802.1 AVB Support for Coordinated Shared Network

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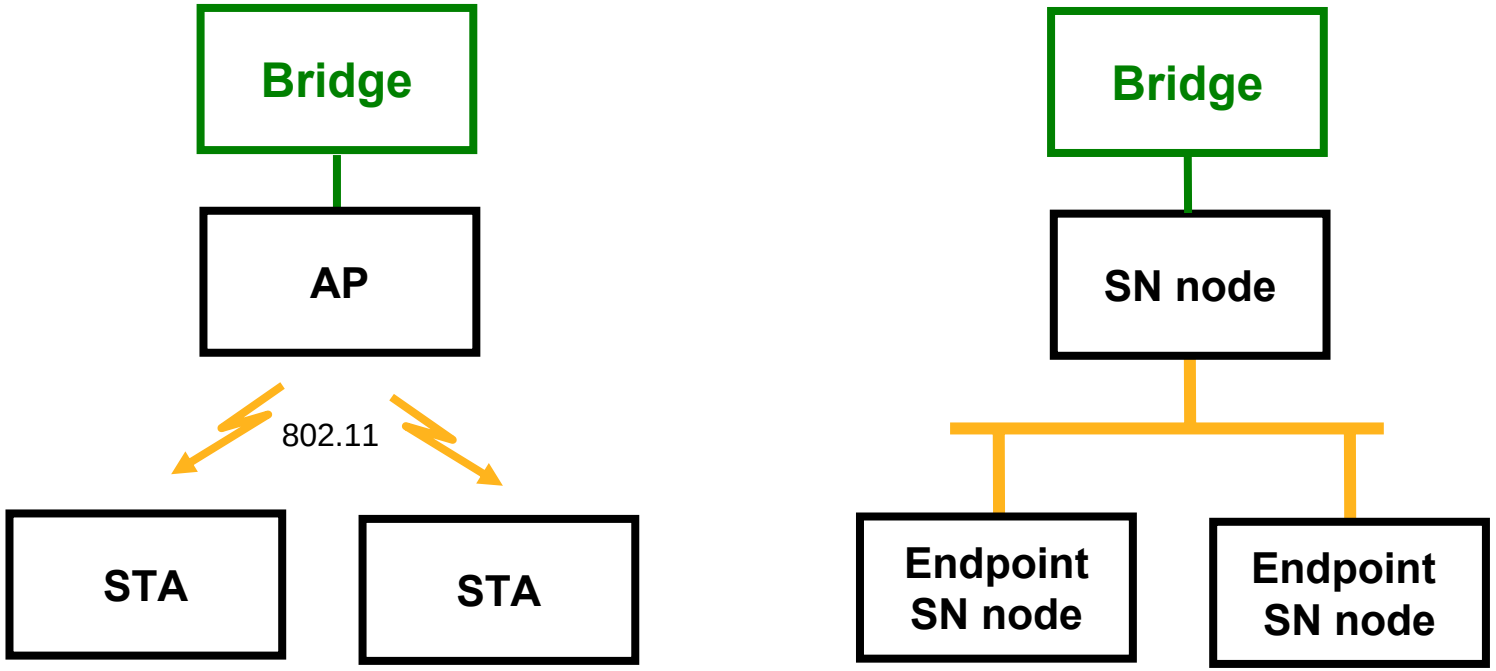
Coordinated Shared Network

- Time domain multiple access (TDMA) network
- Coordinated contention free media access controlled by a single elected or designated network controller (NC)
- Interface for priority (& parameterized) QoS
- CSN is the trend of the more recent (OFDM based) home networks :
  - Moca (coax)
  - Homeplug (powerline)
  - UWB, 802.15 (wireless)
  - 802.11

Shared Network Support in Current Draft IEEE 802.1 AVB

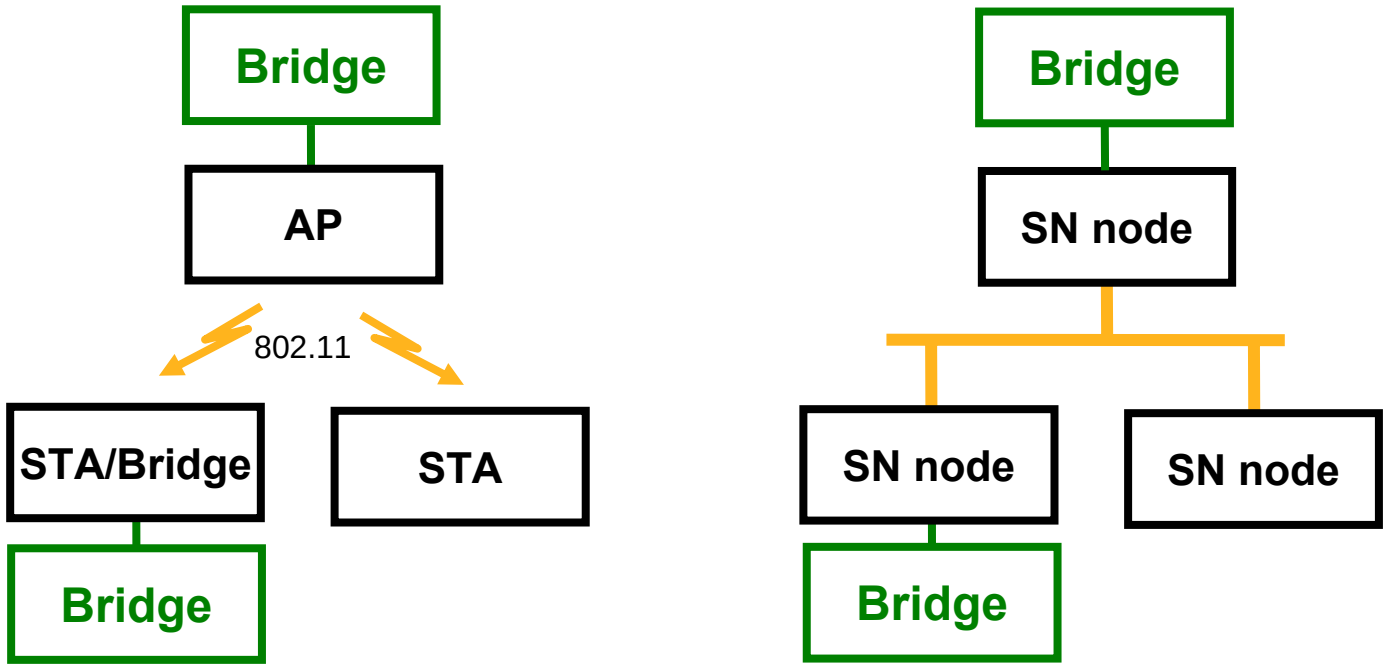
- IEEE 802.1as includes the current 802.11 AP/STA topology
- ”similar *” to the shared network topology if a single node only is connected to a bridge…

