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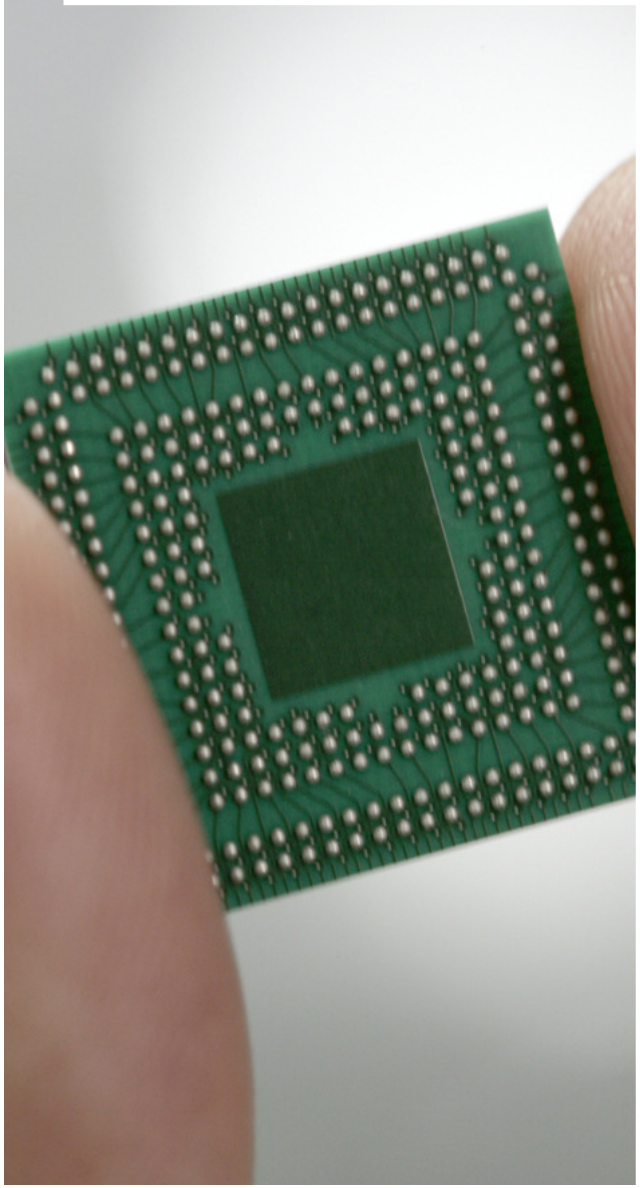

IEEE 802.1AS bt (gPTP) & IEEE 1588 v3 (PTP v3)

2013-03-19

IEEE 802.1 TSN TG Meeting

Orlando / USA

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Structure of this Presentation

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List of Feature to propose for 1588v3:

1. Common 1588 MIB
2. Layering model to support different media
3. Monitoring of Time Quality Gates
4. Improving One-Step PDelay
5. High available Synchronization
6. Two Time Scales
7. Sync Domain Boundaries
8. Reference Clock Model
9. Further Topics?

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1. Common 1588 MIB

Situation:

Two MIB definitions are actually known

- IEEE C37.238
- IEEE 802.1AS

=> it would be great to have a single one covering all aspects

The MIB shall comply with the structure of the bridge MIB, interface MIB to be as close as possible to standard MIBs especially regarding Tansparent Clock / Boundary Clock.

The stakeholders of the existing MIBs shall be involved to produce to keep consistency.

Benefit:

A common MIB enables the use of 1588 in a heterogeneous environment as quite a lot of communication infrastructure includes SNMP for management and diagnostic.

2. Layering model to support different media

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Situation:

The existing model specifies a very simple model. It does not reflect other Layer 2 functions e.g. link aggregation. Some MACs have non symmetric channels (EPON) or specific means for delay calculation (IEEE802.11). Each individual functional element must be allocated to a specific layer.

Benefit:

A generic architectural approach could help to enhance the mapping to a specific technology.

