Specialization of IEEE 1588 Best Master Clock Algorithm to 802.1AS

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Introduction

- IEEE 802.1AS will use a subset of IEEE 1588 version 2 Precision Time Protocol (PTP) to provide timing/synchronization for A/V Bridging (AVB) networks
  - Each AVB node will consist of a co-located Ordinary Clock (OC) and Peer-to-Peer Transparent Clock (TC)
  - One node will be Grandmaster (GM) and the other nodes will be slaves
  - AVB networks will not contain Boundary Clocks (BCs) (nor will they contain End-to-End (E2E) TCs
  - An AVB network will consist of a single PTP sub-domain
    - Given these constraints, an AVB network is equivalent to a single IEEE 1588 communication path
  - AVB networks will have a single clock requirement with a single quality

Introduction (Cont.)

- Reference [1] describes in detail how IEEE 1588, version 2, plus additional profile information are used to transport timing and synchronization over an AVB network
  - The description of how the Grandmaster clock is chosen must still be supplied for Reference [1]
  - The GM will be chosen using a simplified version of the IEEE 1588 Best Master Clock (BMC) algorithm
    - The algorithm is simplified in the sense that the general algorithm of [2] is specialized to the case of the above assumptions (i.e., single communication path, no BCs, and single clock quality)
  - Reference [2] is actually IEEE 1588 version 1
    - No changes are needed for the version 2 introduction of P2P TCs, because TCs do not participate in the BMC
    - Some changes are needed to reflect the fact that BMC information is carried in the Announce message in version 2 (compared to the Sync message in version 1)
    - Several corrections to the BMC algorithm that will very likely be included in Version 2 are described in [3]; these are included here where needed
- The purpose of this presentation is to describe the specialization of the IEEE 1588 BMC algorithm to AVB networks
- The material here will be added, with text description, to [1]

AVB Clock Quality and Preference Level

- There will be a single set of requirements for the AVB node clock (i.e., free-running oscillator), and therefore a single clock quality
- Users will optionally be able to configure a Grandmaster preference level for each clock
  - If the user does not configure a preference level, then all AVB node clocks will be equally preferred
- The preference levels will be set using PTP clock stratum levels (note: clock stratum in IEEE 1588 is not the same as in telecommunications networks)
  - The default clock stratum will be 3
  - Users may optionally set the clock stratum to a number between 3 and X
    - X is to be determined, with $3 \leq X \leq 254$
  - AVB networks will not use stratum 1 or 2 clocks, because the general PTP BMC algorithm partitions a network with multiple stratum 1 or 2 clocks into multiple PTP subdomains (i.e., in a PTP network, a stratum 1 clock is not synchronized by another stratum 1 clock, and a stratum 2 clock is not synchronized by another stratum 1 or 2 clock)

GM Selection in AVB Networks

- The GM will be chosen as follows
  - If there is one clock with the lowest stratum number, it will be chosen as GM
  - If the number of clocks with the lowest stratum number is greater than 1, the clock with the largest uuid (MAC address for the node) is chosen (with the uuid treated as an unsigned integer for ordering)
- Note that it is not necessary to consider a hop count (steps_removed in IEEE 1588) because, in a network where the slaves communicate with the GM through P2P TCs, every slave is one hop from the GM
  - The hop count considered in IEEE 1588 is the number of hops taken through *Boundary Clocks* to get from the GM to the slave
  - This hop count is considered in the BMC algorithm because it is desirable to limit the phase error buildup that can occur when traversing multiple BCs, each possibly with a phase-locked-loop (PLL)
  - In contrast, the same phase error buildup does not occur when traversing TCs; in this case the PLL filtering is done once at the endpoint

GM Selection in AVB Networks (Cont.)

- It is also not necessary to consider port_id, as each node has an internal OC with a single internal (implied) port connecting to the collocated P2P TC
  - The P2P TC may have multiple ports, but these are not relevant for BMC algorithm
- Essentially, the GM selection procedure is a specialization of the general 1588 BMC algorithm to a single subdomain that consists of one PTP communication path and all clocks stratum 3 or greater OCs

Port States

- ❑In general, a state is associated with each port of an OC or BC
- ❑An AVB node will have a single OC (and not a BC), with a single implied port [1]
  - Therefore, there is a single state associated with the AVB node
- ❑The current state of a clock and all its ports are maintained in a number of Data Sets (described in more detail later in this presentation)
- ❑The possible states are
  - PTP_MASTER – port is in the master state
  - PTP_SLAVE – port is in the slave state
  - PTP_LISTENING – port is listening for possible Announce messages from other nodes
  - PTP_UNCALIBRAED – a possible transient state for a potential slave, while the GM is being selected (e.g., a clock may be in this state while any endpoint filter transient is decaying)
  - PTP_INITIALIZING – a port enters this state when the node powers up or is re-initialized
  - PTP_FAULTY – a port enters this state when a fault is detected
  - PTP_DISABLED – a port enters this state if a detected fault is not cleared or if it is placed in this state by a management message

Port States (Cont.)

