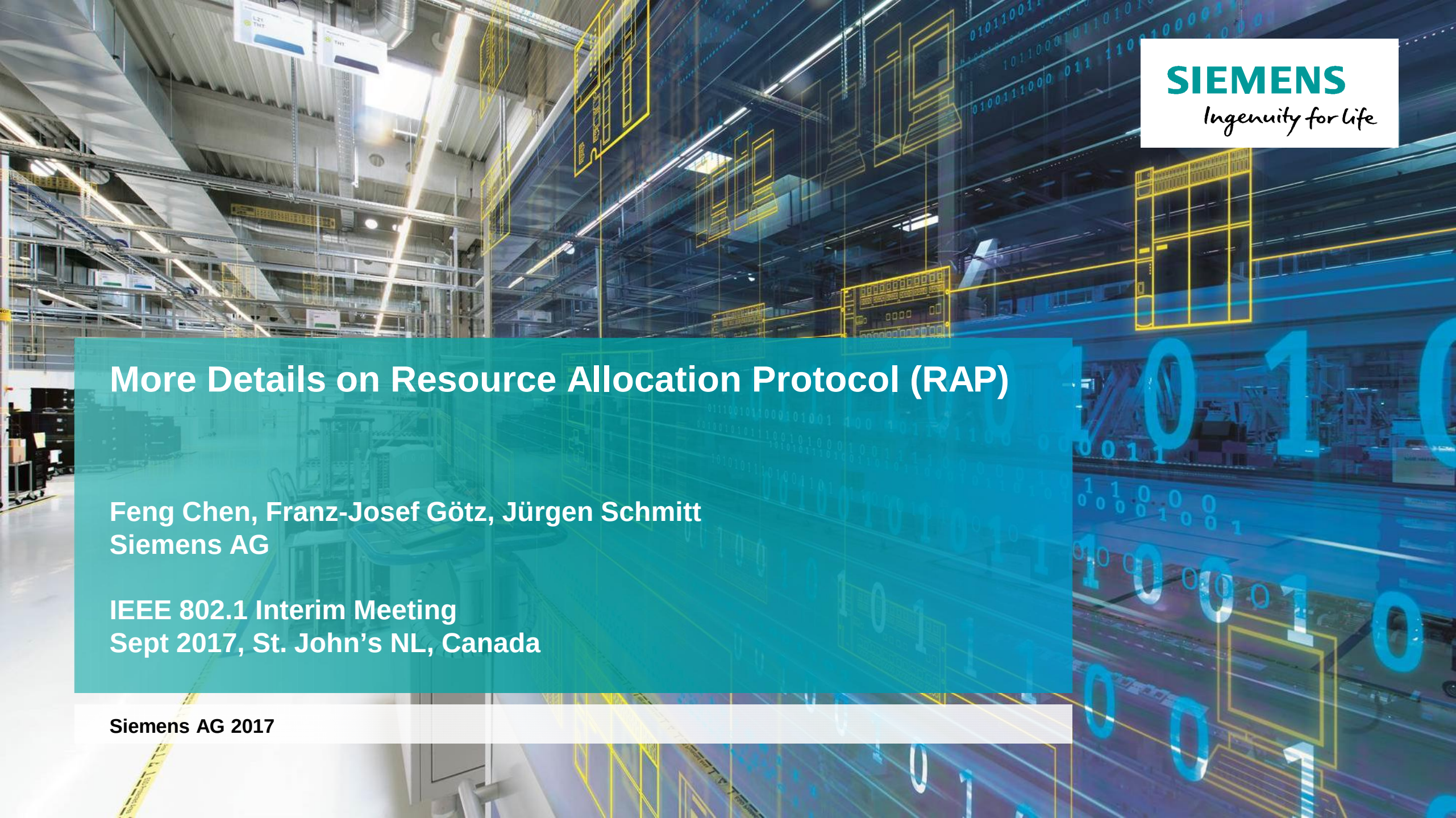

More Details on Resource Allocation Protocol (RAP)

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Recap

Motivations for a new Resource Allocation Protocol (RAP):

(see presentation: http://www.ieee802.org/1/files/public/docs2017/new-chen-RAP-proposal-and-requirements-0517-v02.pdf)

- driven by the need of many industrial applications for bounded latency and zero congestion loss, which are achievable by shaper plus distributed stream reservation without the necessity of applying scheduled traffic with centralized scheduling
- further development of the distributed configuration model for TSN to support more features
- leverage the benefits of LRP – better efficiency and support for larger registration database than MRP

Proposed features of RAP:

(see presentation: http://www.ieee802.org/1/files/public/docs2017/new-kiessling-RAP-poposal-and-features-0517-v01.pdf)

- enhanced domain boundary detection for support of configurable SR classes
- stream configuration for seamless redundancy
- improved attribute propagation (by leveraging the use of Records in LRP)
- collaboration with upper layer reservation

