MSRP++ for Stream Registration and Reservation

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Contents

- Example of a structured industrial network
- Splitting of static and dynamic stream attributes for registration and reservation (why and how)
- Transport mechanisms for MSRP++
- An extended vectoring mechanism for stream reservation

The previous MSRP++ presentation:
http://www.ieee802.org/1/files/public/docs2015/new-goetz-MRPv2-1115-v02.pdf

Logical and Physical View of structured Industrial Network

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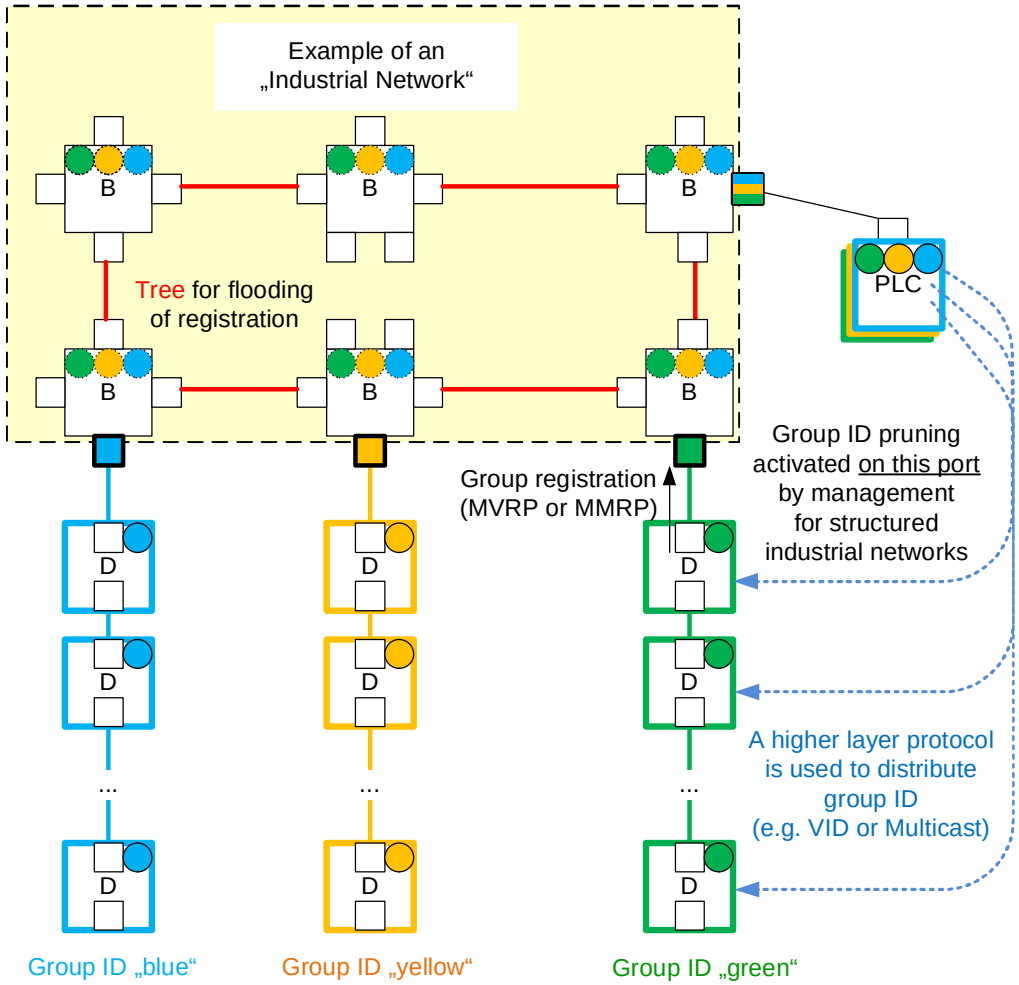
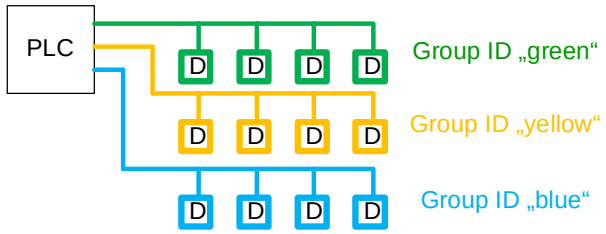
Physical View based on Ethernet



Logical view of the membership for the registration „to map „dedicated field buses“