  [*] SN supports node-to-node connections while 802.1 does not support STA-STA connections (if Direct Link Protocol is not supported)



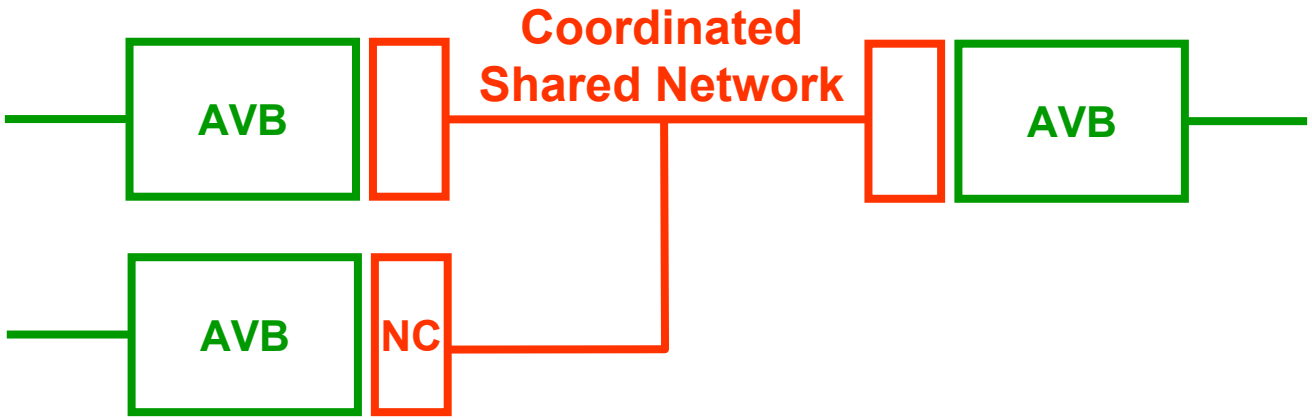
Shared Network Backbone Support in IEEE 802.1 AVB

- Current draft model does not support SN backbone connecting multiple bridges
  - *No support in the current IEEE 802.1 AVB standard for AVB to AVB SN link*
  - *However, an 801.11 STA / Bridge discussion has being initiated in the joint AVB and Video Transport TG.*



AVB Support for Coordinated Shared Network

- Proposal: AVB Standard layer for any Coordinated Shared Network (CSN)
  - MoCA
  - HomePlug
  - Future 802.11 with STA-Bridge support
  - …