- PTP_PRE_MASTER – in general PTP networks that may contain BCs, a port is placed in this state for a qualification interval after the BMC has determined it should be a master
    - This is to enable Announce messages from other possible masters separated from this port by one or more BCs
    - Since AVB networks are equivalent to a single PTP communication path, this state is not needed for AVB networks
- PTP_PASSIVE – not needed for AVB
    - used in BCs to prevent synchronization loops, in the event the underlying network technology does not prevent loops
        - Note: in the case of a BC, if the underlying network technology does prevent loops, the respective links that are not part of the spanning tree will not be visible to the PTP layer
    - AVB nodes will not send Sync, FollowUp, or Announce messages to non-AVB nodes; however, the presence of a non-AVB node at the remote end of a link will be detected by the P2P TC function using the Pdelay mechanism
        - The PTP_PASSIVE state will not be used here

❑Therefore, AVB networks will use 7 of the 9 PTP states

Events

- STATE_CHANGE_EVENT
  - Best Master Clock (BMC) algorithm is executed when this event occurs
  - As a result of BMC algorithm execution, clock port will end up in PTP_MASTER, PTP_SLAVE, or PTP_PASSIVE state
    - BCs will not be used in AVB networks, and therefore PTP_PASSIVE state will not occur
  - This event occurs at least once per announce interval
    - Logically occurs simultaneously on all ports (not relevant for AVB, since OC has only one port (internal to node, since OC and P2P TC are collocated)
    - Convenient (but not required) times to issue this event are
      - Arrival of an Announce message
      - Occurrence of ANNOUNCE_INTERVAL_TIMEOUT_EXPIRES event
        - »Note: This presentation is assuming that IEEE 1588 Version 2 will have an ANNOUNCE_INTERVAL_TIMEOUT_EXPIRES event to indicate when a port in the PTP_MASTER state must send an announce message; this has not yet been discussed in IEEE 1588
  - Execution of BMC algorithm is atomic (i.e., information received after execution begins is not considered (but may be considered the next time the BMC is executed)
  - This event does not occur if the port is in the states PTP_INITIALIZING, PTP_DISABLED, or PTP_FAULTY
- Other events and related state machines will be covered in a subsequent presentation
  - Here we limit consideration to the BMC algorithm

Events (Cont.)

- Therefore, the BMC algorithm may be invoked when the port is in any of the following states
  - PTP_MASTER
  - PTP_SLAVE
  - PTP_LISTENING
  - PTP_UNCALIBRATED
  - PTP_PASSIVE (will not occur in AVB networks)
  - PTP_PRE_MASTER (will not occur in AVB networks)
- As a result of the BMC algorithm, the port may end up in one of the above states
  - As above, PTP_PASSIVE and PTP_PRE_MASTER will not occur in AVB networks

Best Master Clock Algorithm

- The notation below follows that used in [2] and [3]
- Let C_0 denote an OC, and D_0 the information in its data sets (the detailed description of the data sets is given later)
- Let E_{rj} denote the j^{th} Announce message to arrive on port r since the last STATE_CHANGE_EVENT
  - For an OC, r = 1 (there is only one port, which is internal to the AVB node)
  - Note that the E_{rj} may have arrived from different OCs
- The BMC consists of two parts
  - Data Set Comparison (DSC) algorithm
    - Compares the properties of two clocks, as indicated by their respective data sets
    - The input to the algorithm may be taken directly from a data set (e.g., D_0), or from equivalent information contained in an arriving Announce message (e.g., E_{rj})
    - The output of the algorithm is the best of the two clocks (i.e., which of the two is the best candidate for GM
  - State Decision (SD) algorithm
    - Based on the results of the DSC algorithm, the SD algorithm computes the best clock and the recommended state

Best Master Clock Algorithm (Cont.)

