

Support for Coordinated Shared Network in 802.1AVB

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- This presentation is available online at:

<http://www.ieee802.org/1/files/public/docs2007/av-phkl-csn-0801-v1.pdf>

What is a “Coordinated Shared Network (CSN)” ?

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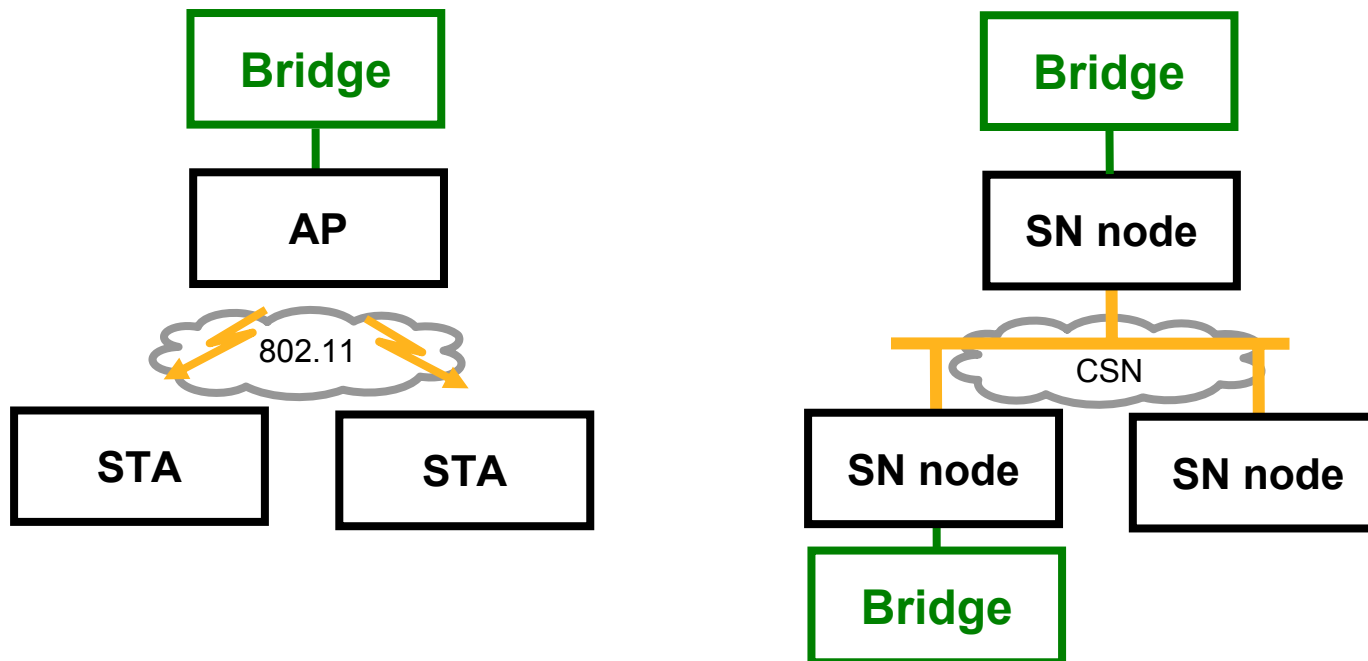
- Time domain multiple access (TDMA) network
- Coordinated contention free media access controlled by a single elected or designated network controller (NC)
- Interface for priority (& parameterized) QoS
- Support both Point to Point and Broadcast traffic
- The trend of the more recent (OFDM based) home networks :
 - Moca (coax)
 - Homeplug (powerline)
 - HomePNA (copperline)
 - 802.11



CSN Support in IEEE 802.1 AVB

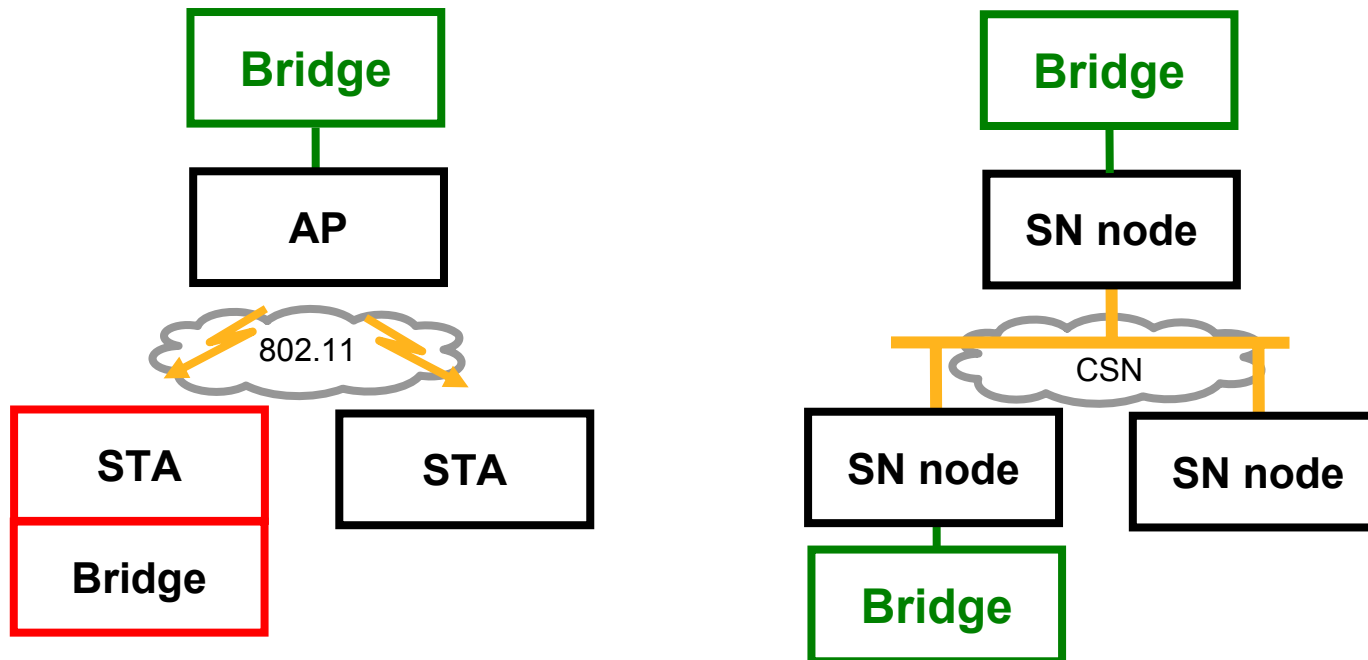
- Currently not supported by the 802.1AVB umbrella...
- ... but shares multiple "similarities*" to the 802.1 topology if the CSN cloud is an leaf.