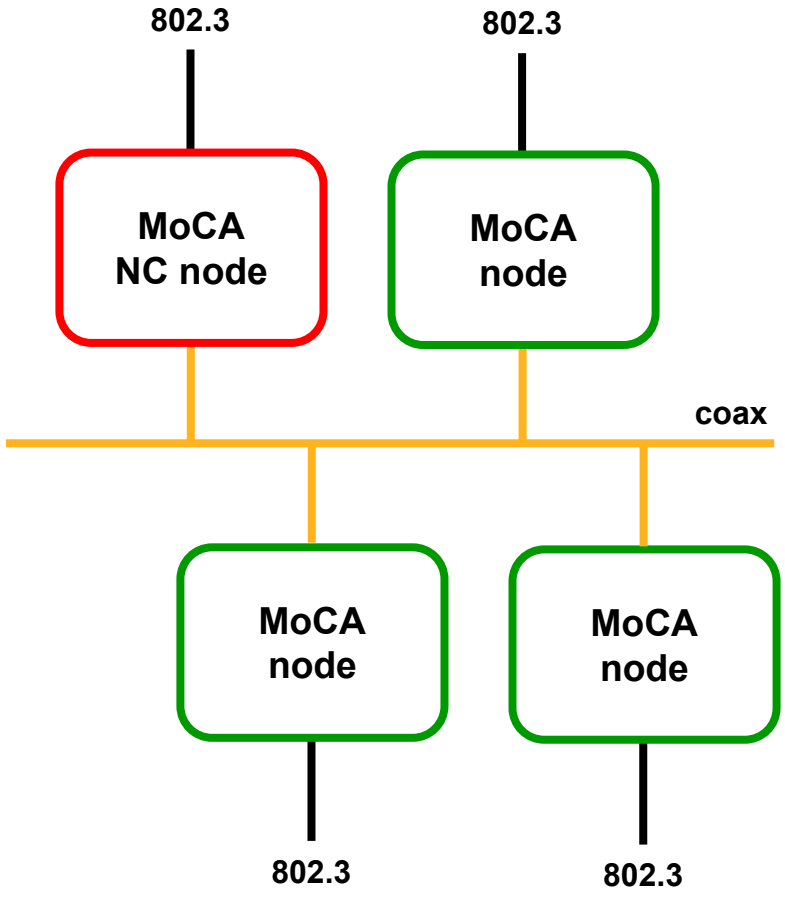


NC = Network Controller

MoCA Network Characteristics

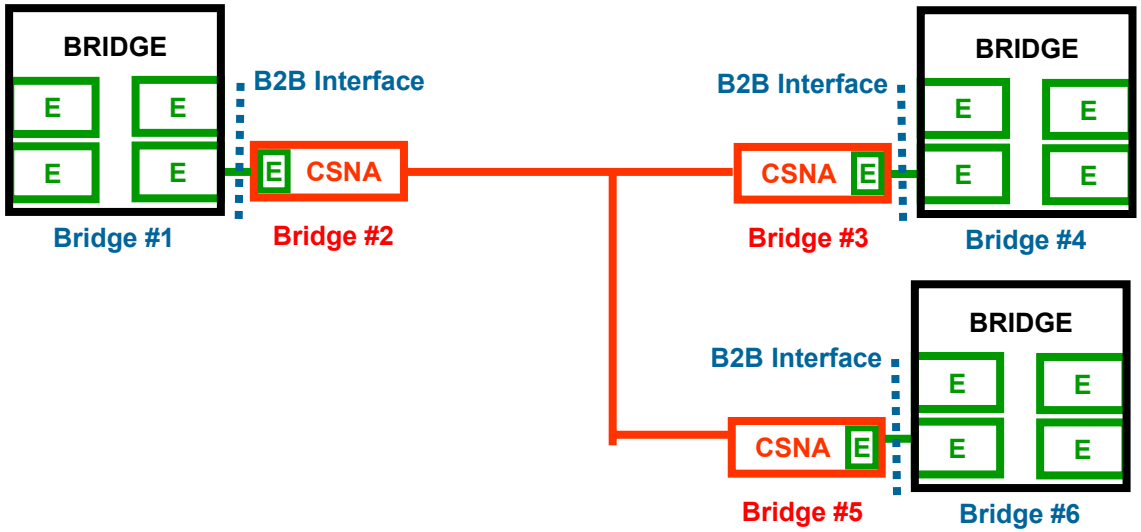
MULTIMEDIA over COAX ALLIANCE

- 802.3 Link emulation over coax
  - Bridge 802.3 packets over coax medium
- Synchronized access network
  - Network access is controlled by an single (self-selected or preferred) Network Coordinator (NC)
- Clock Services
  - NC periodically broadcasts clock references to all the nodes
  - Nodes maintain a local timer, resynchronized by the NC clock references
  - Max permissible jitter defined by the specs



Topology Option #1

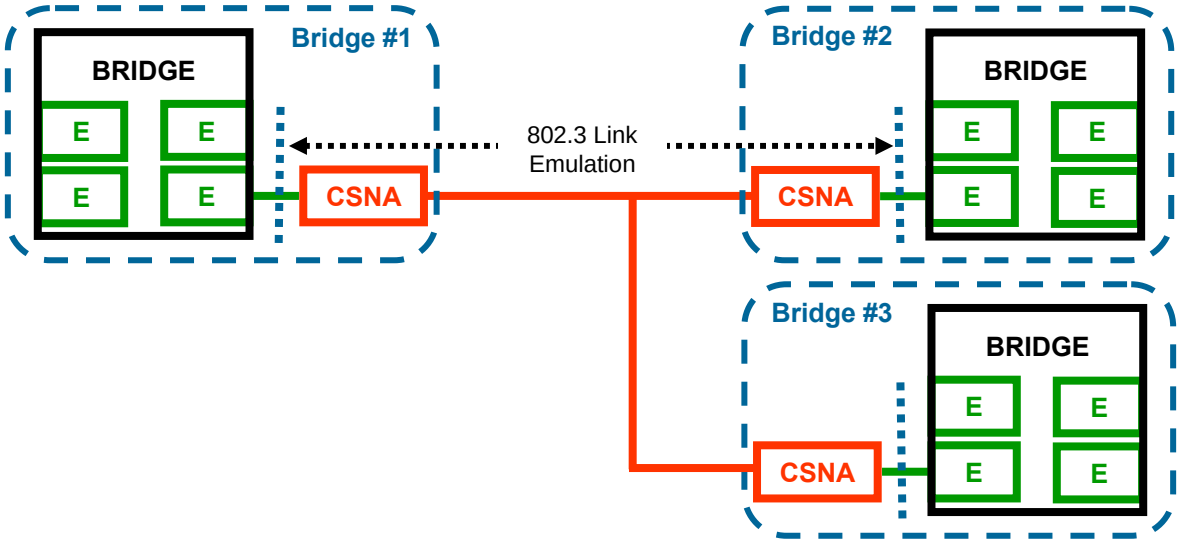
- CSN Adapter (CSNA) is a 802.3 / CSN bridge



PRO	Natural decomposition – Cascaded bridges Bridge 2 Bridge interface is well defined
CONS	Implementing a full bridge HW/SW functionality might be too expensive for low end adapters