- As indicated above, the BMC algorithm is executed as a result of a STATE_CHANGE_EVENT, a least once per announce interval
- Let E_{rbest} denote the Announce message that is the best of all the Announce messages received on port r since the last time the BMC algorithm was executed at this node
  - Let E_{best} denote the best of all the E_{rbest} for the node
    - For an OC, $E_{best} = E_{rbest}$ since r =1 in this case
- In considering the Announce messages that have arrived on port r since the previous execution of the BMC algorithm, only *qualified* Announce messages are considered
- To define what it means for an Announce message to be qualified, must first define the term *foreign master*
  - A received Announce message is considered to be from a foreign master if
    - the receiving port is in the PTP_SLAVE state and the Announce message is not from the port the receiving port currently thinks is its master, or
    - the receiving port is not in the PTP_SLAVE state (in this case all received Announce messages are considered to be from foreign masters)
  - Announce messages received from foreign masters are maintained in the foreign master data set (to be described later)

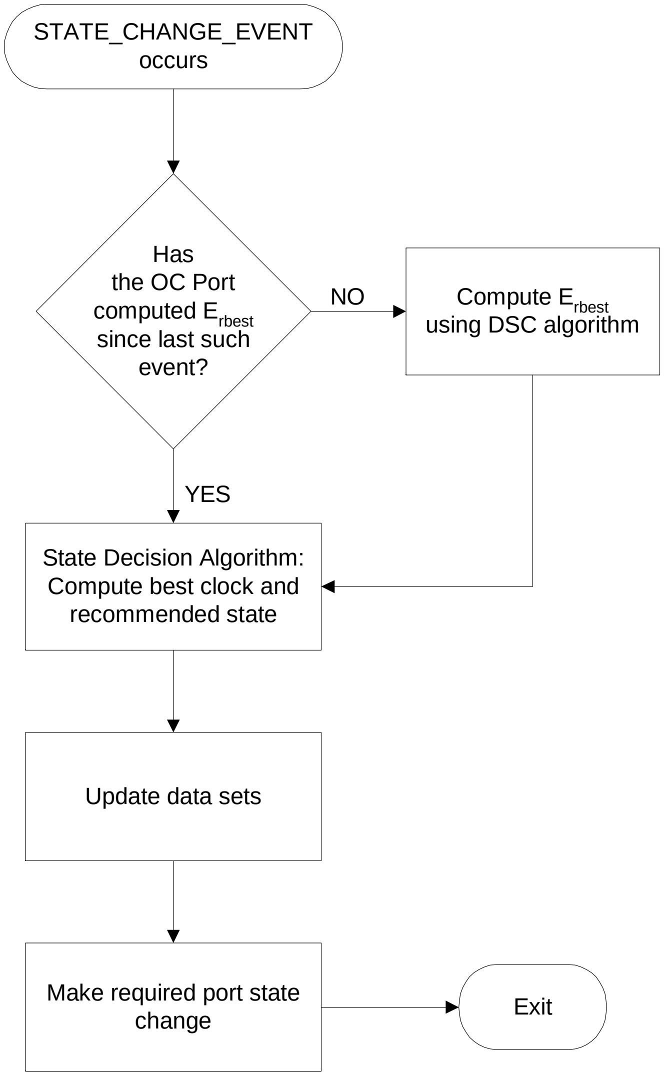
Best Master Clock Algorithm (Cont.)

- An Announce message received on a port is qualified unless
  - The Announce message was sent either by this port or, in the case of a BC, by another port on the same clock
  - The Announce message is not the most recent one received from the clock that sent it
  - If the Announce message is from the foreign master data set, then a minimum number of Announce messages (PTP_FOREIGN_MASTER_THRESHOLD) must have been received in a time window (PTP_FOREIGN_MASTER_TIME_WINDOW) for the Announce message to be considered qualified.
    - In IEEE 1588, v1, the time window is 2 sync intervals (equivalent to 2 announce intervals here) and the threshold is 2
      - This requirement prevents the need for reconfiguration if a clock initially thinks it should be master but quickly discovers that a better master is present
- The above rules mean that the Announce messages considered are those that (1) are the most recent to have arrived from all nodes that are not the current master, providing at least 2 messages have arrived in 2 announce intervals (and excluding any messages sent by the current node), and (2) are the most recent to have arrived from the current master

Best Master Clock Algorithm (Cont.)

- In addition, the computation of E_{rbest} must include the Announce message that was previously computed to be E_{rbest} the last time the BMC was executed, unless
  - There is a more recent message from the same clock, or
  - An ANNOUNCE_RECEIPT_TIMEOUT_EXPIRES event has occurred, i.e., an Announce message has not been received from this clock for time interval PTP_ANNOUNCE_RECEIPT_TIMEOUT (the current default is 10 announce intervals)
- With the preceding background, the BMC algorithm, which is executed when the STATE_CHANGE_EVENT occurs, is specified by the flowchart on the next page
  - This flowchart is a specialization of the flowchart in Figure 14 of [2] and Figure 4.3 of [3], to the case of an Ordinary Clock

