

Timing Measurement Enhancement for Synchronization of AV streams

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Abstract

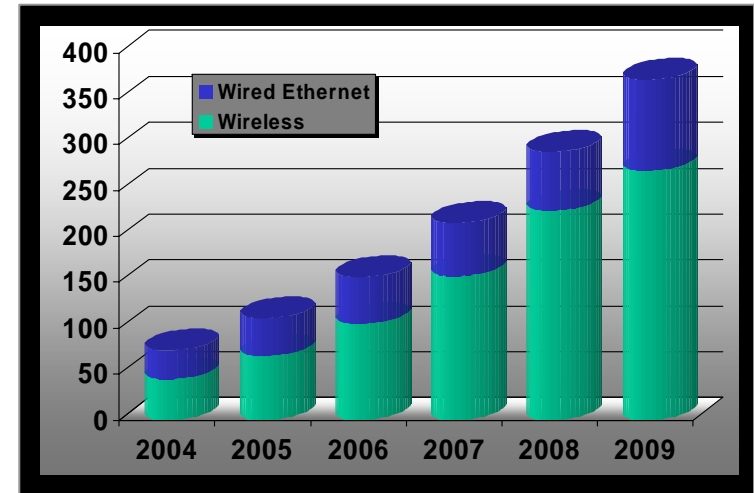
p802.1AS specifies a precise time synchronization protocol and architecture intended to operate across multiple 802 LANs. The task group is initially targeting support for 802.11 and 802.3, and MAC-level support for the timing-offset measurement is required.

The accompanying proposal (11-06-1614-00-000v) recommends modifications/additions to the Presence feature of the p802.11v draft in support of precise multi-MAC timing synchronization.

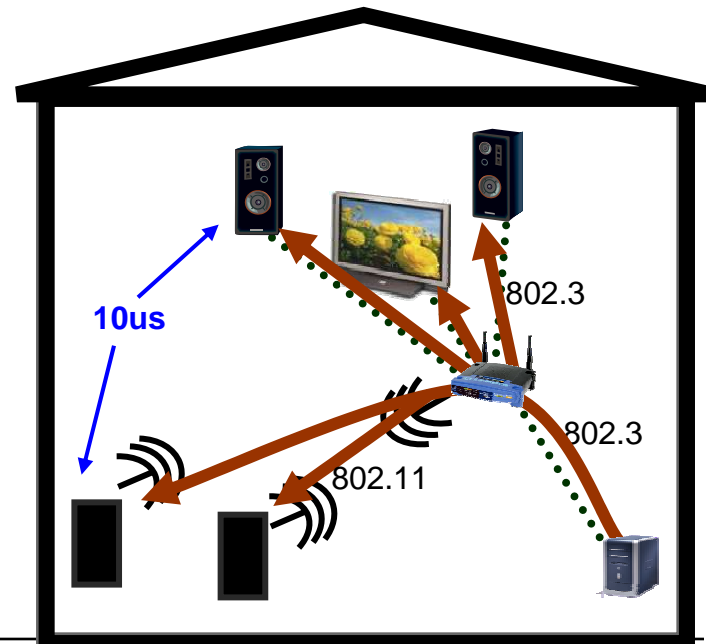
Motivation

- **Wireless speakers have strong customer demand**
 - Diffusion Group: 53% want
- **Most homes have both 802.11 and 802.3**
- **Multi-speakers/displays requires Time Synchronization**
 - Both for simultaneous “Start” and to counteract long-term drift
 - 11us for tightly coupled stereo
 - 15-45ms for lip sync
- **Time synchronization required for “media push” and multicast**
- **MAC-client-only solutions lack accuracy and guarantees**

802 Time synchronization standard needed over heterogeneous LANs



Source: Home Networking Nodes (IDC Aug'05)



Standards from the 802.1 Audio/Video Bridging Task Group

- **p802.1AS – Time Synchronization**
 - Based on emerging IEEE 1588 version 2
- **p802.1Qat – Stream Reservation Protocol**
 - Used to reserve bandwidth for streams
 - Admission Control
- **[802.1Qav]—Traffic Shaping**
 - Bandwidth & latency guarantees
- **802.1???**—Recommended Practice
 - Specifies network parameters
 - Defines a “defended network”

Effort now
comprehending
both wired and
wireless LANs

802.11 feedback yesterday
asked for 802.1Qav
PAR to include 802.11

Location estimation: 802.11 TGv using TOA

Goal: Measure distance between 802.11 entities (in ns)