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3. Monitoring of Time Quality Gates

Situation:

The existing standard specifies only a few possible quality parameters (ParentOffsetVariance, ParentClockPhaseChangeRate). TC can also measure OffsetVariance and ClockPhaseChangeRate to the neighbor. This can be done as absolute value but also as change of the value within a time interval. The path delay measurement value may also change and could be compared to the neighbor measurement. For critical applications it may be necessary to detect errors and thus, all of the parameters should be checked. Thus, a change in the values could indicate a problem and the application could react in case of excessive changes of the values.

Benefit:

Better estimation of the quality of a slave clock. Mission critical application can mask channels with critical quality parameters. Diagnosis and protection of units in the early stage of an error means higher quality for the end customer of sync.

4. Improving One-Step PDelay

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Why using cumulative rate ratio mechanism to measure grandmaster (GM) rate ratio?

1. Measuring neighbor frequency offset is GM independent

2. Fasten network startup & reconfiguration because GM frequency offset is known with first Follow_Up message

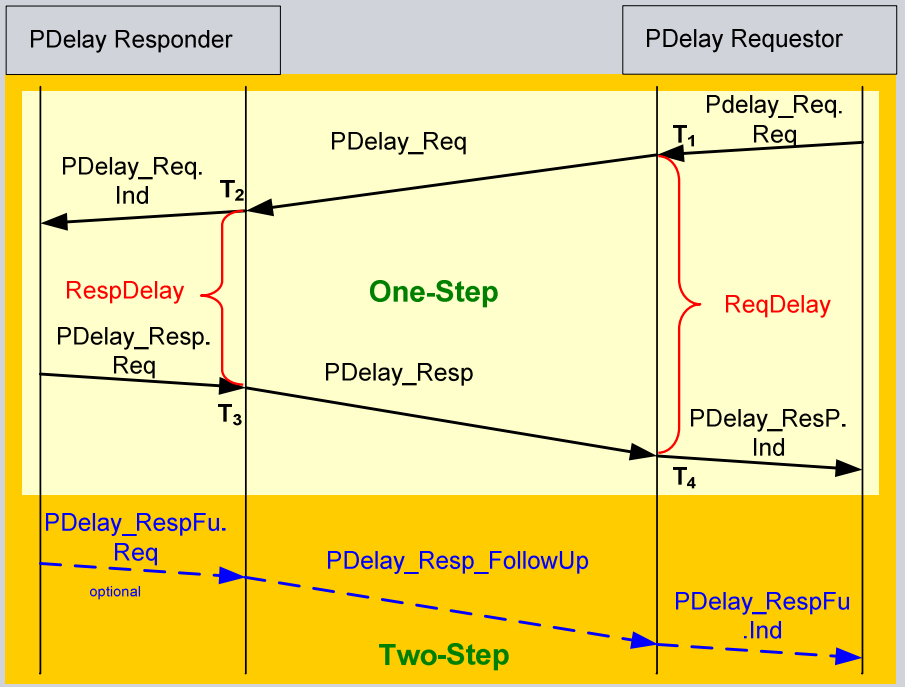
How to measure grandmaster rate ratio :

1. GM frequency ratio is accumulated neighbor frequency ratio peer-two-peer with PDelay messages

   => PDelay responder receipt time stamp T2 or transmit time stampT3 is required to measure neighbor rate ratio

2. After startup GM frequency ratio can also measured end-two-end with sync messages

Comparing own frequency wit neighbor frequency is an additional diagnostic feature



Problem with One-Step definition in PTPv2:

- One-step PDelay responder set 0 the requestReceiptTimestap (T2) in PDelay_Resp message while the turnaround time T3 – T2 is added to the correction field
- No PDelay_Resp_FollowUp message -> no responseOriginTimestamp (T3)

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5. High available Synchronization

Situation:

To get high accuracy and high availability redundant sync messages should be transmitted simultaneously over disjoint path. To establish redundant path knowledge about the physical topology is required. A link state protocol like ISIS and appropriate routing algorithm is required to establish redundant sync path.