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



CSN Backbone Support in IEEE 802.1 AVB

- Currently not supported by the 802.1AVB umbrella...
- ... but CSN backbone support will be needed for 802.11 STA/Bridges



Problem Statement

The Facts ...

Are CSNs “optimal” solutions for AV services ?

No !

Are CSNs been deployed as residential networks ?

Yes !

Will CSNs be used for residential AV services ?

Yes !

Is End to End QoS a prerequisite to any residential SLA (paid per view) service ?

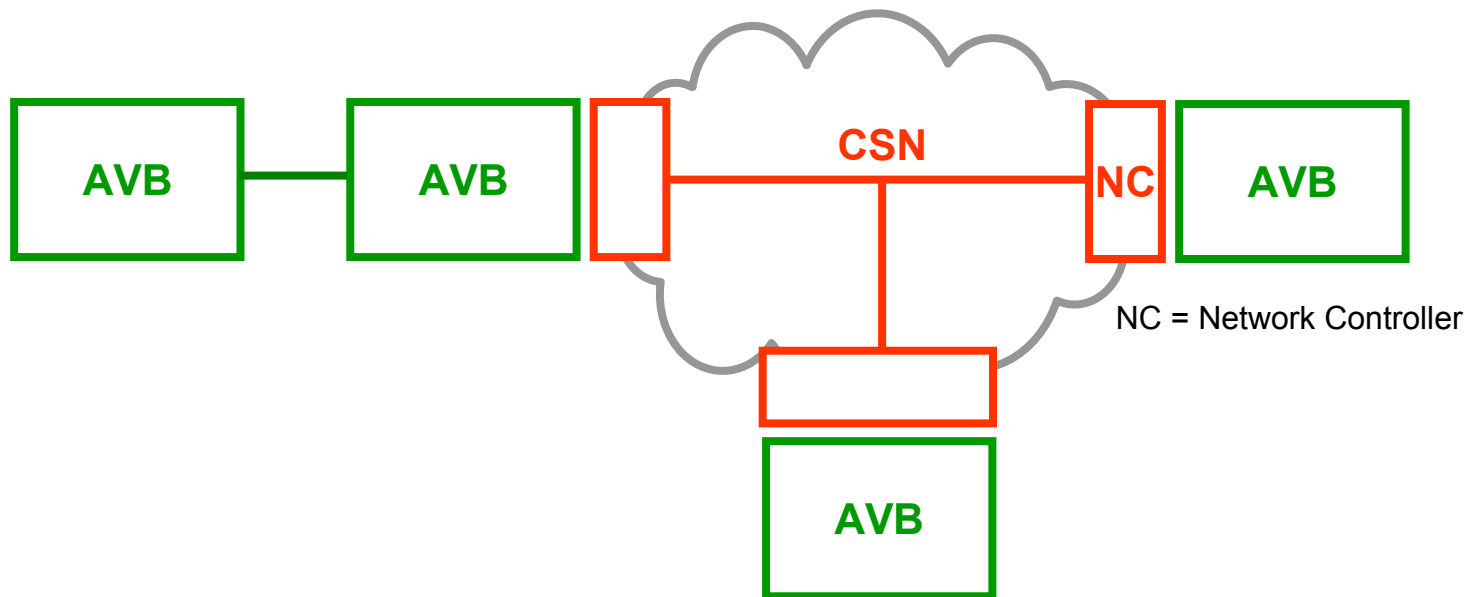
Yes !

Should 802.1 AVB supports residential networks ?

Yes !

The Proposal...

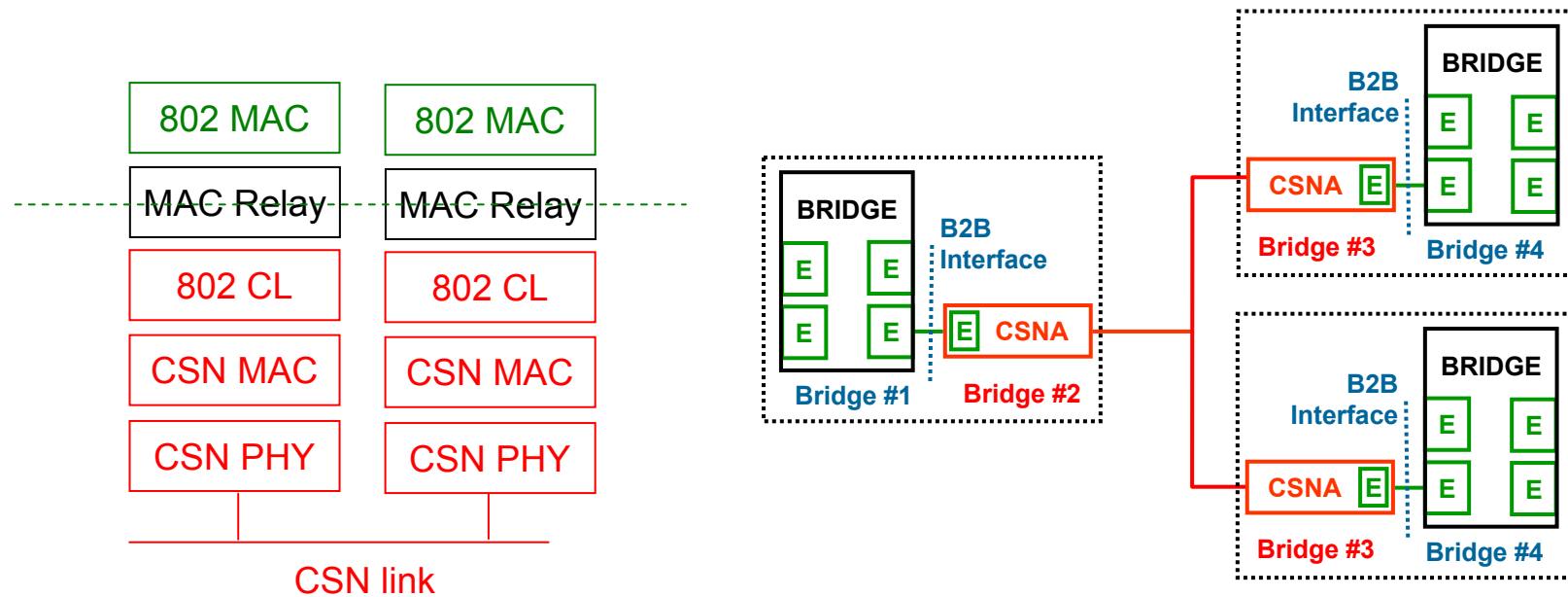
- Include support for Coordinated Shared Networks in the 802.1AVB specifications
- as a generic interface for all CSN Networks:
MoCA, HomePlug, 802.11 network w/ STA-Bridge capabilities,...



