Timestamp Support for IEEE 802.1AS Time and Synchronization Call for Interest

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Supporters

- David Law – 3Com
- Steve Carlson – HSD
- Howard Frazier – Broadcom
- Michael Johas Teener – Broadcom
- Adam Healey – LSI
- Wael Diab – Broadcom
- Mike Bennett – LBL
- Brad Booth – AMCC
- Karl Ruling - ESTA

Why Are We Here

- To measure the **interest** in forming an 802.3 Study Group to investigate:
  - Providing support in 802.3 for IEEE 802.1AS by
    - Providing an accurate indication of the transmission and reception initiation times of certain packets
- **Not to**
  - Fully explore the problem
  - Debate strengths and weaknesses of solutions
  - Chose any one solution
  - Write a PAR and 5 Criteria
  - Write a standard or specification

Why now ?

- Work in this area has been ongoing since July of 2004 with the 802.3 Residential Ethernet SG
- RESG work was transferred to 802.1 in 2005 as the Audio/Video Bridging group
- 802.1 is working on a suite of Audio/Video Bridging protocols
- 802.1AS Timing and Synchronization is what 802.3 is being asked to support
- Other applications (carrier, industrial Ethernet) might benefit from this work

Why now?

- An 802.3 standard isn’t necessarily needed to support 802.1AS, but it would be good practice to have an 802.3 standard that does!

Why now?

- *Links to Residential Ethernet CFI and SG work*
- *http://grouper.ieee.org/groups/802/3/re_study/public/200407/cfi_0704_1.pdf*
- *http://grouper.ieee.org/groups/802/3/re_study/index.html*

Goals for Tonight

- Presentations:
  - 802.1AS Time Synch Requirements for 802.3
  - 802.1 & 802.3 Recent Cooperative Efforts
  - CFI Poll
- Straw Polls
- Develop presentation for closing 802.3 plenary
- Q&A

802.1AS Time Synch Requirements for 802.3

Michael Johas Teener

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802.1 AVB TF Chair

Agenda/notes/cautions

- Agenda
  - Fundamental requirements for 802.1AS
  - Preferences for 802.3
- Note:
  - This represents a personal opinion, but has been reviewed by others in the 802.1 AVB Task Group SBC1
- Caution: SBC2
  - I am NOT an expert on PHY design, nor am I responsible for detailed chip architecture, but ...
  - I've done both in the not too distant past

Slide 9

SBC1 I think this isn't a useful statement for the CFI. My understanding is that the AVB group has blessed this information.
Steve Carlson, 3/3/2009

SBC2 I'm nit sure this is really relevant for the CFI.
Steve Carlson, 3/3/2009

Time Synch Standards

- The IEEE supports two related time synchronization standards: 1588 and 802.1AS
- Both need the same facilities from 802.3:
  - Notification of “start of frame” actually being transmitted at a well known point in the physical media (typically, the connector)
  - Notification of “start of frame” being received at the same point
  - Some kind of reporting of the accuracy of the notification
- The rest of this presentation is done from the point of view of P802.1AS standardization
  - since 1588 has exactly the same requirements