Benefit:

1. Better sync quality – using redundant sync message
2. Zero switchover time by single point of failure to guarantee accuracy (even using low quality oscillators in rough environment)

Link: http://www.ieee802.org/1/files/public/docs2013/asbt-goetz-HighAvailableSync-0319-v02.pdf

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6. Two Time Scales

Situation:

In industrial networks simultaneously synchronization of two independent time scales is required. Universal time is used for time stamping events, production data or sampled values, whereas Working clock (none traceable time, strong monotonic increasing time) is used to synchronize actuator, sensors or control cycles. Universal time should be available over the whole network (128 hops) and work with low configuration efforts (plug & play). A working clock is typical engineered and restricted to geographically limited areas to guarantee accuracy.

Benefit:

Within one industrial network two independent timescale with different requirements on accuracy, functionality and configuration efforts can be synchronized within one network.

Links:

http://www.ieee802.org/1/files/public/docs2013/as-goetz-TwoTimeScales-4-Industrial-20130114-v01.pdf

http://www.ieee802.org/1/files/public/docs2012/as-goetz-ind-req-0712-v2.pdf

7. Sync Domain Boundaries (1)

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Sync messages shall not be forwarded over ports which do not support gPTP!

- **To guarantee accuracy for synchronization**
  => path delay measurement is required an each link

Proposal:

When supporting two time sclaes, multiple sync domains, different profiles only ONE common PDdelay measurement shall be required.

Why Sync Boundaries?

- **When supporting two time scales**
  - **which are transmitted by two sync messages simultaneously within a network**
  - **which are restricted to domains and areas**

  => sync boundaries will be helpful

Link: http://www.ieee802.org/1/files/public/docs2012/as-goetz-multiple-sync-domains-1112-v01.pdf

7. Sync Domain Boundaries (2)

Add Sync-Domain-TLV to PDdelay message to control forwarding of sync message

ONE common PDdelay measurement

Default behavior:

- No Sync-Domain-TLV from neighbor
  & PDelay measurement successful
  & Slave port

-> forward sync message

New behavior:

- Adjacent nodes support sync domain number
  & PDelay measurement is successful
  & port in Slave state

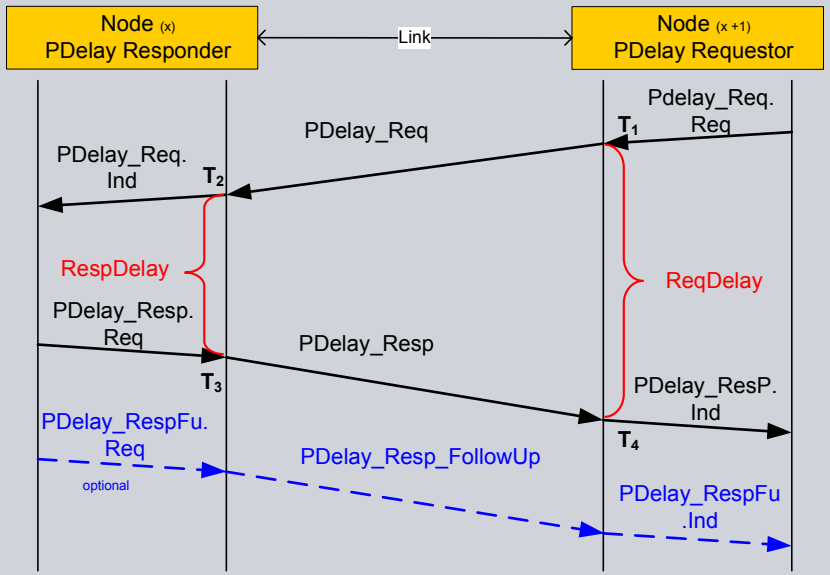
-> forward sync message for corresponding sync domain

