New Data Objects & New Protocols

Supporting new TSN features in a decentralized and centralized controlled network

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Thoughts about
Centralized and Decentralized Systems

1. Centralized Organized Systems
   - Within industrial automation there are a lot of established centralized organized systems (e.g. EtherCat, PROFInet, VARAN, …).

2. Decentralized Organized Systems
   - Ethernet and Internet are well known decentralized organized Systems.
   - AVB is also a decentralized organized system.

When talking about industrial automation we have to differentiate between administration, applications and communication.

With introducing TSN in industrial automation, vendors are also requesting for a decentralized organized communication system.
One example is the ongoing discussion about OPC_UA over TSN.
See: http://www.ieee802.org/1/files/public/docs2015/tsn-munz-requirements-for-tsn-in-manufacturing-0515-v01.pdf

ONE Solution for Centralized and Decentralized organized industrial networks

- TSN is talking about how to implement deterministic Ethernet
- Deterministic Ethernet can be implemented “all traffic is scheduled”
  BUT TSN has also specified other mechanism (e.g. traffic classes, reservation in combination with strict priority and pre-emption)
- The communication can be organized centralized and decentralized
- Diagnostic / double check is very important for industrial communication

- IEEE 802.1 has already standardized a lot of building blocks for a centralized or decentralized organized networks
- TSN has to reuse the in IEEE 802.1 standardized mechanism and building blocks
- TSN has to take care not to overload existing protocols
- If the existing building blocks have too much functionality we should specify a “profile” for an industrial TSN network ***to restrict*** the functionality
- If the existing building blocks do not cover the required functionality TSN has to fill the gap

=> The task of TSN within IEEE 802.1 is to standardize <u>ONE and only ONE </u>solution handling centralized or decentralized organized TSN networks.
=> This is the only way TSN becomes successful for the industrial market!

Motivation

IEEE 802.1 has standardized a lot of mechanism and building blocks

(e.g. .1Qai, .1Qak, .1Qal, .1AS, .1Qat, .1Qav, .1Qbu, .1Qbh, .1Qca, .1CB, …)-

The following slides shows how these buildings blocks can be used for TSN to support centralized or decentralized organized TSN networks!

The following slides shows

- **gaps**, which must be filled and
- **interfaces** for which the TSN group has to specify **data objects**

Current Discussion!

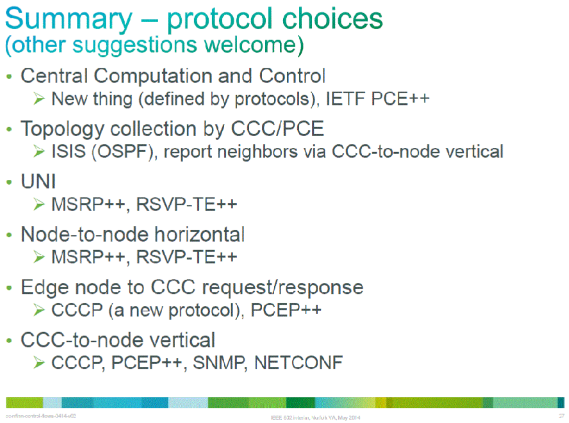
The current .1Qcc draft shows three concepts for network configuration:

1. **Fully Distributed Model**
2. **Centralized Network** (based on system protocols) ***/ Distributed User Model***
3. **Fully Centralized Model** (based on system protocols) + supporting “Scheduled Traffic”

This presentation shows an alternative based on mechanism and building blocks already introduced in IEEE802.1:

1. **Fully Distributed Model** (not supporting “Scheduled Traffic”)
2. **Centralized Network** (*based on .1Qca*) ***/ Distributed User Model*** + supporting “Scheduled Traffic”
3. **Fully Centralized Model** (*based on .1Qca*) + supporting “Scheduled Traffic”

See also slides 4,5,6 of presentation: http://www.ieee802.org/1/files/public/docs2014/cc-nfinn-control-flows-0414-v02.pdf



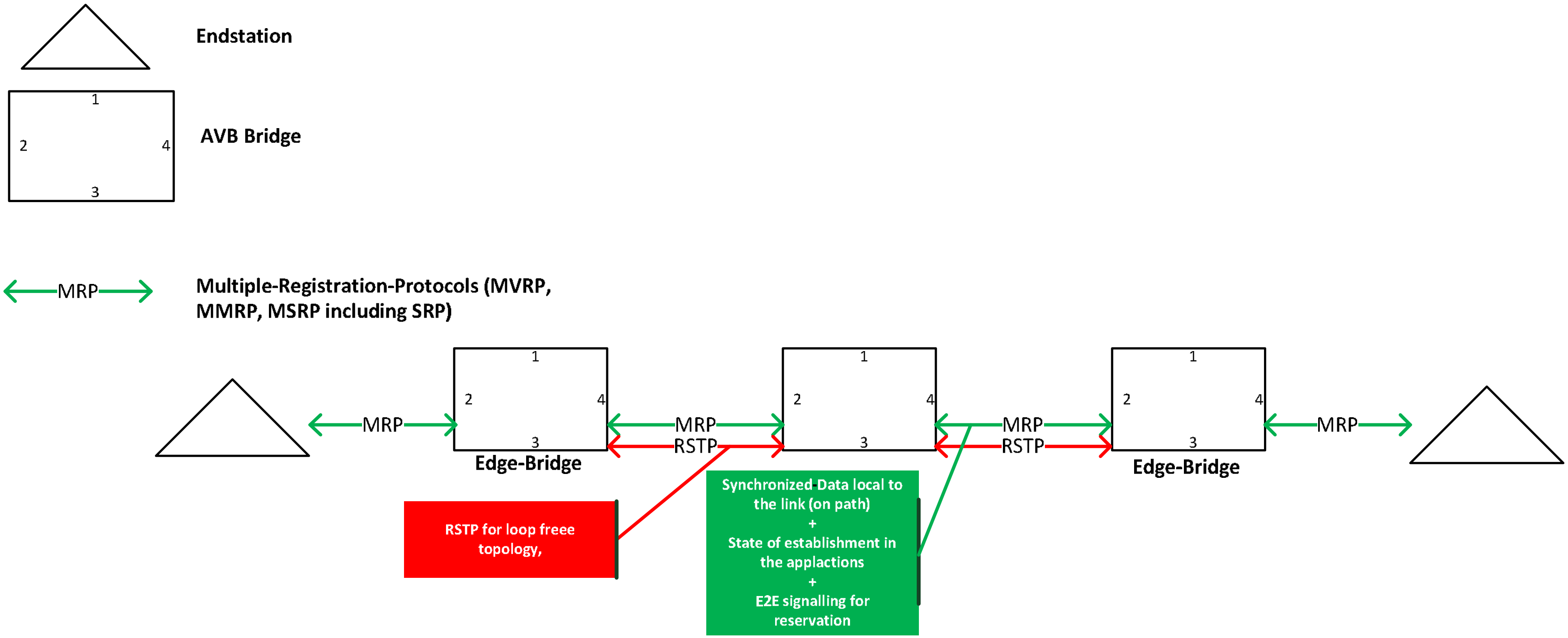
Summary – protocol choices
(other suggestions welcome)

- Central Computation and Control
  - New thing (defined by protocols), IETF PCE++
- Topology collection by CCC/PCE
  - ISIS (OSPF), report neighbors via CCC-to-node vertical
- UNI
  - MSRP++, RSVP-TE++
- Node-to-node horizontal
  - MSRP++, RSVP-TE++
- Edge node to CCC request/response
  - CCCP (a new protocol), PCEP++
- CCC-to-node vertical
  - CCCP, PCEP++, SNMP, NETCONF

cc-nfinn-control-flows-0414-v02 IEEE 802 interim, Norfolk VA, May 2014 27

AVB: Decentralized controlled Network with Registration & Reservation based on RSTP

