

Potential 802.1 Support for Time Functionality in Telecommunications Networks

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Current Status in MBH

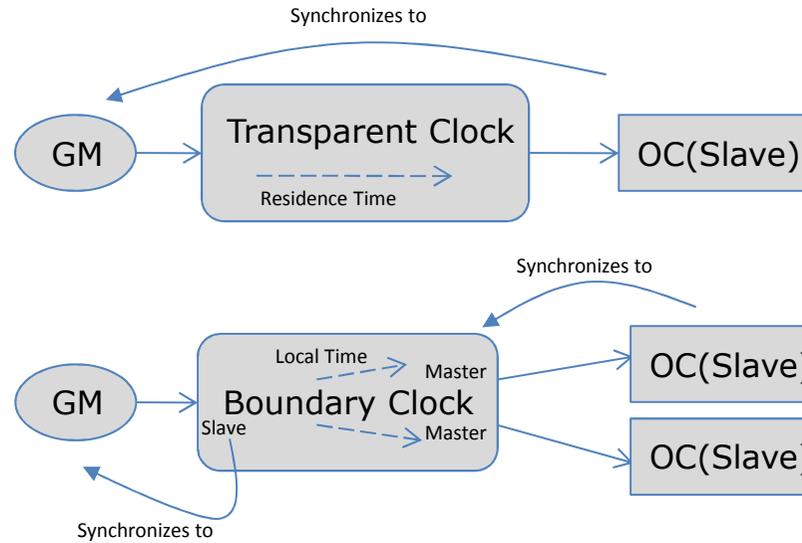
- Ethernet widely adopted in telecommunications networks - Especially Mobile Backhaul (MBH)
- Mobile base stations require Time of Day Alignment (aka Phase)
 - Needed for TDD (Time Division Duplex) Air Interface
 - Requirement - 1us accuracy over Access Network
 - Future - 200ns already being discussed
 - Coordinated MultiPoint (CoMP)
- IEEE 1588 PTP Favoured Method of achieving Time/Phase
 - On Path support seems likely
 - Two ways of achieving this
 - Boundary Clock (BC) or Transparent Clock (TC)
- Some representatives within the ITU are asking for help on TC
 - See Liaison request from SG15Q13 in November 2012 Plenary

BC Versus TC

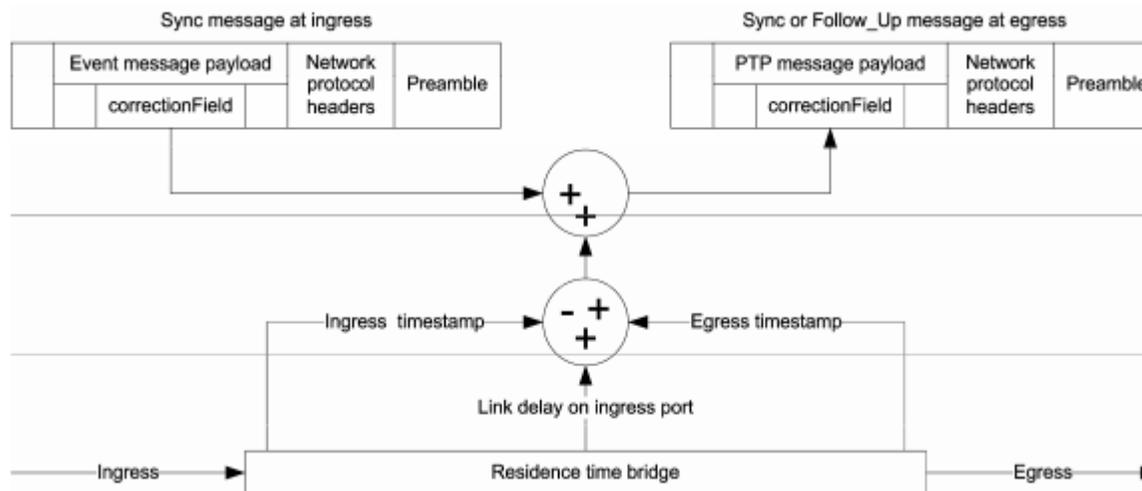
- Boundary Clock (BC)
 - Has at least one Slave Clock
 - Can have one or multiple Master Clocks
 - Inherent Slave Offset
- Operationally
 - One BC per 1588 stream
 - Participates in BMCA
 - Needs to cope with protection events and potentially converge on a new Time
- Transparent Clock (TC)
 - Has no Slave Clock
 - Residence Time is recorded
 - Negates delay variation
 - Avoids Slave Offset
- Operationally
 - Support multiple 1588 streams
 - No BMCA
 - Does not need to converge on Time in case of protection events