AV Bridge / CSN Network Topology Questions

Topology Option #1

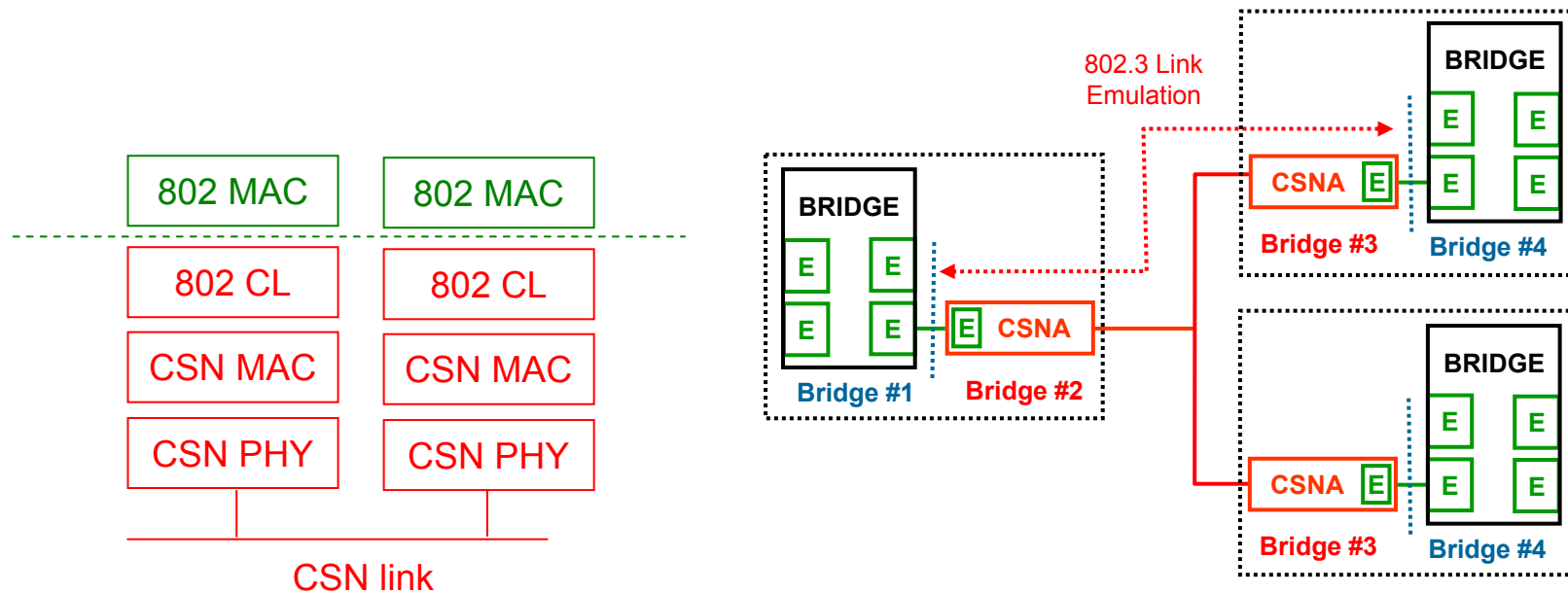
- CSN Adapter (CSNA) is a 802.3 / CSN bridge



PRO	Natural decomposition – Cascaded bridges Bridge 2 Bridge interface is defined
CONS	Implementing a full bridge HW/SW functionality might be too expensive for low end adapters Double bridge entities within the same enclosure when co-located

Topology Option #2

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



PRO	<p>Cheaper implementation</p> <p>Could be added as a port to existing AVB 802.3 bridges</p>
CONS	<p>CSN access latencies</p> <p>CSN link characteristics might change over time</p> <p>Need a new AVB interface to CSN sub-layer to query CSN characteristics</p>

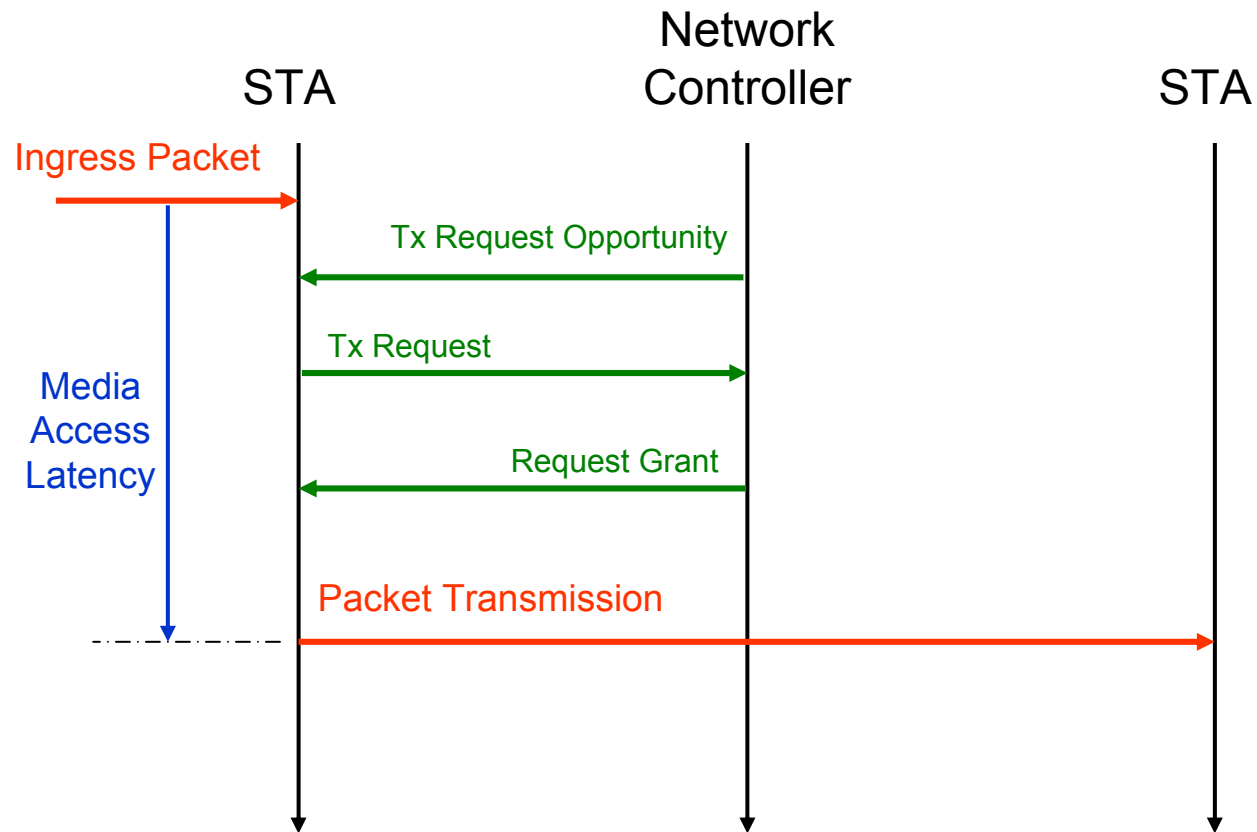
QoS on Coordinated Shared Networks

Coordinated Shared Network supports:

