IEEE 802.1ASbt for Industrial Networks

Requirements on Forwarding of Sync Messages

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Outline

- Requirements from industrial applications
  - for Universal Time
  - for Working Clock
- Constraints to meet the requirements from industrial
  - for Universal Time
  - for Working Clock
- Problem on forwarding of sync messages

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Requirements from Industrial Applications

Parameters	Universal Time	Working Clock
Hop count	up to 128	up to 64
Sync accuracy at the last hop	< ± 100 µs	< ± 1 µs
Max. frequency drift rate *	3 ppm/sec	3 ppm/sec

* due to temperature changes, shock, vibration or aging, @SyncMaster, modelled as sine curve)

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Constraints to Meet the Industrial Requirements

Parameters	For Universal Time	For Working Clock
Time stamp accuracy	< 8ns	< 8ns
Time stamp resolution	<= 8ns	<= 4ns
Sync interval	125ms	31.25ms
Forwarding delay of Sync messages in bridges	< 10ms	< 1ms
Frequency tolerance	< ± 50ppm	< ± 25ppm for GM < ± 50ppm for others

Problem on Forwarding Delay of Sync Messages

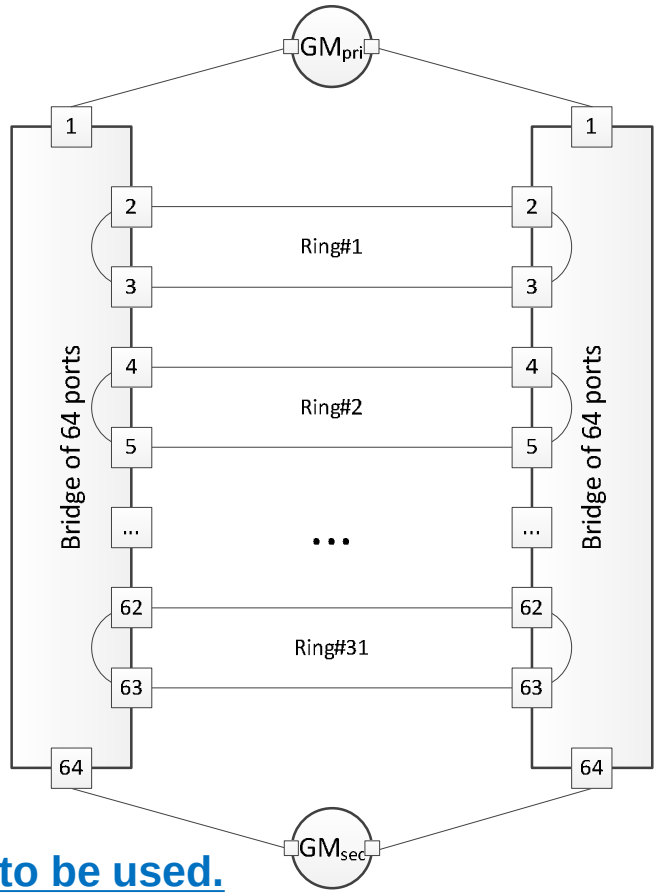
One of the essential constraints to meet industrial requirements for working clock synchronization is *Forwarding delay of Sync messages in bridges < 1ms*

Consider the following use case

- 2 GMs (primary and secondary)
- 2 bridges, each with 64 ports
- 31 rings, each with 32 devices
- both redundant GM/Sync paths applied

⇒ Each bridge needs to forward
63 x 2 Sync Msgs per Sync interval

Problem: if forwarding of sync msgs (incl. port selection and Sync Msg replication) is primarily conducted by software, it is very difficult to guarantee that the Sync forwarding delay < 1ms



Sync Forwarding with bridging mechanism needs to be used.