Outline

This presentation focuses on the following two issues

- Configuration data needed by RAP
- RAP for seamless redundancy

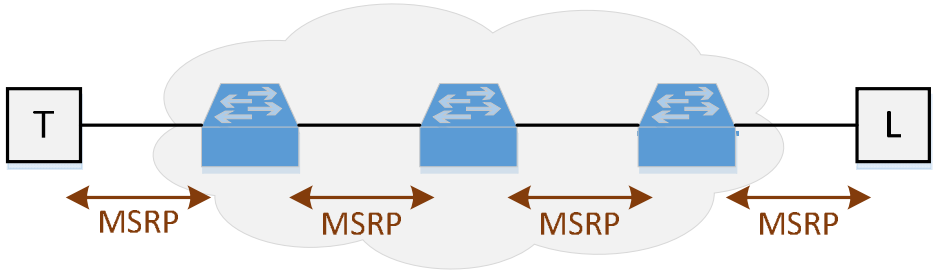
Refer to the RAP white paper for a detailed description of the other proposed RAP features

<http://ieee802.org/1/files/public/docs2017/tsn-chen-RAP-whitepaper-0917-v01.pdf>

- RAP Domain boundary detection *(see the RAP white paper v0.1)*
- Improved attributes propagation *(to be provided in the RAP white paper v0.2)*
- Collaboration with upper layer reservation *(to be detailed in RAP white paper v0.2)*

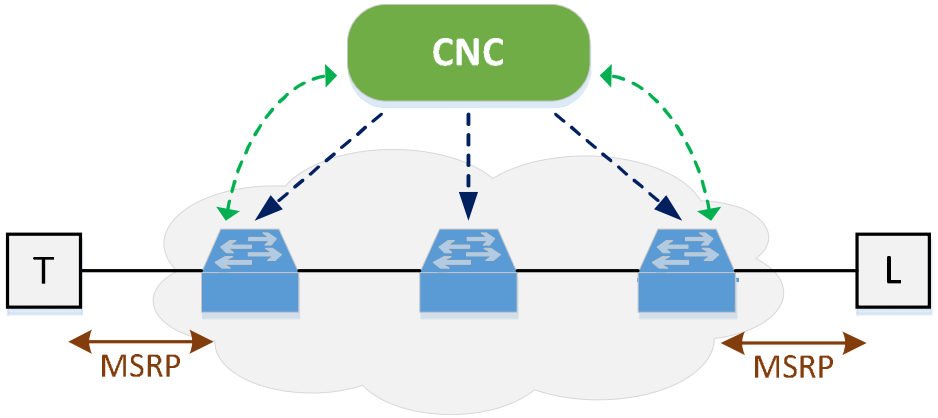
Configuration Data for RAP

Distributed and Centralized Stream Configuration Models



Distributed Configuration (SR class based)

- Network service is described and provided for user **on a per SR Class base**
- SR classes exist on the network as default (AVB Class A/B) or can be preconfigured by management (already enabled by Qcc)
- End-stations have knowledges of SR class settings on the network and decide which SR class to use for their streams before sending their requests
- A peer-to-peer protocol performs stream reservation hop-by-hop using both stream-specific information (like T-Spec) and SR class parameters (e.g. measurement interval, shaper, etc)