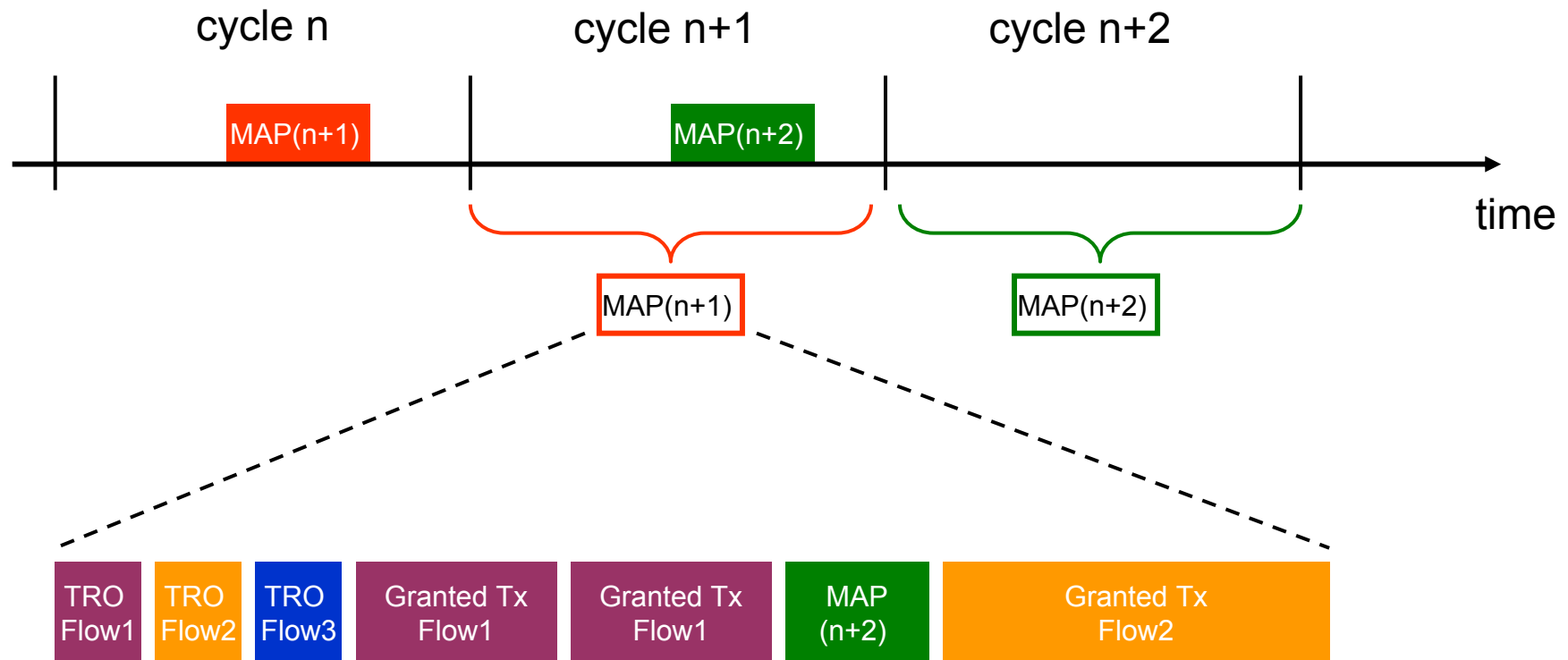
- **Contention free access**
- **Bandwidth reservation:**
 - solicited bandwidth
 - unsolicited bandwidth
- **Prioritized QoS:**
 - either uses 802.1Q priority levels
 - or maps a subset of priority levels from 802.1Q
- **Parameterized QoS:**
 - flow specifications

CSN - Solicited Media Access

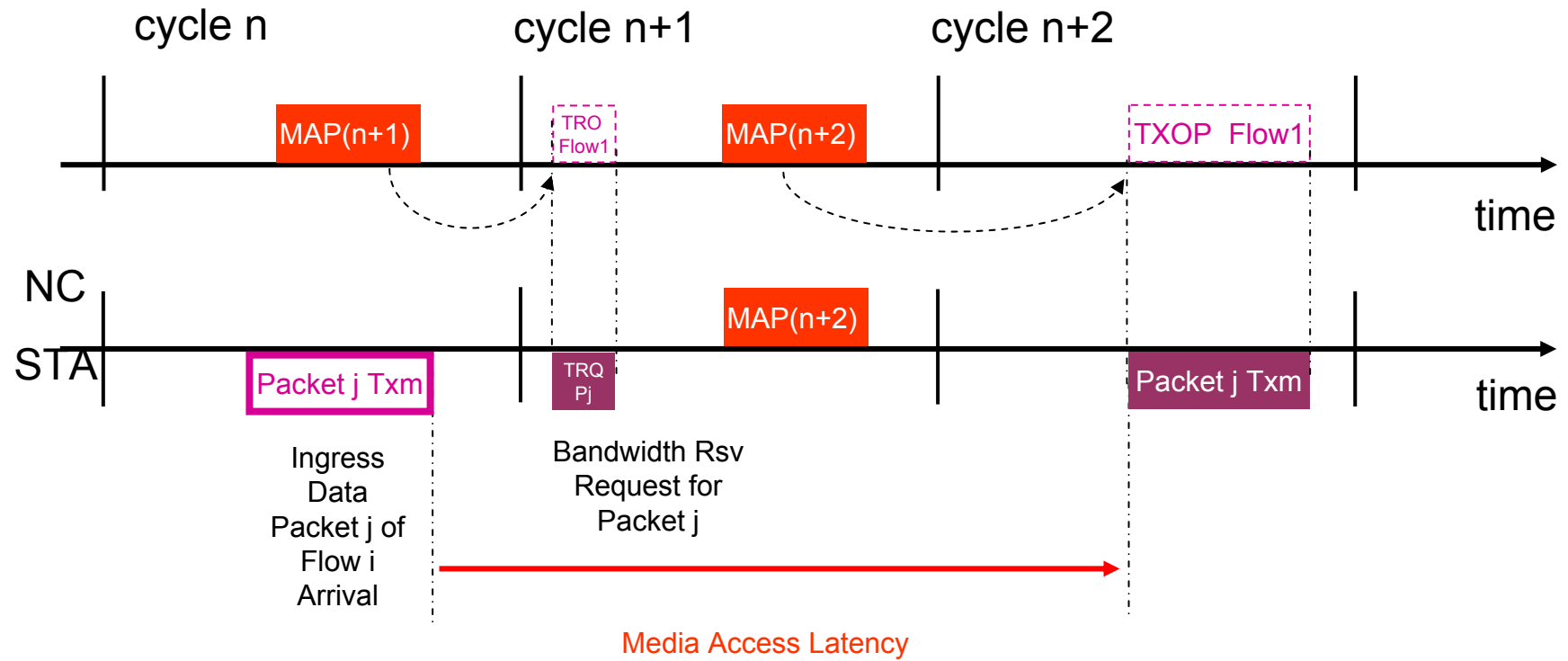
- **Pros:** Optimized bandwidth usage (Bandwidth on Demand)
- **Cons:** Access latency, difficult management for QoS Flows