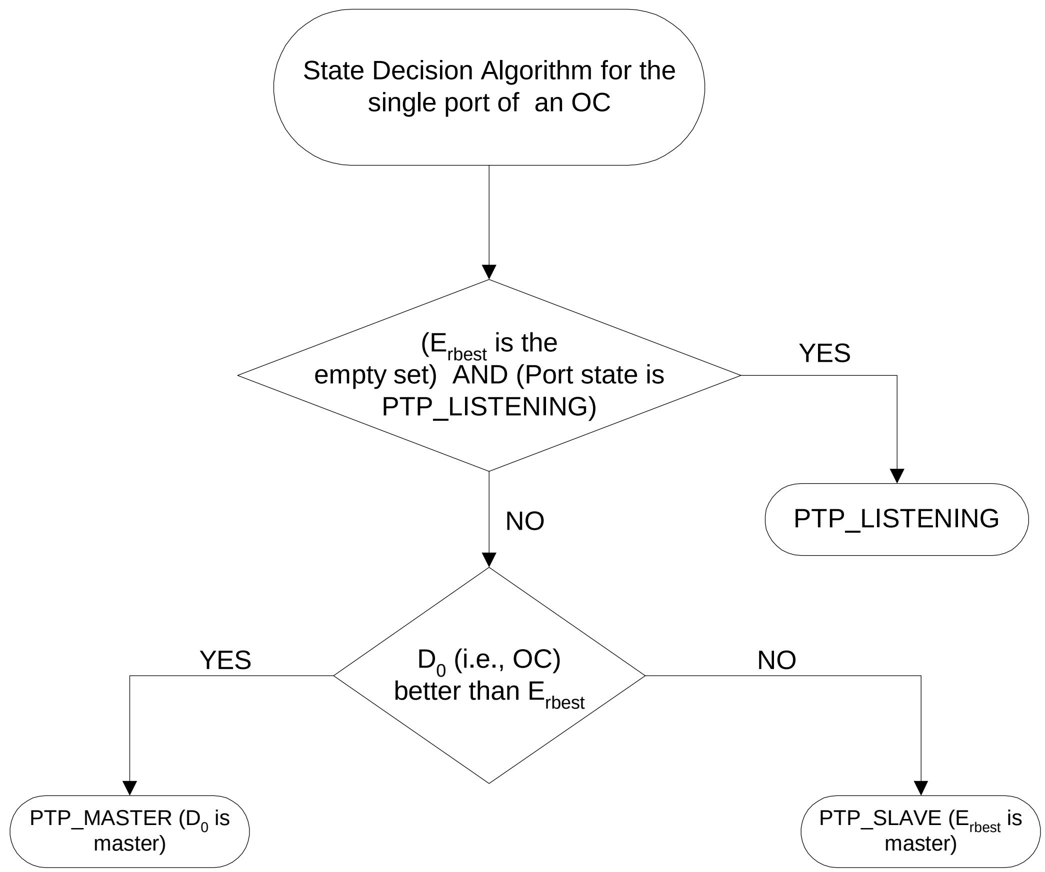
Best Master Clock Algorithm (Cont.)



This is the BMC Algorithm, specialized To the case of an OC.

