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MSRP Gen 2 for Time Sensitive Networks (TSN - AVB Gen 2)

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IEEE 802.1 Interim Meeting – Vancouver

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Structure of this Presentation

- 1. AVB Gen1 with MSRP Gen 1**
Tasks of MSRP Gen 1
Open Problems when using MSRP
- 2. New MSRP Gen 2 Requirements**
High Availability
L2 Routing based on IS-IS
- 3. Combining ISIS Routing (ISIS-SPB-PCR) and MSRP**
Presented possible way's of MSRP Integration
Which parameters should be considers for routing?

Tasks of MSRP Gen 1

MSRP Gen 1 is used for:

- Announcement of stream properties
- Finding Path to Talker on RSTP Tree
- Checking of Resource-Availability on RSTP Tree (= Transmission Path)
- Calculation of the max. Latency
- Reservation of Resources
- Setting the forwarding path
- Starting the transmission of streams

(<http://www.ieee802.org/1/files/public/docs2012/ca-goetz-SPB-PCR-stream-ext-1112-v01.pdf>)

Open Problems of MSRP Gen 1

Only max. Latency of Streams

- Size of buffer unknown

Packaging of Streams Advertisements

- only works under special conditions

“L2 Routing” and Reservation based on the RSTP Tree

- Reconfiguration times are undefined (RSTP time + Reservation time)

No Pre-Reserved Streams

- Listener starts the reservation of resources

Open Problems of MSRP Gen 1

Reservation order affects the result (Deadlock possible?)

- Ranking is the age of the active stream (start of reservation)

Fixed Observation Intervals

- 125 μ s for Class A, 250 μ s for Class B
- <http://www.ieee802.org/1/files/public/docs2012/avb-dolsen-alternate-fqtss-observation-intervals-1112.pdf>

VLAN Handling and Domain support

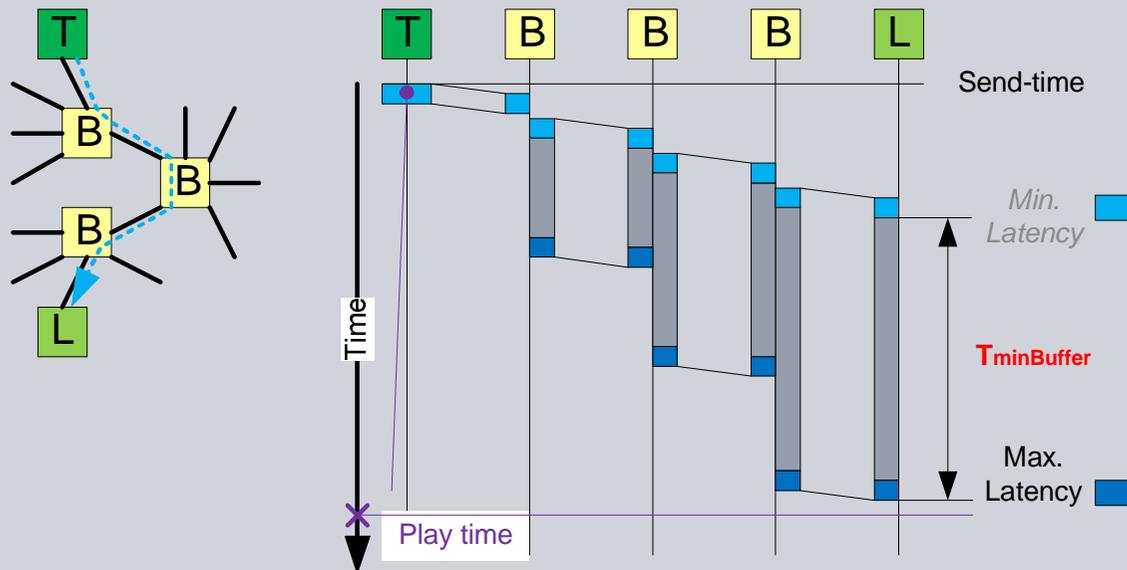
- No Support of TSN Domains and VLAN (MVRP)
<http://www.ieee802.org/1/files/public/docs2012/new-avb-afredette-msrp-improvements-0313.pdf>

Only max. Latency of Streams

Listener has the following information:

- max. Latency of the Stream from MSRP
- Play time in the streamed data

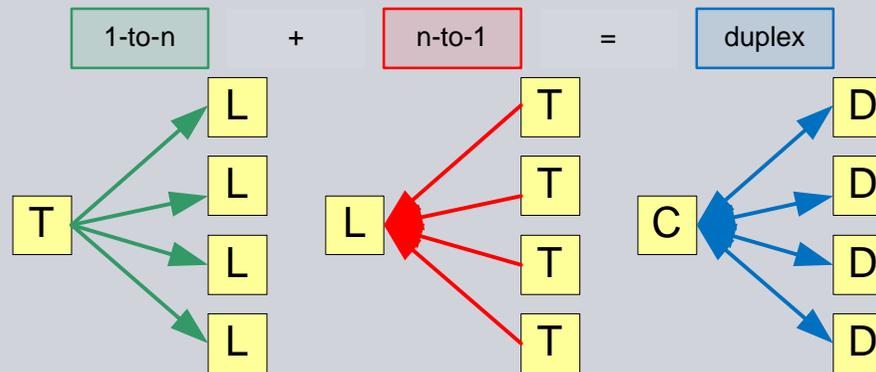
How long must a frame be stored?