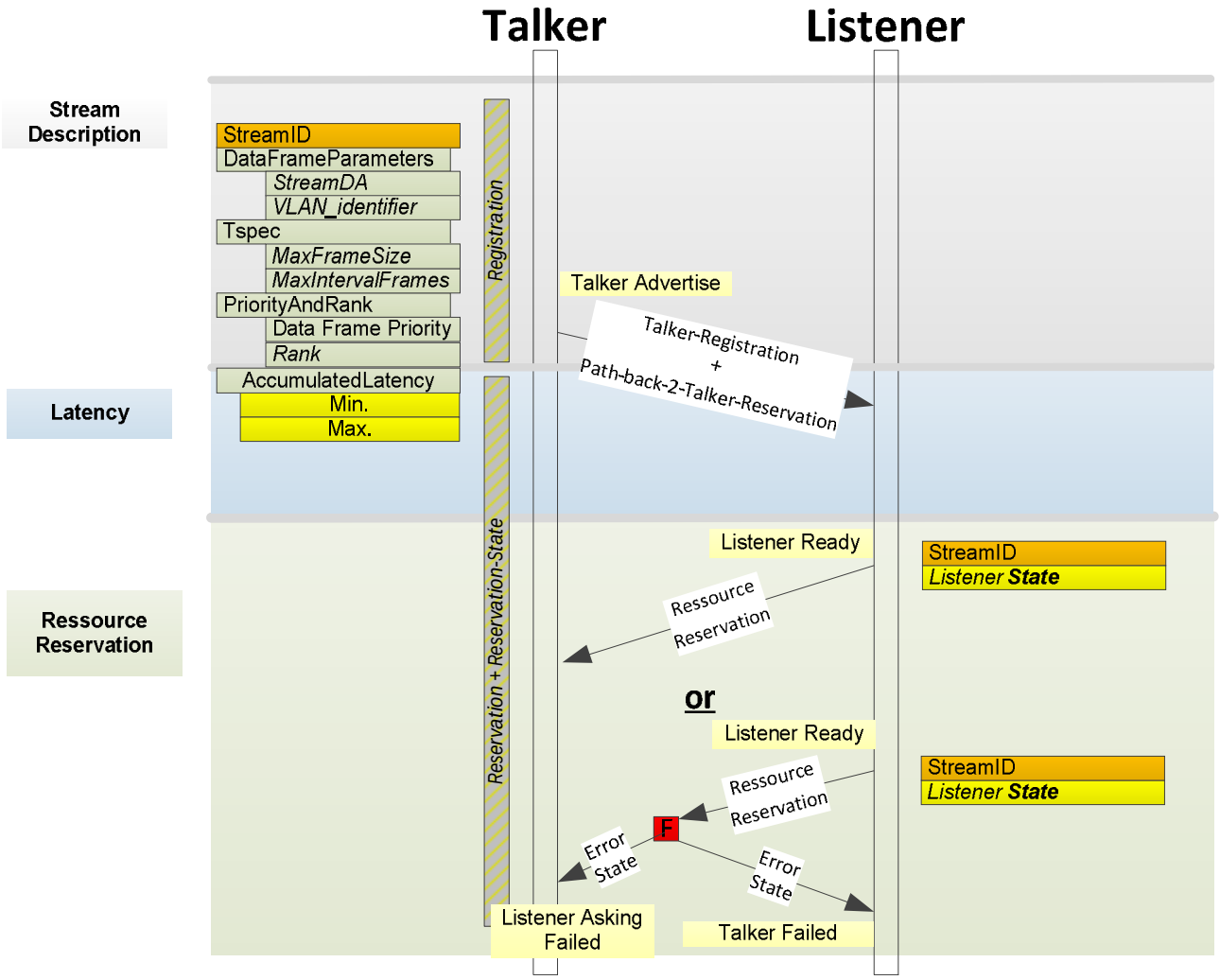
Group ID for each field bus

Bridge / 2-Port-Device is active member of the group

Port is border - member of the group

Group information is stored in the device

Recap
Registration and Reservation of current MSRP



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Static and Dynamic Stream Attributes

Why splitting attributes into static (for registration) and dynamic (for reservation)?