1. Fully Distributed Model (specified with AVB)



Endstation

AVB Bridge

Multiple-Registration-Protocols (MVRP, MMRP, MSRP including SRP)

Edge-Bridge

Edge-Bridge

RSTP for loop freee topology,

Synchronized Data local to the link (on path)
+
State of establishment in the applactions
+
E2E signalling for reservation

ASSUMPTION:

- *Loop free topology based on STP (spanning tree protocol)*

TSN: Decentralized controlled Network with Path Computation, Registration & Reservation

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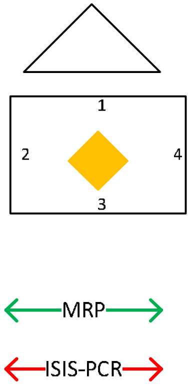
***TSN** has introduced **new features** like (seamless) redundancy based on path computing.*

*To support the new features like **"Seamless Redundancy"** in a **decentralized controlled network** additional data objects and protocols are necessary:*

- ISIS-PCR (specified in .1Qca) for topology discovery and path computing
  (also path computing algorithm like Dijkstra, SP – shortest path or MRT – Multiple-Redundant-Tree)
  => **BLCE's** – Bridge-Local-Computing-Elements (specified in .1Qca)
- NEW MRRP Multiple-Relation-Registration Protocol to nail down the path for the registration of network attributes (see: http://www.ieee802.org/1/files/public/docs2015/new-goetz-schmitt-dyn-registration-on-ISIS-PCR-0309-v01.pdf)
- MVRP is used to establish the data planes (VLAN's / VID's)
- MMRP (optional) to configure the forwarding behavior for unregistered MAC addresses
- MSRP to register the Stream Attributes (e.g. SR-DA, Tspec, availability, ..)
- SRP to do stream reservation (min. latency, max latency, ..)

TSN: Decentralized controlled Network with Path Computation, Registration & Reservation

1. Fully Distributed Model (for TSN to support redundancy)

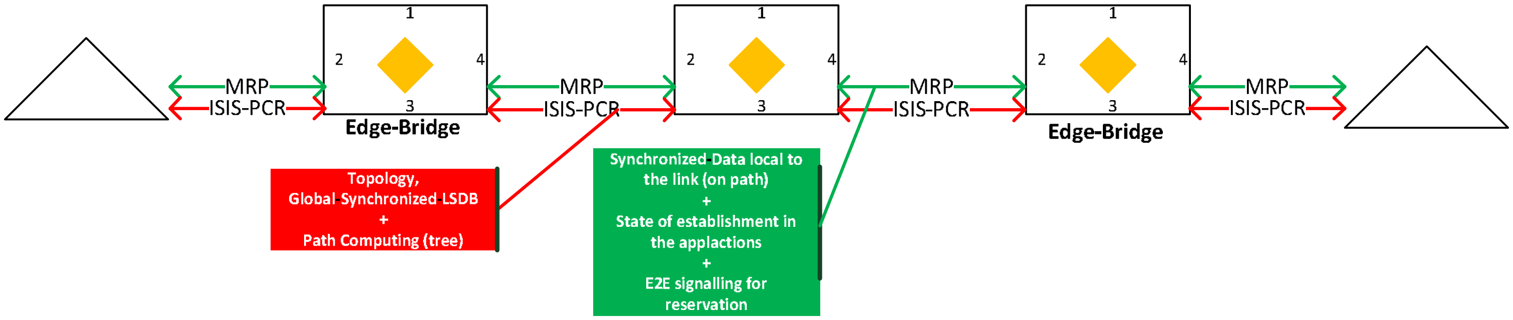


Endstation

BLCE (= Bridge-Local-Computing-Engine, distributed network control)

Multiple-Registration-Protocols (MRRP, MVRP, MMRP, MSRP including SRP)

Intermediate-System-to-Intermediate-System



Topology, Global Synchronized LSDB + Path Computing (tree)

Synchronized Data local to the link (on path) + State of establishment in the applactions + E2E signalling for reservation

NEW:

- ***Each bridge has to support BLCE functionality** (specified in .1Qca, **distributed** path computation)*
- ***ISIS-PCR is just for topology discovery and path computing ("Next Hop")***
- ***New MRP application MRRP – Multiple Relation-Registration protocol to nail down the path for Stream registration & reservation** (is a replacement of RSTP)*

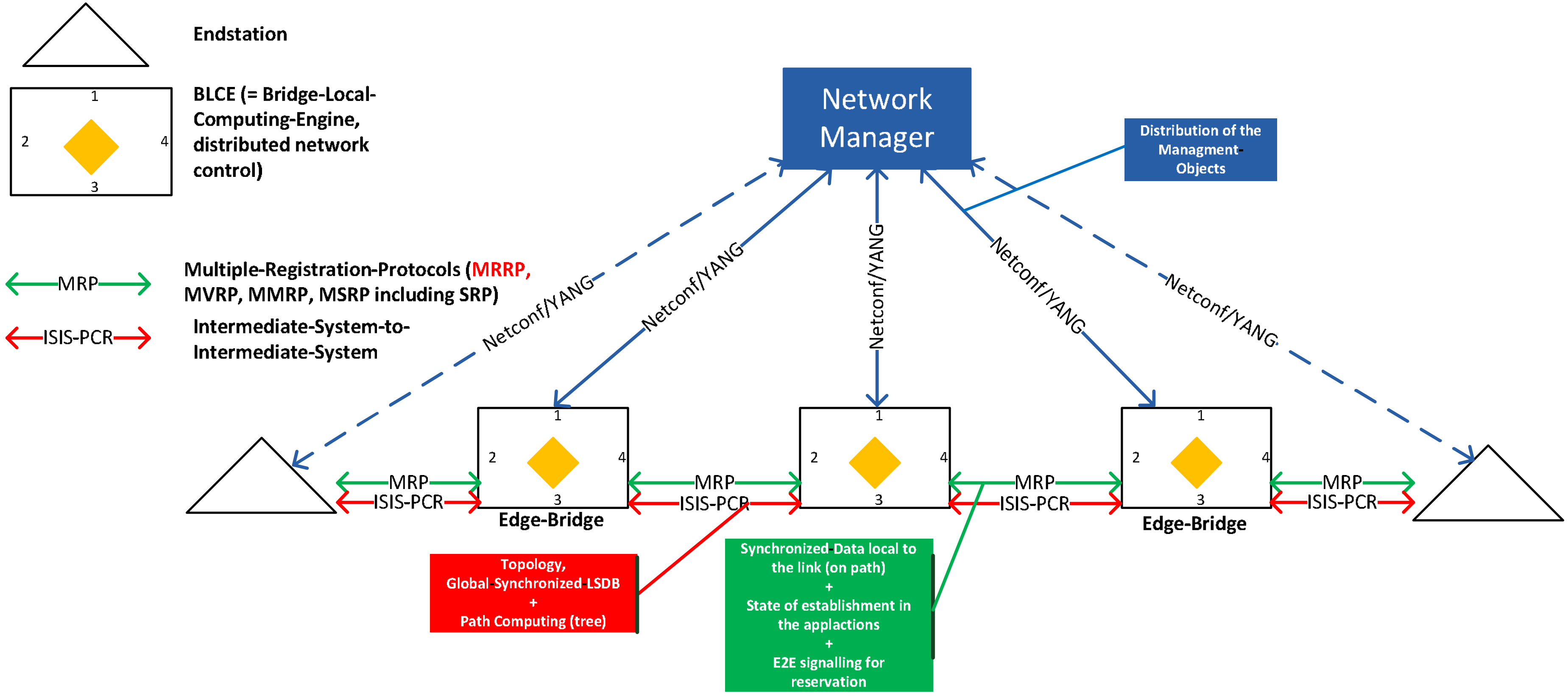
TSN: Decentralized / centralized controlled Network with Path Computation, Registration & Reservation