1588 and 802.1AS differences

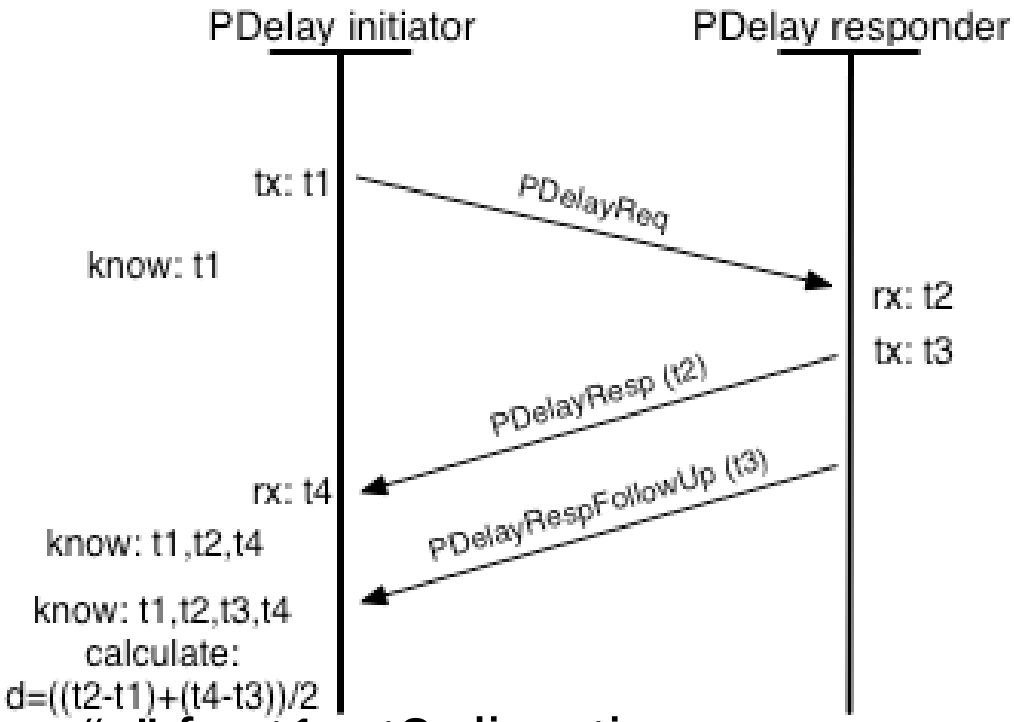
- IEEE 1588-2008 is the 2nd generation “Precision Time Protocol” based on full duplex point-to-point networks.
  - Many options, can run directly above L2 or above IPv4 or IPv6
  - Loosely defined “boundary clock” operation, no APIs
  - Supports non-802 L2 connections
- P802.1AS is both a subset and a superset of 1588
  - Runs as a profile of 1588 directly above 802.3 as an L2
    - almost no options, much simpler
    - very tightly defined algorithms for predicable performance, higher level API defined
    - compatible extensions to support very fast “grand master” switchover
  - Superset of 1588 to allow various “coordinated shared media” operation, e.g. 802.11 and “generic CSN”

Fundamental requirements

- 802.1AS needs to measure how long it takes for an event to travel from a master clock (“grand master”) to a slave clock (“ordinary clock”)
- The accuracy and resolution of that time measurement directly affects the accuracy and responsiveness of 802.1AS implementations
- There are two basic procedures within 802.1AS that need to know the exact time of an 802.3 event:
  - measuring the delay time of an event through a network link (one cable hop)
  - propagation and correction of a time synchronization signal through the network (time offset)