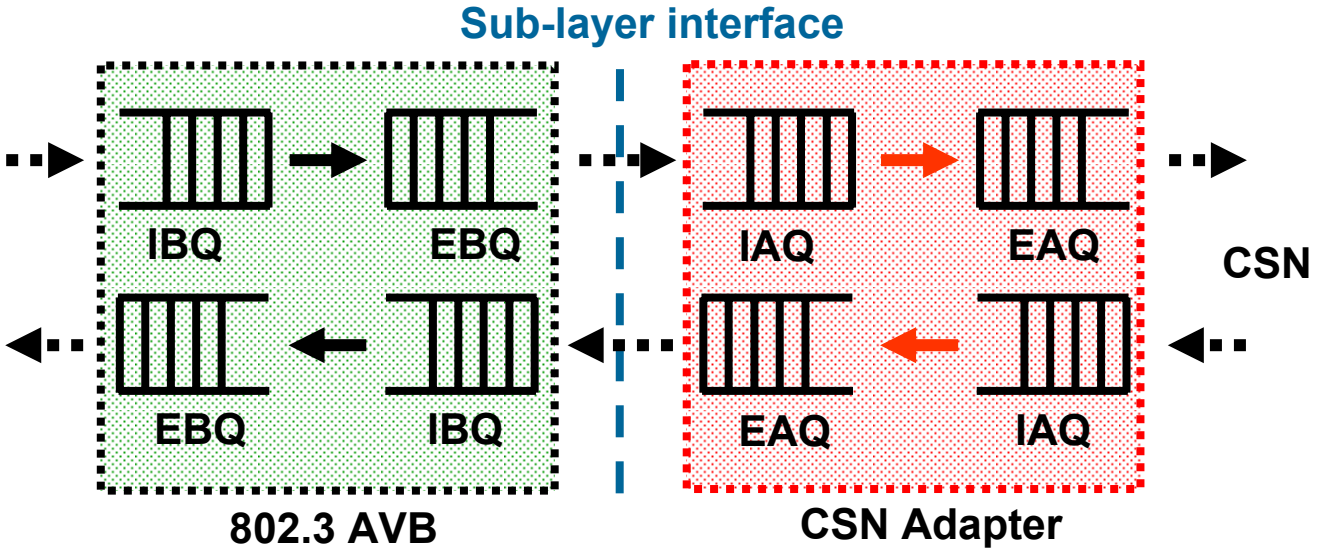
Topology Option #2

- CSN Adapter emulates links (CSNA is seen as a PHY)



PRO	Cheaper implementation Transparent to AVB
CONS	Transparent to AVB (LLDP & RSP messages should be spoofed & modified) SNA inner queue latencies SN link latencies might change over time No Bridge interface to export / import CSN characteristics / policies for 802.1Qav

Ingress / Egress Queue Latencies

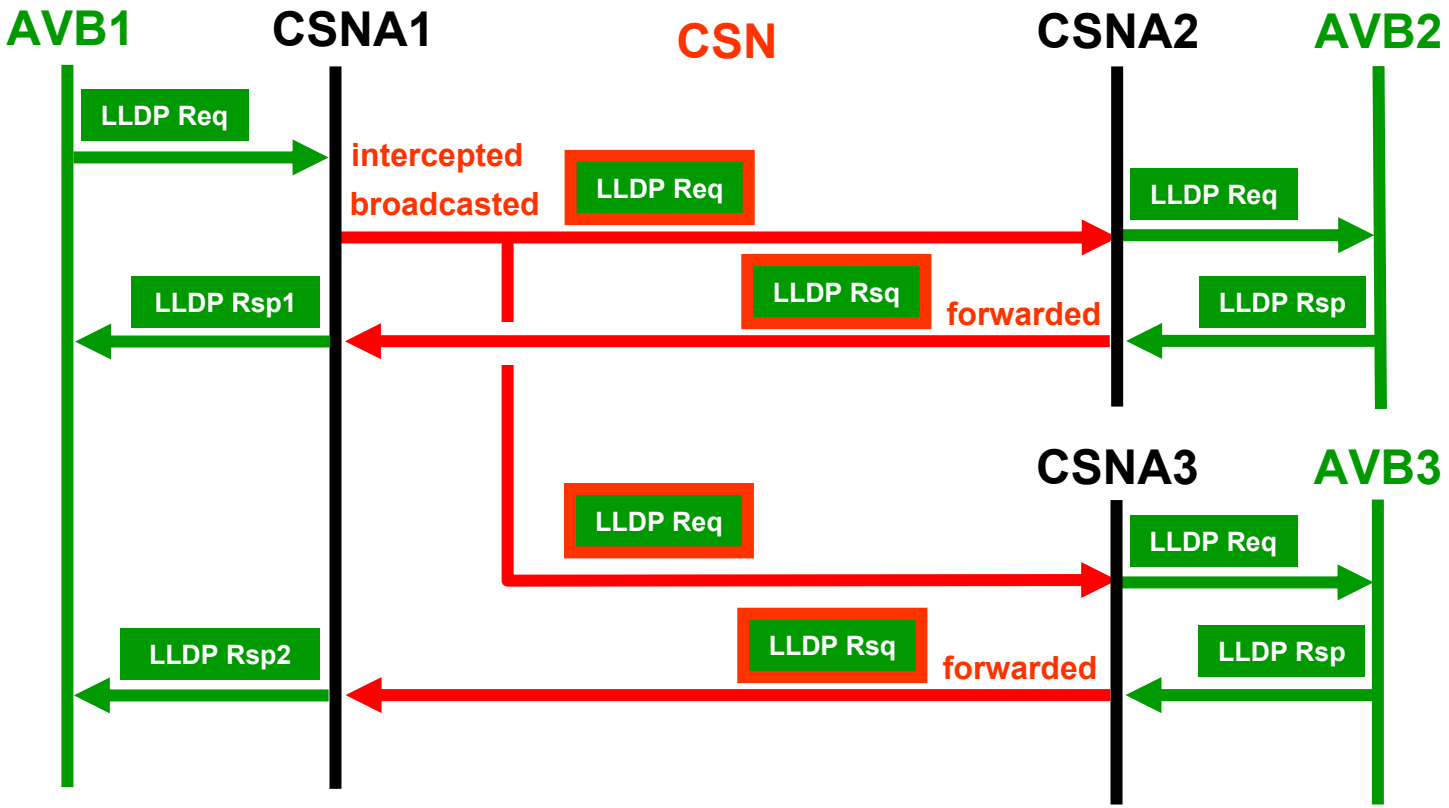


- IBQ-EBQ latencies and policies are covered by IEEE 802.1Qav
- CSNA's S&F inner queues cannot be transparent to AVB:
  - IAQ-EAQ max latencies should be queried and accounted for by the AVB
  - IAQ-EAQ policies exported by the AVB
- Could be done thru a AVB standardized sub-layer interface