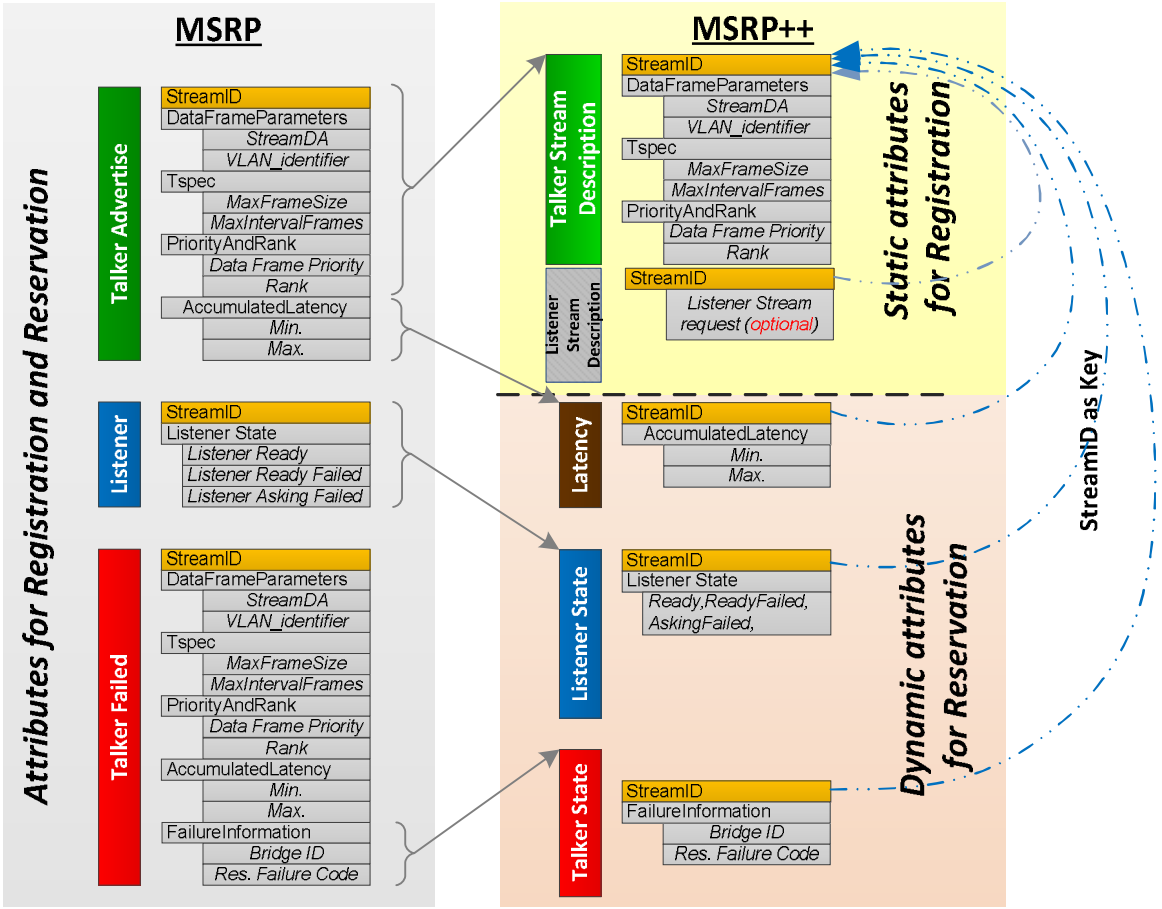
- **Static Stream attributes – stream registration info**
  - independent of stream forwarding path → **can be flooded on a spanning tree**
  - Don't get changed by bridges (constant)

- **Dynamic Stream attributes – stream reservation info**
  - dependent of stream forwarding path → **has to be distributed on tree(s) of a data plane**
  - Can be changed by bridges

	Static Attributes	Dynamic Attributes
Timing requirements	can be refreshed slowly	must be propagated fast
Topology changes	unaffected, no changes	changes applied to the entire affected stream forwarding path
Size of attributes	huge	small

Due to the different natures of static and dynamic stream information, MSRP++ aims to apply different improvements to stream registration and reservation.