Open Problems of MSRP Gen 1

Packaging of reservations

MSRP Frame format optimized for 1 Talker with multiple Listeners



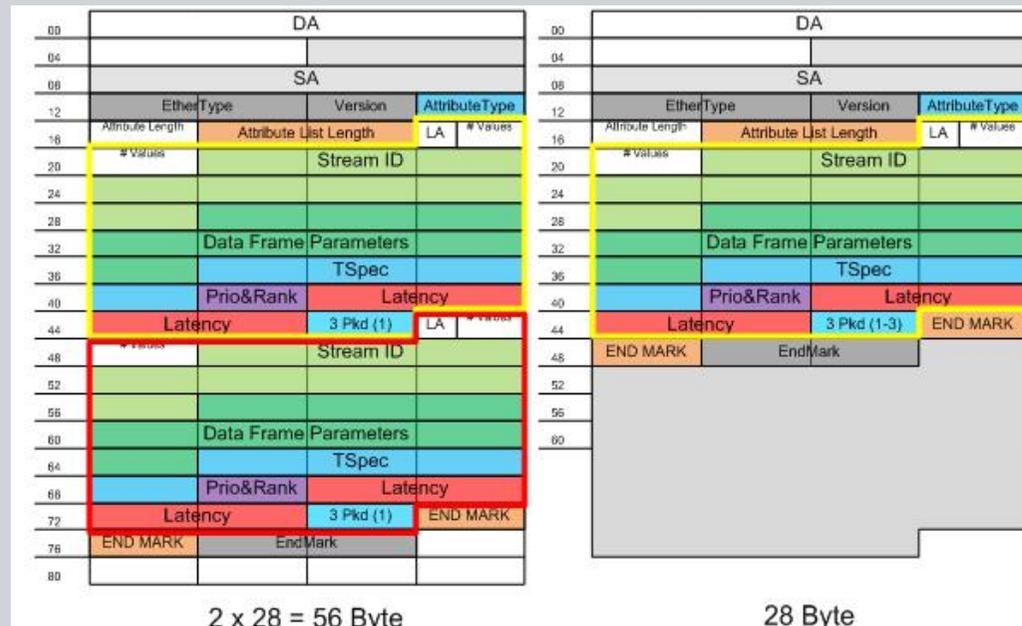
Packaging only possible if:

- sequential Stream ID: Stream from same Talker
Unique Stream ID + 1
- same Stream Parameters: TSpec (Bandwidth BW)
Prio & Rank
Latency

Open Problems of MSRP Gen 1

Packaging of reservations

2 unpacked Reservations vs. 3 packed Reservations



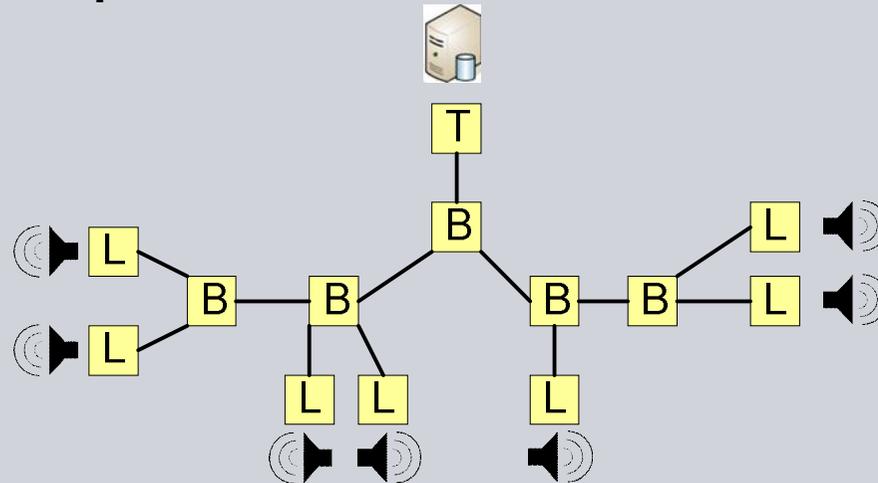
Packaging can be influenced

- on the Way to the Listener by Talker-pruning
- deletion of one offered Stream
- Availability of resources (Multicast-MAC Address entry)

Open Problems of MSRP Gen 1

Packaging of reservations – AV example

1 Talker with multiple Listeners



Multiple Streams with

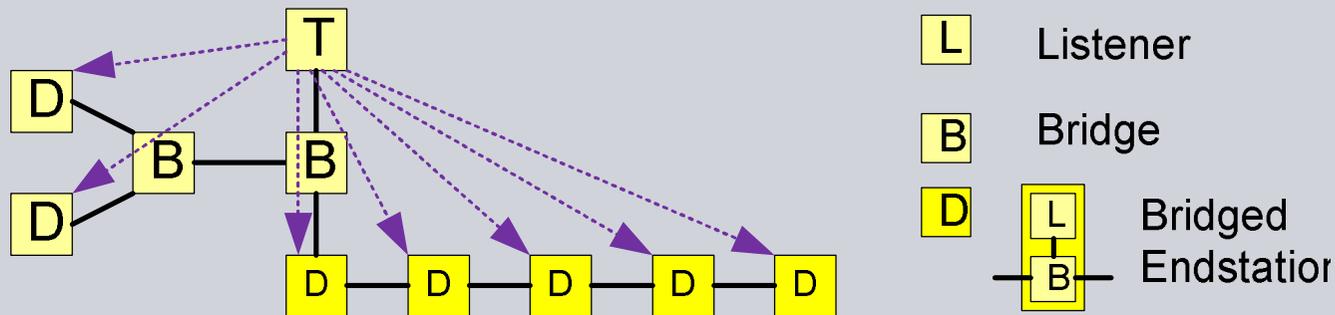
- same Talker
 - same Stream Parameters:
- Same MAC + Unique Stream ID + 1
TSpec (Bandwidth BW)
Prio & Rank
Latency (same Source!)