It is invoked independently at each OC

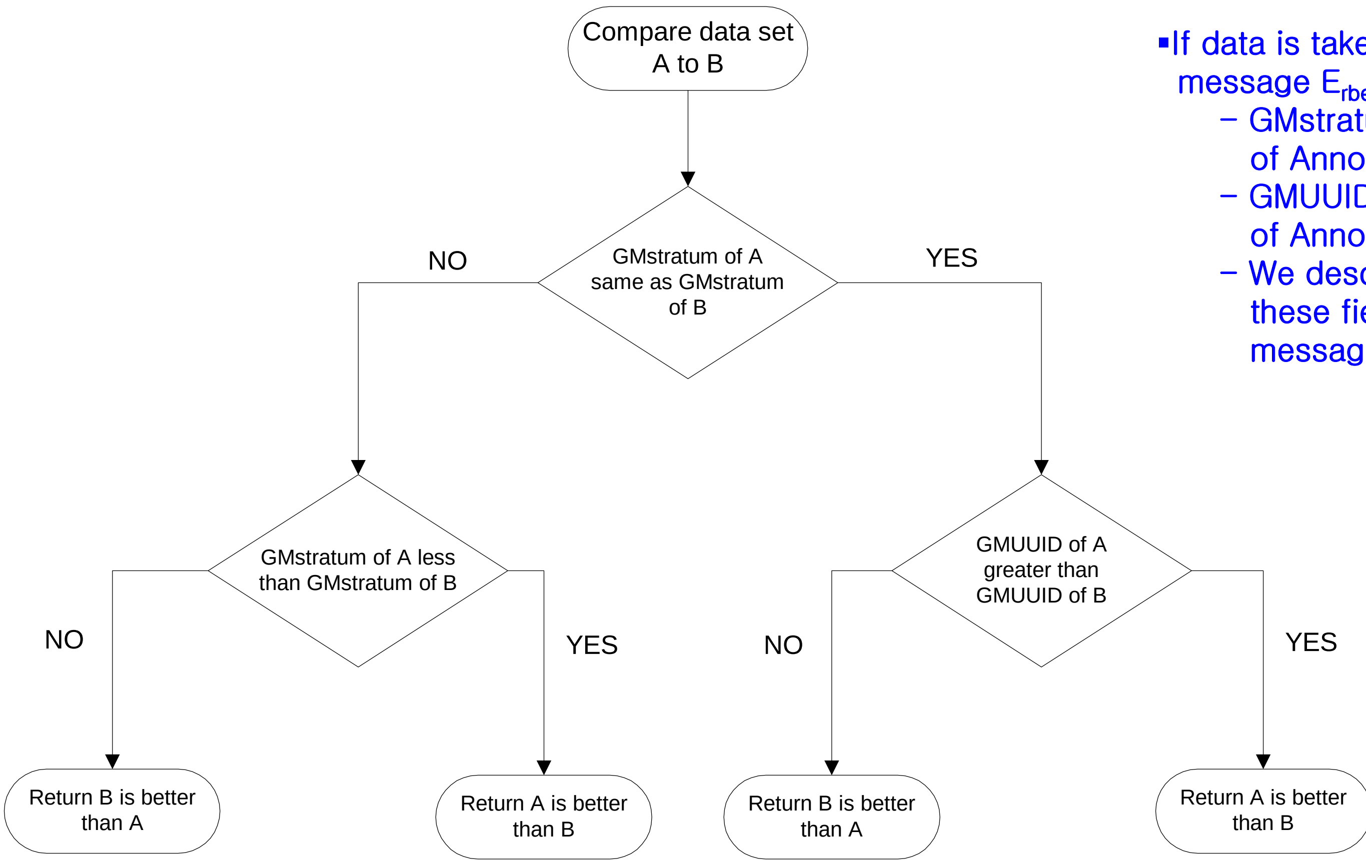
State Decision Algorithm



Update clock data sets according to table M2 (described later)

Update clock data sets according to table S1 (described later)

Data Set Comparison Algorithm



- If data is taken from local clock D_0
  - GMstratum = local clock stratum
  - GMUUID = local clock uuid
- If data is taken from best incoming message E_{rbest}
  - GMstratum = grandmasterStratum of Announce message
  - GMUUID = grandmasterUuid of Announce message
  - We describe later the sources of these fields when an Announce message is sent

Data Sets

- The values of various parameters, plus the current state, of an OC are maintained in 6 data sets (maintained at each OC)
  - Default data set – contains inherent or assumed properties of the local clock (oscillator)
  - Current data set – contains current properties of the local clock, used for both BMC selection and synchronization
  - Parent data set – contains information on the current master of the clock (i.e., its parent)
  - Global Time Properties data set – contains information that is useful in synchronizing to UTC (e.g., current offset between PTP time (based on TAI) and UTC, warning of impending leap second, etc
    - not directly used in PTP protocol
  - Port Configuration data set – contains information that characterizes a PTP port
    - There is one Port Configuration data set per BC port, and therefore only one such data set in an OC or AVB node
  - Foreign Master data set – stores the Sync messages and their qualification status for each foreign master of the node in question

Data Sets (Cont.)

- Note that not all parameters of all data sets are needed for BMC algorithm
- The following slides list the data set members
- For each member, we indicate
  - Whether it is used by BMC algorithm and, if so, a detailed definition
  - Whether it is needed by AVB but not by BMC algorithm
  - Whether it is not needed by AVB at all
  - Whether, in the view of the author, the member may be needed by AVB (a decision would be needed by the 802.1 AVB TG)
  - Members definitely needed by AVB are highlighted in **red**
  - Members that may be needed by AVB are highlighted in **green**
- We do not cover data sets and members needed for P2P TCs; this will be considered in a future presentation
- In the following, the parent of a slave clock refers to the master port that the slave clock is synchronized to (a GM does not have a parent)