BUT in TSN we need mechanisms that allow Stream Reservation class (SR class) parameters to be configured because TSN has introduced new shaper, pre-emption, CT, … (in comparison to AVB we have predefined traffic classes)

- *Managed Objects are required to configure traffic classes for a time sensitive network*
  (observation interval, priority, VID, shaper, redundancy, max. MTU size, …)
- Managed Objects are required to configure max. available bandwidth for each traffic class
  (traffic classes for stream and traffic classes for best effort traffic)
- …

TSN: Decentralized controlled Network with Path Computation, Registration & Reservation

1. Fully Distributed Model (with Network Manager)



Endstation
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BLCE (= Bridge-Local-Computing-Engine, distributed network control)
MRP
Multiple-Registration-Protocols (MRRP, MVRP, MMRP, MSRP including SRP)
ISIS-PCR
Intermediate-System-to-Intermediate-System
Network Manager
Distribution of the Managment-Objects
Netconf/YANG
Netconf/YANG
Netconf/YANG
Netconf/YANG
Netconf/YANG
MRP
ISIS-PCR
Edge-Bridge
Edge-Bridge
Topology, Global-Synchronized-LSDB + Path Computing (tree)
Synchronized-Data local to the link (on path) + State of establishment in the applactions + E2E signalling for reservation

NEW:

- ***Network manager to distribute managed objects*** *(supporting new managed objects for new TSN features)*

TSN: Decentralized controlled Network
with Path Computation, Registration & Reservation

BUT within TSN we still have the requirement to (parts of the .1QCC PAR)

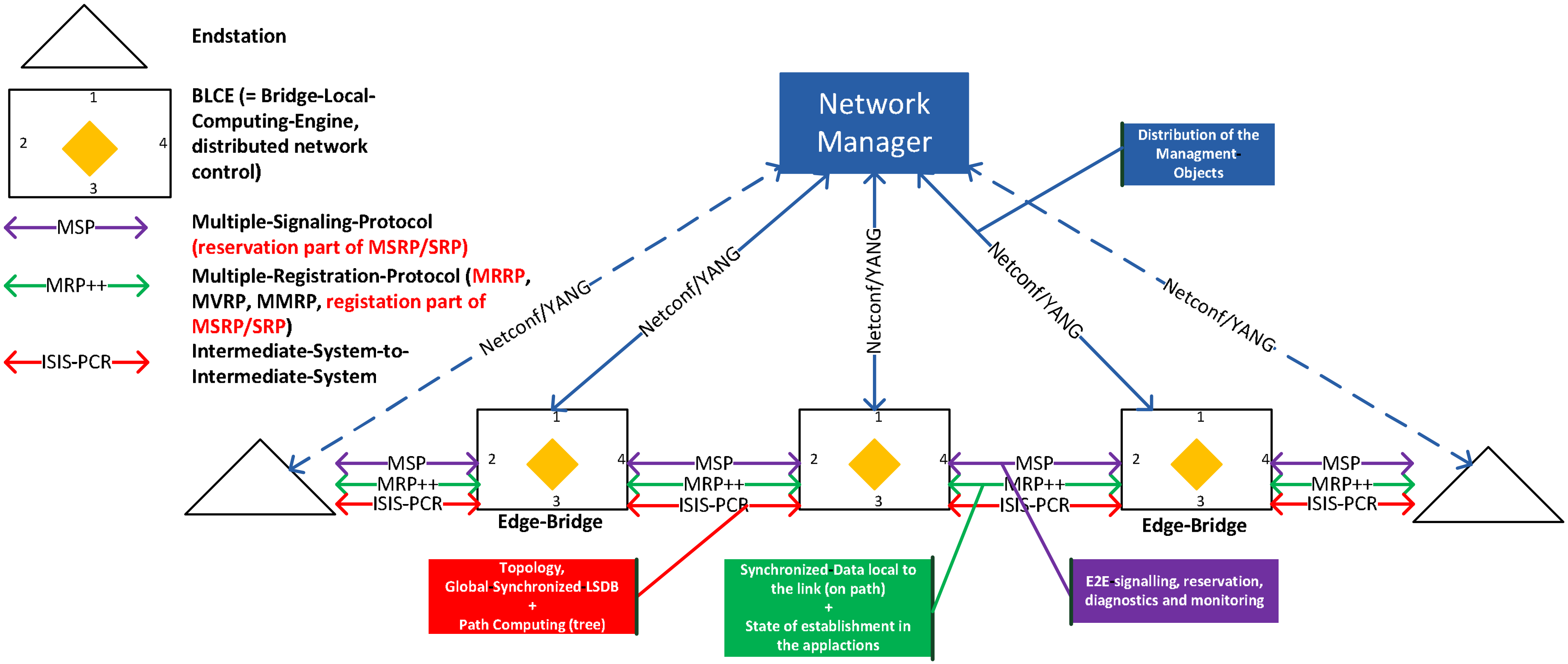
- *Support for more streams. The current worst case limit is less than 500 streams; there are use cases hat require two orders of magnitude greater than this.*
- *Inclusion of additional parameters and mechanisms in the stream reservation protocol that support additional applications, such as higher reliability, latency requirements, and latency changes due to network reconfiguration.*
- *Support for higher layer streaming sessions, such as Real-Time Protocol (RTP)-based sessions.*
- *Deterministic stream reservation convergence.*

With MSRP/SRP we have already overloaded MRP AND with MRRP and additional parameters to describe streams (supporting high reliability). TSN is continuing overloading MRP *(more data objects, more MRP PDU's, more applications, more …)*

Proposal:
Splitting Registration and Reservation into MRP++ for registration and MSP for reservation (more details in the end of this presentation)

Decentralized controlled Network
with Path Computation, Registration & Reservation

1. Fully Distributed Model (distinguishing registration & reservation)



Endstation

BLCE (= Bridge-Local-Computing-Engine, distributed network control)

Multiple-Signaling-Protocol (reservation part of MSRP/SRP)

Multiple-Registration-Protocol (MRRP, MVRP, MMRP, registation part of MSRP/SRP)

Intermediate-System-to-Intermediate-System

Distribution of the Managment Objects

Topology,
Global Synchronized LSDB
+
Path Computing (tree)

Synchronized Data local to the link (on path)
+
State of establishment in the applactions

E2E signalling, reservation, diagnostics and monitoring

NEW:

- ***MRP++ for registration to support more data objects, streams, … with one PDU*** (ISIS like on link)
- ***MSP for reservation to support better performance and to support more reservation applications*** (which a necessary for converged networks like rate constrained best effort traffic)

TSN: Decentralized controlled Network with Path Computation, Registration & Reservation