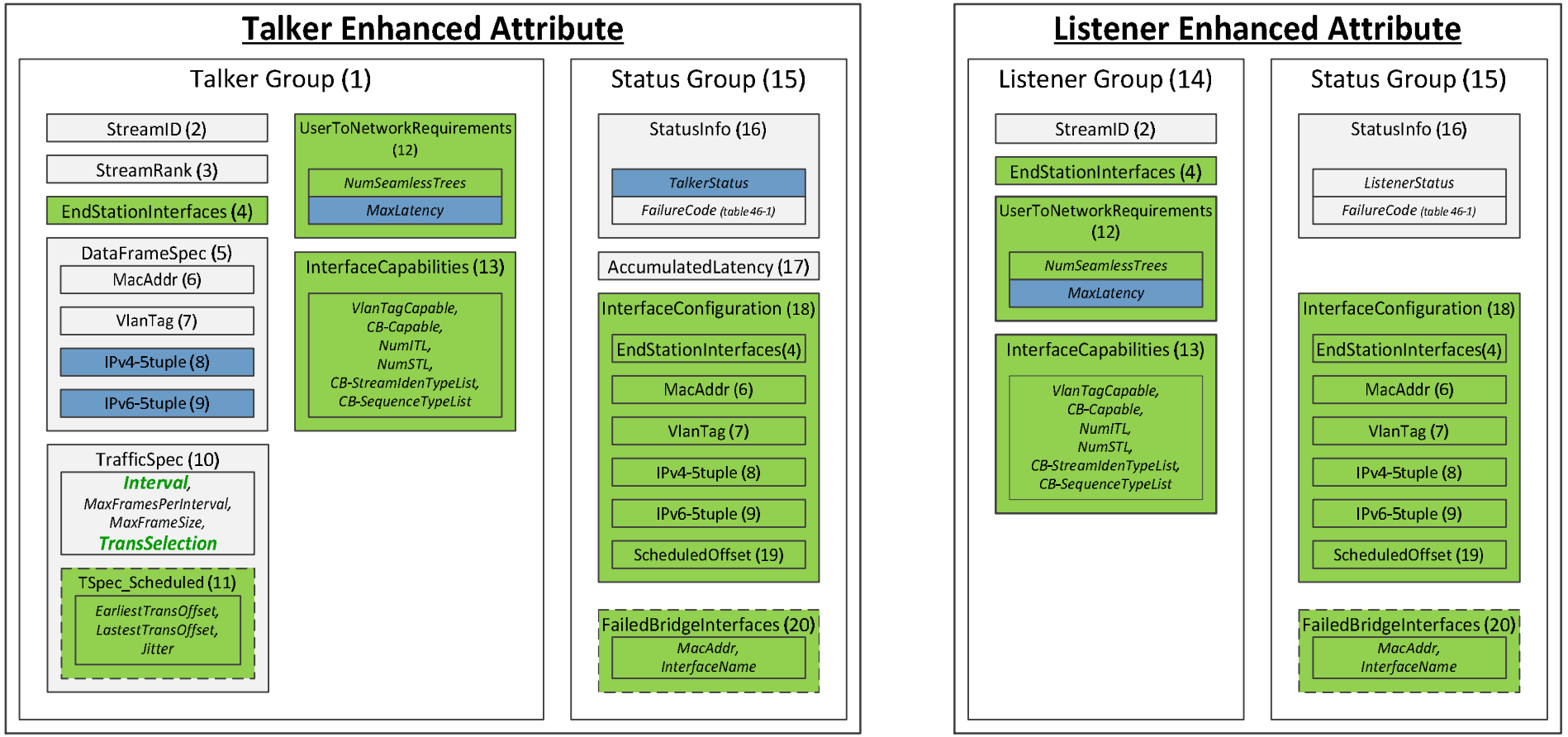


Centralized configuration

- A per-stream request-response model, where **SR class is not explicitly used**
- End-stations can send request for a specific stream (via edge port) to CNC without knowledge of the network configuration
- CNC processes each stream request and perform steam reservation centrally
- MSRP runs only on the link to end-stations, as “information carrier“ between end-stations and CNC (not really used for stream reservation in the network)

Different configuration models require different configuration information.

MSRPv1 Attributes
based on the Information Model in Qcc Clause 46



XXX *defined by MSRPv0*

XXX *defined by MSRPv1, applicable for both distributed and centralized models*

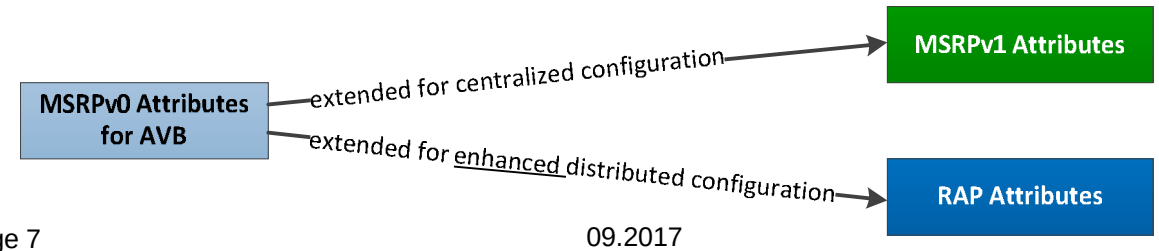
XXX ***defined by MSRPv1 exclusively for centralized configuration (with a CNC and „MRP External Control" enabled in the** nearest **bridge)***

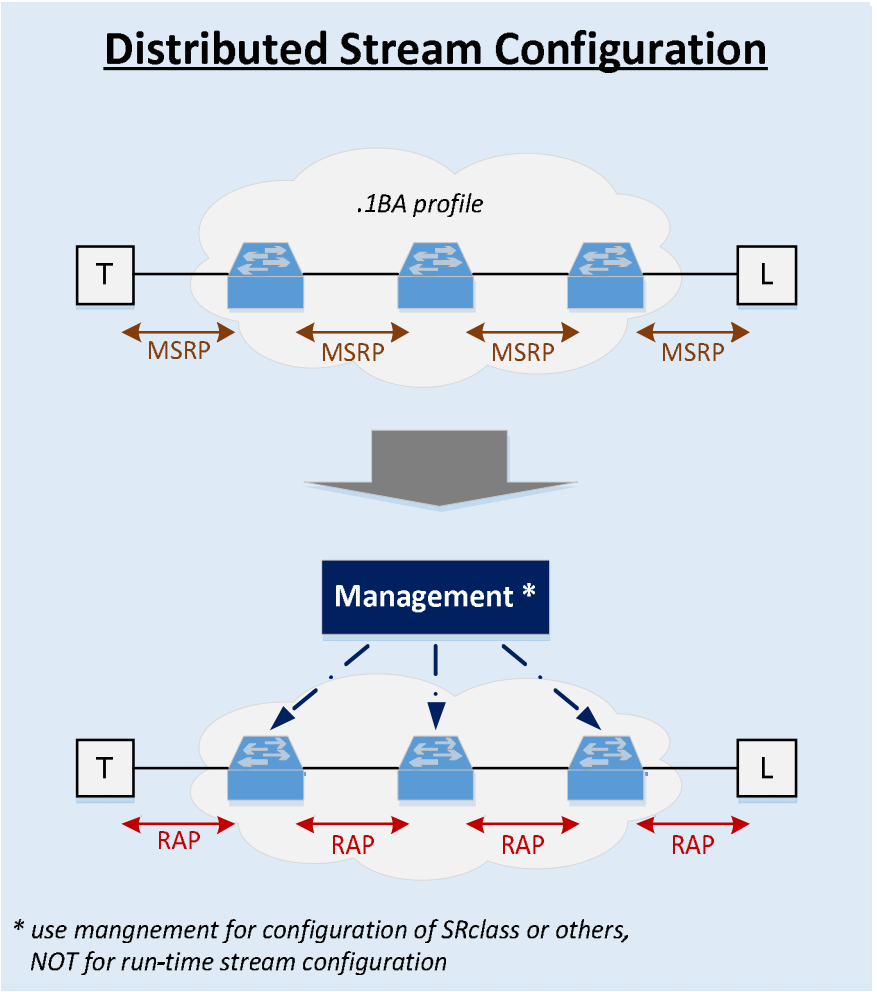
(These MSRPv1 items suits not for the distributed Stream configuration model because path control and scheduling is not part of it.
For path control the IEEE 802.1Q standard has already defined different managed objects and procedures.)

