Maintenance Item #322

Alternate set of information needed to correlate preciseOriginTimestamp (to 802.11 timestamp counter)

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Goals of this discussion

- Present the problem we encountered while implementing IEEE802.1AS-2020 over IEEE802.11 Fine Timing Measurement
- Present a solution developed as a workaround
- Get feedback from IEEE802.1AS experts
- In the next revision of this presentation incorporate feedback and present a standard solution
  - To be incorporated into IEEE802.1AS-2020-Corrigendum

Terminology

- In the spirit of inclusive language, we have taken the liberty to replace the terms used in IEEE802.1AS-2020 with the following. We are aware of the discussions in IEEE1588 and in IEEE802.1 related to this topic:
  - Master -> Leader
  - Slave -> Follower

Introduction

- Maintenance Item #322 identifies requirement for an alternate representation of follow_up_information in order for some IEEE802.11 implementations to be able to correlate the system clock to the corresponding Wi-Fi subsystem timestamp counter
- Timestamps in 802.11 media are derived from a free running counter
  - the 64-bit counter ticking at rate that is implementation specific.
  - The values of t1, t2, t3 and t4 are snapshots of this counter (in 10ns units or 1ps units for TM and FTM respectively)
- implementation of the Wi-Fi stack dictates how the snapshot of the free running counter, and the corresponding value of the system clock is obtained
  - In some cases, the snapshot includes non-deterministic errors causing time synchronization (using 802.1AS) to be constrained by the non-deterministic error, i.e, the synchronized clock at the Follower is off by the non-deterministic error (or more).
  - E.g., non-deterministic error: the time elapsed between when the free running counter value was obtained and when it was returned to the higher layer which captures the corresponding system-time value.
  - The specification should allow for all possible implementations

Gist of Maintenance Item #322

- Rationale: Some implementations require an alternate set of information in order to correlate the time value in the preciseOriginTimestamp field of the FollowUpInformation to the timestamp information (t1, t4).
- Proposed Revision Text:
  - Define a type-1 Follow_Up_Information in Clause 12-7 of IEEE802.1AS-2020 that represents an alternate interpretation of FollowUpInformation
  - Define how the Follower uses this alternate FollowUpInformation in computing the offset value (for synchronizing time)
- Impact on Existing Networks
  - There should be no impact on existing networks/implementations as type-1 is currently a reserved value (and existing implementations are expected to ignore this type).

What is in IEEE802.1AS-2020 Clause12-7?

- Fine Timing Measurement (FTM) and Timing Measurement (TM) frames include a VendorSpecific (Standards Institution Specific) element

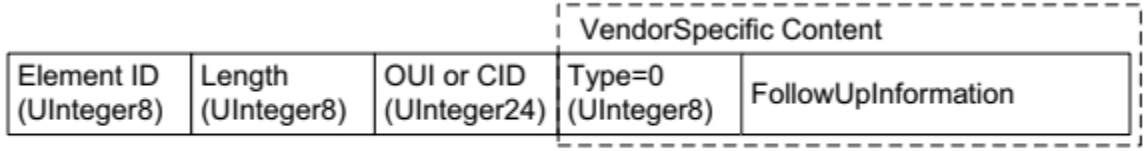

Figure 12-8—Format of VendorSpecific information element when Type = 0

This mechanism shall be used to carry end-to-end link-independent timing information from the master port to the associated slave port, including preciseOriginTimestamp, rateRatio, correctionField, and other fields of the Follow-Up message, as described in 12.5.1.4. For consistency, all of these fields are packed into the FollowUpInformation field using exactly the same format as used for full-duplex point-to-point links. In other words, the master state machine communicates an entire Follow_Up message [i.e., including all the fields of the common header (see 11.4.2 and 10.6.2), the preciseOriginTimestamp, and all the fields of the Follow_Up information TLV (see 11.4.4)] using this mechanism. The Type field, illustrated in Figure 12-8, identifies this use of the OUI or CID within the VendorSpecific information element. Table 12-4 lists values for the Type field.

Table 11-9—Sync message fields if twoStep flag is FALSE

Bits	Octets	Offset
7 6 5 4 3 2 1 0		
header (see 11.4.2)	34	0
originTimestamp	10	34
Follow_Up information TLV	32	44

Table 10-7—PTP message header

Bits	Octets	Offset
7 6 5 4 3 2 1 0		
majorSdoId | messageType	1	0
minorVersionPTP | versionPTP	1	1
messageLength	2	2
domainNumber	1	4
minorSdoId	1	5
flags	2	6
correctionField	8	8
messageTypeSpecific	4	16
sourcePortIdentity	10	20
sequenceId	2	30
controlField	1	32
logMessageInterval	1	33

What is proposed?

- Type 0: FollowUpInformation includes preciseOriginTimestamp (from the GrandLeader) and correctionField* is set to

```
residenceTime = MDSyncSend.rateRatio *
        (paramsFromConfirm.T1 * 10^K*(2^16) - MDSyncSend.upstreamTxTime);

requestParams.VendorSpecific.correctionField =
residenceTime + MDSyncSend.followUpCorrectionField;
```

State machine invoked by instance-specific peer-to-peer delay mechanism:
upstreamTxTime = syncEventIngressTimestamp - (meanLinkDelay/neighborRateRatio) - (delayAsymmetry/rateRatio)
State machine invoked by CMLDS:
upstreamTxTime = syncEventIngressTimestamp - (meanLinkDelay/neighborRateRatio)

- Type 1: FollowUpInformation
  - requestParams.VendorSpecific.preciseOriginTimestamp = UTC time T1 corresponding to timestamp t1
  - requestParams.VendorSpecific.correctionField = UTC Time T4 corresponding to timestamp t4

* See 12.5.1.4.1 a) and Figure 12.5 (12.5.1.4.4 for TM) and 12.6 for (12.5.1.4.6 for FTM)

Questions?