BUT

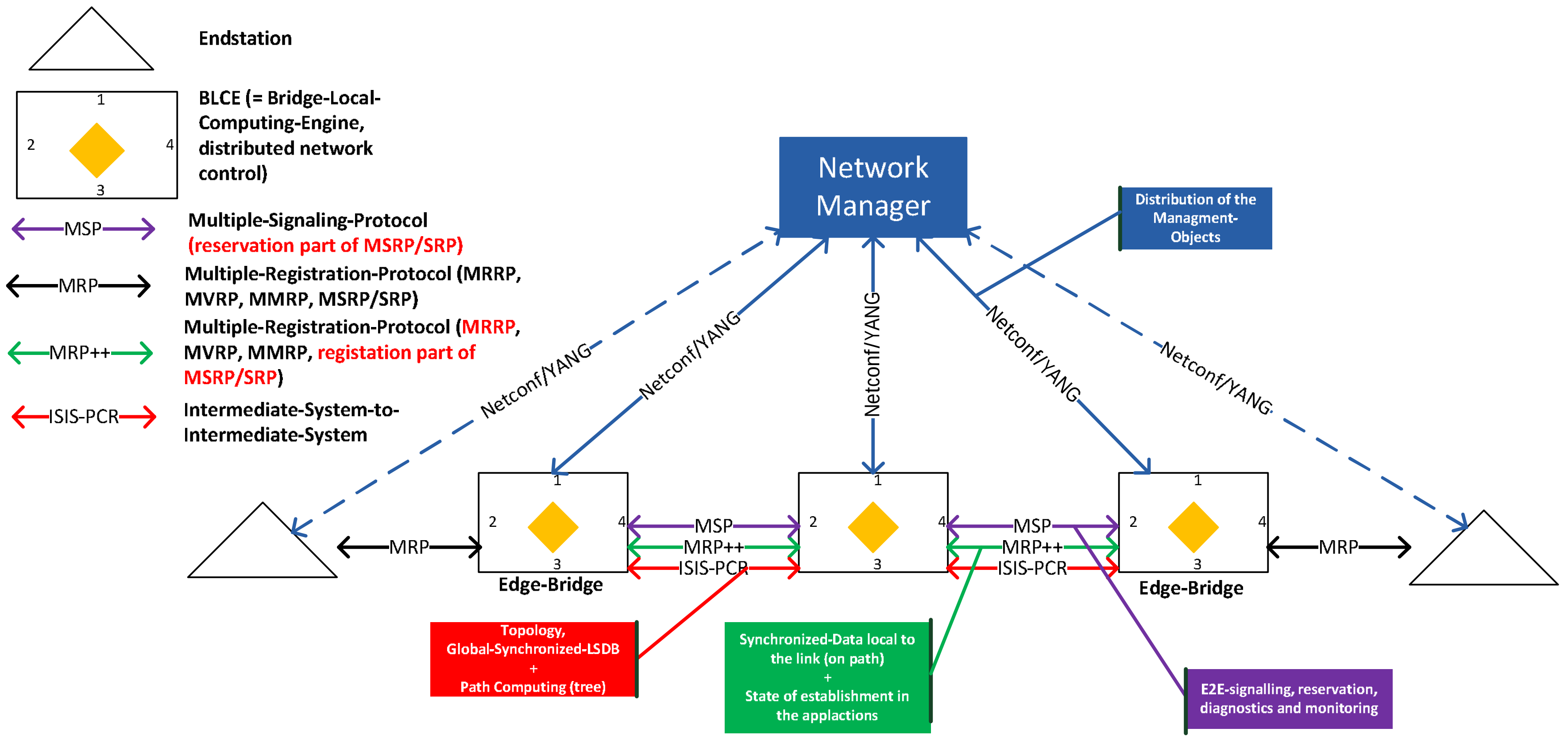
we have to be compatible to the current version of MRP (MRRP, MVRP, MMRP, MSRP/SRP)

AND

we should expand the current version of MRP to support the new TSN features.

Decentralized controlled Network with Path Computation, Registration & Reservation

1. Fully Distributed Model (using existing MSRP/SRP as outbound interface)



Endstation
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BLCE (= Bridge-Local-Computing-Engine, distributed network control)
MSP
Multiple-Signaling-Protocol (reservation part of MSRP/SRP)
MRP
Multiple-Registration-Protocol (MRRP, MVRP, MMRP, MSRP/SRP)
MRP++
Multiple-Registration-Protocol (MRRP, MVRP, MMRP, registation part of MSRP/SRP)
ISIS-PCR
Intermediate-System-to-Intermediate-System
Network Manager
Distribution of the Managment-Objects
Netconf/YANG
Netconf/YANG
Netconf/YANG
Netconf/YANG
Netconf/YANG
MRP
MSP
MRP++
ISIS-PCR
MSP
MRP++
ISIS-PCR
MRP
Edge-Bridge
Edge-Bridge
Topology, Global-Synchronized-LSDB + Path Computing (tree)
Synchronized-Data local to the link (on path) + State of establishment in the applactions
E2E-signalling, reservation, diagnostics and monitoring

ToDo:

- ***Using existing MRP (including MRRP, MVRP, MMRP, MSRP/SRP) for registration & reservation between end station and edge bridge*** *(guess UNI-Interface)*
- ***Adding to existing MRP data objects for control (TLV's) to support new TSN features like redundancy***

Centralized Network / *Distributed User Model* with Path Computation, Registration & Reservation

ISIS-PCR, specified in .1Qca, supports also a centralized controlled network by introducing PCEs (Path-Computing-Element specified in IETF).

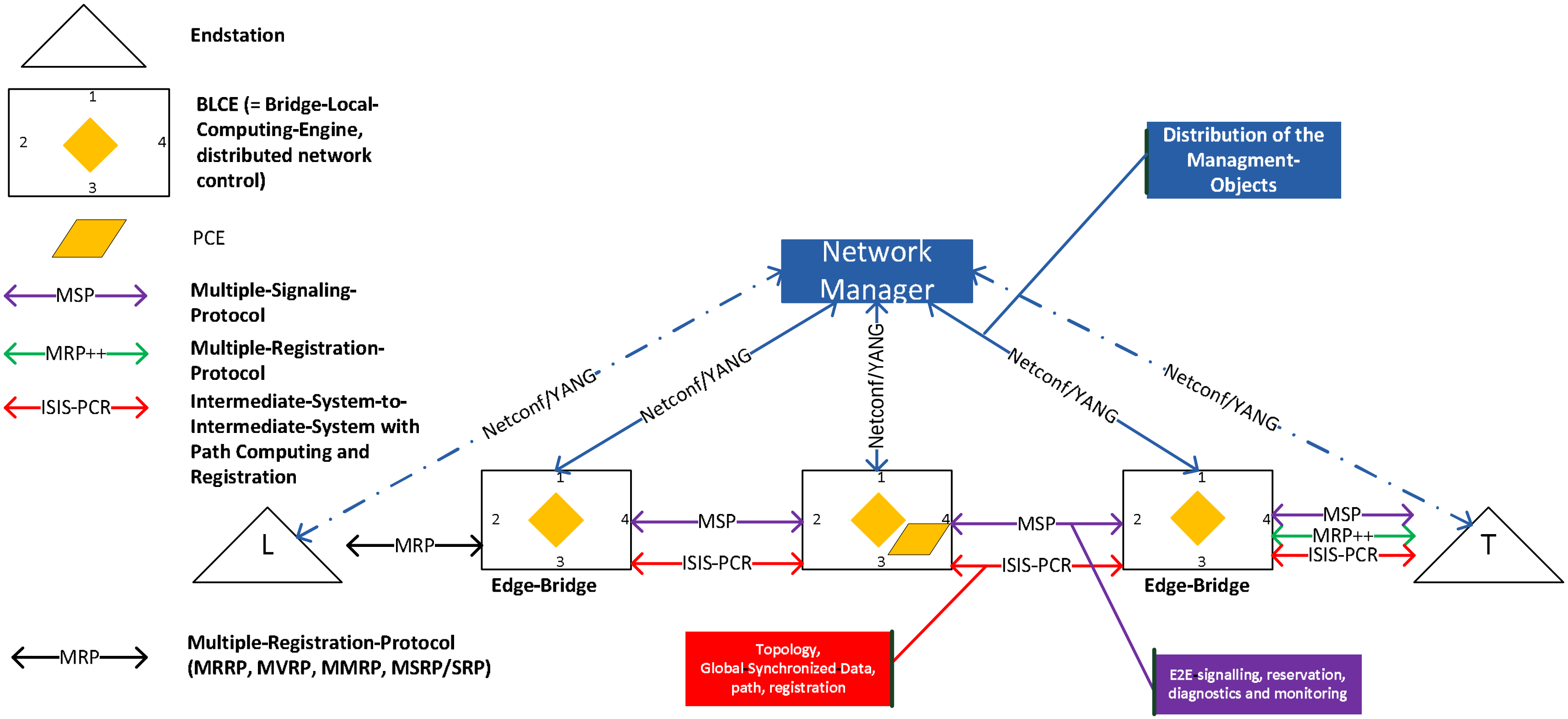
New TSN features like (seamless) redundancy, time aware shaper (TAS) are based on path computing.