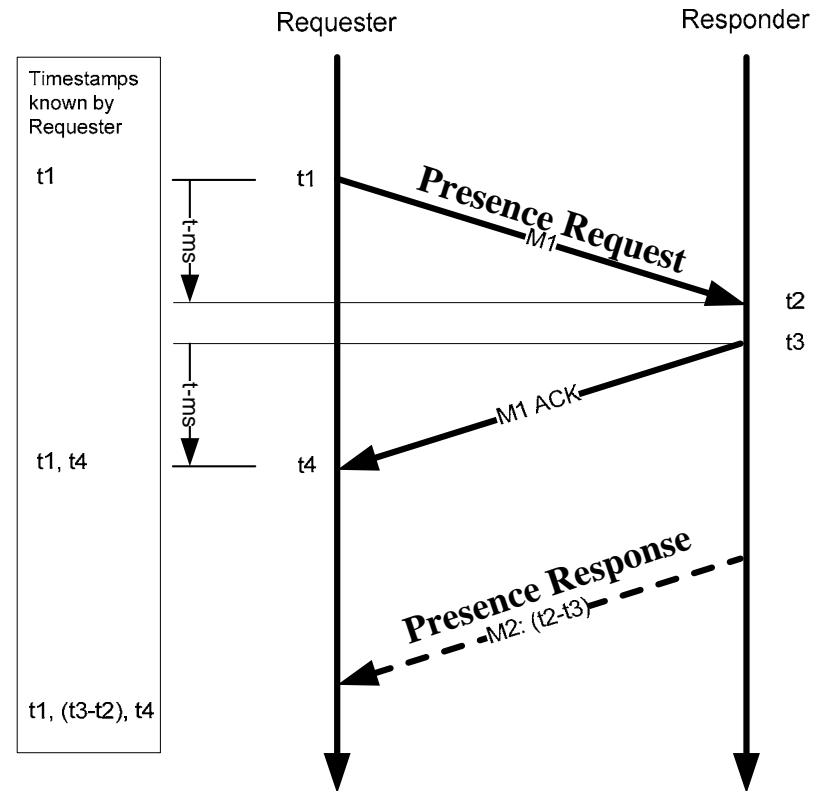
1. Requester schedules M1 for Tx
2. As it passes through the PHY, t1 captured
 - Using requester clock
3. Time t2 captured in PHY on Rx
 - Using slave clock
4. Responder MAC automatically sends M1 ACK very quickly (a control frame)
5. t3, t4 captured as above
 - Using slave clock
6. M2 carries (t3-t2) to requester

If link delay is fixed & symmetric:

$$\text{Link delay} = [(t4-t1) - (t3-t2)] / 2$$

Clock offset between master and slave
 $= [(t2-t1) - (t4-t3)] / 2$

BUT Requester doesn't know t3 and t2...

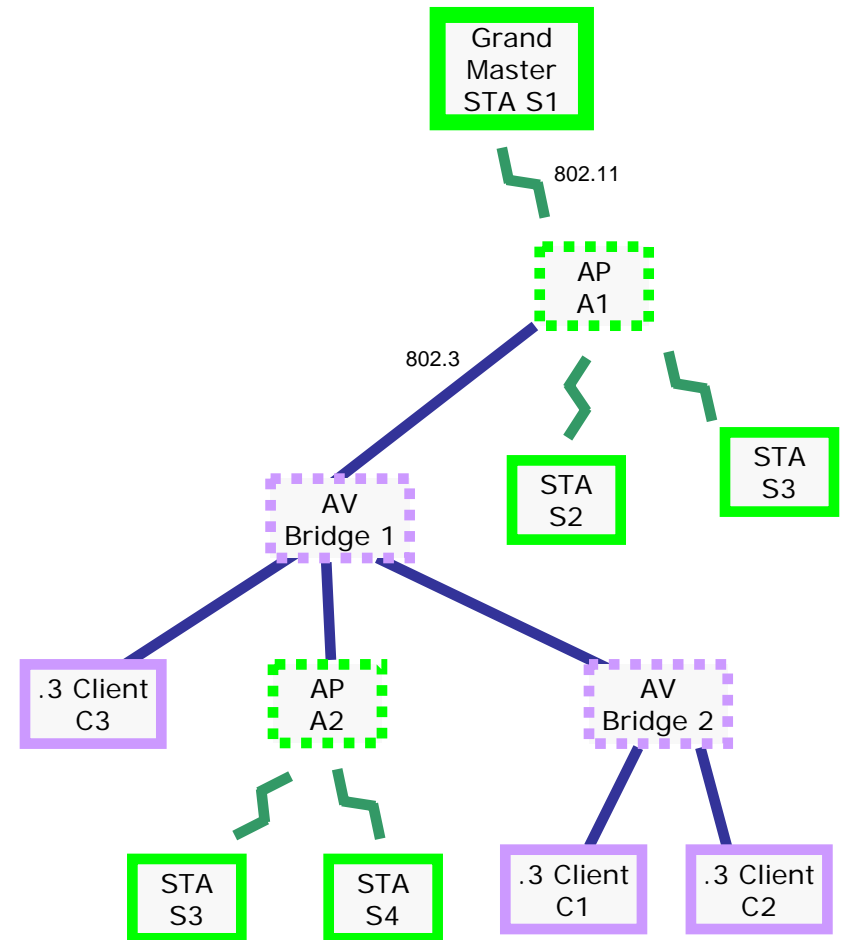


Backup

[Slides from my previous, 5/20/06 presentation 11-06-0984-00-000v]

