Proposed 802.11v “Timing Measurement” changes and implications to 802.1AS

Kevin Stanton

Intel Corporation

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Introduction

- November 2006, 802.11v approved a proposal to add time-offset-measurement option to existing location feature
- This week, Alan Thompson of Cisco proposing rewrite of location feature
  - https://mentor.ieee.org/802.11/file/08/11-08-0441-00-000v-normative-text-for-d2-0-location.doc
- The proposal redefines and separates time measurement from location
- This presentation provides an overview of the relevant changes and enhancements

But first, some review…

For Ethernet links (step 1 of 2)

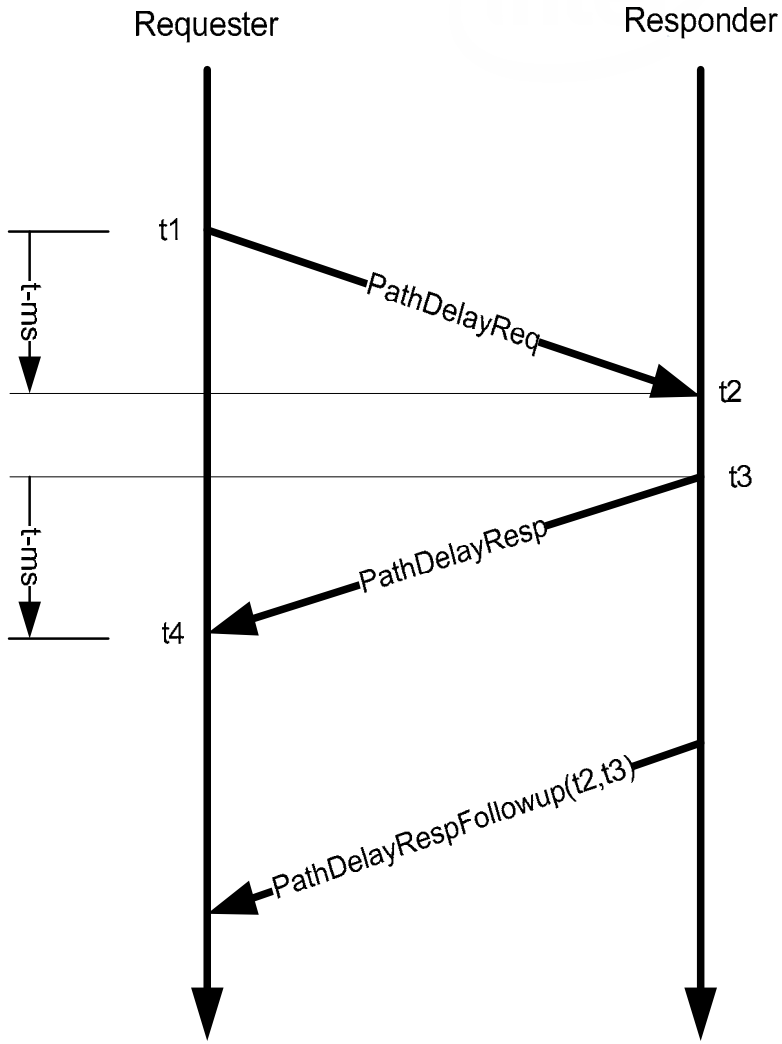
Measure link delay:

1. Requester schedules PathDelayReq for transmission
2. As it passes out the PHY, t1 is captured
   - Using master's free-running clock
3. Time t2 captured as passes from PHY to MAC
   - Using slave clock
4. Responder schedules PathDelayResp for transmission
5. Timestamps t3 and t4 captured
   - Using local free-running clock
6. PathDelayRespFollowup carries t2 and t3 to requester

If link delay is fixed & symmetric:

link_delay = [(t4-t1) – (t3-t2)] / 2

Timestamps known by requester
t1
t1,t4
t1,t2,t3,t4



Ethernet time sync (step 2 of 2)