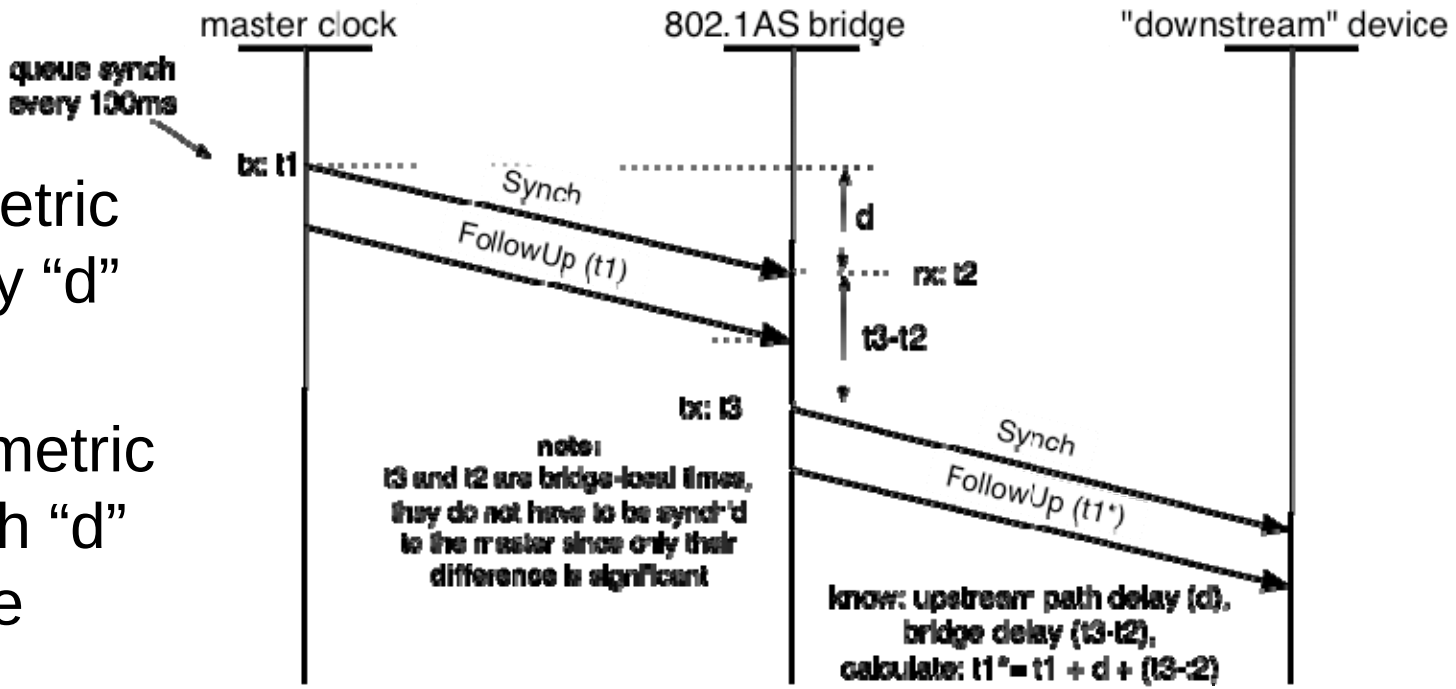
Delay calculations

- Process requires t1, t2, t3 and t4 *and* that the propagation time in both directions is the same
  - or the offset between the two is known



- For known fixed extra delay “x” for t1->t2 direction:
  - d=((t2-t1-x)+(t4-t3))/2

Time offset calculation



- For symmetric paths, only “d” is needed
- For asymmetric paths, both “d” and “x” are needed:
  - –t1* = t1 + d + x +(t3-t2)
  - –(note that “d” is the delay from ingress, while “x” is the offset from egress)

Accuracy and resolution requirements

- Most applications of 802.1AS assume:
  - measurement granularity (resolution) of time is ±20ns
    - actually 0-40ns because truncation is assumed
  - local clocks are accurate with 100ppm
  - delay is symmetric within (*a*) and does not change more than (*b*)
    - (*a* and *b* are numbers that are TBD, but small)

SBC3

- There are high value use models for test and measurement applications that require better performance
  - requests have been made for ±0.5ns granularity to support phased array radar test gear
    - to support network time synch of better than 5ns

SBC3 How small? What ballpark?

Steve Carlson, 3/3/2009

Standards problem for 802.1AS

- 802.1AS for 802.3 specifies the “tn” measurement point as the start of frame at the cable interface
  - there is no place in any 802.3 standard which provides this information
  - the AVB TG needs this to be nicely integrated into an 802 architecture
- Note: this is a standards problem, not an implementation problem
  - we specifically do NOT want to define a new MII-type or MDI-type
  - any discussions like that will *definitely* slow down the process