Packaging of reservations possible

Open Problems of MSRP Gen 1

Packaging of reservations – Industry example

1 Talker with multiple Listeners



Controller to Devices

Multiple Streams with

- same Talker (Controller)
- same Stream Parameters:

Same MAC + Unique Stream ID + 1

TSpec (Bandwidth BW)

Prio & Rank

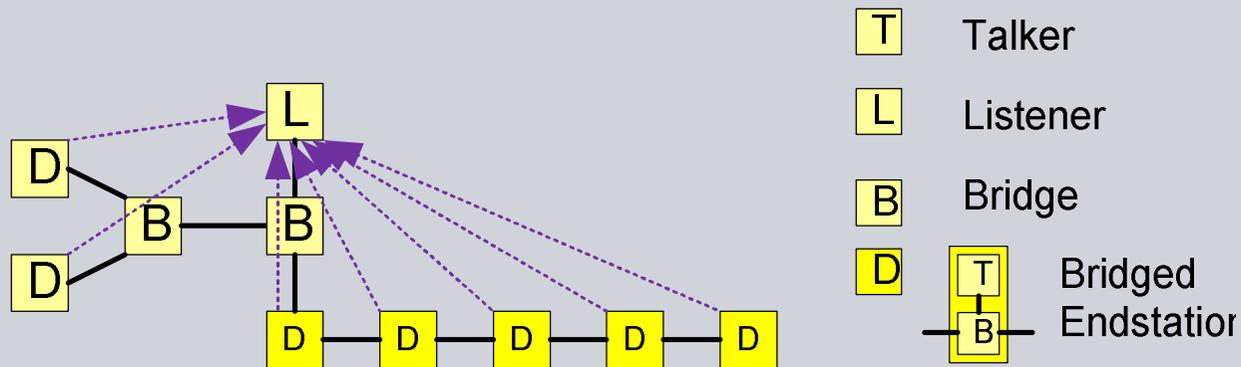
Latency (same Source!)

Packaging of reservations sometimes possible

Open Problems of MSRP Gen 1

Packaging of reservations – Industry example

multiple Talker with same Listener



Devices to Controller

Multiple Streams with

- different Talker (Controller)
- same Stream Parameters:

Different MAC + Unique Stream ID + 1

TSpec (Bandwidth BW)

Prio & Rank

Latency (different Source!)

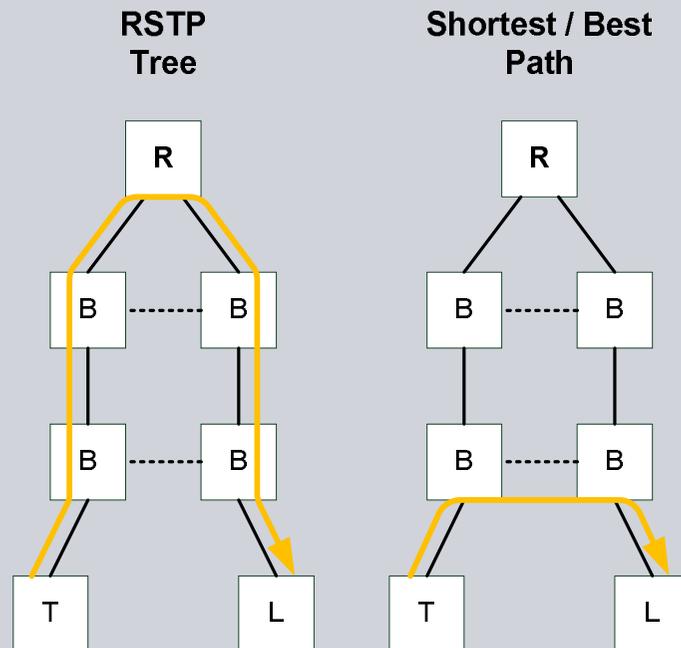
Packaging of reservations not possible

Open Problems of MSRP Gen 1

L2 Routing based on RSTP Tree

Only one possible way between Talker and Listener

- Path is part of best way to Root (not the best path for the stream)
- Failure of Root-Bridge effect all Links (RSTP Tree Change)
- RSTP Reconfiguration forces a **re-reservation** of Streams