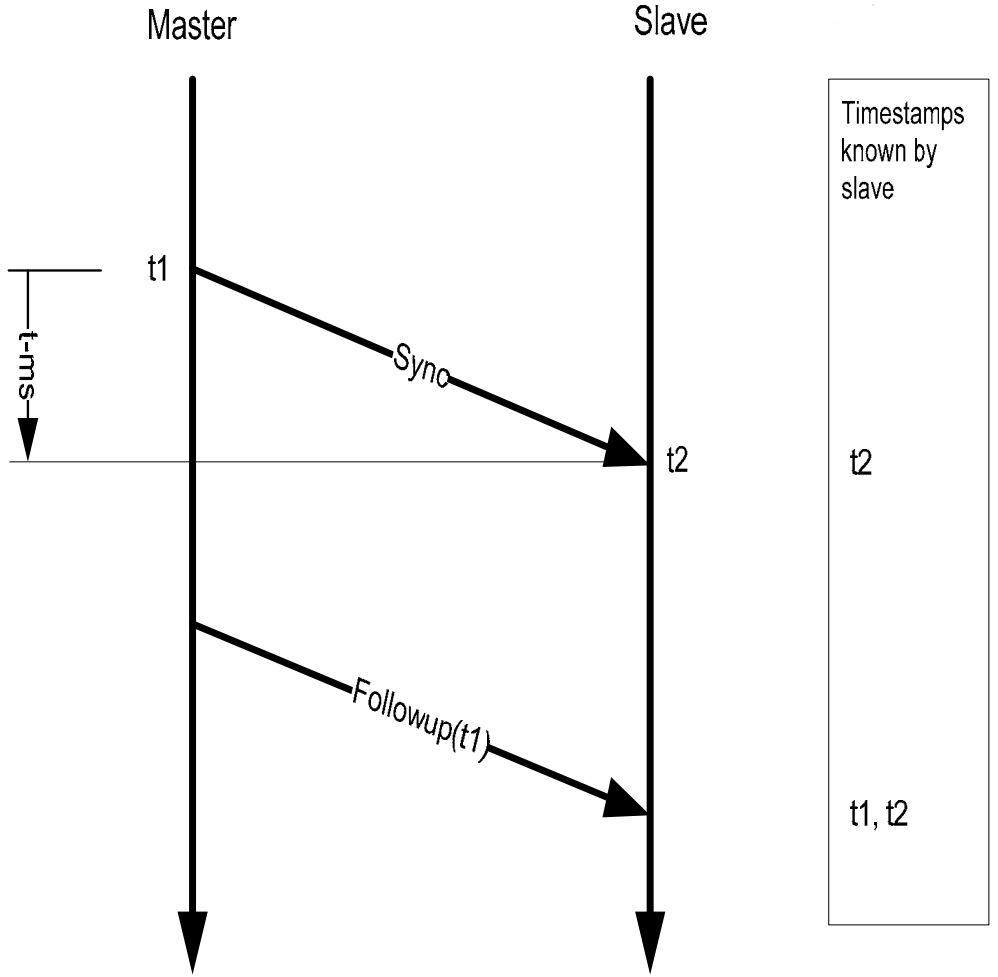
Synchronize clocks

1. Master schedules Sync for Tx
2. As it passes out the PHY, t1 captured
   - Using master's free-running clock
3. Time t2 captured as passes from PHY to MAC
   - Using slave clock
4. FOLLOWUP carries t1 to slave