AVB Messages CSN Handling

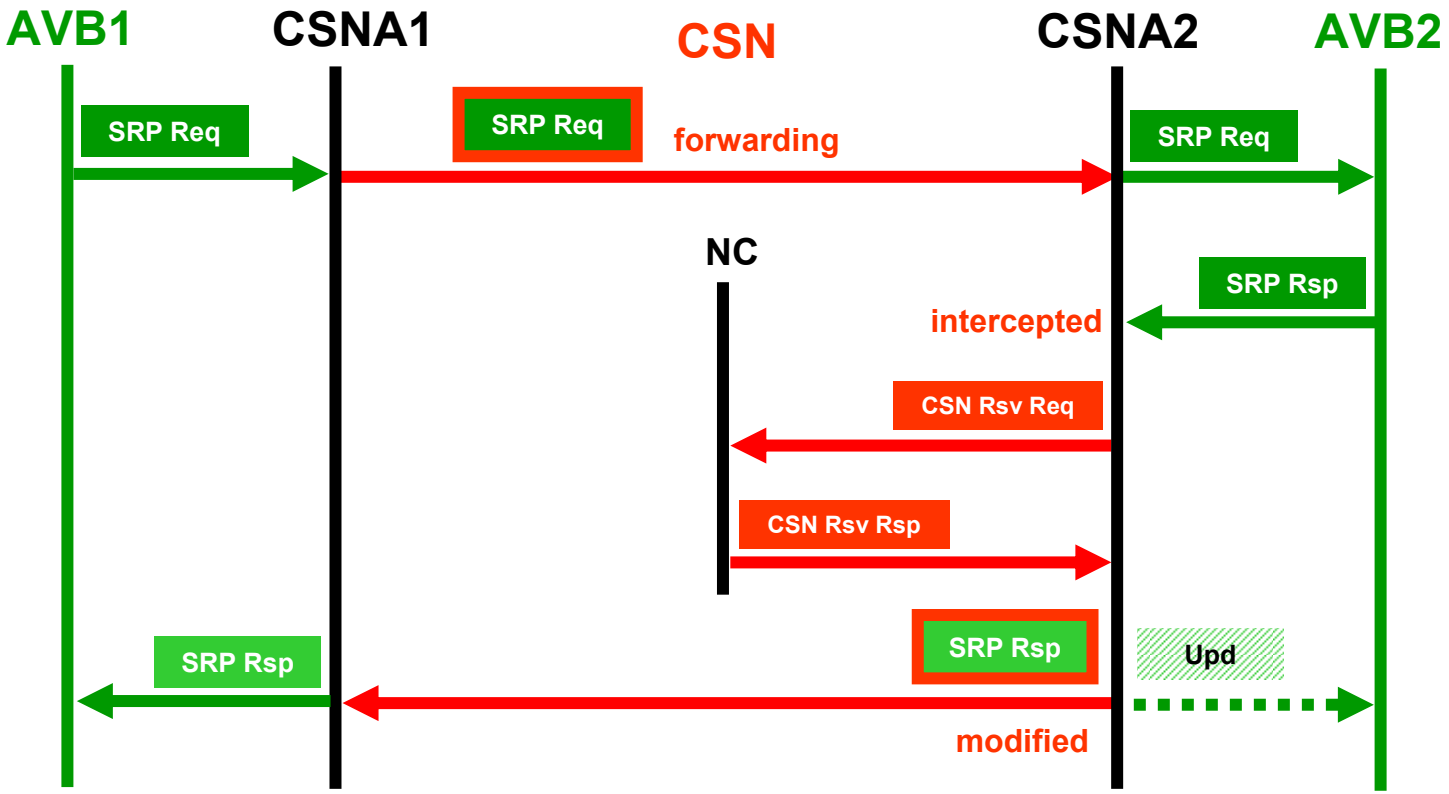
Messages	CSN Handling	
802.1 ab Link Layer Discovery Protocol Msgs	Spoofed and broadcasted by CSN	• LLDP queries messages broadcasted to every CSNAs • LLDP responses forwarded over the CSN
802.1 at Stream Reservation Protocol Msgs	Spoofed & intercepted by CSN	• Similar to non AVB intermediate bridge… – Request are transparently forwarded from SN edge to edge – Responses are intercepted and eventually modified (*if i.e. the SN capabilities are lower than the 802.3 capability for this link)*
802.1 as Clock Synchronization Msgs	Boundary Clock or Transparent Clock	• SN Native Sync handling

AVB LLDP Messages Broadcasting



- LLDP request messages are encapsulated in CSN containers and broadcasted over the CSN network
  - *AVB support to on to many links (multiple discovery responses to the same discovery request)?*

