AV Bridge Summary: an early view
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Preface and warnings

• Outline of bridge (and DTE) operation
  – To be used as the very start of a “Ethernet AV” recommended practice
    • (there needs to be an “802 AV” recommended practice that includes .11/.15/.16/.etc … but that is later work)

• Personal point of view
  – No one else has reviewed this

• Very preliminary!
Contents

• Structure of an 802 AV network
• 802-only time synchronization
• Reservation protocol
  – What is being reserved?
• AV stream frames
• Setting up a defended network
• Traffic shaping
Structure of an 802 AV network

- Directly connected participating devices … any intervening non-participating device defines a boundary to AV QoS
802-only time synchronization

- Assume something between a 1588 profile (preferred) and a timing domain that appears to be a 1588 subdomain
  - Time synchronization between 1588 and 802.1 is very simple
- Bridges (and 802.1 layer of endpoints) have “pretty good” idea of time, and very accurate measurement of delay to attached peers
  - “pretty good” means within a microsecond or so
- Specification TBD, but all current proposals have adequate performance
  - Cost/complexity/interoperability/robustness will be metrics used to choose a method
  - Assume unique Ethertype with subtype to uniquely identify packets that must have accurately measured launch/receive times
  - Measurement granularity of launch/receive times ≤ 40ns
- Separate PAR (P802.1as) for stand-alone document
Reservation protocol

• Will be based on “SRP” as described by Felix Feng
  – MRP (P802.1ak) application to register a multicast address along a path and to associate a traffic class with that address
• Reserves bandwidth at a defined class of service for a specific stream
  – Bandwidth is defined as “bytes per class interval”
  – Class of service is “highly interactive” (with 125us class interval) or “normal interactive” (with 1ms class interval)
  – Stream is identified by destination address (multicast)
• Will be amendment to IEE Std 802.1Q-2005
  – perhaps P802.1at?
AV stream frames

- 802.1Q tagged frames with PCP 5 for highly interactive and PCP 4 for normal interactive

- How is multicast address chosen?
  - Should this be an 802 problem?
    - UPnP has some mechanisms for this
  - If so, default 802 operation could be same as “auto IP”:
    pick an address from an 802-owned multicast set, probe using it to see if anyone responds … repeat for “n” times
Setting up a defended network

- Need to prevent interference from non-participating traffic.
- If all bridges were managed ones (participated in spanning tree), we could do this with existing protocols like LLDP.
  - Oops … unmanaged bridges are *the most likely* type to find in the home.
- So … since we require time synch on AV networks, we can use that to determine if an unmanaged bridge is attached to a port.
  - If cable delay between peers is “unreasonable” (>> 100 m), we can assume that the link cannot be used for AV streaming.
  - Time synch granularity is ≤ 40ns, so cable length uncertainty on the order of ±8m.
- If cable delay is OK, and peer responds to enhanced link discovery with correct attributes, then peer can be assumed to be a part of the AV cloud.
Traffic shaping

• Source device must do traffic shaping to match reservation (launch no more than $x$ bytes per class interval)
  – Right? No arguments?

• Advantages for shaping traffic at bridges
  – Allows better best-effort performance
    • Nothing to be gained if stream data arrives early … all streaming applications are built around worst case latency and provide appropriate buffering
    • Delaying “early” stream data allows best effort traffic to use unneeded transmission opportunities … best effort QoS is typically improved with reduced latency
  – Network scalability
    • Buffers within bridges and endpoints can have fixed “small” size regardless of network topology and never drop packets with streaming QoS
SRP-assisted traffic shaping

- SRP allows a bridge the maximum streaming traffic that is expected to be transmitted and received on each port at any point in time.
- Time synch protocol guarantees that bridges agree on common time reference (± some small delta … e.g., 1us).
- These two pieces of information allow a bridge to make a good guess whether a particular frame should be transmitted during a particular class interval.
  - Use a kind of dynamically adjusted WRR queue draining algorithm.
- Delivery jitter greatly reduced, but bounds increase with number of hops.
Misc. services

• Will provide other services for higher layers
  – Localization (content protection methods frequently require that devices that share protected content must be “close” to each other
    • AVB can provide a good estimate of the cable distance between two devices … on the order of ±8m per cable hop
  – Device authentication/link security
    • AVB can use 802.1 security services to validate endpoints and bridges, and provide link-level encryption