Proposal 1 - Using ISIS-PCR also for registration:

- Using PCE for centralized path computing
- ISIS-PCR is used for topology discovery
  - and to distribute Stream specification (currently not in .1Qca)
  - and to distribute the “Explicit Trees” for streams
- Using MSP for Stream reservation (E2E signaling)

Centralized Network / *Distributed User Model* with Path Computation, Registration & Reservation

2. Centralized Network / *Distributed User Model* (Using ISIS-PCR also for registration)



Endstation

BLCE (= Bridge-Local-Computing-Engine, distributed network control)

PCE

MSP: Multiple-Signaling-Protocol

MRP++: Multiple-Registration-Protocol

ISIS-PCR: Intermediate-System-to-Intermediate-System with Path Computing and Registration

MRP: Multiple-Registration-Protocol (MRRP, MVRP, MMRP, MSRP/SRP)

Distribution of the Managment-Objects

Topology, Global Synchronized Data, path, registration

E2E signalling, reservation, diagnostics and monitoring

Proposal 1:

- *PCE for centralized path computing and registration*
- ***ISIS-PCR is used for topology discover and distributing registration for data objects for network control** (e.g. stream specification)*
- ***MSP is used for stream reservation and also E2E signaling***

Centralized Network / *Distributed User Model* with Path Computation, Registration & Reservation

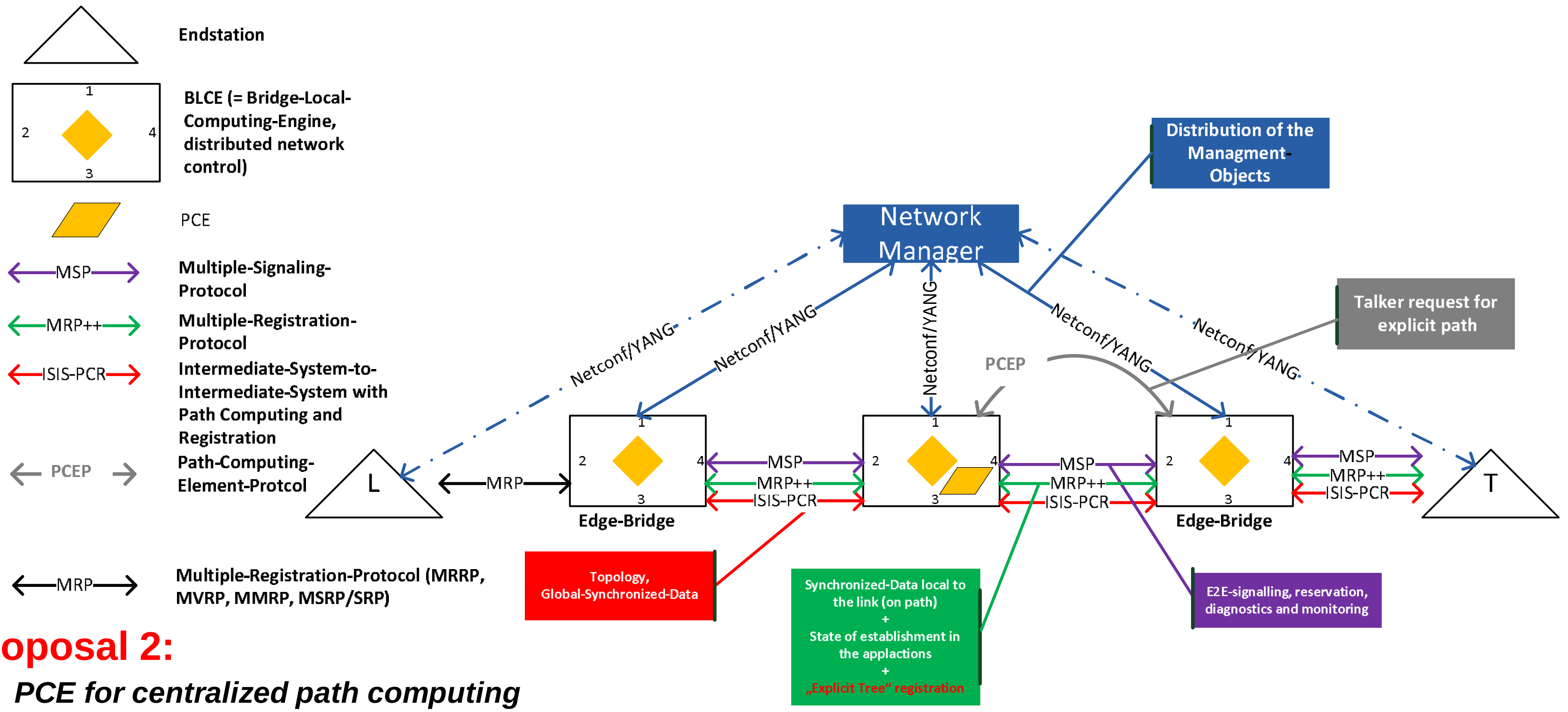
ISIS-PCR, specified in .1Qca supports also a centralized controlled network by introducing PCE’s (Path-Computing-Element specified in IETF) supporting the new TSN features like (seamless) redundancy based on path computing

Proposal 2 - Introducing PCEP for path computing request / response and using MRP++ for “Explicit Tree” registration:

- Using ISIS-PCR **just** for topology discovery
- Using PCE for centralized path computing
- Introducing PCEP (Path-Computing-Element-Protocol original specified in IETF) to
  - request / response for path-computing (communication relation)
- Using MRP++ to distribute
  - “Explicit Tree” for streams (gained by PCEP response)
  - stream specification
- Using MSP for Stream reservation (E2E signaling)

Centralized Network / *Distributed User Model* with Path Computation, Registration & Reservation

2. Centralized Network / *Distributed User Model* (Introducing PCEP for path computing request / response and using MRP++ for "Explicit Tree" registration)



Endstation

BLCE (= Bridge-Local-Computing-Engine, distributed network control)

PCE

MSP: Multiple-Signaling-Protocol

MRP++: Multiple-Registration-Protocol

ISIS-PCR: Intermediate-System-to-Intermediate-System with Path Computing and Registration

PCEP: Path-Computing-Element-Protcol

MRP: Multiple-Registration-Protocol (MRRP, MVRP, MMRP, MSRP/SRP)

Network Manager

Distribution of the Managment-Objects

Talker request for explicit path

Netconf/YANG

PCEP

L

T

MRP

MSP

MRP++

ISIS-PCR

Edge-Bridge

Edge-Bridge

Topology, Global-Synchronized-Data

Synchronized-Data local to the link (on path)
+
State of establishment in the applactions
+
„Explicit Tree" registration

E2E-signalling, reservation, diagnostics and monitoring

Proposal 2:

- *PCE for centralized path computing*
- *ISIS-PCR is just used for topology discover*
- *PCEP is used to request / response path computing ("Explicit Tree") for streams / relations*
- *MRP++ to register data objects for network control, stream specification, distributing also the data object for "Explicit Tree" and all the others*
- *MSP is used for stream reservation and also E2E signaling*

Centralized Network / *Distributed User Model* with Path Computation, Registration & Reservation