Open Problems of MSRP Gen 1 Ranking



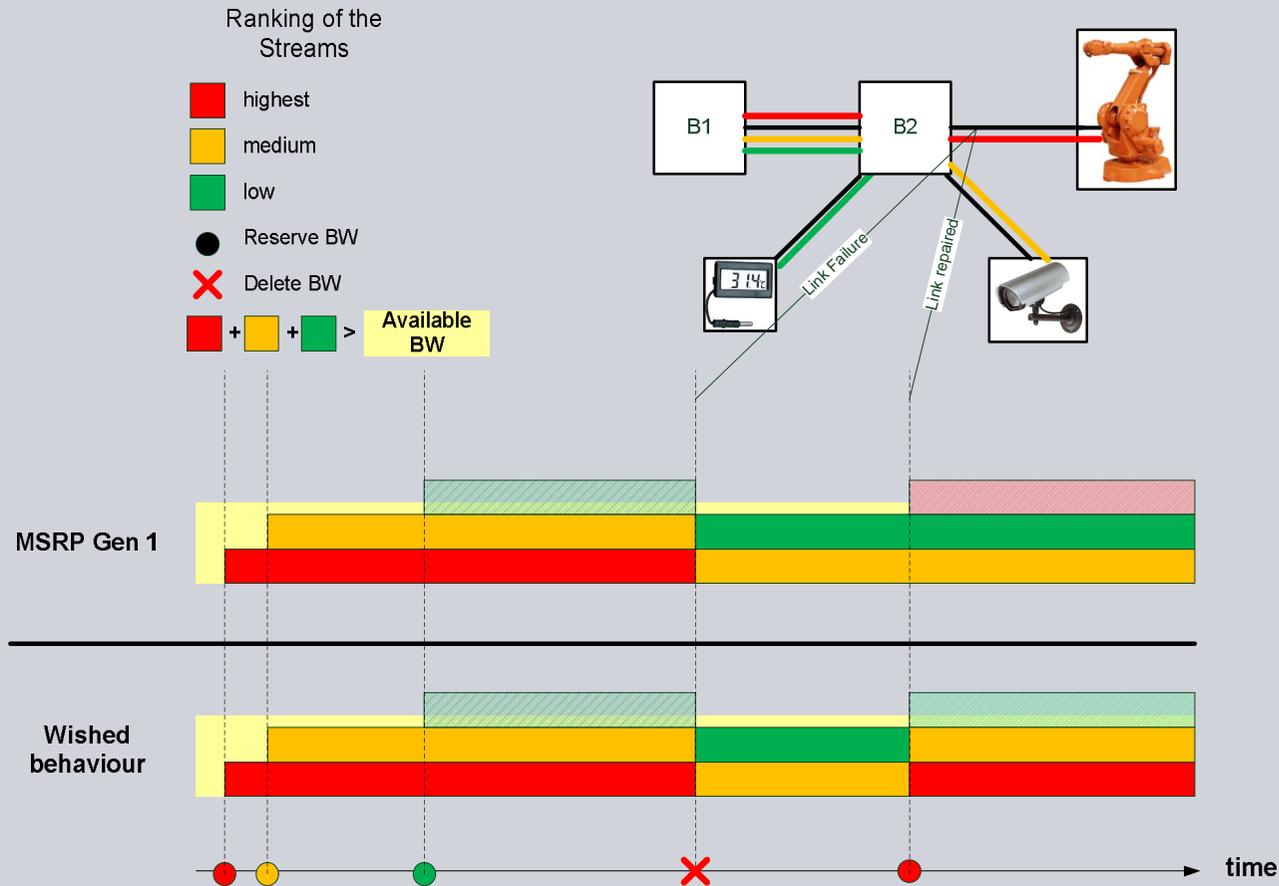
Older Streams have a higher Priority => Time of Reservation is used for Ranking

- Idea: Do not disturb running streams with new reservations

The result in the reservation is not determinable

- RSTP Reconfiguration
 - Root-Bridge Failure – new tree with new ways for **all** streams
 - Link Failure – new “local” root bridge with own tree
 - Repaired Links – RSTP Reconfiguration?
- Startup-Phases
 - All devices start at the same time with advertisements
 - Reservations start at same time
 - Streams over shared Links requesting same resources
 - Which streams win, when Resources last only for subset of streams?

Open Problems of MSRP Gen 1 Ranking



Link down may be caused by planned production brake, maintenance, ...

Open Problems of MSRP Gen 1

VLAN Handling and Domain support

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VLAN Handling

- <http://www.ieee802.org/1/files/public/docs2012/new-avb-afredette-msrp-improvements-0313.pdf>



Domain-Concept

- Problems at the domain borders (Priority Regeneration)
- Control inside the domain
 - Who is allowed to announce a Stream ?
 - Who is allowed to join an offered stream ?
 - Ranking – who controls the Ranking ?

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Possible Solutions
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High Availability
L2 Routing based on IS-IS
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Presented possible way's of MSRP Integration
Which parameters should be considers for routing?

Changes in TSN (AVB Gen 2) affecting MSRP

Gen 1 path was based on the RSTP Tree

- RSTP for “simple” applications with MSRP Gen 1 should be still possible
- **IS-IS** combined with MSRP Gen 2 for Routing of streams with higher requirements

Traffic classes will no longer have a fixed Observation interval

- Reduce Waste of bandwidth (125 us = 8000 frames / s)
(<http://www.ieee802.org/1/files/public/docs2012/avb-dolsen-alternate-fqtss-observation-intervals-1112.pdf>)

Additional Traffic classes and Shaper for Scheduled Traffic

- Maximum usage of BW for each Traffic Class
 - e.g. Class A = 5%, Class B = 10% of Link-BW
- Used Shaper with Shaper-ID
 - TAS with Preemption
 - BLS with Preemption
 - CBS (AVB Gen 1)
 - ...

Table I-2—Traffic type acronyms

Priority	Acronym	Traffic type
1	BK	Background
0 (Default)	BE	Best Effort
2	EE	Excellent Effort
3	CA	Critical Applications
4	VI	“Video,” < 100 ms latency and jitter
5	VO	“Voice,” < 10 ms latency and jitter
6	IC	Internetwork Control
7	NC	Network Control

Changes in TSN (AVB Gen 2) affecting MSRP

Latency Calculation considering additional aspects

- Used Scheduler (new types) determines the latency
- Min. Fragment size with Preemption
- Max. Legacy Frame size (no Preemption)
- Max. useable BW of Traffic Classes with higher priority
- Minimum Latency
- Redundancy with more than one way