Proposal for RAP Data Model

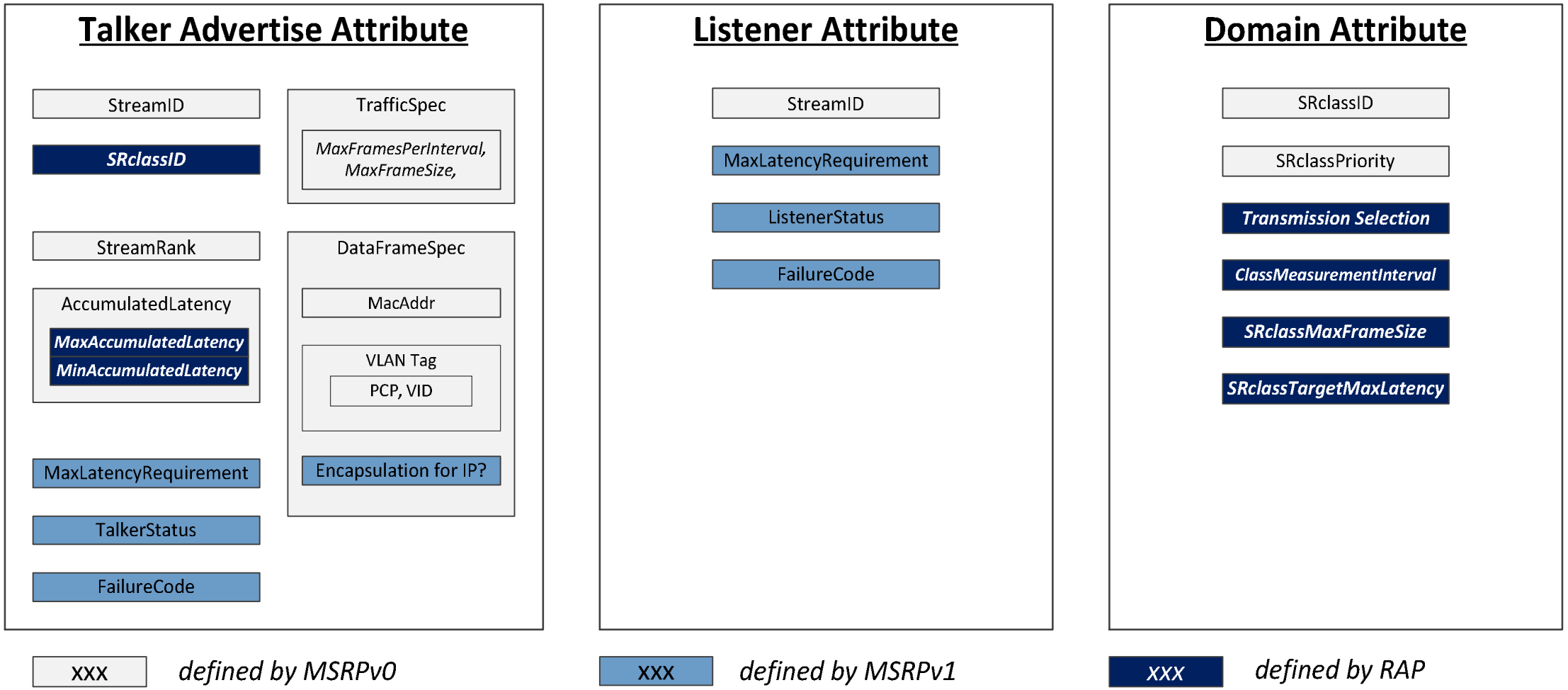
- The **MSRPv1** attributes contains many items that are exclusively designed for **centralized configuration** and only used by CNC to conduct the following operations:
  - **centralized path computing**
  - **centralized scheduling and reservation for streams**
  - **centralized configuration for seamless redundancy**
- The main focus of **RAP** is **distributed stream reservation**
  - **path computation is not part of RAP and will be provided by other mechanisms** (e.g. SPB-PCR, MST-TE, …)
  - **seamless redundancy can be supported, e.g. based on MRT established** by ISIS-PCR
  - **scheduling is not directly supported**