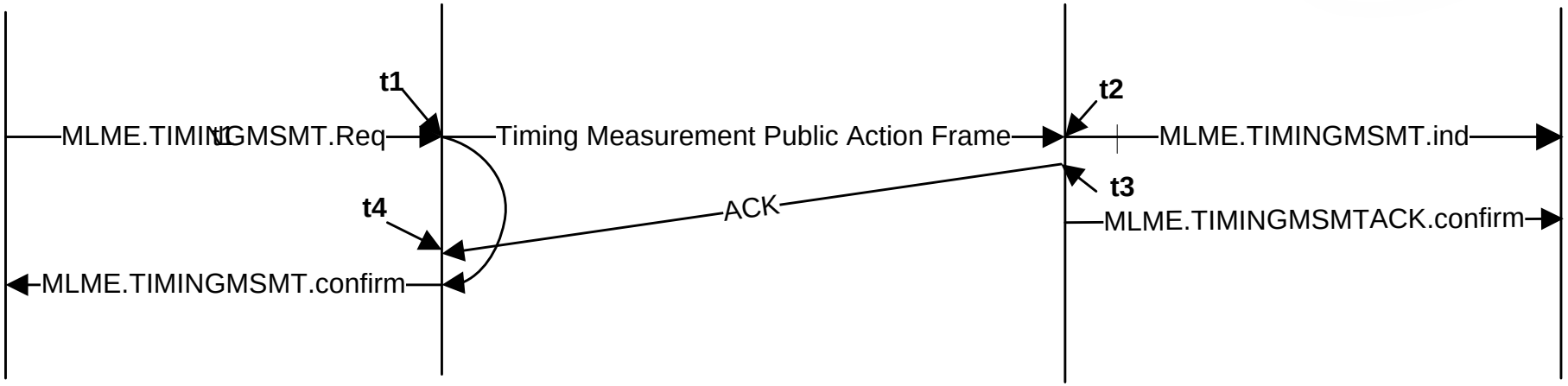
If link delay is fixed & symmetric:

Slave's clock offset
= t2 – t1 – link_delay

Note: APs & bridges do this too, communicate the 'residence time' of each Sync in each corresponding Followup frame



802.11v measurement protocol



STA initiates request, unicast action frame → 2 timestamps

Subsequent ACK control frames → 2 timestamps

Time offset = [(t4-t3) – (t2-t1)]/2

Link delay = [(t4-t1) – (t3-t2)]/2

Question: How are timestamps communicated?

Communicating timestamps to the peer station

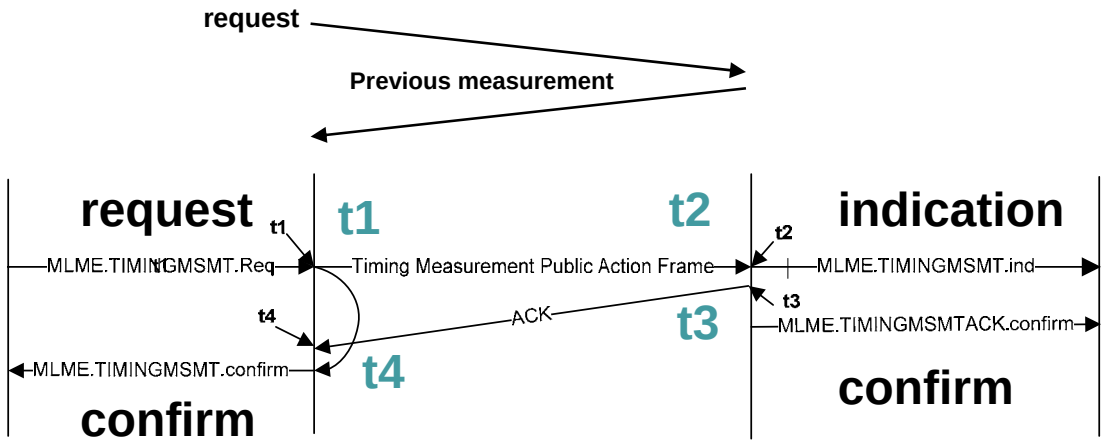
Two choices:

1. Requester sends its timestamps t1 and t4 in a subsequent frame
   - Just like Sync / Followup of 1588
2. Responder sends its timestamps t2 and t3 in a subsequent frame
   - Just like PathDelayReq / PathDelayRespFollowup
   - Note: “PathDelayResp” is implicit via the ACK control frame

FrameUseMode bit selects which mode is intended

Proposal “11-08-0441” supports both choices

FrameUseMode=0 ➔ “Follow-up”



request

Peer MAC Address,
Dialog Token,
Follow On to Dialog Token,
Timestamp Difference, etc.
Timestamp

t1, (t2-t1) From previous →

indication

Peer MAC Address,
Dialog Token,
Follow On to Dialog Token,
Timestamp Difference, etc
Timestamp,
Ingress Timestamp ← t2