CF Media Access Plan



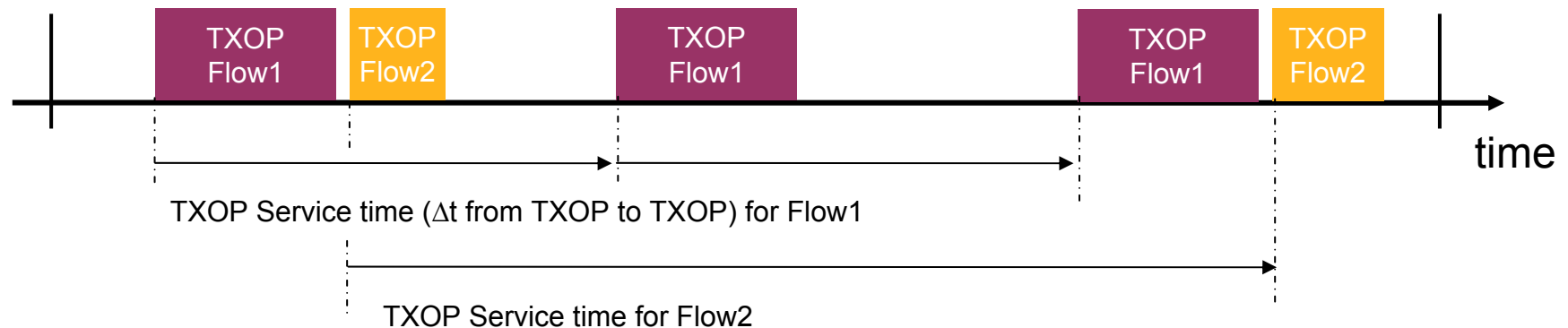
Contention Free Media Access



Unsolicited Media Access

- **Pros:** Bandwidth management, QoS, low latency
- **Cons:** Wasted bandwidth for bursty flows

MAP cycle i



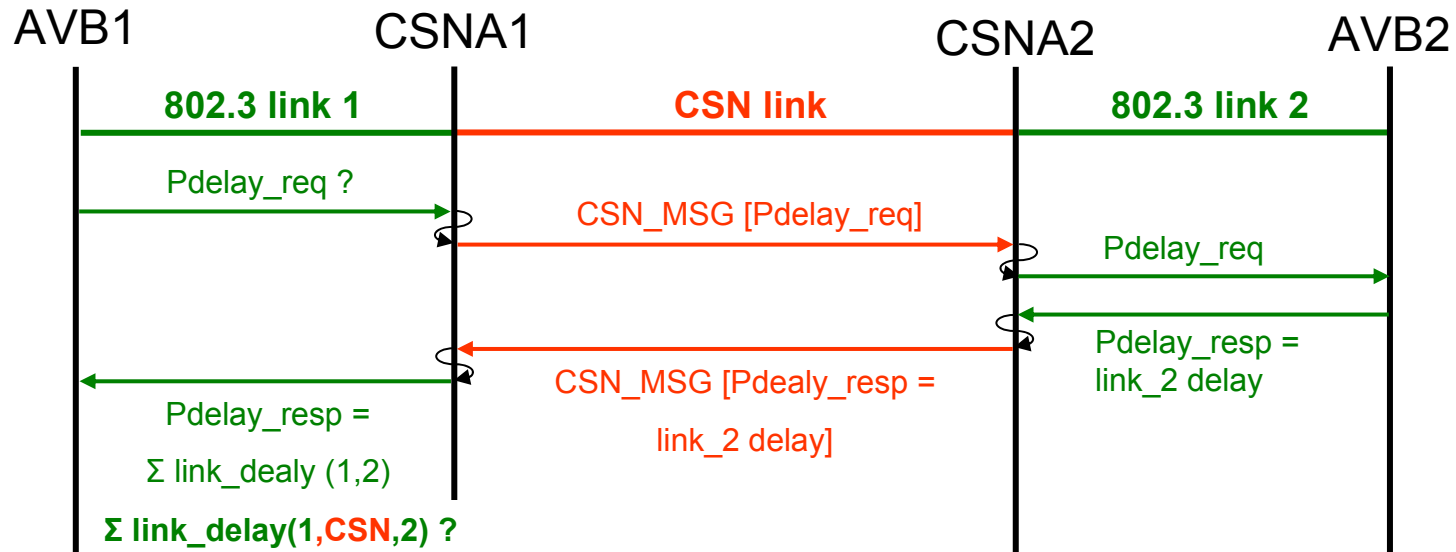
QoS Flow Parameters for AVB/CSN

QoS Flow Parameter Comparison

AVB	MoCA	802.11e	uPnP QoS v3	HomePlug v1.1	HPNA v3
TSPEC	TSPEC	TSPEC	TSPEC	CSPEC	Service Flow
Max Bit Rate	Peak Data Rate	Mean, Peak & Min Data Rates	Mean, Peak & Min Data Rates	Average, Max & Min Data Rate	Average, Max & Min Data Rate
Max Frame Rate	(Max) Burst Size	Burst Size	Max Burst Size	Max Burst Size	
	(Max) Packet Size	Nominal & Max MSDU Sizes	Max Packet Size	Mean & Max MSDU Sizes	Nominal Packet Size
		Delay Bound (MAC End to End max latency)	End to End Max Delay High	Delay Bound	Max Latency
			End to End Max Jitter	Jitter Bound	Max Jitter
		Surplus Bandwidth Allowance		Surplus Bandwidth	
			Loss Sensitivity (max size frames/sec)	MSDU Error Rate Requirement	Service Level BER Requirement
		Min PHY Rate	QoS Segment Max Delay High & Max Jitter		
				Arrival Time Stamp tolerance at TX CL SAP	