Proposal: **The data model for RAP should be defined based on the MSRPv0 attributes, as extensions for distributed configuration**





Proposal for RAP Attributes



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RAP for Seamless Redundancy

.1CB Use Case 1: End-To-End FRER

Assumptions:

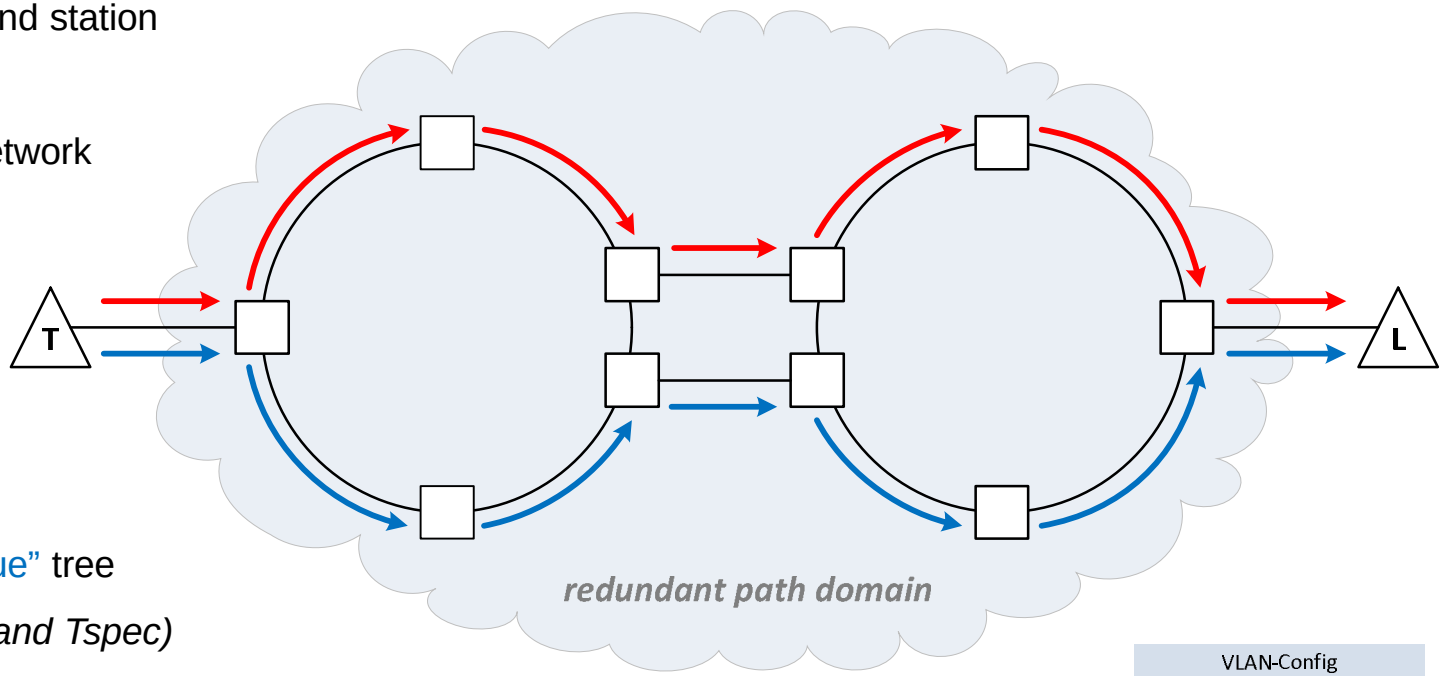
§ End stations send and receive redundant frames (one compound stream with two member streams)

§ Duplicate generation and eliminations done within the end station

§ End stations recognize if one path fails

§ Redundant spanning trees are pre-established in the network

§ Each tree uses a different VID



Proposals for RAP:

§ The Talker transmits two **TalkerAdvertises**

- one over the "red" tree and the other over the "blue" tree
- using the same values in *(StreamID, DA, Priority and Tspec)*
- but with different *VIDs*

=> RAP needs to accept two **TalkerAdvertises** with the same values of (StreamID, DA, Priority, Tspec) but with different **VIDs**