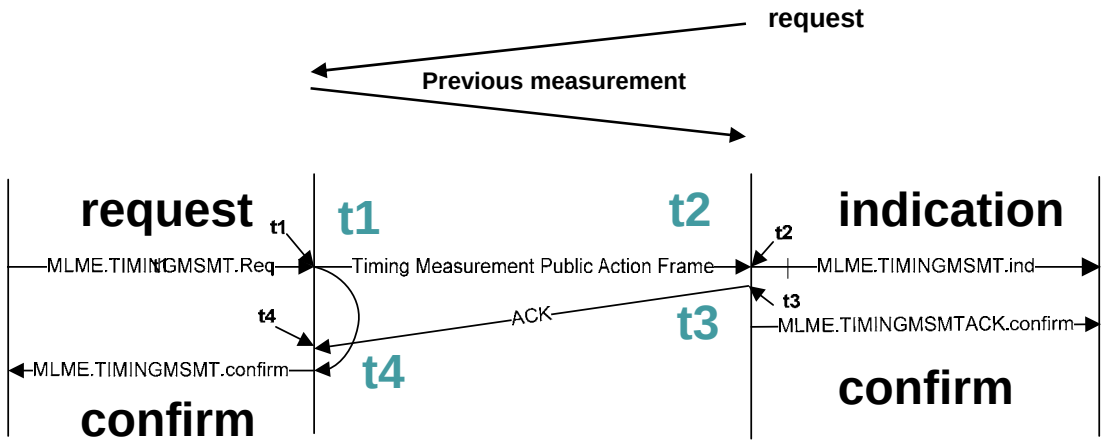
confirm

Peer MAC Address,
Dialog Token,
t1 → Timestamp,
t4 → Ingress Timestamp

confirm

Peer MAC Address,
Dialog Token,
Timestamp ← t3

FrameUseMode=1 ➔ “Follow-up”



request

Peer MAC Address,
Dialog Token,
Follow On to Dialog Token,
Timestamp Difference, etc.
Timestamp

t1, (t2-t1) From previous →

indication

Peer MAC Address,
Dialog Token,
Follow On to Dialog Token,
Timestamp Difference, etc
Timestamp,
Ingress Timestamp ← t2

confirm

Peer MAC Address,
Dialog Token,
t1 → Timestamp,
t4 → Ingress Timestamp

confirm

Peer MAC Address,
Dialog Token,
Timestamp ← t3

Time measurement action frame

	Category	Action	Dialog Token	Follow On to Dialog Token	Timestamp Difference	Frame Use Mode/Timestamp Difference Units	Timestamp Difference Accuracy	Timestamp
Octets:	1	1	1	1	4	1	1	10

- Rx & Tx times from previous measurement are in the Timestamp & timestamp difference fields
- Currently this is a Public Action Frame – can be sent to STA even if not associated

Vendor specific extensions

We must translate TLV extensions to .11v

7.4.5 Vendor-specific action details

The Vendor Specific Action frame is defined for vendor-specific signaling. The format of the Vendor Specific Action frame is shown in Figure 7-101. An OUI, in the octet field immediately after the Category field, differentiates the vendors.

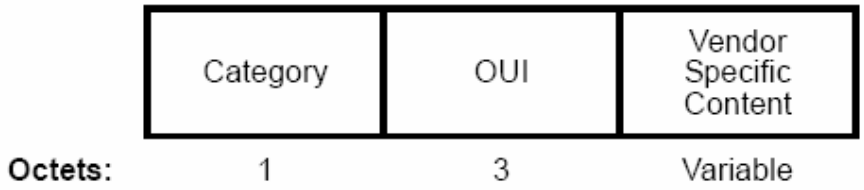


Figure 7-101—Vendor Specific Action frame format

The Category field is set to the value indicating the vendor-specific category, as specified in Table 7-24.

The OUI field is a public OUI assigned by the IEEE. It is 3 octets in length. It contains the OUI of the entity that has defined the content of the particular vendor-specific action.

Agenda

- Media synchronization (why)
- The 802.1 AVB standards (how)
- Clock requirements (how accurate)