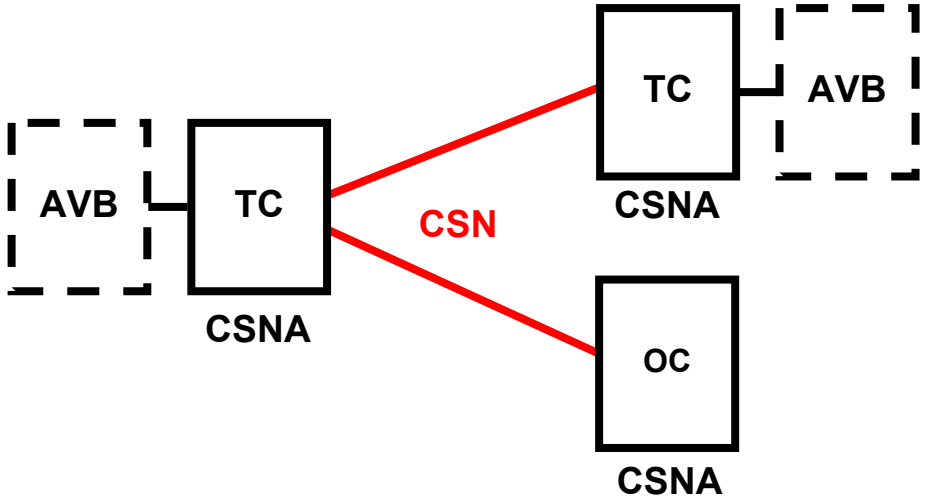
AVB SRP Messages Interception



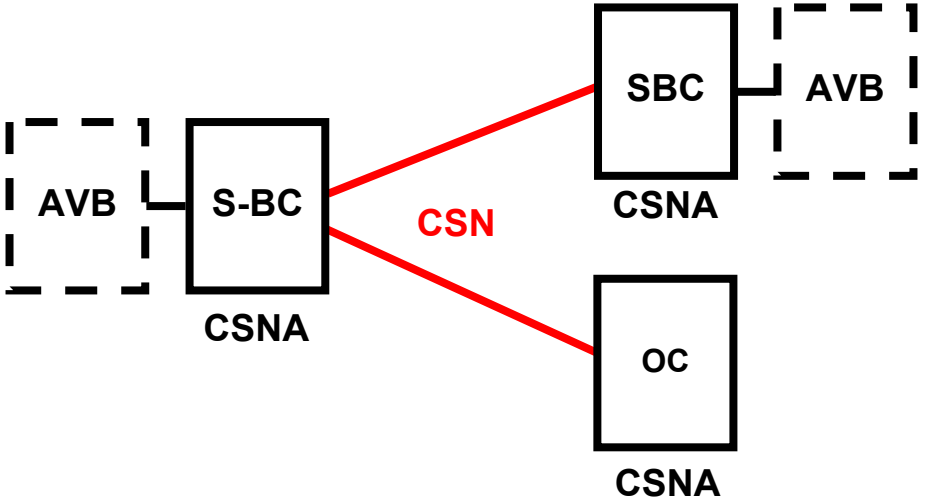
- Available bandwidth of the SN link might be lower that the bandwidth reservation acknowledged by AVB2
  - AVB reservation responses should be demoted by the SN
  - *do we need feedback msg to AVB2 to update AVB2 ?*

SN 802.1as Clock Model

Model #1



Model #2



OC = Ordinary Clock

S-BC = Simple Boundary Clock

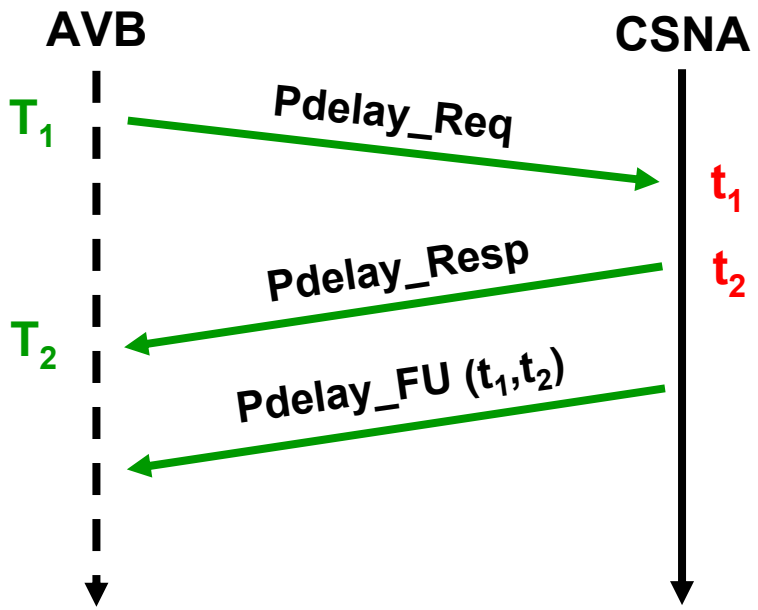
TC = Transparent Clock

SN AVB Timing Services

- AVB Timing Services
  - If the CSN clock is accurate enough, the 802.1as CSN media dependant part could be provided by the CSN time services:
    - NC's master clock periodically (~1…100ms) broadcasted to all CSNAs
    - CSNAs local timer synchronized on NC's master clock references
    - Time-stamped Txm frames

- AVB CSN Timing SAP:
  - Sync, Follow_Up,
  - Pdelay_Req, Pdelay_Resp, Pdelay_Resp_Follow_Up