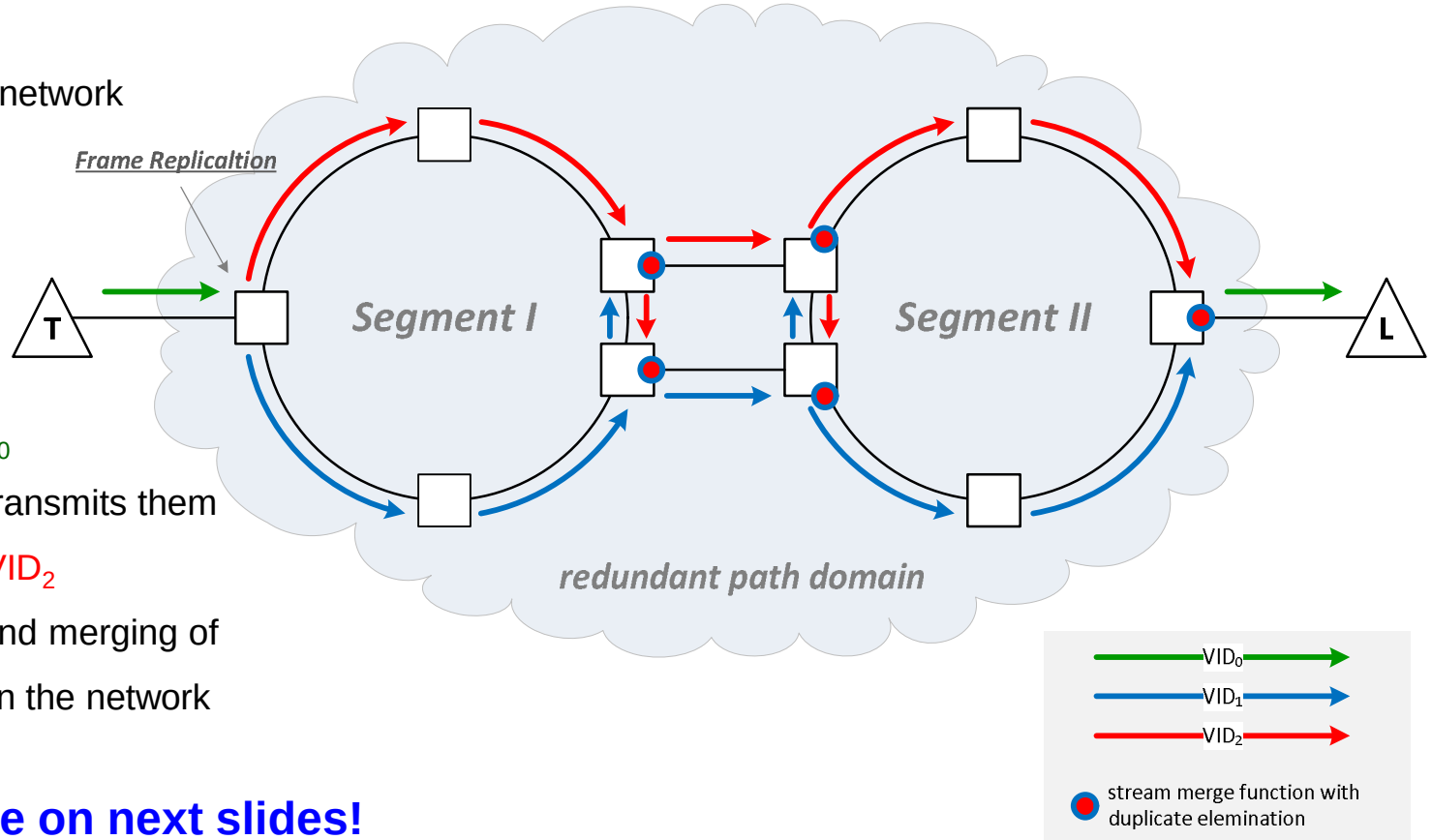
.1CB Use Case 2: Ladder Redundancy

Assumptions:

- End stations send and receive one frame
- FRER is done by Bridges according to 802.1CB
- Redundant spanning trees are pre-established in the network
- Each tree uses a different VID

Proposals for RAP:

- The Talker transmits one **TalkerAdvertise** using VID_0
- The first bridge replicates the **TalkerAdvertise** and transmits them over the "blue" tree with VID_1 and the "red" tree with VID_2
- RAP needs to define some rules to support splitting and merging of the attributes over redundant trees at certain points on the network



=> We show more details for this use case on next slides!