Default Data Set

- **clock_communication_technology** – refers to the network technology, which is Ethernet for AVB (fixed and the same for all nodes, and therefore not explicitly needed)
- **clock_uuid_field** – uuid for the clock, i.e., Ethernet MAC address for the node; needed for AVB and BMC algorithm
- **clock_port_field** – port ID for the clock as a whole, which is specified to be zero in IEEE 1588. In AVB, each OC will have only one port with port_id of 1; therefore, it is not necessary to maintain explicit port members for clocks and ports (since the only IDs used are 0 and 1, respectively). This member is therefore not explicitly needed)
- **clock_stratum** – clock stratum number; for AVB, this is a number between 3 and X (inclusive), with X TBD but ≤254; needed for AVB and BMC algorithm
- **clock_identifier** – not needed by AVB
- **clock_variance** – not needed by AVB
- **clock_followup_capable** – whether the clock is follow-up or on-the-fly; needed for AVB
- **preferred** – not needed by AVB (AVB will use multiple stratum levels to indicate multiple GM preference levels

Default Data Set (Cont.)

- **initializable** – whether receipt of the respective management message can cause the clock to re-initialize
- **External_timing** – whether the clock is capable of providing external timing signals to other AVB nodes, via non-AVB path; not needed by AVB
  - AVB nodes may possibly be capable of being synchronized by external means, e.g., signal from service provider, but this member does not seem to refer to that
- **is_boundary_clock** – indicates whether the clock is a BC; always FALSE for AVB node, and therefore not needed by AVB
- **log_sync_interval** – logarithm to base 2 of the current sync interval; needed for AVB
- **log_announce_interval** – logarithm to base 2 of the current announce interval; needed for AVB and operation of BMC algorithm
- **subdomain_number** – number assigned to the subdomain. Since an AVB network will consist of the single default PTP subdomain, i.e., subdomain 0, this number is implied and therefore not needed by AVB
- **number_ports** – number of ports in the node; since AVB nodes will contain only OCs and not BCs, this member is always set to 1; therefore, its value is implied and not needed by AVB

Default Data Set (Cont.)

- **number_foreign_records** – maximum number of foreign master records maintained in the foreign master data set; for AVB, it may be possible to simply specify a sufficiently large value for this, and therefore an explicit member in the default data set would not be needed

Current Data Set

- **steps_removed** – number of PTP communication paths traversed between the local clock and GM clock. This member is not needed by AVB, because an AVB network is equivalent to a single PTP communication path and, therefore, every slave is one hop from the GM
- **offset_from_master** – slave offset from the master (GM in the case of AVB) computed by the PTP protocol (this member is zero for the GM); needed for AVB
- **one-way-delay** – measured one-way propagation delay computed using Sync, Delay_Req, Delay_Resp, and possibly Follow_Up messages. In the case where there are no peer-to-peer transparent clocks between the local clock and the PTP clock to which it is synchronized via PTP, this member's value represents an actual estimate of the one-way propagation delay between the local clock and the PTP clock to which it is synchronized via PTP. This member is not needed in the case where P2P TCs are present (and therefore in AVB) because, for that case, propagation delays are computed using the Pdelay mechanism.

Parent Data Set

- **parent_communication_technology** – refers to the network technology for the parent port if the current clock is a slave, and to the network technology of the current clock if it is GM. This member is Ethernet for AVB (fixed and the same for all nodes, and therefore not explicitly needed)
- **parent_uuid** – uuid for the parent clock if the current clock is a slave, and uuid of the current clock if it is GM. The uuid is the Ethernet MAC address for the node; needed for AVB and BMC algorithm. If the clock is a slave, this member is the value of the sourceUuid field of the last Announce message received from the parent of the slave port. Needed for AVB and operation of the BMC algorithm.
- **parent_port_id** – for a slave clock, the clock port ID of the parent port; for a GM, the clock port ID of the default data set. For AVB, this will be 1, since each AVB node has a single OC (i.e., the port ID is fixed and the same for all nodes, and therefore not explicitly needed)
- **parent_last_announce_sequence_number** – for a slave clock, the sequenceId field of the last Announce message sent by the parent port; for a GM, zero. Needed for AVB and operation of the AVB algorithm.
- **parent_last_sync_sequence_number** – for a slave clock, the sequenceId field of the last Sync message sent by the parent port; for a GM, zero. This member may not be needed in IEEE 1588 (was used in v1 for BMC; in v2 the parent_last_announce_sequence_number is used).

Parent Data Set (Cont.)