Transparent Clocks seen as key component for large scale roll out

Background Figures



Ref: A. Magee, "Synchronization in Next-Generation Mobile Backhaul Networks", IEEE Communications Magazine, October 2010



Time Distribution is a Multi-Layer Model

- Physical Layer Time Stamping to indicate Start of Packet
 - Improved accuracy
 - Compared to detection mechanism deeper in the stack (after which, delay variation may have already occurred)
 - 802.3 already took some steps to support this
 - Phy based Time Stamp Indications and Latency within Phy – Note it does not discuss placement on Timestamp into any MAC frames or fields
- Time Stamp location – which Layer?
 - Where would Time Stamps fields be ideally positioned
 - In the payload of the L2 frame – 1588 Direct mapping over Ethernet?
 - In the payload of the IP packet – 1588 over IP and UDP, also NTP?
 - Note that IETF have TICTOC Group looking at how to deal with 1588 and MPLS
 - Having the timestamps in the payload introduces complexity
 - How to deal with security?
 - FCS recalculation at Layer 2 and 3 potentially
 - Timestamp manipulation by TCs introduces arguments about 'Layer' violations
 - Potential for redesign the Timestamp format and mechanism for each new Time of Day Protocol that comes along?

Putting Time stamps in Payload and Transparent Clock Model simply don't fit well

So what is the proposal?

- A generic timestamp field within the Layer 2 Header
 - Time Tag
- Intend to remove the whole discussion about layer violations
- Support Layer 2, Layer 3 and MPLS TC models
 - Provides a service to other layers
- Potential work on 1588v3 provides golden opportunity to make use of such a tag
 - 1588 would need to define a function which maps the timestamps in the tag back into the protocol as appropriate

Potential 802.1 Activities

- Define a Time Tag
 - Recognised by Time Aware devices
 - Allow such devices to manipulate fields within the tag without incurring a Layer violation
 - Within the Tag
 - Identifier, Timestamp fields, Correction field and Traceability
- Define how fields could used by 802.1 devices
 - Define an 802.1 Transparent Clock Bridge within 802.1 TSN

One Potential Time Tag Proposal

- Time Tague (T-TAG)
 - T-TAG ID
 - One T-TAG ID per time domain
 - A Bridge only looks at T-TAG fields if it is configured to be a member of that T-TAG ID
 - A Bridge can be a member of multiple T-TAG IDs
 - T-TAG Type (used to define the types of operation that can be performed on the fields)
 - Boundary Clock Model
 - Transparent Clock E2E
 - Transparent Clock P2P
 - TimeStamp Fields
 - Source TimeStamp
 - placed by a GrandMaster or a BC Master
 - Ingress TimeStamp
 - Placed at ingress to a time aware Bridge, and/or possibly for a distributed function i.e. Time Aware Edge Bridge concept. This is used when packet gets to an egress interface for calculation purposes
 - CorrectionField
 - Time aware Bridge operating in Transparent Clock mode will calculate residence time using ingress Time Stamp and time at transmit, and add the result to the correctionField
 - Traceability Fields
 - For use in verification of the time layer, and Sync Service Level Agreement definitions
 - Hopcount – Incremented if the device in question has modified the correction field
 - Others – Last MAC Address to modify the correction field, PRC traceability, Syntonized etc
- Ideally Time Tag would be the first Tag in the Mac Header, i.e. prior to C-VLAN, etc
 - Although it may be useful in support of multiple domains etc if the Time Tag sits after C-VLAN
 - Request further guidance from 802.1 Experts on the pros and cons of this