.1CB Use Case 2: Ladder Redundancy with MRT VLAN Configuration

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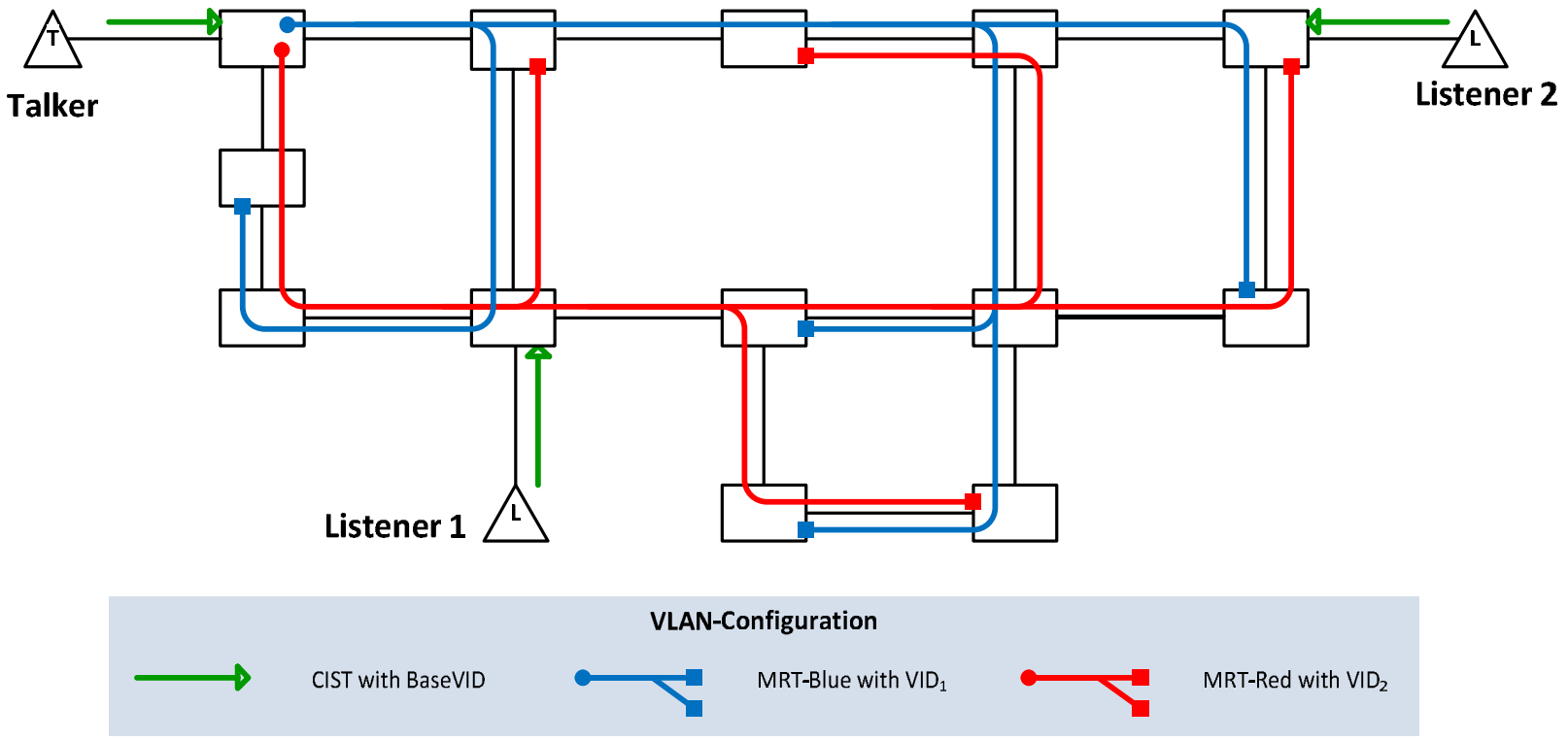
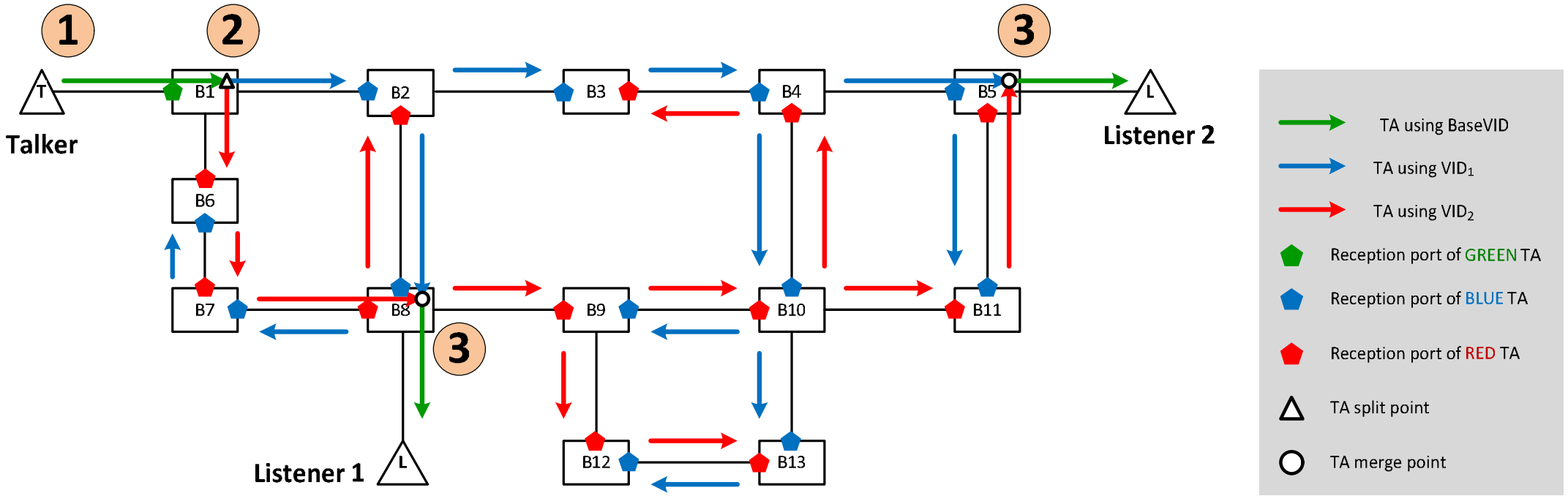
Assumption: pre-installed Maximal Redundant Trees (MRT)