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Domain Specific Forwarding of Sync messages

Assumptions

- All sync messages use the same group MAC address
- Use different domain numbers for redundant GMs/Sync trees, thus each of redundant gPTP packet is transported within its own gPTP instance

Problem on Sync forwarding with bridging mechanism

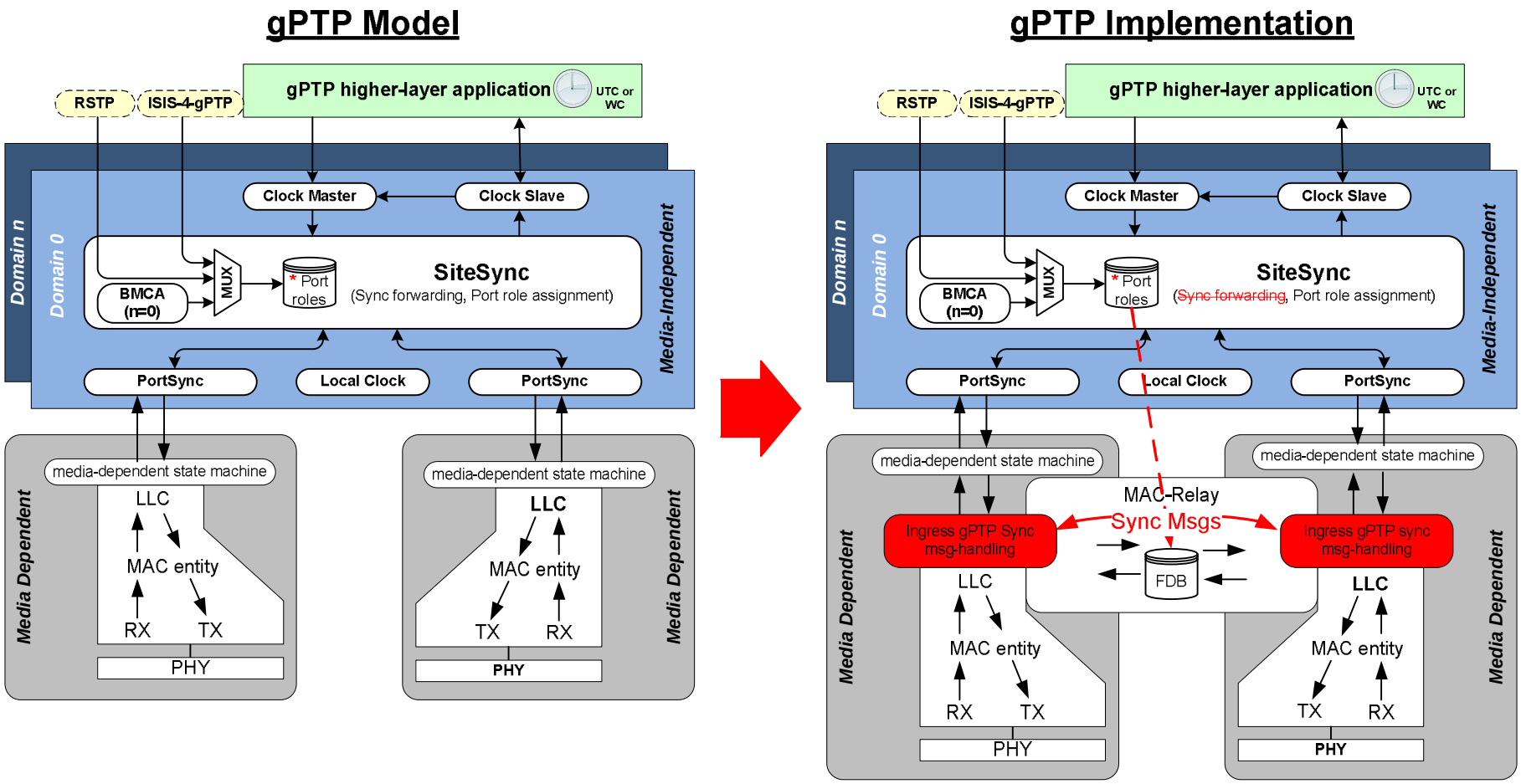
- In principle the existing bridging mechanism cannot be used for sync forwarding e.g. domain number is present in the gPTP header
  => Special HW is needed to identify domain specific gPTP Sync Msgs

Discussion: possible ways to enable domain specific forwarding of Sync Msgs with existing bridging mechanism (one may not solve all the problems)

- VLAN-tagged PTP sync packet
- One group MAC address per domain
- Implementation-specific solution:
  Map domain-specific port roles sets to FDB (per domain slave port <-> master ports)

Summary

The standardization should take care that the gPTP model (also for redundant synchronization) allows a HW implementation using existing bridging mechanism + small add-ons per port!



Thank you for your attention!

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