Proposal for Splitting of Attributes into Static Registration and Dynamic Reservation information



Using the Stream ID as a Key for referencing the Stream Description is important:

- to split dynamic and static information
- to gain smaller attributes for reservation

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Transport Mechanisms for MSRP++

Proposal:

Introducing different transport mechanisms which respect the different natures of stream attributes

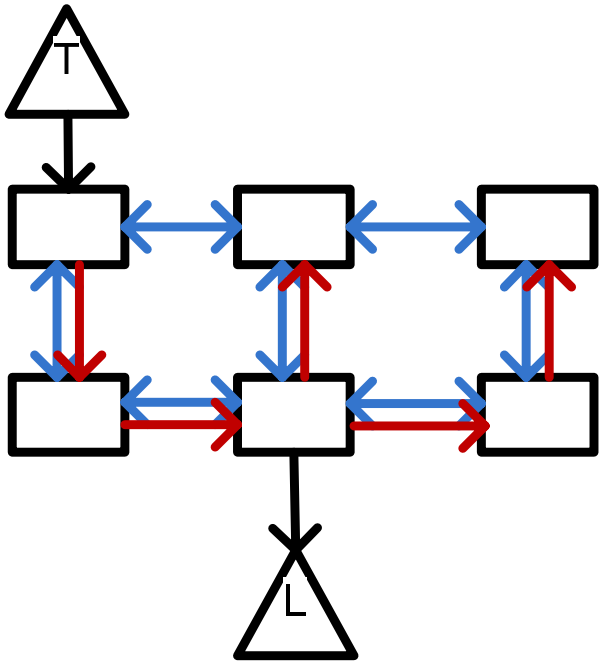
IS-IS like:

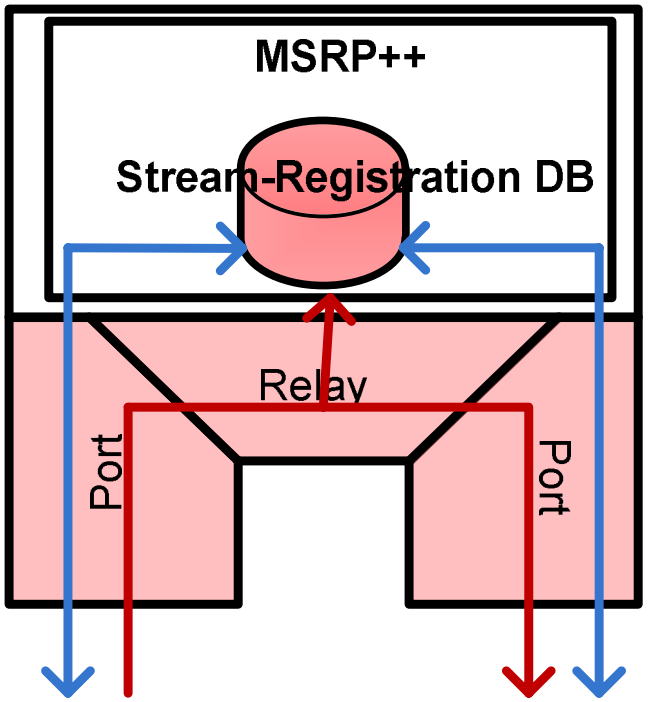
- A flooding mechanism on a spanning tree
- CSNP/PSNP like mechanism as link-layer for additional synchronization on link

LL-IS-IS (Link-Local-IS-IS):

An improved attribute synchronization mechanism between two ports (link-local) utilizing some mechanism of IS-IS (e.g. hold time, checksum,…)