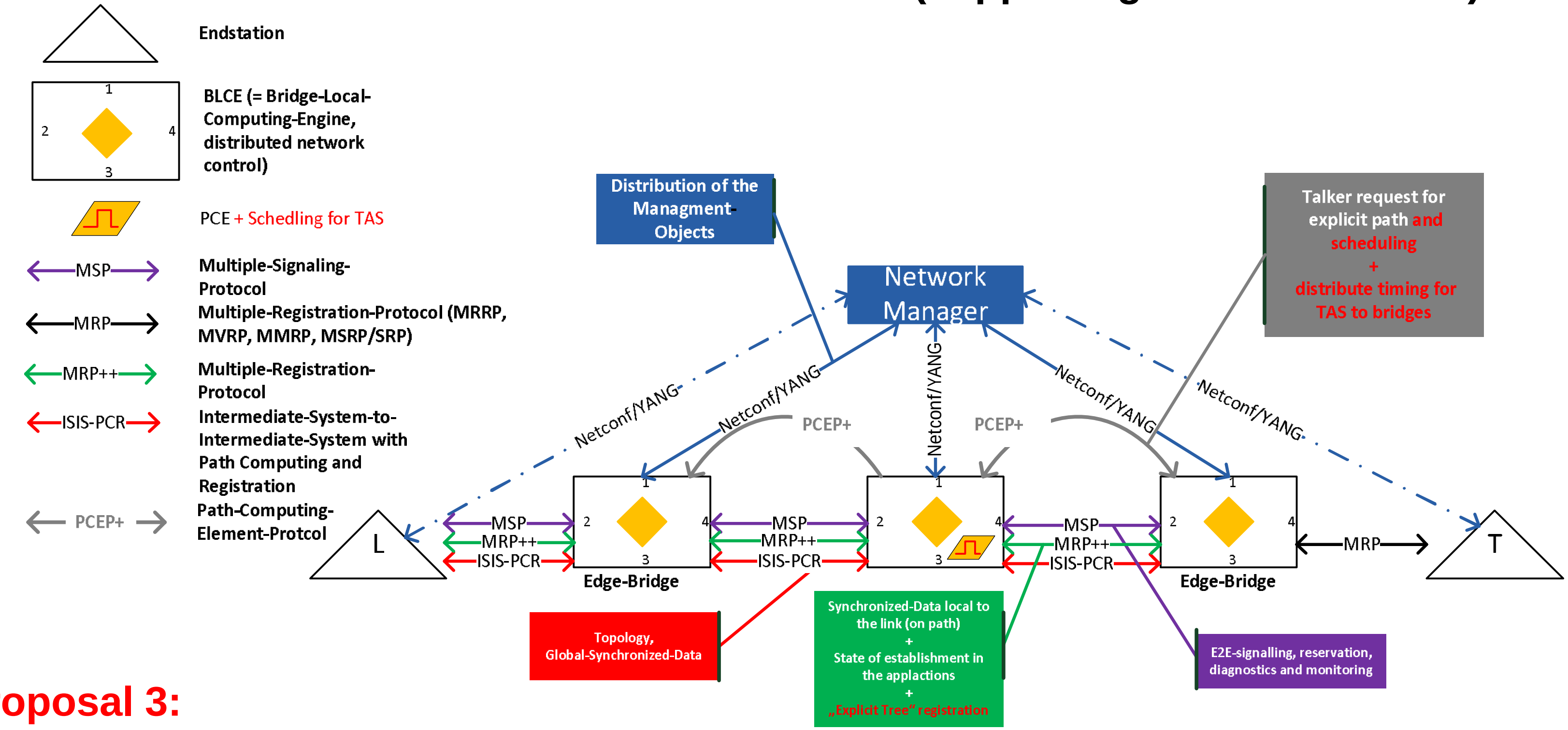
BUT to support SCHEDULING (TAS- time-aware-shaper) introducing new SCHEDULING-Function into PCEs is necessary. The current functionality of PCEP and also MRP must be extended.

Proposal 3 – Supporting "SCHEDULING":

- Using ISIS-PCR die topology discovery
- Using PCE for centralized path computing and scheduling for TAS (time aware shaper)
- Using PCEP+ to
  - request / response for path-computing and for scheduling for specified streams
  - distributing the window size for each scheduled traffic class and also distributing the information like which streams are scheduled
- Using MRP++ to distribute
  - "Explicit Tree" for streams (gained by PCEP response)
  - stream specification
- Using MSP for Stream reservation (looking that the Stream is correctly scheduled)

Centralized Network / *Distributed User Model* with Path Computation, Registration & Reservation

2. Centralized Network / *Distributed User Model* (supporting “SCHEDULING”)



Endstation
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BLCE (= Bridge-Local-Computing-Engine, distributed network control)
PCE + Schedling for TAS
MSP
Multiple-Signaling-Protocol
MRP
Multiple-Registration-Protocol (MRRP, MVRP, MMRP, MSRP/SRP)
MRP++
Multiple-Registration-Protocol
ISIS-PCR
Intermediate-System-to-Intermediate-System with Path Computing and Registration
PCEP+
Path-Computing-Element-Protocl
Distribution of the Managment-Objects
Network Manager
Talker request for explicit path and scheduling + distribute timing for TAS to bridges
Netconf/YANG
Netconf/YANG
Netconf/YANG
Netconf/YANG
Netconf/YANG
PCEP+
PCEP+
L
T
MSP
MRP++
ISIS-PCR
MSP
MRP++
ISIS-PCR
MSP
MRP++
ISIS-PCR
MRP
Edge-Bridge
Edge-Bridge
Topology, Global-Synchronized-Data
Synchronized-Data local to the link (on path) + State of establishment in the applactions + „Explicit Tree“ registration
E2E-signalling, reservation, diagnostics and monitoring

Proposal 3:

- *PCE for centralized path computing*
- *ISIS-PCR is just used for topology discover*
- *PCEP+ is used to request / response path computing and scheduling + distributing data objects to each bridge along the path like window size*
- *MRP++ to register data objects for network control, stream specification, distributing also the data object for “Explicit Tree” and all the others*
- *MSP is used for stream reservation and also E2E signaling*

Centralized Network / *Distributed User Model* with Path Computation, Registration & Reservation