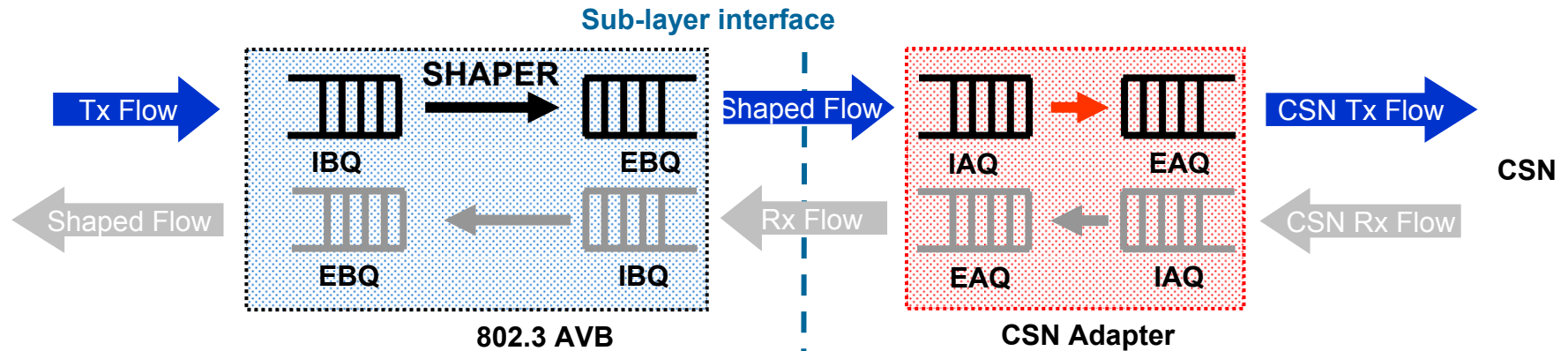
Questions

#1: Path Delay Measurement



- Option #1: $Pdelay = \Sigma Pdelay(I1,CSN,I2)$
 - CSN delay too high for current 802.3 P2P link selection (AVB capable path)
- Option #2: $Pdelay = \Sigma Pdelay(I1,I2)$
 - Not reporting the CSN delay (“cheating mode”) will not work if AVB establish the data link cost of the data STP based on Pdelay
 - *Is MSTP / 802.1s a solution to create specific data spanning tree per CoS ?*

#2: Credit Based Shaper with Sub Layer Queuing



- **Shaper Parameters:**

- **loLimit** = $\text{maxFrameSize} * (\text{sendSlope} / \text{linkTransmitRate})$
- **hiLimit** = $(\text{max interference size}) * (\text{idleSlope} / \text{linkTransmitRate})$
- **max burst size** = $(\text{linkTransmitRate} * ((\text{hiLimit} + \text{loLimit}) / \text{sendSlope}))$

CSN Parameters (queried during SRP reservation)

maxFrameSize
linkTransmitRate
maxBurstSize

Flow Control

802.1AS Clock Synchronization on CSN

SN AVB Timing Services

- **AVB Timing Services**

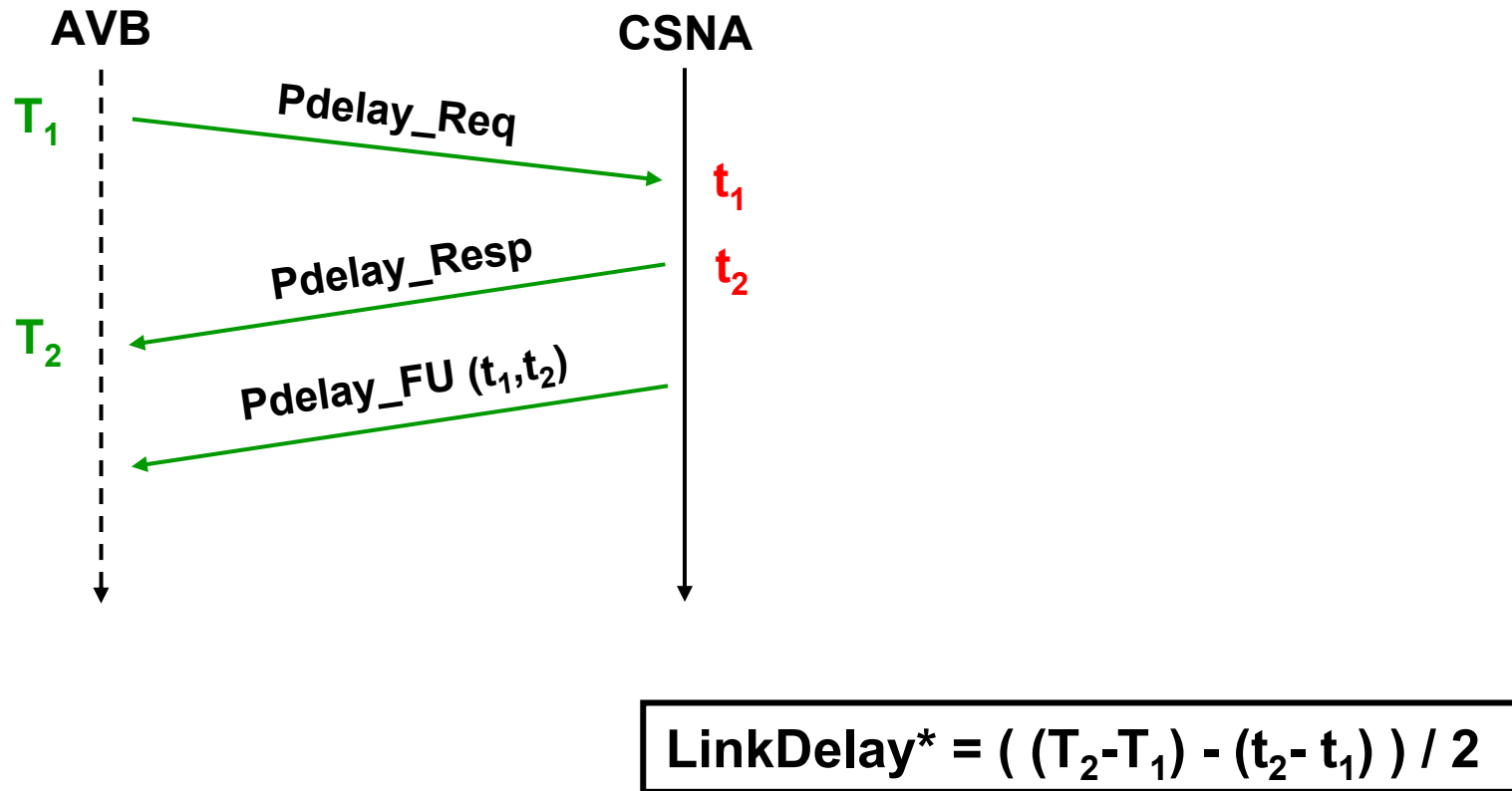
- If the CSN clock is accurate enough, the 802.1as CSN media dependant part could be provided by the CSN time services:

- 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:**

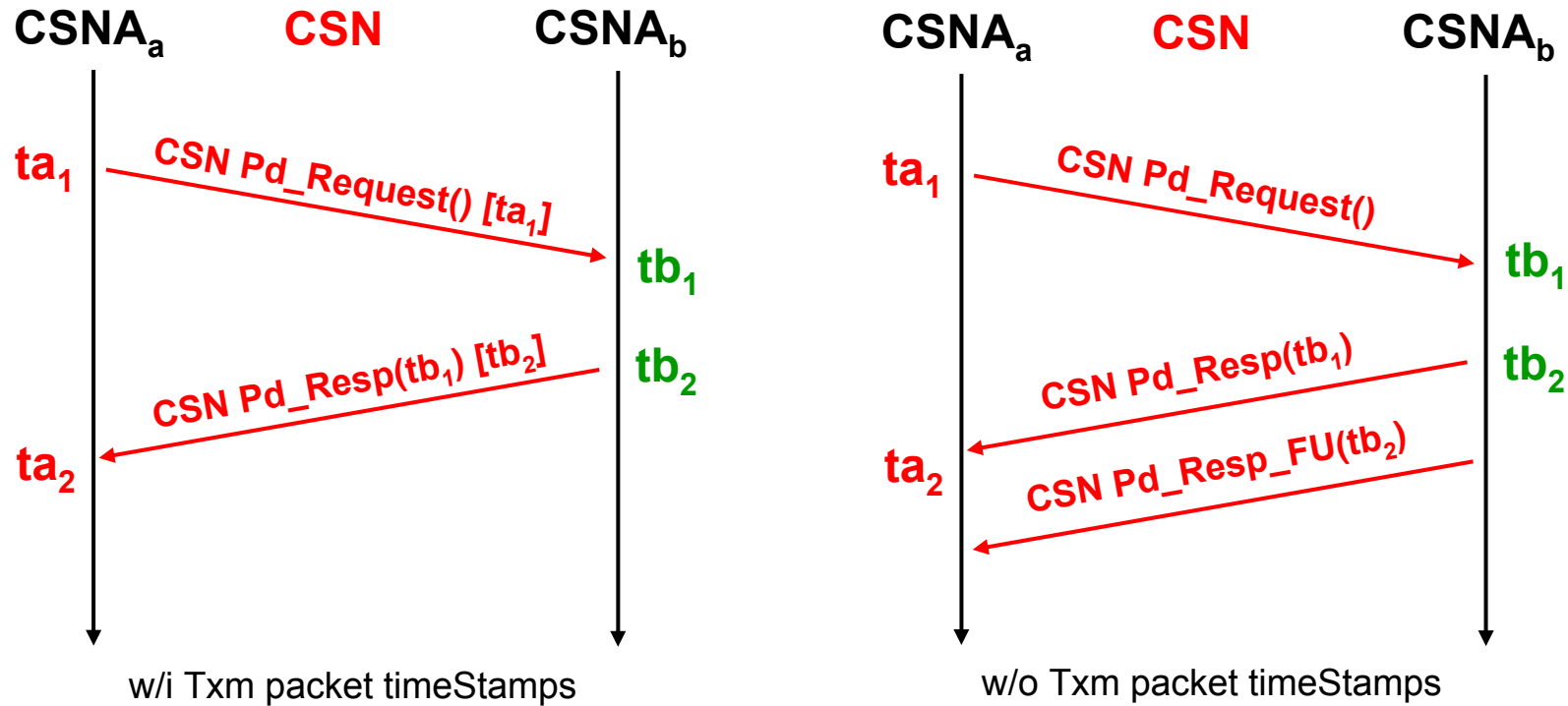
- Sync, Follow_Up,
 - Pdelay_Req, Pdelay_Resp, Pdelay_Resp_Follow_Up