IS-IS like Transport Mechanism

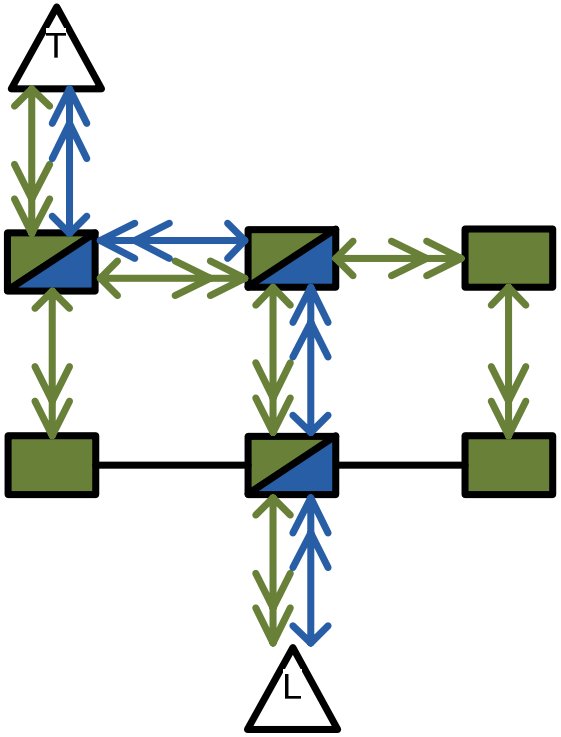


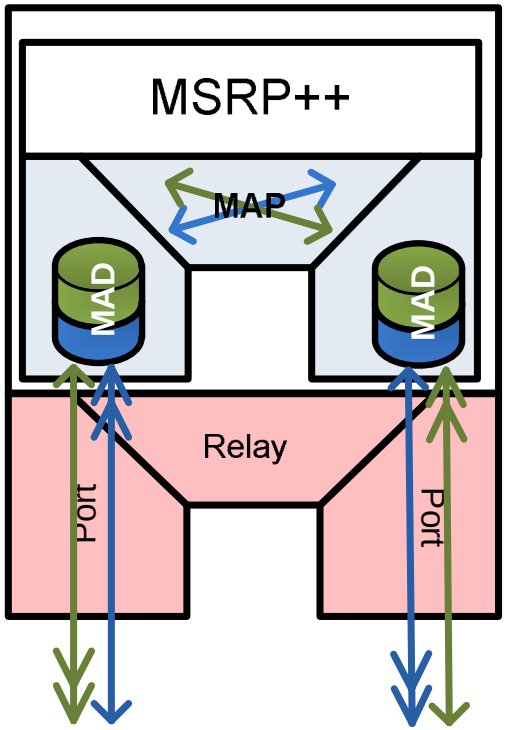


Flooding static information (e.g. stream description) on a spanning tree

Additional Sync on link with PSNP/CSNP like mechanism

LL-IS-IS (Link-Local-IS-IS) Transport Mechanism





- Distributing dynamic stream information for Path-Reservation (e.g. Talker state)
- Can be also used to distribute static stream information (e.g. Registration)

- Distributing dynamic stream information for Resource-Reservation (e.g. Listener state)

Transportation Mechanisms for Stream Registration

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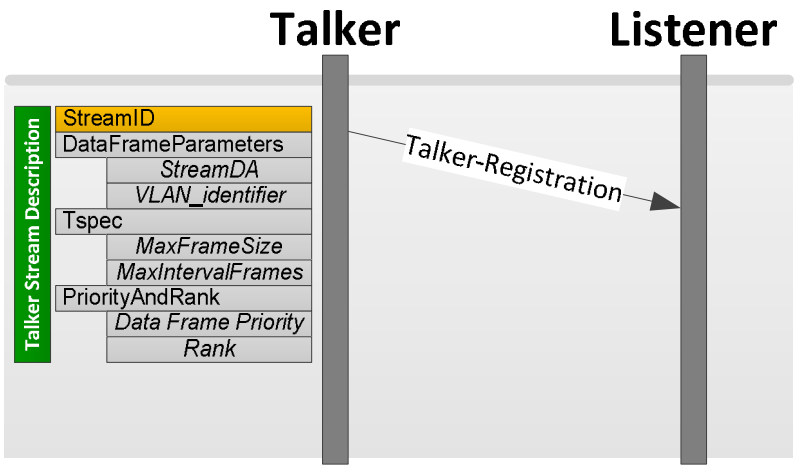
LL-IS-IS



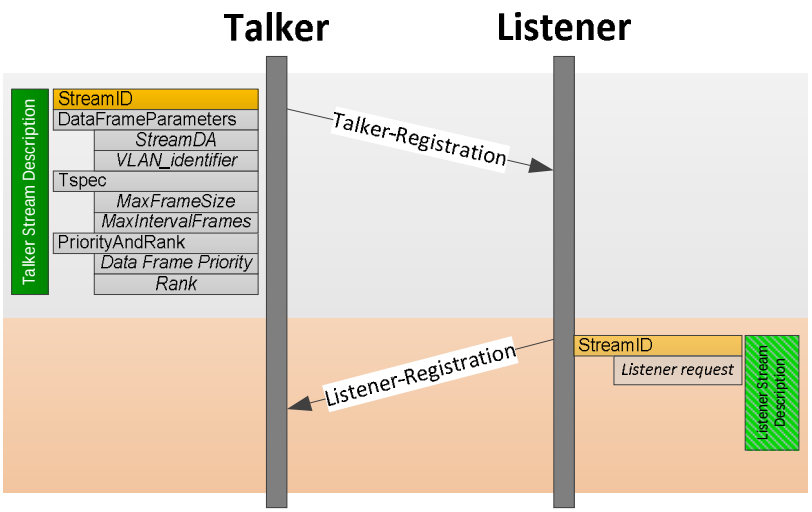
Basic operation:

- Without pruning the Stream description will be distributed on tree(s) of a data plane

Optional

- Stream registration can be pruned by
  - MVRP
  - MMRP
  - …

IS-IS like

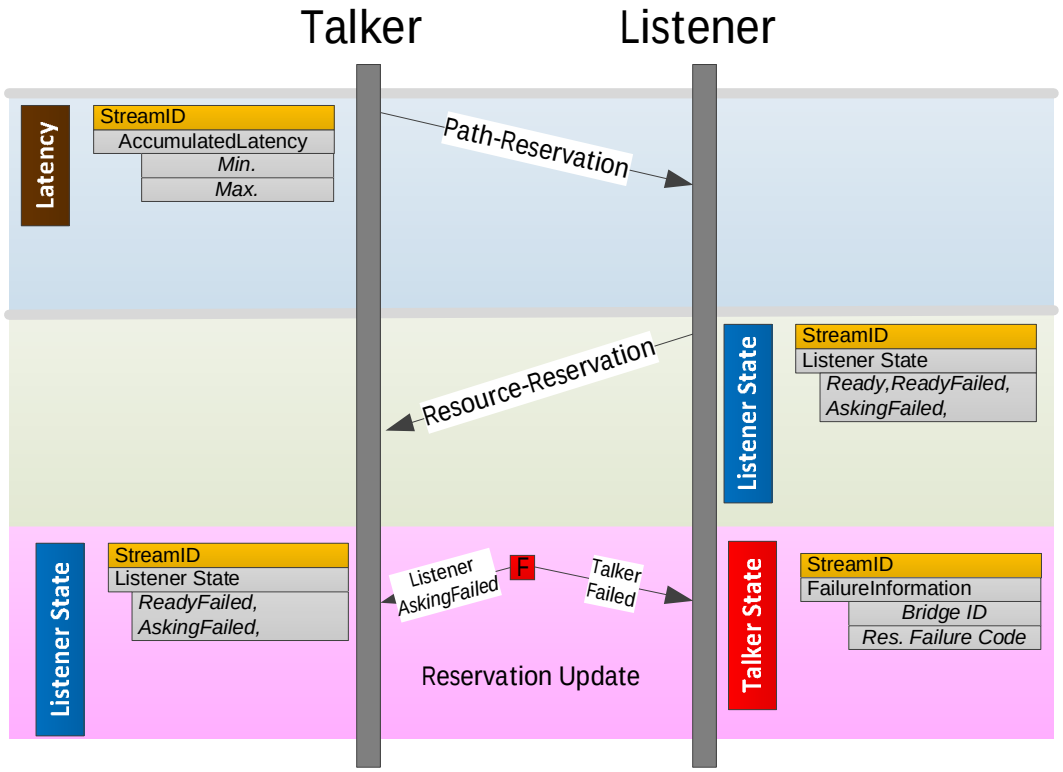


Basic operation:

- The Talker and Listener stream registration will be flooded on a spanning tree + PSNP/CSNP mechanism for synchronization on link

LL-IS-IS Protocol for Stream Reservation

- **Path-Reservation**
  - Latency (optional) + Talker state is distributed on tree(s) of a data plane
- **Resource-Reservation**
  - Listener state is reversely distributed on tree(s) of a data plane (Listener → Talker)
- **Reservation-Update**
  - Talker- and Listener-State-Changes along the reserved path



MSRP++
Stream Registration / Reservation Models

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typical usage by Bridges: **Network** — typical usage by End Stations: **part of UNI**

Registration / Reservation Elements	Mechanism	Model 1	2	3	4		5	
	IS-IS like — Talker Registration	X	X	X	X			
	IS-IS like — Listener Registration	X	X	X				
	LL-IS-IS — Talker-Registration						X	
	LL-IS-IS — Path-Reservation				X		X	
	LL-IS-IS — Resource-Reservation			X	X		X	
	LL-IS-IS — Reservation- Update		X	X	X		X	

Model 1: Stream registration with implicit reservation

Model 4: Stream registration IS-IS like flooded on a spanning tree with LL-IS-IS reservation distributed on tree(s) of data plane

Model 5: Stream LL-IS-IS registration and LL-IS-IS reservation on link (Bridge←→End-Station ≅ part of UNI)

How to improve scalability for optional Reservation (LL-IS-IS)?