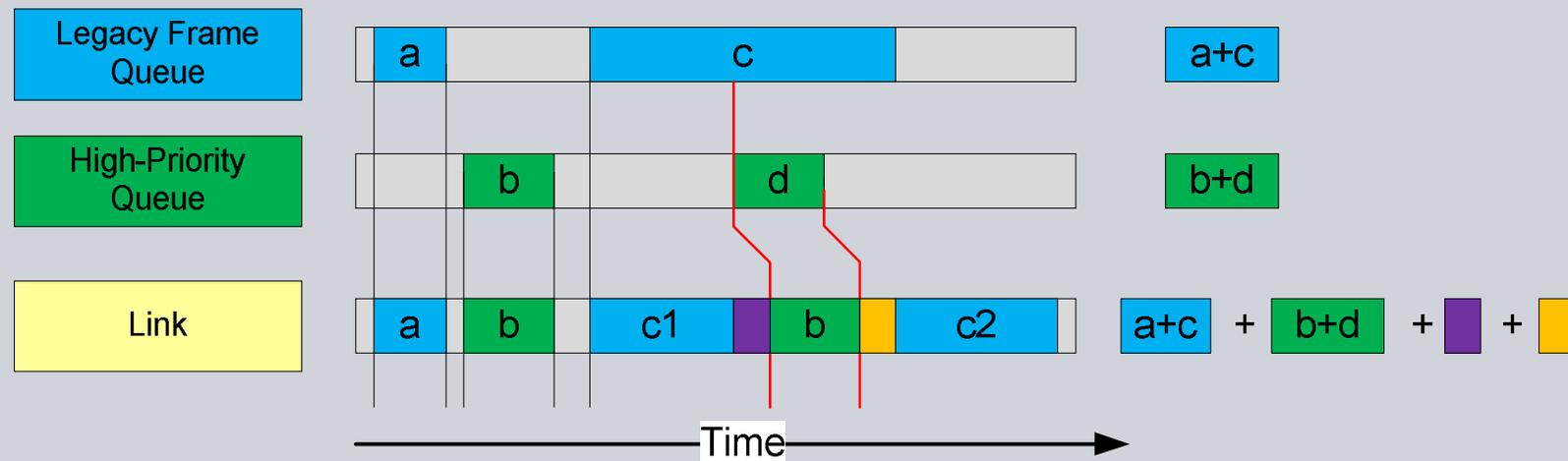
Changes in TSN (AVB Gen 2) affecting MSRP

Preemption influences the used Link-Bandwidth



Preemption impacts MSRP

- More Bandwidth on the Link needed
 - Bandwidth going through the queues is still the same
 - Additional delay for Traffic classes with lower priority



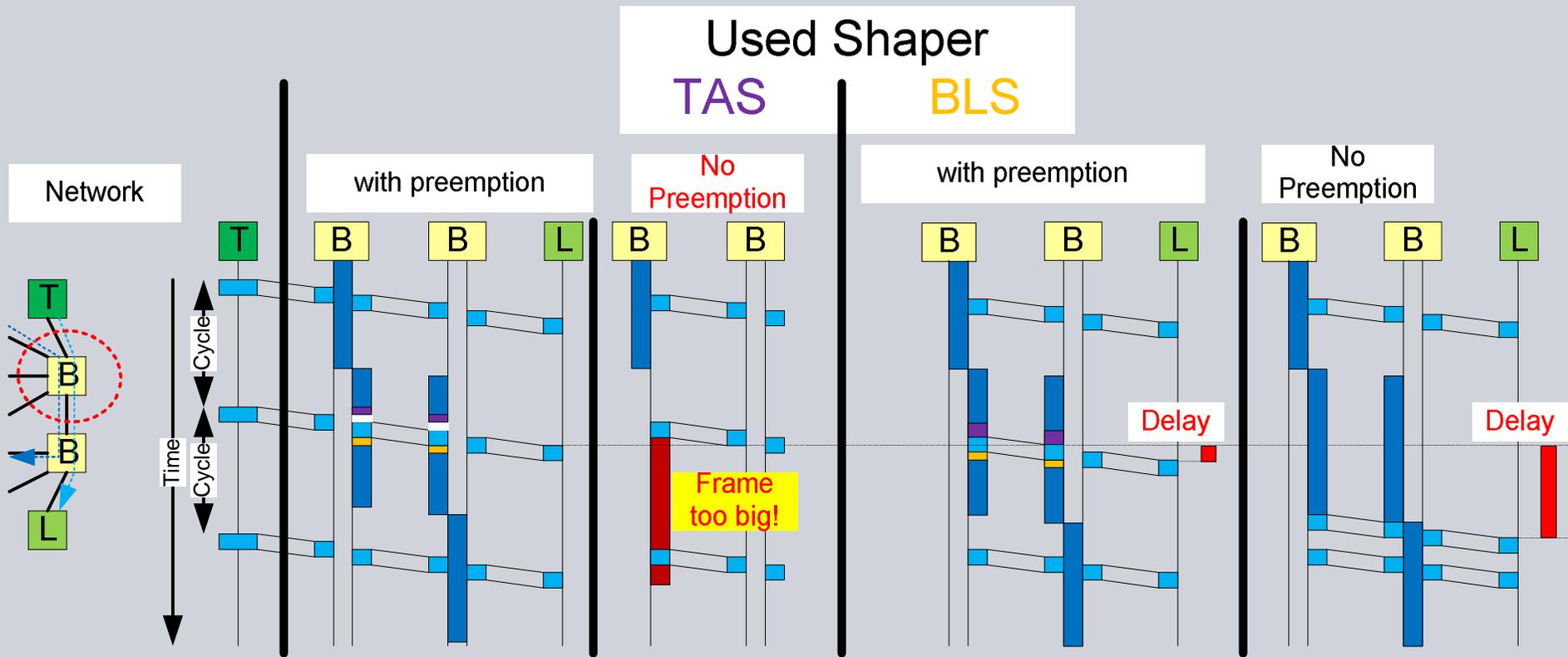
Changes in TSN (AVB Gen 2) affecting MSRP Latency with Preemption



Compared Latency between different Shapers w and w/ preemption

Industrial Cycle e.g. 62,5 μ s (@FE)

TAS w/ Preemption limits the max. Frame size!