- **parent_followup_capable** – for a slave, whether the parent is follow-up capable; for a GM, whether it is follow-up capable (and therefore equal to the clock_follow_up_capable member of the default data set). This information is communicated to a slave via the TIME_APPROXIMATE (formerly called PTP_ASSIST) flag. Needed for AVB.
- **parent_external_timing** – whether the parent (or GM, if the current clock is GM) is capable of timing a slave via an external timing signal; not needed by AVB.
- **parent_variance** – clock_variance of the parent (or of the GM, if the current clock is GM); not needed by AVB.
- **parent_stats** – whether or not the current clock will compute estimates of its parent's variance and drift rate; not needed by AVB
- **observed variance** – computed value of parent's variance, if this is computed; not needed by AVB
- **Observed_clock_phase_change_rate** – computed value of parent's drift rate, if this is computed; not needed by AVB

Parent Data Set (Cont.)

- **utc_reasonable** – used only if the parent_stats field is TRUE; therefore, not needed by AVB
- **grandmaster_communication_technology** - refers to the network technology for the clock perceived to be the GM. This member is Ethernet for AVB (fixed and the same for all nodes, and therefore not explicitly needed)
- **grandmaster_uuid_field** - uuid for the clock perceived to be the GM. If the current clock is a slave, this is taken from the grandmasterClockUuid field of the last Announce message received from the parent of the slave port. If the current clock is GM, this is taken from the clock_uuid member of the default data set. Needed for AVB and operation of the BMC algorithm.
- **grandmaster_port_id_field** – refers to the clock port ID of the clock perceived to be the GM. For AVB, this will be 1, since each AVB node has a single OC (i.e., the port ID is fixed and the same for all nodes, and therefore not explicitly needed)
- **grandmaster_stratum** - stratum for the clock perceived to be the GM. If the current clock is a slave, this is taken from the grandmasterClockStratum field of the last Announce message received from the parent of the slave port. If the current clock is GM, this is taken from the clock_stratum member of the default data set. Needed for AVB and operation of the BMC algorithm.

Parent Data Set (Cont.)

- **grandmaster_identifier** – clock identifier for the clock perceived to be GM. Not needed by AVB.
- **grandmaster_variance** - variance for the clock perceived to be GM. Not needed by AVB.
- **grandmaster_is_preferred** – indication of whether the clock perceived to be GM is preferred. Not needed by AVB, as AVB will use different stratum numbers between 3 and X (with $3 \leq X \leq 254$ and X TBD) to indicate preference levels.
- **grandmaster_is_boundary_clock** – indication of whether the clock perceived to be GM is a BC. Not needed by AVB, as AVB will not use BCs.
- **grandmaster_sequence_number** – sequence number of the lowest numbered port of the clock currently perceived to be GM. This may not be needed in 1588 v2, as it appears that the most recent Announce message will be based on Announce message sequence_number and not Announce message grandmaster_sequence_number.

Global Time Properties Data Set

- **current_utc_offset** – indication of current offset between UTC and TAI, if the information is available. This will be needed by AVB if there is a desire to supply UTC; this is because the PTP timescale is based on TAI. This is not needed for the BMC algorithm.
- **leap_59** – indication of whether the last minute of the current day will contain 59 seconds, if this information is available. This will be needed by AVB if there is a desire to supply UTC; this is because the PTP timescale is based on TAI. This is not needed for the BMC algorithm.
- **leap_61** – indication of whether the last minute of the current day will contain 61 seconds, if this information is available. This will be needed by AVB if there is a desire to supply UTC; this is because the PTP timescale is based on TAI. This is not needed for the BMC algorithm.
- **epoch_number** – current number of times the 32-bit seconds portion of the timestamp has rolled over since the PTP epoch. Needed for AVB.

Foreign Master Data Set

- Note: A separate record containing each of the following members is needed for each foreign master seen by the port of the OC in an AVB node (in a more general 1588 network with BCs, a foreign master data set would be needed for each BC port)
- **foreign_master_communication_technology** - refers to the network technology of the foreign master, which is Ethernet for AVB (fixed and the same for all nodes, and therefore not explicitly needed)
- **foreign_master_uuid_field** - uuid for the foreign master, i.e., Ethernet MAC address for the node; needed for AVB and BMC algorithm
- **foreign_master_port_id_field** – foreign master port ID; for AVB, this will be 1, since each AVB node has a single OC (i.e., the port ID is fixed and the same for all nodes, and therefore not explicitly needed)
- **foreign_master_syncs** – number of Announce messages received from the foreign master within a time window PTP_FOREIGN_MASTER_TIME_WINDOW. Needed for AVB and BMC algorithm. Note that IEEE 1588, v1 seems to not fully specify a state machine for the updating of this parameter; it is not clear whether that is because the details are left to implementation, or for some other reason.