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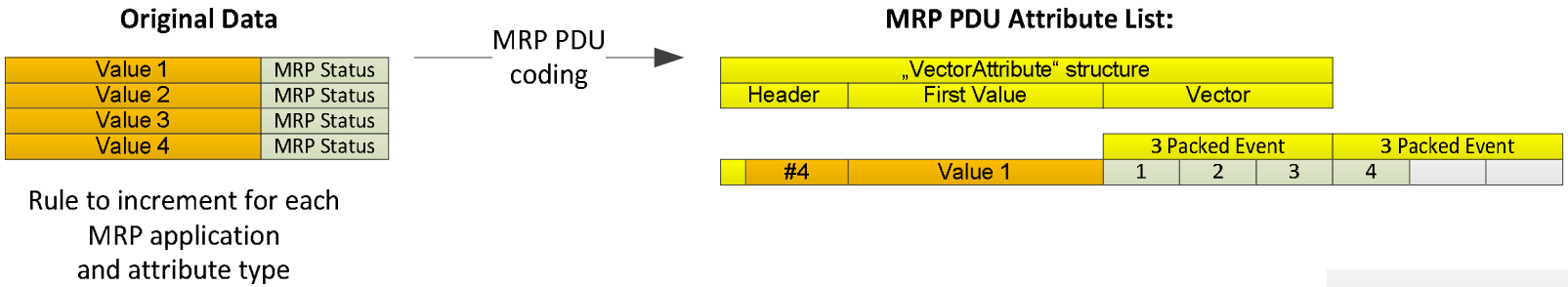
Proposed methods to compress dynamic reservation information:

- Periodical checksum exchange on link (not the focus of this presentation)
- Using *Stream ID* as KEY for referencing to static Stream Description
- Introducing a more effective vectoring mechanism (compared to current MSRP version)

Recap
Vectoring mechanism of current MSRP version

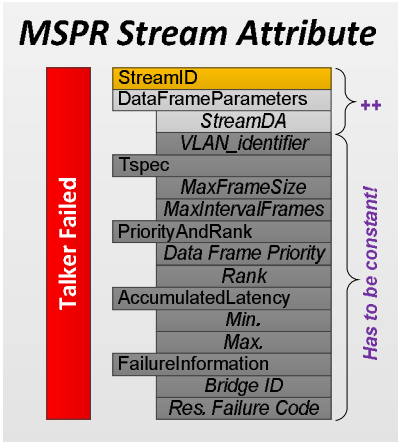
Current MSRP version uses a vectoring mechanism to reduce the size of PDUs.

Principle: If the values follows a given known pattern, then they can be combined in an vector



Problem:

- ***Huge Stream attributes prevent usage of vectoring mechanism***
  → The vector mechanism relies on ascending Stream attributes without gaps*
- ***The usability highly depends on the application model***
  → Stream ID ++, Stream DA++ and constant Stream description with status are highly unlikely



*) Current MSRP version introduces an “ignore” value for the Listener status to enable gaps

Example (PLC ←→ Actuator / Sensor) for Reservation with Vectoring Mechanism in structured Industrial Networks

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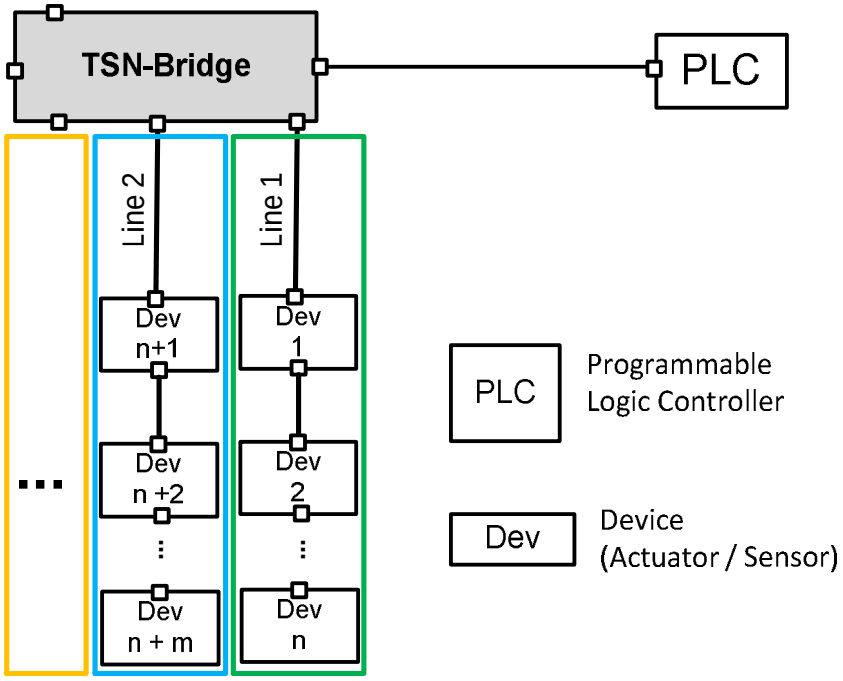
Vectoring mechanism can be used to pack streaming reservation information in structured industrial networks