Link Delay SAP



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

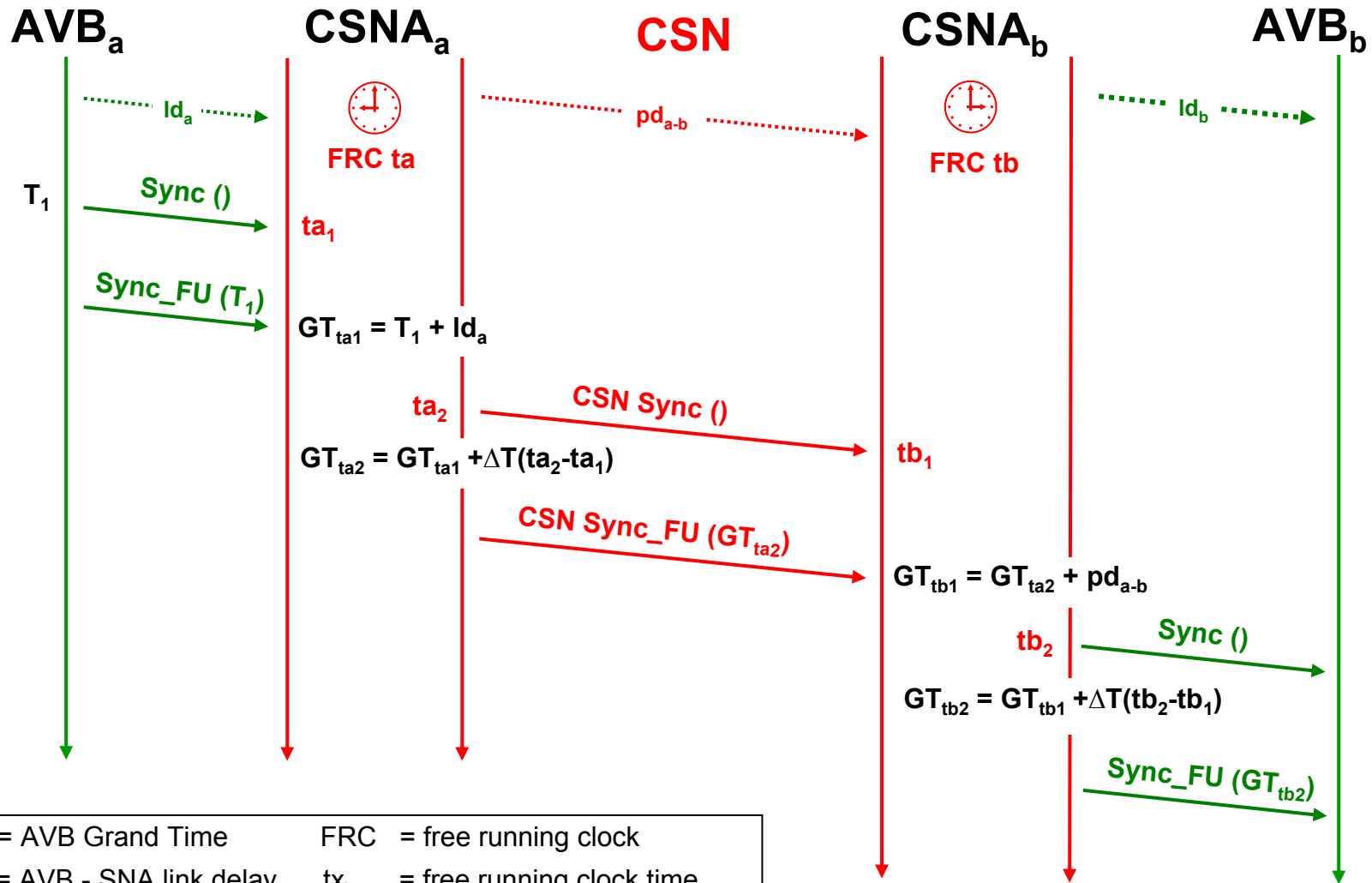
CSN Propagation Delay Measurement between 2 CSNAs



$$\text{CSN_PropagationDelay} = ((ta_2 - ta_1) - (tb_2 - tb_1)) / 2$$

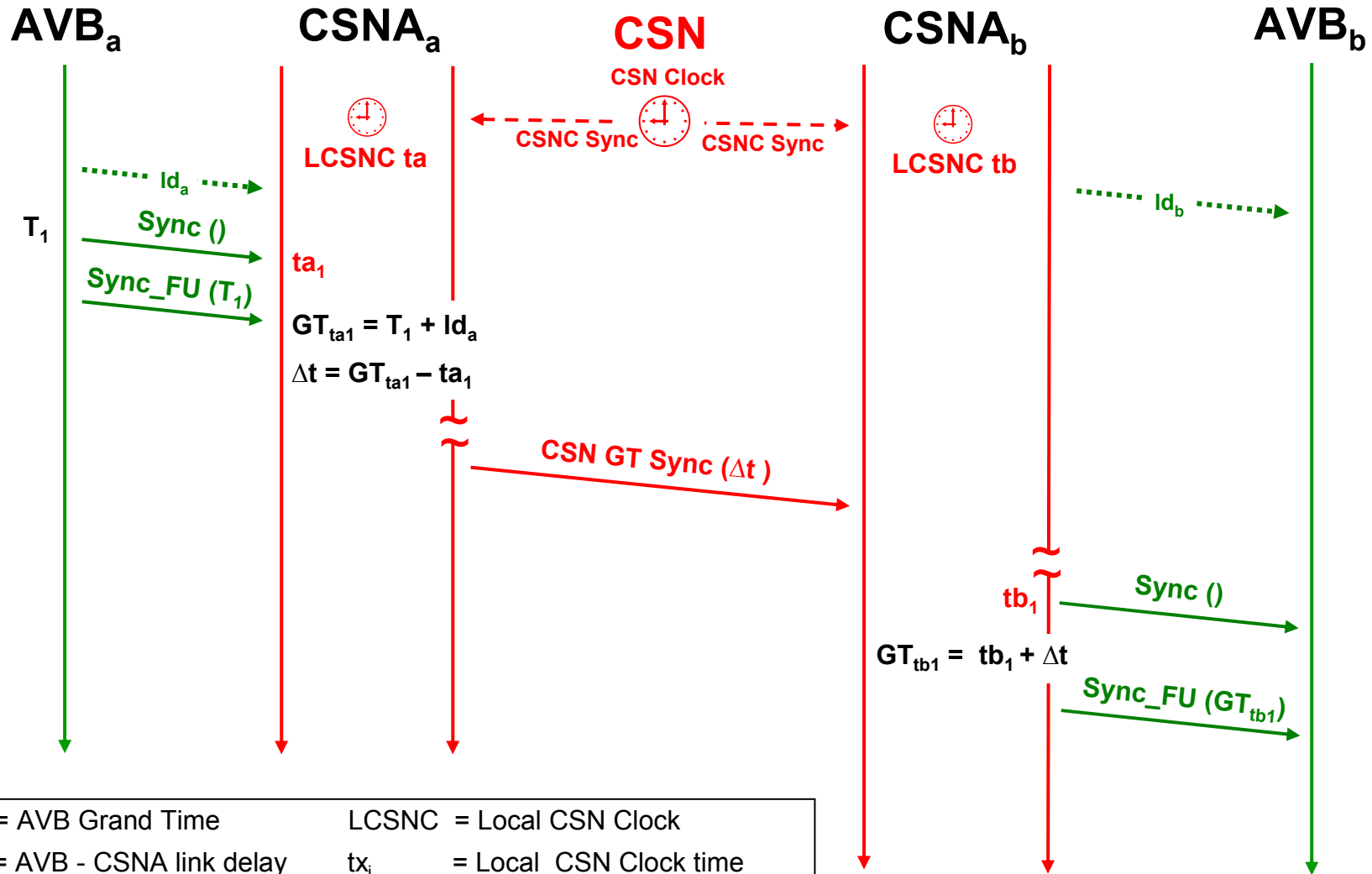
[t] Tx Packet Header 's TimeStamp
 (t) API Parameters

Scheme 1: Clock Sync w/o CSN Master Clock Ref



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

Scheme 2: Clock Sync w/ CSN Master Clock Ref



GT = AVB Grand Time	LCSNC = Local CSN Clock
Id = AVB - CSNA link delay	tx _i = Local CSN Clock time
pd = CSN propagation delay	

Thank you

