802.1 AVB Power Management

Philippe Klein

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Power Management in AVB

Main points of the discussion:

- discuss how powering AV sub-system devices should be handled
- include in AVB protocols the hooks to maximize power savings when the AVB system is not in active use
- raise any issue you might seek…

Power Management Context

- Several organizations are writing recommendations to reduce total energy consumption in homes. Among others, STBs, digital TVs and other Video/networking devices are considered:
  1. US Energy Star
  2. European Commission – Code of Conduct (CoC)

     European Commission directive

- References:
  - *European Commission – Digital TV Service Systems Code of Conduct – V 7, Jan 2008*
    http://sunbird.jrc.it/energyefficiency/pdf/CoC%20Digital TV-version%207.pdf
  - *European Commission – Voluntary Code on STB power consumption Initial proposals from the informal industry group, 27 August 2008*
    http://sunbird.jrc.it/energyefficiency/pdf/meeting%20digital%20TV%209%20September%202008/indicative%20COC%20proposal%20-%2027-8-08.pdf
  - *ES - ENERGY STAR Program Requirements for Set-top Boxes*
    http://www.energystar.gov/ia/partners/prod_development/revisions/downloads/settop_boxes/Set-top_Boxes_Spec.pdf

Power Consumption Allowance

- *Both ES and CoC sets of rules are very similar.*
  - *CoC rules are being drafted (10/2008) after the Energy Star final release (04/2008)*
- *Both ES and CoC specify a base power usage as well as allowances for specific features.*
  - *The home networking allowance is one of them.*
- *Each set of rules defines 2 tiers:*
  1. *tier 1 defines an allowance for the short term*
  2. *tier 2 for the long term.*

Tier 1	Tier 2
20kWh/y	10kWh/y

translates to 1..2W AC for STB

- *Tier2 applies to all boxes sold after:*
  - *1/1/2011 for Energy Star*
  - *1/1/2013 for CoC*

STB Power States

ON	• Fully powered up • Video/Audio output • Network connected
SLEEP	• "Partially" powered • **No** Video/Audio output • **able to be remotely "reactivate" (for data/AV traffic) thru the network**
OFF	• Powered off • No network connection

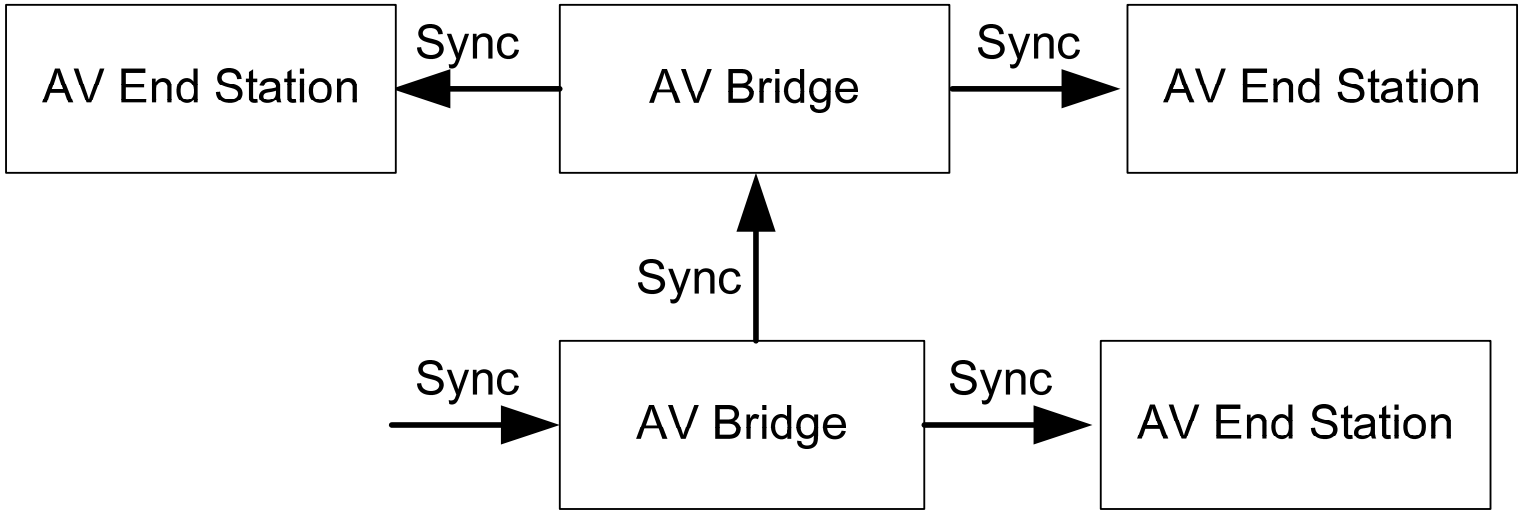
Network Connection vs Power Saving

Wakeup times/delays induced by the Protocols/Methods to stay connected **have a impact on AVB**