- The neighbor does not support sync domain number

-> set sync boundary for sync domain

- Adjacent nodes which do not support a certain sync domain number

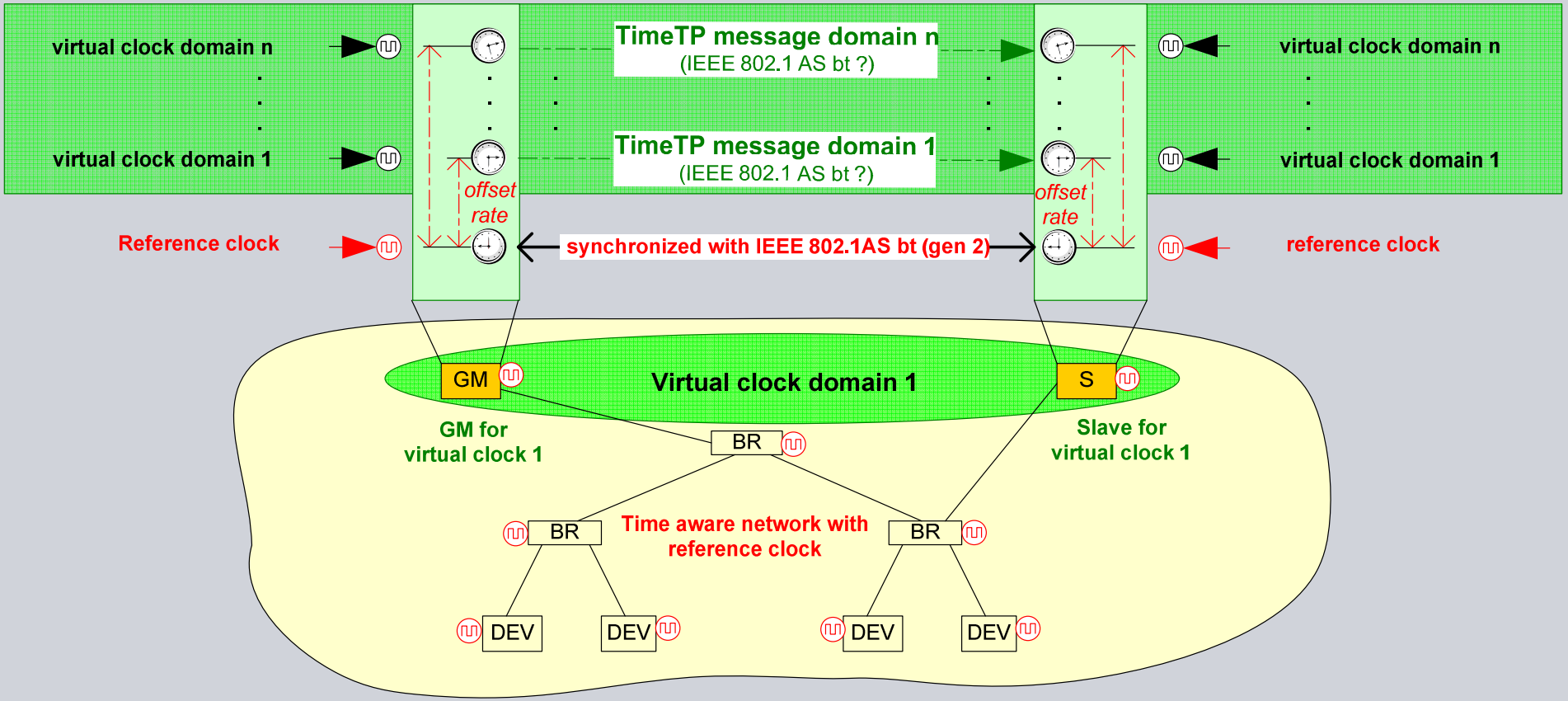
-> for unknown sync domains nothing to do



Sync-Domain-TLV

		Octet	Length
	Type	1	1
	Length	2	1
Domain Tuple 1	Domain Number	3	1
	...		
Domain Tuple n	Domain Number	n + 2	1