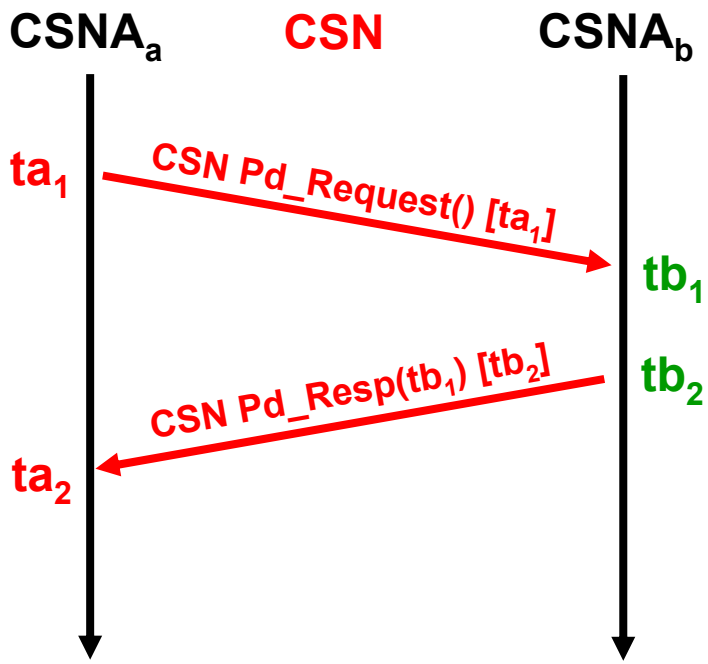
Link Delay SAP



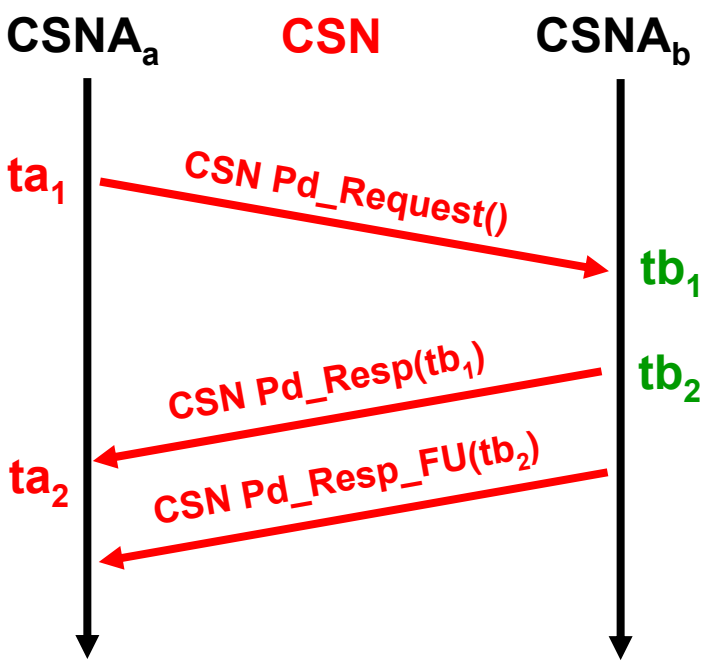
$$\text{LinkDelay}^* = ((T_2 - T_1) - (t_2 - t_1)) / 2$$

* In most cases ,CSNA will be co-located on the AVB board and LinkDelay will be = 0