Changes in TSN (AVB Gen 2) affecting MSRP

Calculation of TAS window size for one or multiple windows

- Start and End point of the window in the cycle (Qbv?)
- Possible?

Redundant paths for Control Traffic with Gen 2

- redundant Streams using VLAN mechanisms (e.g. path A and B)
- Signaling of Reservation status of multiple streams
- Activate Duplicate elimination on the path (half BW)

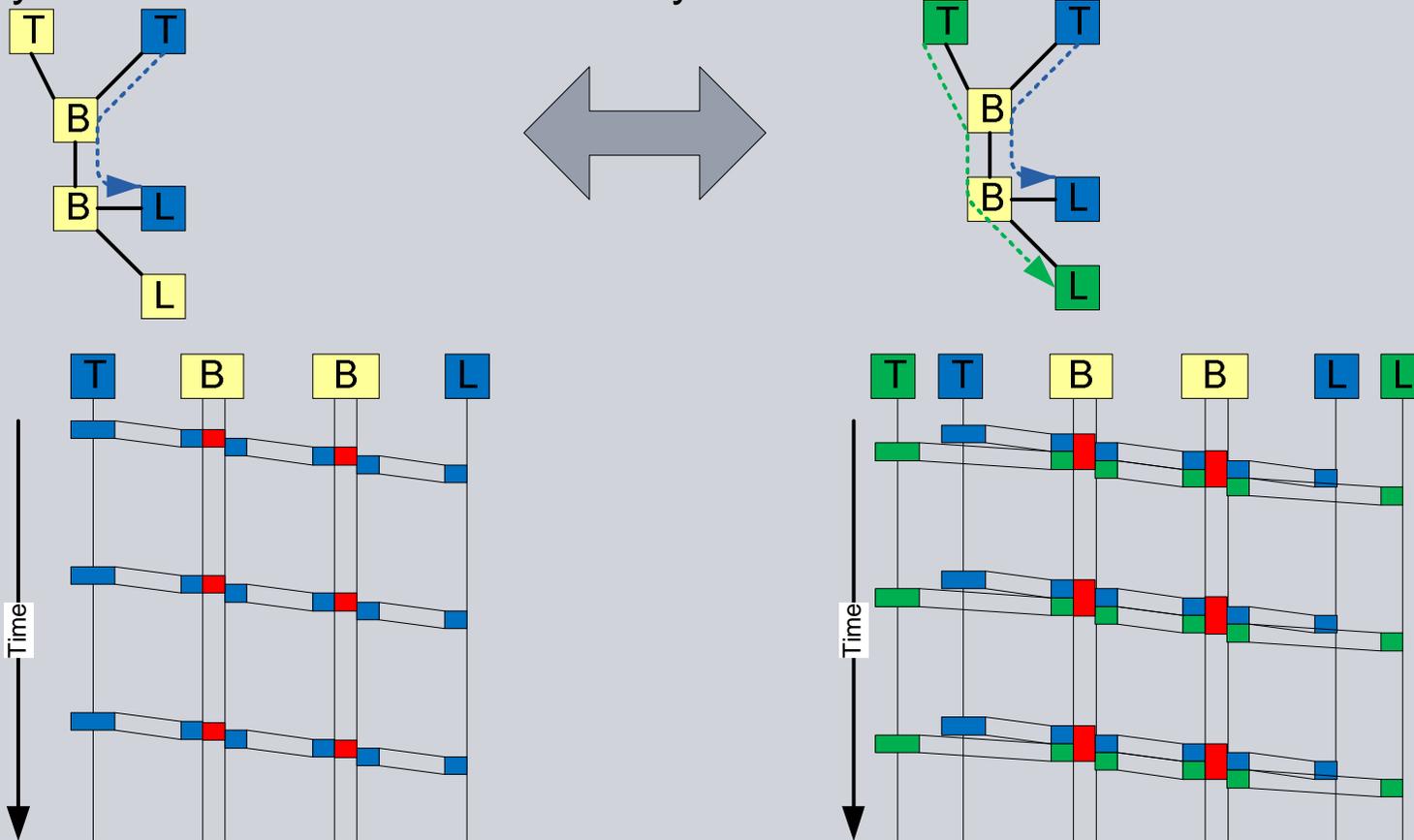
Min. and max. latency of streams

- Calculate resources for Scheduled- and Reserved-Traffic in Listeners
- Calculate resources for Scheduled- and Reserved-Traffic in bridges
- Calculate window size duplicate elimination

Setting of active TAS window size

TAS window size needs to be calculated (Start- & End-Time + Cycle)