1. One VLAN with a BaseVID (“green”) and **two** associated VIDs for the Maximal Redundant Trees (“red” and “blue”), e.g. installed by ISIS-PCR (è MRT)
2. RAP can learn about the **VLAN configuration** from e.g. the MST configuration table

.1CB Use Case 2: Ladder Redundancy with MRT
Propagation of Talker Attribute

Proposal for RAP's rules of propagating the **Talker Attribute (TA)** along the pre-installed MRT



1. The Talker sends one **TA** using BaseVID
2. The bridge with the Talker edge-port replicates the "green" **TA** into a "red" and a "blue" one
   - è The "blue" **TA** follows the "blue" tree using VID_1
   - è The "red" **TA** follows the "red" tree using VID_2
3. The edge-port to the Listener merges the "red" and "blue" **TAs** to a "green" **TA** for the Listener
   - è hence the "red" and "blue" maximal redundant tree are transparent for the Listener

.1CB Use Case 2: Ladder Redundancy with MRT
Propagation of Listener Attribute

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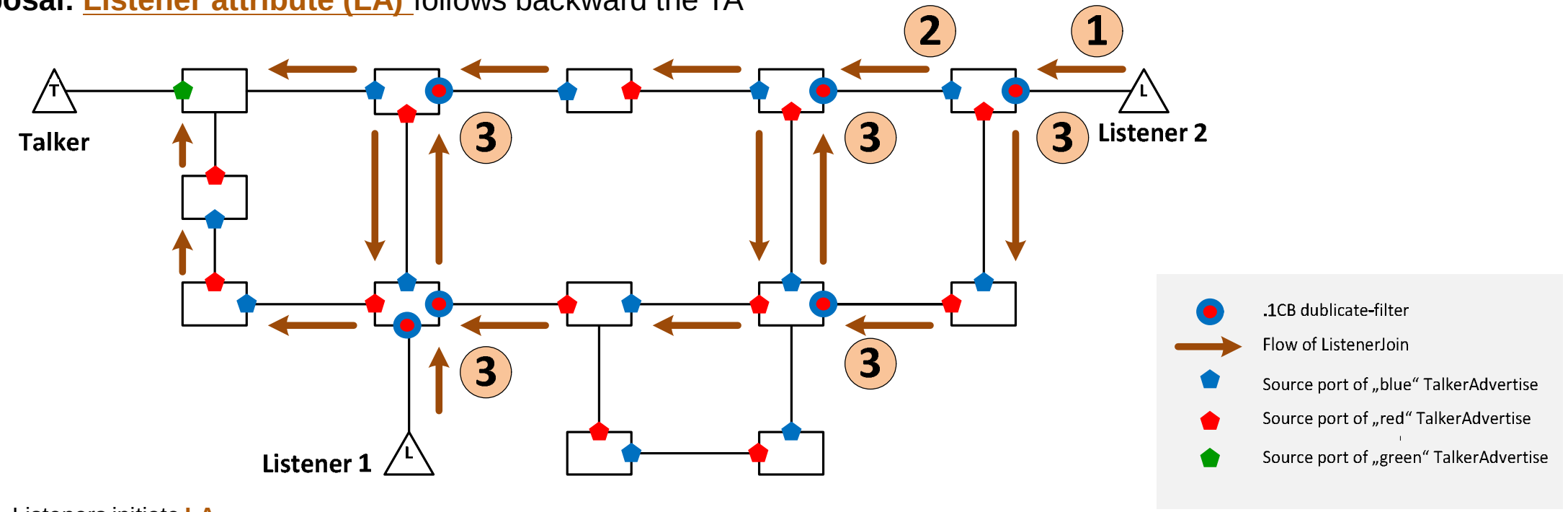
Proposal: Listener attribute (LA) follows backward the TA



1 Listeners initiate LA

2 The LA folllows the TA backwards according to the following rules:

- è Forward the LA only to source ports of all received LA (on ”blue” and ”red” trees)
- è but do not mirror the LA backwards (no loop back)

3 Activate .1CB filter according to the following rule:

- è Activate the .1CB duplicate-filter on the source port of a LA when a LA must be forwarded to more then one source ports (e.g. ”blue” and ”red”) of TA - *(set the .1CB duplicate-filter on an egress port of a bridge where duplicates from different ingress ports are received)*

Summary

Why Distributed Stream Configuration for Industrial?

Ø The distributed Stream configuration based on RAP with

- § decentralized and centralized path computing (not part of RAP)
- § **SRclass based Streams** (with its associated shaper / transmission mechanism like CQF, CBSA and in future ATS) are able to guarantee a bounded max. latency and zero congestion loss
- § redundancy and seamless redundancy (e.g. based on MRT established by ISIS-PCR) can be supported
- § distributed Stream reservation

Ø The (fully) centralized Stream configuration model with

- § centralized path computing
- § centralized scheduling for **none-SRclass based Streams** (with its associated shaper / transmission mechanism like CT and TAS)
- § centralized configuration to support (seamless) redundancy
- § centralized Stream reservation

Thank You!

Questions?