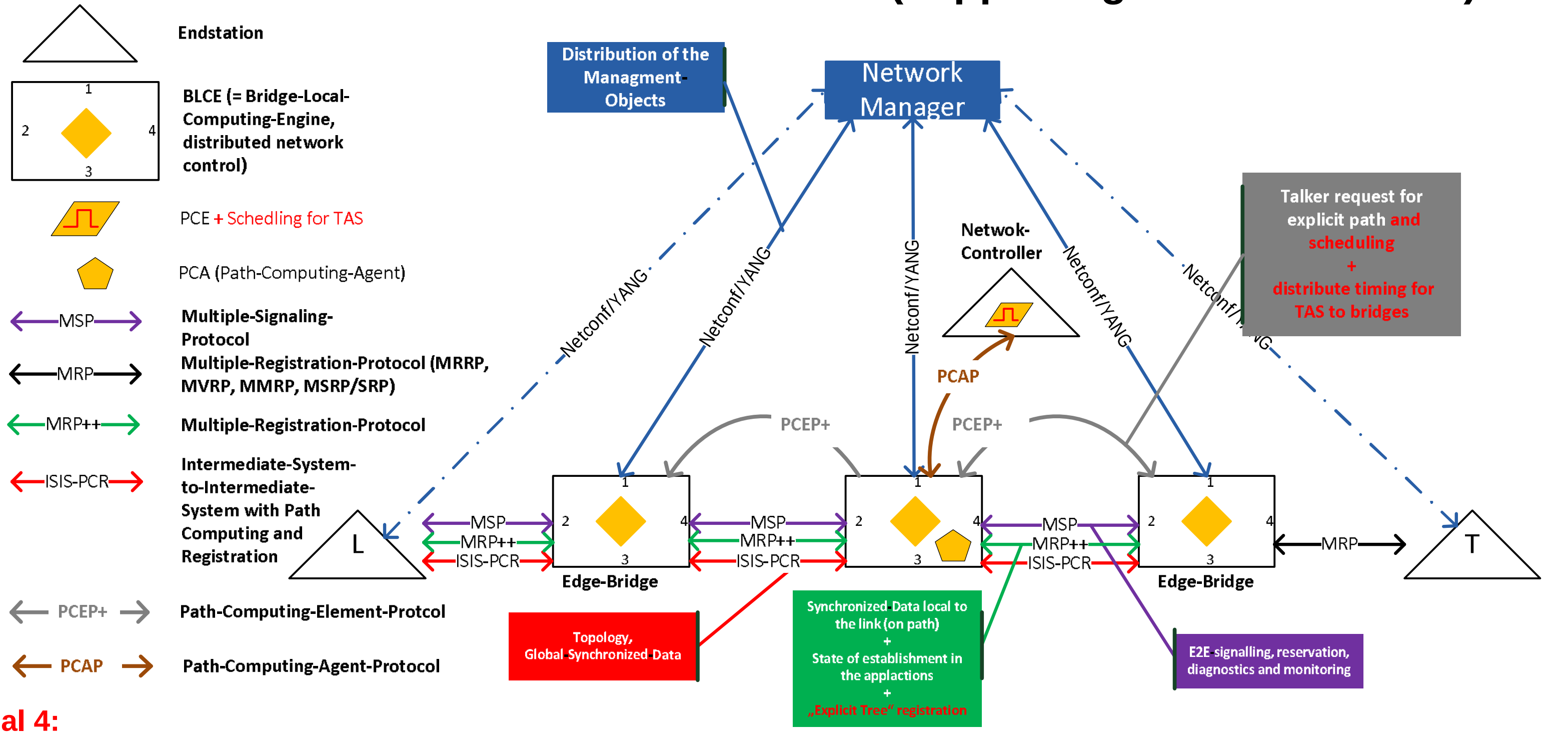
BUT to support Path-Computing and Scheduling with a Network-Controller

Proposal 4:

- Using ISIS-PCR die topology discovery
- Using PCE in a Network-Controller for centralized path computing and scheduling for TAS
- Using PCA (Path-Computing-Agent) to communicate with a Network-Controller (includes a PCE)
- Using PCEP+ to
  - request / response for path-computing and for scheduling for streams
  - distributing the window size for each scheduled traffic class and also distributing the information like which streams are scheduled
- Using MRP++ to distribute
  - “Explicit Tree” for streams (gained by PCEP response)
  - stream specification
- Using MSP for Stream reservation (looking that the Stream is correctly scheduled)

Centralized Network / *Distributed User Model* with Path Computation, Registration & Reservation

2. Centralized Network / *Distributed User Model* (supporting “SCHEDULING”)



Endstation

BLCE (= Bridge-Local-Computing-Engine, distributed network control)

PCE + Schedling for TAS

PCA (Path-Computing-Agent)

Multiple-Signaling-Protocol

Multiple-Registration-Protocol (MRRP, MVRP, MMRP, MSRP/SRP)

Multiple-Registration-Protocol

Intermediate-System-to-Intermediate-System with Path Computing and Registration

Path-Computing-Element-Protcol

Path-Computing-Agent-Protocol

Distribution of the Managment-Objects

Network Manager

Netwok-Controller

Talker request for explicit path and scheduling + distribute timing for TAS to bridges

Topology, Global Synchronized Data

Synchronized Data local to the link (on path) + State of establishment in the applactions + „Explicit Tree“ registration

E2E signalling, reservation, diagnostics and monitoring

Proposal 4:

- *PCE for centralized path computing*
- *ISIS-PCR is just used for topology discover*
- *PCEP+ is used to request / response path computing and scheduling + distributing data objects to each bridge along the path like window size*
- *PCAP is used for communication between a PAC and PCE*
- *MRP++ to register data objects for network control, stream specification, distributing also the data object for “Explicit Tree” and all the others*
- *MSP is used for stream reservation and also E2E signaling*

Fully Centralized Model
with Path Computation, Registration & Reservation

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To support the “Fully Centralized Model”

Proposal 5:

- Using ISIS-PCR die topology discovery

- Using PCE in a Network-Controller for centralized path computing and scheduling for TAS
  - The Network-Controller get the communication relations and stream specification from a “Centralized-User-Configuration”

- Using PCA (Path-Computing-Agent) to communicate with a Network-Controller (includes a PCE)

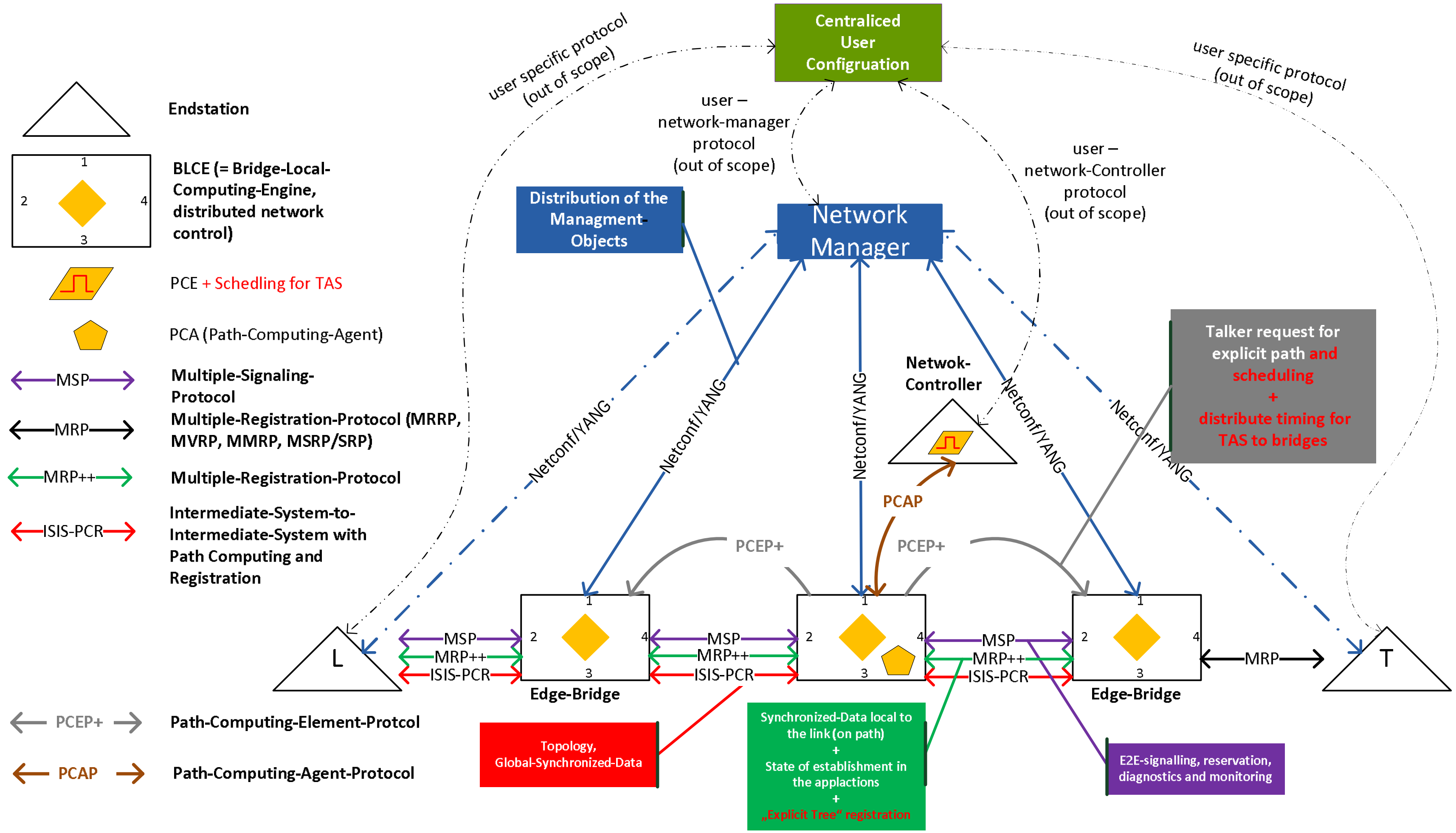
- Using PCEP+ to
  - distributing result of path-computing and scheduling
  - distributing the window size for each scheduled traffic class and also distributing the information like which streams are scheduled