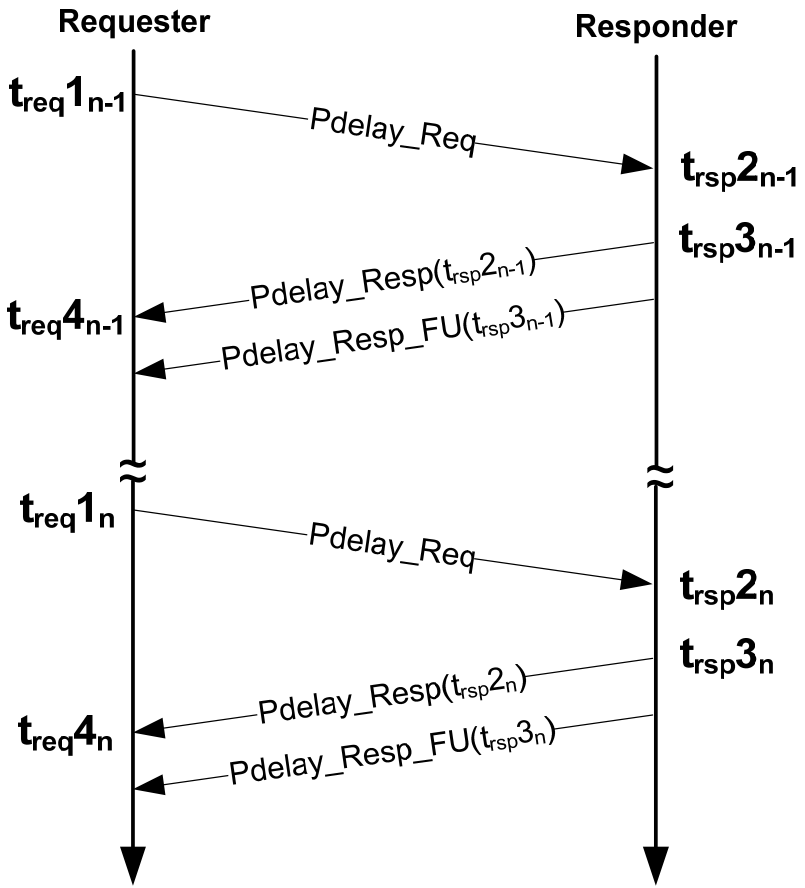
Protocols/Methods to consider:

- 802.3at - Power over Ethernet Protocol (PoEP)
- 802.3az – Energy Efficient Ethernet (EEE)
  - Is AVB applicable on EEE network ?
  - Is EEE compatible with AVB ?
- Wake on LAN
  - The network device is able to receive frames and generates a Wake-Up signal to the system on specific frames
    - Directed (Unicast) frame
    - IPv4 ARP to the device's IP address
    - IPv6 ICMPv6: Neighbor & Router Solicitation, Router Redirect
  - Internal Proxy
    - ARP answered by the device in SLEEP state
- Proxy (in large networks)

AVB 802.1AS Sync Message Propagation



AVB 802.1AS Path Delay Measurement



neighborRateRatio =
($t_{rsp}3_n$ - $t_{rsp}3_{n-1}$) / ($t_{rsp}4_n$ - $t_{rsp}4_{n-1}$)

neighborPropDelay =
(($t_{req}4$- $t_{req}1$) * neighborRateRatio - ($t_{rsp}3$- $t_{rsp}2$)) / 2

AVB behavior for End-Station in SLEEP Mode

- AS (synchronization)
  - AV End-Station should stay on the AVB cloud…
  - ...but AS protocol should NOT significantly impact the end-station power saving budget
- Qat (reservation)
  - AV End-Station should de-register its flows before entering the SLEEP state
  - Other “side effects”?
    - i.e. should the End-Station be “awaked” on Talker Advertise ?
- Qav (queuing)
  - Anything to do ? (No data traffic on End-Stations in SLEEP state)

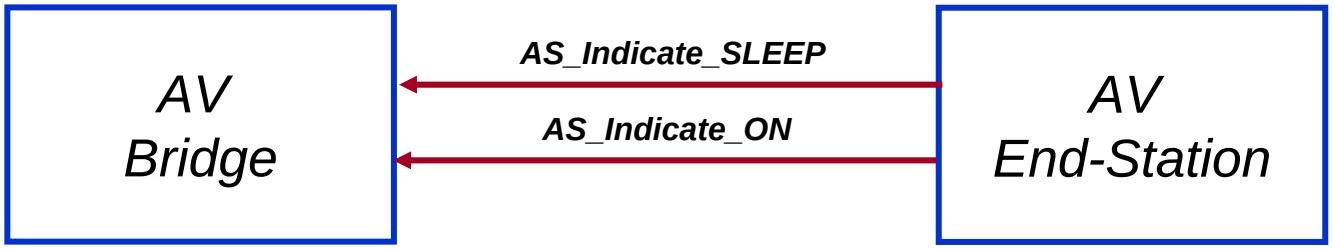
AVB behavior for End-Station in EEE Low Pwr Mode

- AS (synchronization)
  - Sync propagation accommodates to variable residence time
  - Timestamp accuracy should me maintained for both Rx and Tx
- Qat (reservation)
- Qav (queuing)
  - If EEE “wake-up” latency is within the range of Txm time of a 803.2 Max packet transmission = same latency as best effort traffic interference

AS Power State Transition Indication Messages

- Asynchronous message from the End-Station to the Upstream Bridge
- Notify the Bridge of a power state transition:
  - ON to SLEEP
  - SLEEP to ON

  to let the Bridge modifies its behavior toward the End_station accordingly



AV Bridge Behavior
Toward Downstream AV End-station in SLEEP Mode

- Two proposed options
  1. The Bridge reduces the periodicity of its pDelay_Requests
     - pDelay_Request/Answer used as AVB hearbeat only
     - STA local system clock could be discontinued in SLEEP mode
     - NeighborRateRatio could be rapidely recalculated after the STA re-enters ON pwr state if the bridge sends a “burst” of pDelay_Requests
  2. The AV Bridge acts as proxy for the STA in SLEEP pwr state

Open Questions

- Should /Could Pwr Management be extended to AV Bridges ? YES
- When ?
- Should AVB be part of a more general (i.e. 802.1) network power management ? YES – Need a PAR

Finally...

- Q&A
- Call for Actions
- Next steps…

Thank you