8. Reference Clock Model (1)

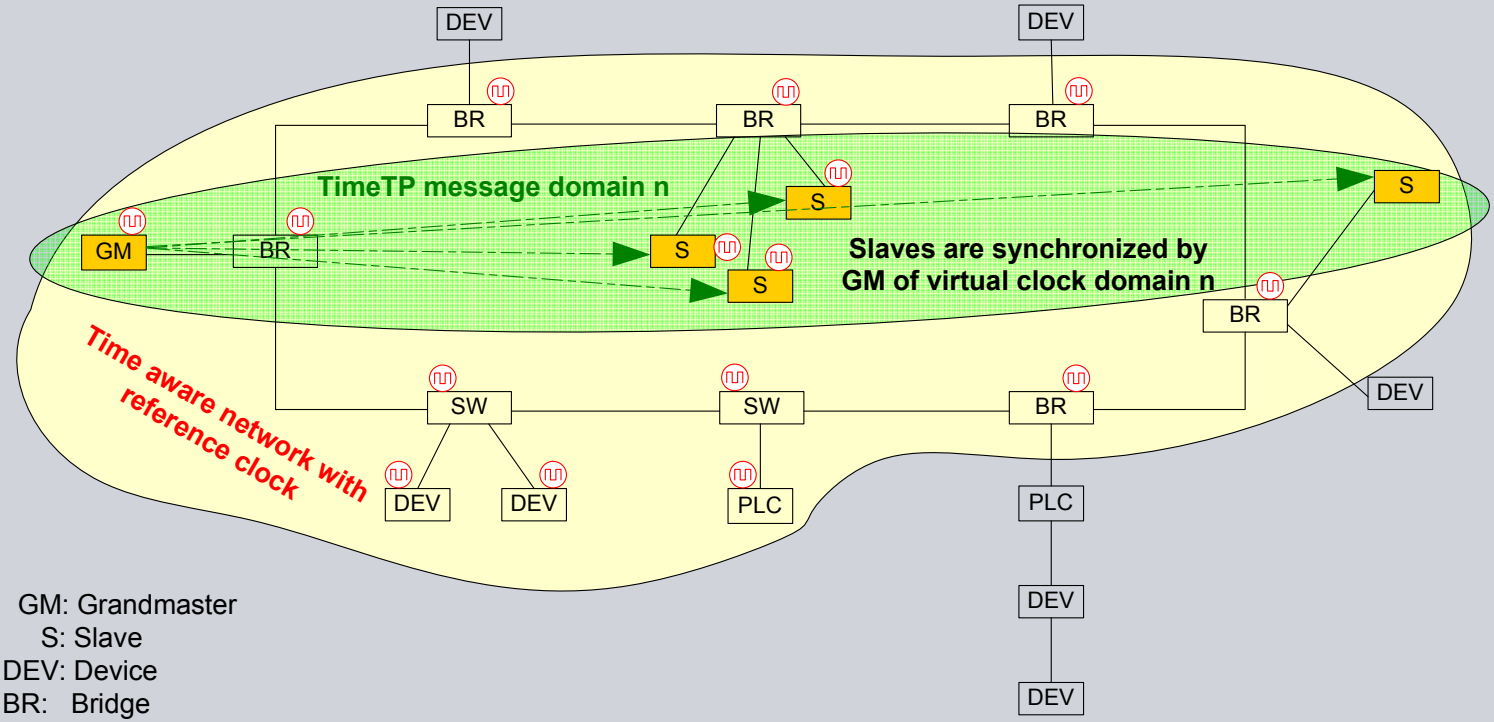


GM: Grandmaster
S: Slave
BR: Bridge

8. Reference Clock Model (2)

Multiple overlapping virtual clock domains within a flat network

- One reference clock domain
- Multiple virtual overlapping clock domains synchronized by different GM's
- Each virutal GM synchronize its devices with a TimeTP (time transport) messages
- TimeTP messages is an end-to-end messages and only time stamped by the end stations
- The network residence time of the TimeTP messages is measured based on reference clock



GM: Grandmaster
S: Slave
DEV: Device
BR: Bridge

9. Further Topics?

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Thank you for your attention!

Questions?