PLC <-> Actuator / Sensor (Device)

Assumption:

- Bidirectional PLC ←→ Device communication
- Structured network
  - by topology e.g. daisy-chain, ring, comb, spoke, ring with uplink, …
- Max number of streams
  - Per line (e.g 256 streams)
    (is scaling issue for 2-port-devcies)
- Max number of streams per PLC
  (e.g. 256, 512, … 4096 streams)



- **PLC is responsible for Stream ID generation (PLC ←→ Dev [1, n+m]) => SA part of Stream ID meets PLC System ID**
- **Stream ID generation is topology dependent**

MSRP++ Reservation with Extended Vectoring Scheme

Proposal:

Use an extended vectoring scheme for encoding of reservation attributes.

Example encoding: **Listener State**

No Vectoring Mechanism

StreamID		Listener **State**
System ID	ID 1	*Ready*
System ID	ID 2	*Ready*
System ID	ID 3	*Ready*
System ID	ID 4	*Failed*
System ID	ID 5	*Ready*

FULL vectoring (as today)

„First-Value“

Length	Stream ID	Listener **State**

Example:

Length = 3	System ID	ID 1	*Ready*
Length = 1	System ID	ID 4	*Failed*
Length = 1	System ID	ID 5	*Ready*

PARTIAL vectoring (proposal)

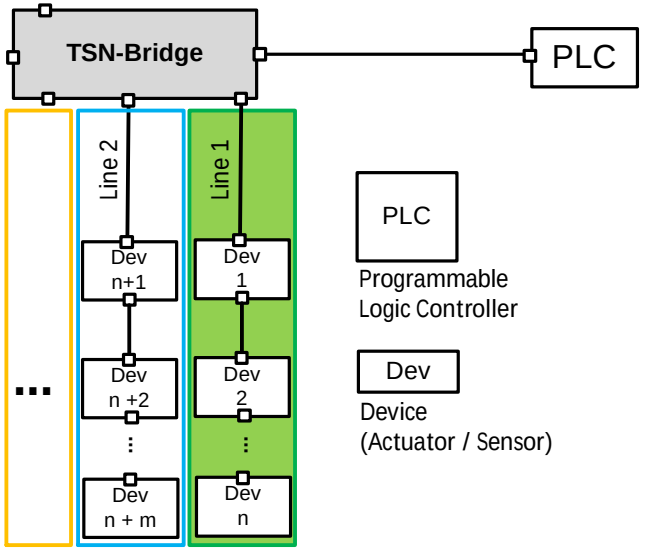
„First-Value“

NEW: Compressed part | Individual encoded part

Length	Stream ID	Listener **State** Array

Example:

Length = 5	System ID	ID 1	*Ready*	*Ready*	*Ready*	*Failed*	*Ready*



Reservation attributes can be encoded more efficiently using an extended vectoring mechanism, thus improving the scalability of MSRP++.

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Next Steps!

Industrial automation has a strong requirement for scalable and performance optimized registration and reservation protocol to support dynamic network configuration.

Our proposals:

- **Step 1:**
  - Detach the items that are not treated from the existing .1Qcc

- **Step 2:**
  - Start a new PAR for the items not covered in the existing .1Qcc PAR
  - Work on MSRP++ to improve scalability and performance

A decision is needed to start the protocol work fulfilling the enhanced requirements of professional Audio/Video and Industrial Automation on MSRP!

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