802.1 & 802.3
Recent Cooperative Efforts

Support for 802.1AS precise
time synchronization protocol
Call For Interest

David Law
3Com Corporation

IEEE Std 802.3ac-1998 VLAN tag

- Amendment project to IEEE Std 802.3 to accommodate the addition of a four octet VLAN tag field
- Project initiated at the request of 802.1 WG in July, 1997 and completed by September, 1998
- Five members of the 802.1 WG and five members of the 802.5 WG were allowed to participate in the 802.3 WG ballot on the draft standard

IEEE Std 802.3ad-2000 Link Aggregation

- Amendment project to IEEE Std 802.3 to allow multiple physical links to be logically bundled together for greater bandwidth and resiliency
- Essentially a joint effort, with significant participation and contribution from members of the 802.1 WG
- Recently moved to IEEE Std 802.1AX-2008

IEEE Std 802.1AE-2006 MAC Security

- Initially "incubated" within 802.3 EFM task force (primarily motivated by EPON)
- Spawned a CFI, which lead to the creation of the Link Security Executive Committee Study Group
- Resulted in the generation of 802.1AE and 802.1af (key security – subsumed into 802.1X-REV)

Get IEEE 802®

- Program in which IEEE 802 standards are made freely available six months after initial publication
- Supported in large measure by financial contributions from everyone who attends IEEE 802 plenary sessions
- Initial concept raised by the 802.1 WG, and forcefully advocated by the 802.3 WG

IEEE Std 802.3as-2006 Frame Format Extensions

- Amendment to IEEE Std 802.3 to support "envelope frames" for applications such as provider bridges and MAC Sec
- Initiated in July, 2004 and completed in September, 2006

Congestion management

- Some initial work performed in Backplane Ethernet task force
- Eventually moved to 802.1 Data Center Bridging Task Group
- Resulted in generation of 802.1Qau Congestion Notification, 802.1Qaz Enhanced Transmission Selection, and 802.1Qbb Priority-based Flow Control

Logical Link Discovery Protocol

- 802.1AB defined LLDP, and included a provision for Ethernet specific Type/Length/Value (TLV) assignments
- The Ethernet specific assignments are in the process of being moved from IEEE Std 802.1AB to IEEE Std 802.3 via the 802.3bc project

Audio/Video Bridging

- Call for interest in July, 2004
- Initiated as the "Residential Ethernet" Study Group within the 802.3 WG
- Moved to 802.1 "Residential Bridges" task group in November, 2005
- Generated 802.1AS Timing and Synchronization, 802.1Qat Stream Reservation Protocol, and 802.1Qav Forwarding and Queuing Enhancements for Time-Sensitive Streams

Conclusions

Where do we go from here?

Conclusions

- Co-operation between 802.1 and 802.3 to insure the best possible 802 standards has been a long-standing process
- The work is a follow-on to the RESG project started in 802.3 in 2004
- When project moved to 802.1 (AVB TF) it was understood that there would be 802.3 work to complete the project
- That time is now

Questions and Answers

Call for Interest

Request 802.3 at the Closing Plenary to form a Study Group to develop a standards project proposal (PAR and 5 Criteria) for (insert exact wording here)?

Yes: No: Abstain:

Poll #1

How many people are in the room?

_____

_____802.3 Voters

Poll #2

A Study Group to investigate (fill in exact wording here)?

I would support and participate in this Study Group:

Total individuals: _____

Total 802.3 Voters: _____

Poll #3

A Study Group to investigate (fill in exact wording here)?

My company would support and participate in this study group:

Total companies

Yes: _____

Poll #4 Meeting Planning

I will attend the Timestamp Interim Meeting in May:

Yes: _____ No:_____

More Q & A

Next Steps

- Request 802.3 to authorize formation of the Study Group at the 802.3 Closing Plenary
- Request 802.3 to setup the SG email reflector
- Inform the 802 SEC of the SG
- Schedule and plan a meeting of the SG at the May 802.3 Interim, week of ??

Thank You!

We hope to see you at the Study Group meeting in ???