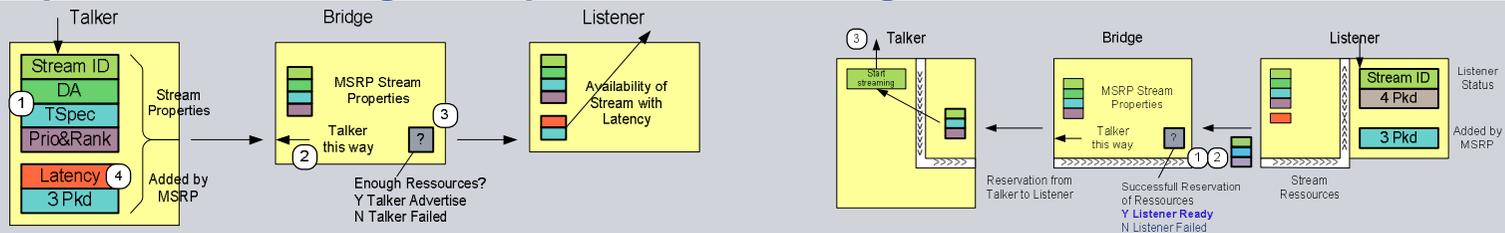
Who synchronizes all nodes on the way from T to L



New MSRP Parameters

Sequence of Reservation

<http://www.ieee802.org/1/files/public/docs2012/ca-goetz-SPB-PCR-stream-ext-1112-v01.pdf>



Used MSRP Parameters Gen 1 and possible future Parameters for MSRP Gen 2

MSRP Gen 1

Stream ID	Unique Identification of the Stream
DA	MAC-Adress used for forwarding of Frames
TSpec	Frame Size und Transmission period
Prio&Rank	Priority and Ranking (1-bit)
Latency	
3 Pkd	MRP Information
4 Pkd	Listener-Reservation Status

MSRP Gen 2 / ISIS

Stream ID	
DA	
TSpec	„Variable“ Transmission Period
Priority	Priority = Traffic Class + Shaper
Ranking	Ranking (>> 1-bit)
Path	High-Availability (Redundancy), Loadbalancing, RSTP, ...
Min. Lat.	Min Latency } Combination of redundant Paths
Max. Lat.	
3 Pkd	
4 Pkd	
...	

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Presented Possible Solutions

<http://www.ieee802.org/1/files/public/docs2012/new-avb-anfredette-srp-spb-v02.pdf>

MSRP

SPB

MSRP Lite

IS-IS SPB
PCR

IS-IS
SPB with
MSRP

Models for Running SRP over SPB/IS-IS

- Model 1: SRP over SPB
 - SPB is used to calculate the topology.
 - SRP is used as-is: SRP messages propagated over the topology calculated by SPB instead of RSTP or MSTP.
- Model 2: Constraint-Based Routing + Signaling
 - Extend IS-IS to advertise information needed to compute paths for streams.
 - A constraint-based routing entity selects a path based on stream requirements and network capabilities.
 - A signaling protocol (e.g. a modified SRP) is used to set up the path.
- Model 3: Full Integration
 - SRP is run at the edge to allow end-stations to register Talker advertisements and Listener requests.
 - Integrate the MSRP functionality into SPB/IS-IS.
 - Distribute via IS-IS Talker registrations, Listener registrations, and all other information required to make **deterministic** stream path and reservation decisions.
 - Switches compute paths and reservations **independently** using this information.

3



Presented Possible Solutions

<http://www.ieee802.org/1/files/public/docs2012/ca-goetz-SPB-PCR-stream-ext-1112-v01.pdf>

	AVB Gen1	AVB Gen2		
		I	II	III
		Possible Way's for Gen 2		
		MSRP IS-IS	Bandwidth-Linkmetric IS-IS	Linkspeed-Linkmetric IS-IS
Distribution of Stream Properties	MRP Protocol Mechanisms	ISIS-SPB-PCR mechanism (TLV's or Sub-TLVs) to distribute information		
Path of Streams	RSPT data tree	ISIS-SPB-PCR for routing of single / multiple path streams		
Calculation effort	Low effort	ISIS-SPB-PCR algorithm for single / multiple Paths in every node		
Sharing of Reservationstatus	By MRP Protocol MSRP Gen 1	MSRP Lite	Local Calculation Storage of Results needed for new Calculations	Via ISIS Linkstate instable ISIS behaviour because of fast changing values?
Latency Calculation	By MRP Protocol MSRP Gen 1	MSRP Lite	On ISIS basis = Information's about all Delays from all devices needed in every device -> huge synchronised database needed	
Setting of Forwarding Information	MRP Protocol Mechanisms	ISIS Mechanism		
Repeatable result of Reservation	Depending on Starting-order	Unique Priority for fixed result needed to get a stable, repeatable result		

Presented Possible Solutions

Seen Problems with the Calculation from IS-IS based data:

Bandwidth

- Calculation is needed to reserve the Resources
 - Information on the complete path to know if reservation fails / succeeds
 - In every device for every Stream going to all affected stations?
 - Ranking (start of Reservation) needed for

