:D2:0
Port identity: port number: 22
PTP version: 2
Port state: MASTER
Delay request interval(log mean): 5
Announce receipt time out: 3
Peer mean path delay(ns): 0
Announce interval(log mean): 0
Sync interval(log mean): 0
Delay Mechanism: Peer to Peer
Peer delay request interval(log mean): 0
Sync fault limit: 500000
```

Note: Field not present in Default End to End TC

Same Profiles – Default profile

- Both switch and OC in same default profile
- Client syncing

```
IE4010-24P#show ptp port gil/22
PTP PORT DATASET: GigabitEthernet1/22
Port identity: clock identity: 0x0:6B:F1:FF:FE:68:D2:0
Port identity: port number: 22
PTP version: 2
Port state: MASTER
Delay request interval(log mean): 5
Announce receipt time out: 3
Announce interval(log mean): 1
Sync interval(log mean): 0
Delay Mechanism: End to End
Peer delay request interval(log mean): 5
Sync fault limit: 500000
```

Note: has a non-zero value



3rd party PTP Test Equipment

- Equipment used by IE Switching PTP development
 - LinuxPTP(on UBUNTU)
 - Calnex Paragon-X
 - IXIA PTP Testing
 - GMC : meinberg LANTIME

In closing



You make networking **possible**

In closing ...

Basics of PTP

Configuring PTP on Cisco IE Switches

Troubleshooting: How to know its working?

Close

You are here

Closing Notes



You make networking **possible**

PTP in Industrial / Utility deployments

- Transparent mode (end to end , and peer to peer) is easiest configure
 - least impactful
- Announce messages – more frequent is better in ‘well behaved’ networks
 - Faster convergence during Primary GMC failure
- Sync messages – more frequent is better in ‘well behaved’ networks
 - Faster convergence during Topo change
- GMC overloaded with Delay_Requests from OCs?
 - Possible response: Convert a Transparent Clock to Boundary Clock
- Use Default Profile in Networks with non PTP aware bridges.
- VTP mode and domain must match
- TTL in PTP = 1; won't FWD through L3 devices unless in BC mode

Cisco Webex Teams

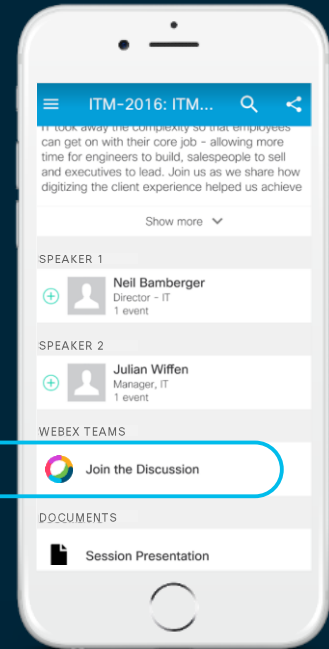
Questions?

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Thank you





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Backup



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Ubuntu PTP notes – client for PTP testing

- Install ptpd

- upgrade to 16.4 LTS

```
sudo apt-get install ptpd
```

- Generate a default config file

```
Sudo ptpd -O > ./ptpd_config.txt
```