Port Configuration Data Set

- Note: An AVB node has a single OC and therefore a single port configuration data set; in more general PTP applications with BCs, a BC has one port configuration data set for each port
- **port_state** – current state of the port; needed for AVB and BMC algorithm
- **last_sync_event_sequence_number, last_general_event_sequence_number** – In IEEE 1588, v1, these members are used to generate sequence numbers for event and general messages, respectively. For v2, the current proposal is to not specify how sequence numbers are generated, but simply to indicate that they must be monotonically increasing except when rollover occurs, and that rollover will not happen until a sufficient number of messages of the same type have been transmitted (the current proposal is 20). With this proposal, it is up to the implementation whether to use a separate series of sequence numbers for each message type, a single series for all messages, or separate series where each series include a subset of message types. It therefore is up to the implementation as to how many sequence number counters are needed. As a result, IEEE 1588 may only specify a single member here (or not specify any member at all); in any case, the implementation will need as many members as necessary for the algorithm it chooses to use.

Port Configuration Data Set (Cont.)

- **sub_domain_address** – network address corresponding to the sub_domain_number in the default data set. Not needed by AVB, and likely not needed by any PTP applications over layer 2 Ethernet (this is used, e.g., for layer 3 applications of PTP over UDP over IPv4).
- **event_port_address** – port address for the event port associated with this PTP port. Not needed by AVB, and likely not needed by any PTP applications over layer 2 Ethernet (this is used, e.g., for layer 3 applications of PTP over UDP over IPv4).
- **general_port_address** – port address for the general port associated with this PTP port. Not needed by AVB, and likely not needed by any PTP applications over layer 2 Ethernet (this is used, e.g., for layer 3 applications of PTP over UDP over IPv4).
- **port_communication_technology** - refers to the port network technology, which is Ethernet for AVB (fixed and the same for all nodes, and therefore not explicitly needed)
- **port_uuid_field** - uuid for the port, i.e., Ethernet MAC address for the node; needed for AVB and BMC algorithm
- **port_id_field** – port ID; for AVB, this will be 1, since each AVB node has a single OC (i.e., the port ID is fixed and the same for all nodes, and therefore not explicitly needed)

Port Configuration Data Set (Cont.)

- **burst_enabled** – indicated in IEEE 1588 v1 whether the clock is capable of requesting and providing a burst of Sync messages. The current proposal for IEEE 1588 v2 is to eliminate burst mode as no longer necessary (because shorter sync intervals are available in v2 compared to v1). In any case, not needed by AVB.

Update of Clock Data Sets after SD Algorithm

- BMC algorithm (slide 16) indicates that data sets are updated after executing State Decision Algorithm
- State Decision Algorithm (slide 17) indicates that
  - Data sets are updated according to Table M2 if the OC (D_0) is placed in the master state (i.e., its port is placed in the PTP_MASTER state)
  - Data sets are updated according to Table S1 if the OC (D_0) is placed in the slave state (i.e., its port is placed in the PTP_SLAVE state)
- Tables M2 and S1 are on the following slides; updates only for members relevant to AVB are indicated (the full set of updates needed for more general PTP applications are given in [2])

Table M2 (specialized to AVB)

Update this member of the indicated data set	From the indicated field of the default data set unless otherwise stated
offset_from_master (current data set)	Set to 0
parent_uuid (parent data set)	clock_uuid_field
parent_last_announce_sequence_number (parent data set)	Set to 0
parent_followup_capable (parent data set)	clock_followup_capable
grandmaster_uuid_field (parent data set)	clock_uuid_field
grandmaster_stratum (parent data set)	clock_stratum
port_state (port configuration data set)	New state of port, determined by SD algorithm

Table S1 (specialized to AVB)

Update this member of the indicated data set	**From the indicated field of the default data set unless otherwise stated**
parent_uuid (parent data set)	sourceUuid of E_{best}
parent_last_announce_sequence_number (parent data set)	sequenceId of E_{best}
parent_followup_capable (parent data set)	Logical value of TIME_APPROXIMATE flag of E_{best}
grandmaster_uuid_field (parent data set)	grandmasterClockUuid of E_{best}
grandmaster_stratum (parent data set)	grandmasterClockStratum of E_{best}
current_utc_offset	currentUTCOffset of E_{best}
Leap_59	Logical value of PTP_LI_59 flag of E_{best}
Leap_61	Logical value of PTP_LI_61 flag of E_{best}
port_state (port configuration data set)	New state of port, determined by SD algorithm

References

1. Geoffrey M. Garner, *Description of Use of IEEE 1588 Peer-to-Peer Transparent Clocks in A/V Bridging Networks*, Revision 2.0, May 12, 2006.
2. IEEE 1588, *IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems*, IEEE Instrumentation and Measurement Society, November 8, 2002.
3. John C. Eidson, *Measurement, Control and Communication Using IEEE 1588*, Springer, 2006.