Latency

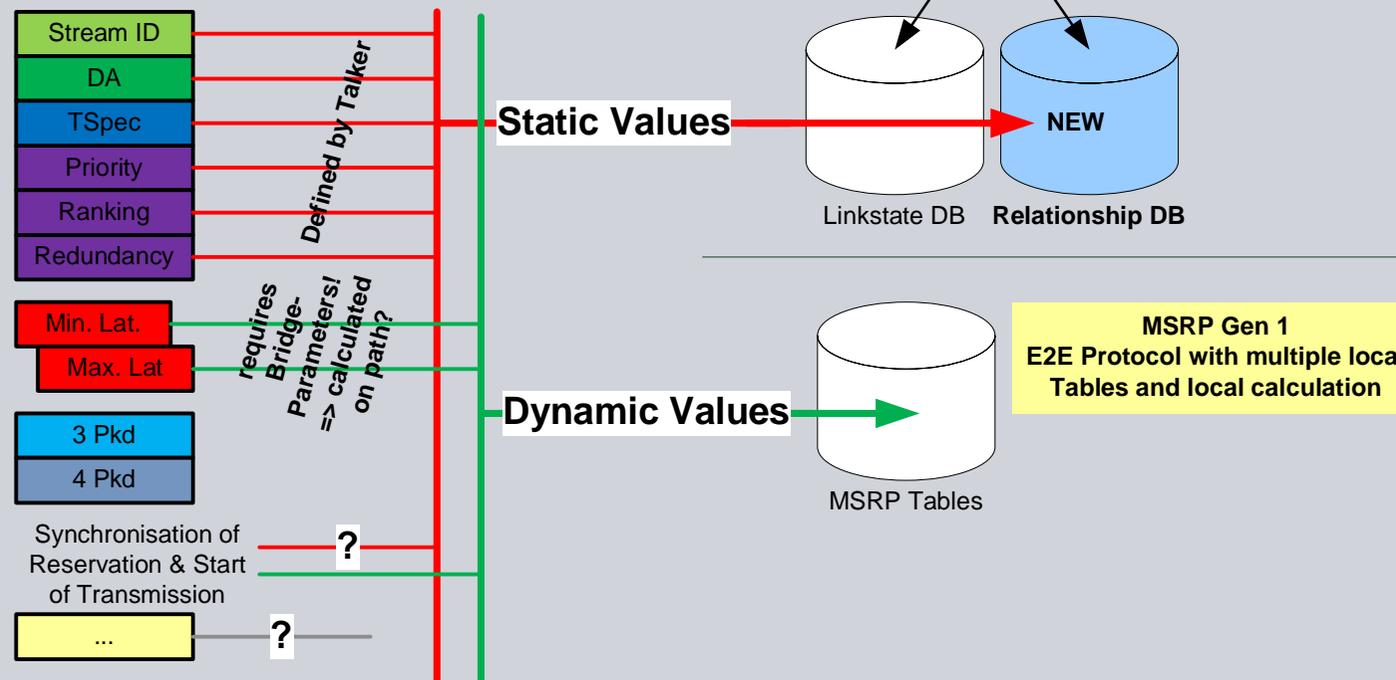
- Will change with every new reservation
- All Bridge Delays are needed

Computing and Storage demand?

- Embedded / 2-Port Devices

Common Message in both Presentations

IS-IS Mechanisms are suitable for sharing static values and keep it consistent
 MSRP will change the reserved bandwidth
 E2E Synchronization needed



Relation between Reservation and Routing

Which Values are dynamic, which are static?

The following Parameters are available and **can** be used for Routing:

- **Topology** (IS-IS DB)
to find routes from T to L
- **Stream Parameters**

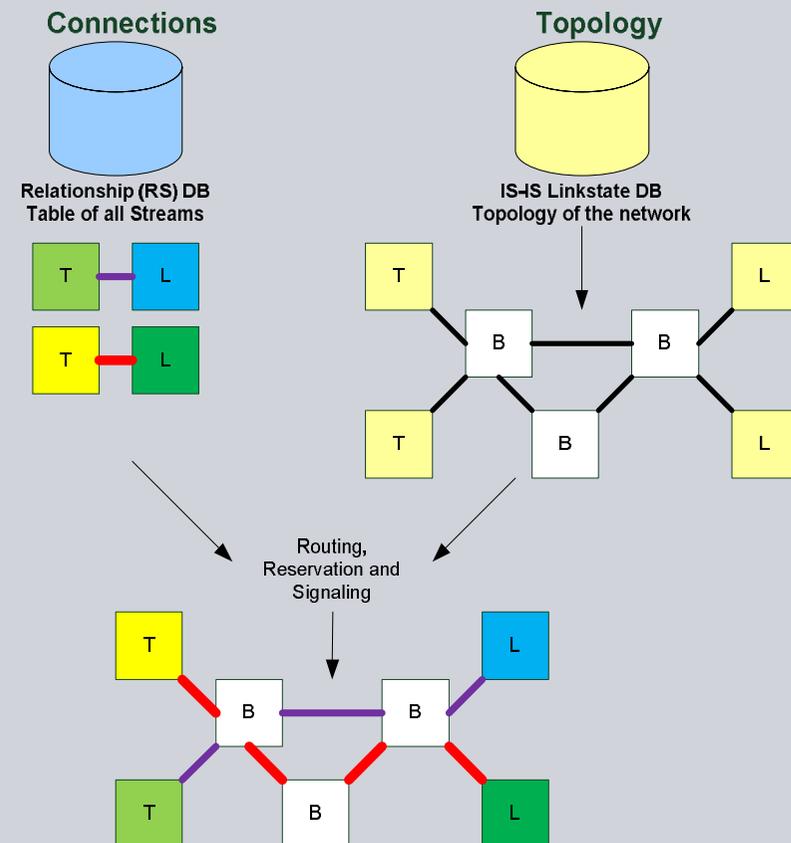
MSRP Parameters:

- Source, Destination
- Needed Bandwidth
- Redundancy

Bandwidth

Current used BW / Link BW to use only useful links
Useable Bandwidth per Traffic class (in %)

- On the Link / In the Domain
- **Ranking of the Streams**
Needed for repeatable results



Conclusion

ISIS is good for sharing static Information in the network.

- Which Parameters are static “enough”?

ISIS SPB Mechanisms are good for routing

ISIS SPB TSN

- L2 and Redundant path support
- Part of MSRP Gen 1 Tasks (Stream Announcement)?

MSRP is used for E2E synchronization of the reservation.

- E2E protocols can be used to minimize the size of the synchronized data

MSRP need's to be adopted (MSRP Gen 2) for the TSN Mechanisms

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Thank you for your attention!



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