CSN Propagation Delay Measurement between 2 CSNAs



w/i Txm packet timestamps



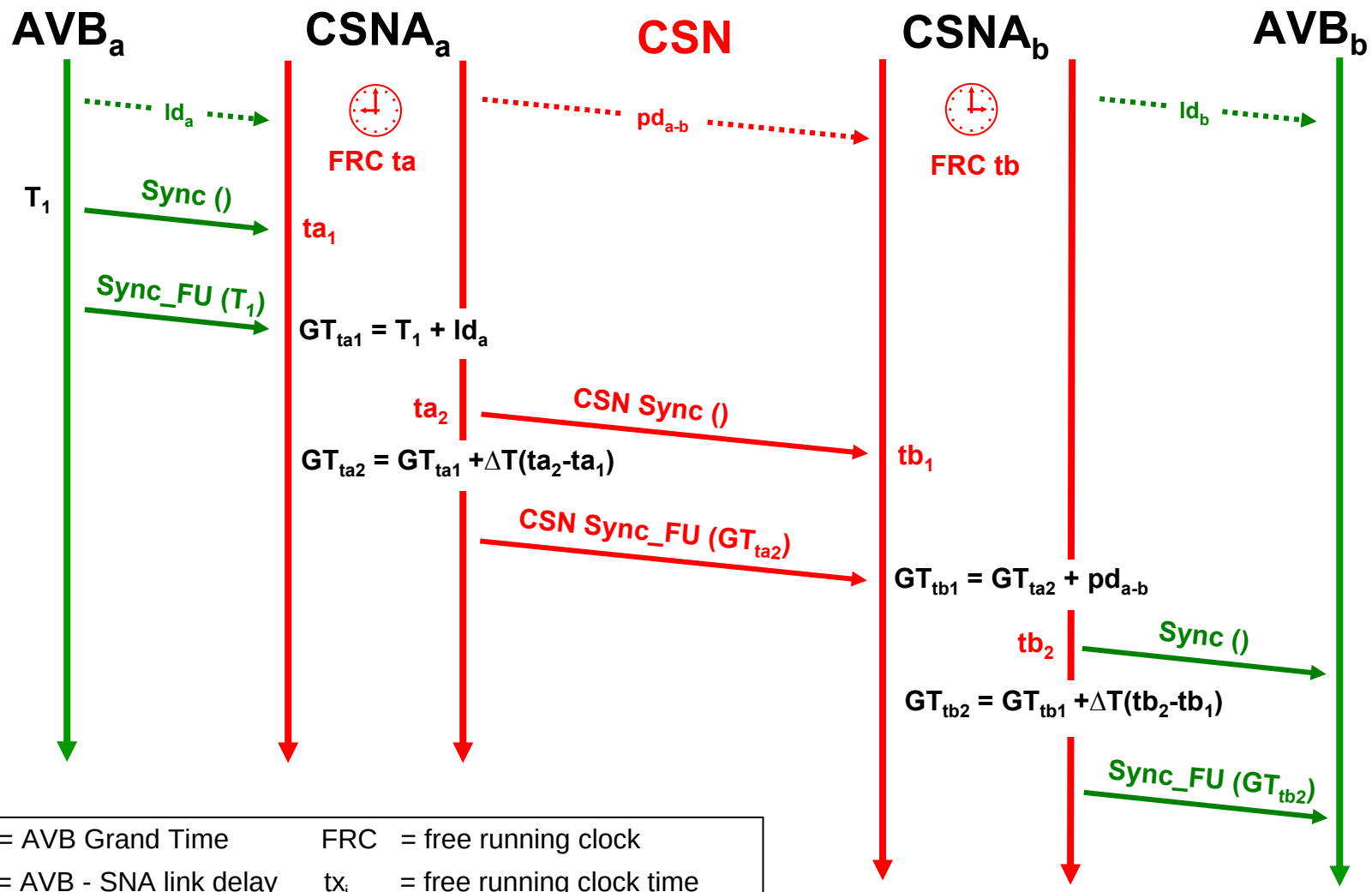
w/o Txm packet timestamps

CSN_PropagationDelay = ((ta$_2$-ta$_1$) - (tb$_2$-tb$_1$)) / 2

[t] Tx Packet Header ‘s Timestamp

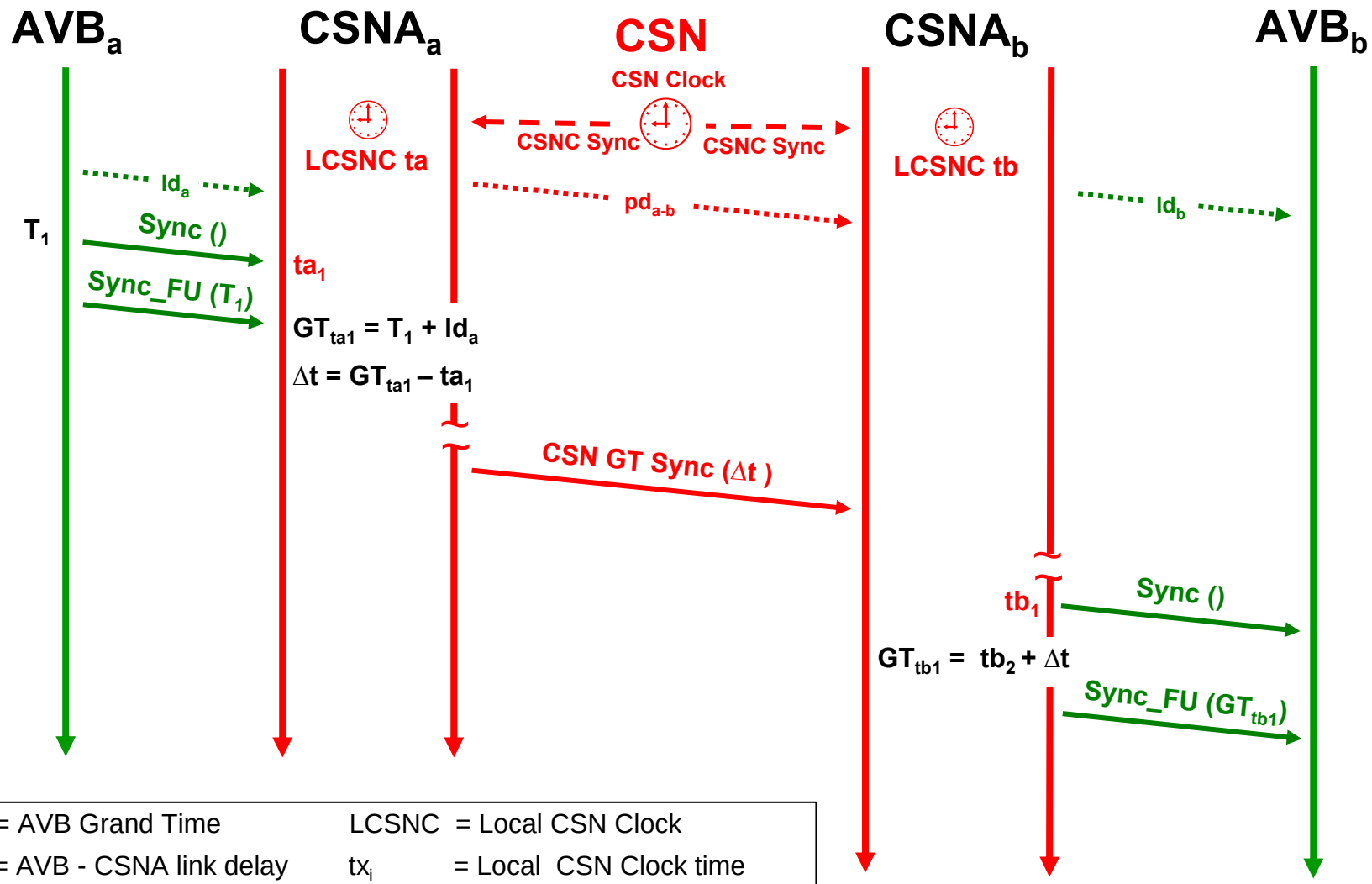
(t) API Parameters

Transparent Clock Sync SAP



GT = AVB Grand Time	FRC = free running clock
ld = AVB - SNA link delay	tx_i = free running clock time
pd = SN propagation delay	

Boundary Clock Sync SAP



GT = AVB Grand Time	LCSNC = Local CSN Clock
ld = AVB - CSNA link delay	tx_i = Local CSN Clock time
pd = CSN propagation delay	

Call to Action

Thank you