Time Synchronization: A high level view

- **Grand Master selected**
- **Clock tree established**
- **Offset to Grand Master determined**
 - Per “Link”
 - Accumulated downstream
- **Time service provided to MAC client**

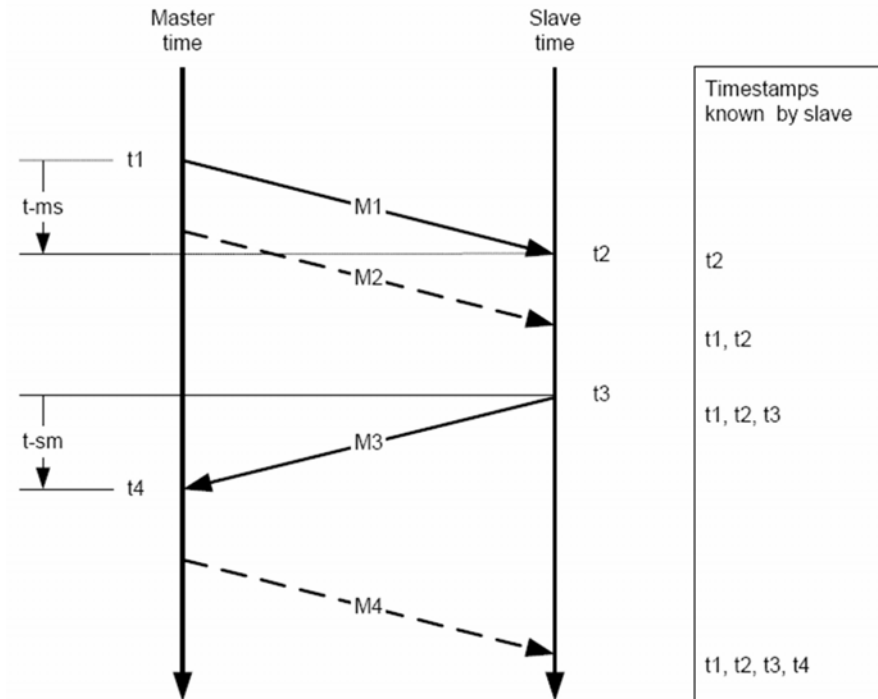


Time sync with IEEE 1588v1

[Similar to a proposed method for 802.1AS]

Goal: Synchronize clocks of networked nodes

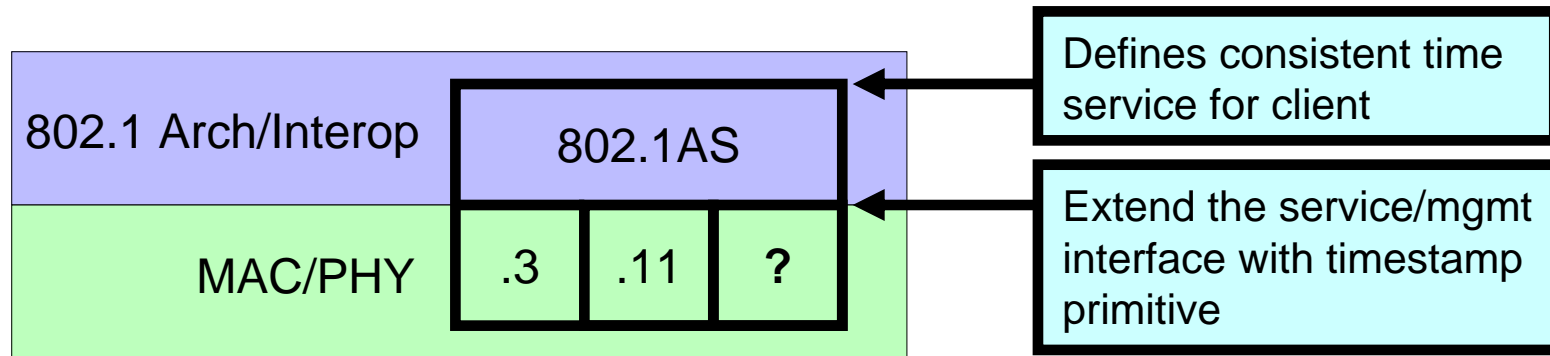
1. Master schedules SYNC (M1) for Tx
2. As it passes from MAC to PHY, t1 captured
 - Using master clock
3. Time t2 captured as passes from PHY to MAC
 - Using slave clock
4. FOLLOWUP (M2) carries t1 to slave
5. Slave schedules M3 for Tx
6. t3, t4 captured as above
7. M4 carries t4 to slave



If link delay is fixed & symmetric:

Clock offset between master and slave
 $= [(t2-t1) - (t4-t3)] / 2$

Our approach in 802.1



- **Interoperability, client time service**
- **Protocol:**
 - Include “Generic Messages Protocol” recommendation
 - Media may use the “Generic Messages” or define their own
- **Measurement:**
 - Define extension to MAC Service Interface to get timestamp information
 - Define measurement accuracy options, as appropriate for application