- Using MRP++ to distribute
  - “Explicit Tree” for streams (gained by PCEP response)
  - stream specification

- Using MSP for Stream reservation (looking that the Stream is correctly scheduled)

Centralized Network / *Distributed User Model* with Path Computation, Registration & Reservation

3. Fully Centralized Network (supporting “SCHEDULING”)



Endstation

BLCE (= Bridge-Local-Computing-Engine, distributed network control)

PCE + Schedling for TAS

PCA (Path-Computing-Agent)

MSP: Multiple-Signaling-Protocol

MRP: Multiple-Registration-Protocol (MRRP, MVRP, MMRP, MSRP/SRP)

MRP++: Multiple-Registration-Protocol

ISIS-PCR: Intermediate-System-to-Intermediate-System with Path Computing and Registration

PCEP+: Path-Computing-Element-Protocl

PCAP: Path-Computing-Agent-Protocol

Centraliced User Configruation

Distribution of the Managment-Objects

Network Manager

user – network-manager protocol (out of scope)

user – network-Controller protocol (out of scope)

user specific protocol (out of scope)

Talker request for explicit path and scheduling + distribute timing for TAS to bridges

Topology, Global-Synchronized-Data

Synchronized-Data local to the link (on path) + State of establishment in the applactions + „Explicit Tree“ registration

E2E-signalling, reservation, diagnostics and monitoring

Centralized Network / *Distributed User Model*
with Path Computation, Registration & Reservation

3. Fully Centralized Network (supporting “SCHEDULING”)

Proposal 5:

- ***PCE for centralized path computing***
- ***ISIS-PCR is just used for topology discover***
- ***PCEP+ is used to distribute path computing and scheduling + distributing data objects to each bridge along the path like window size***
- ***PCAP is used for communication between a PAC and PCE***
- ***MRP++ to register data objects for network control, stream specification, distributing also the data object for “Explicit Tree” and all the others***
- ***MSP is used for stream reservation and also E2E signaling***

MRP++ and MSP
Reasons for splitting Registration and Reservation

At the moment within the TSN group there is a discussion

- How to “support for more streams. The current worst case limit is less than 500 streams; there are use cases that require two orders of magnitude greater than this.”
- How to get “deterministic stream reservation convergence.”
- …

(excerpt from the .1Qcc PAR)

The following slides

- explain registration
- explain reservation
- and show the difference also in the architecture between both

Registration:

Properties:

- Attributes get synchronized between links *(ISIS-like on link)*
- Synchronized data is constant (no modification within a Bridge)
- No creation of new Attributes
- Has to scale to larger amount of data (🡐 Fragmentation of PDU is necessary)
- Performance of attribute propagation is not the main focus

Main focus:

- Reliable synchronization of network attributes within an active topology given by a context. (In contrast to ISIS where Attributes are flooded all over the network to everybody)

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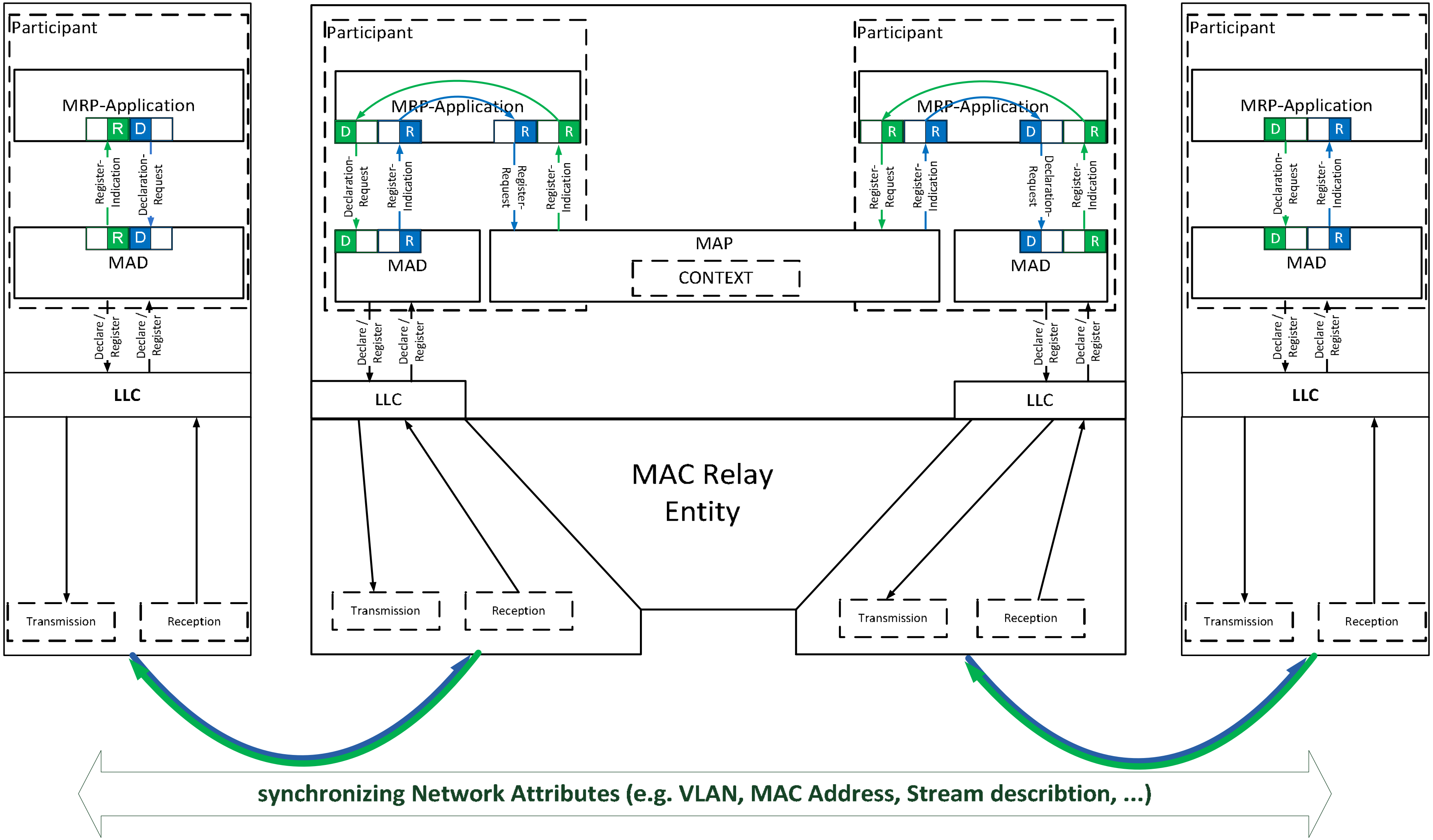
MRP++ Architecture



One Registration Application (out of others) is MSRP (Multiple Stream Registration Protocol)

Used to propagate the static properties of a stream along the path.

Such properties are for example:

- VID
- Max. frame size
- Frame priority
- Rank
- Stream-ID
- Tree-ID (for path)
- Stream destination MAC
- …

Signaling

Properties:

- Directed from source to sink
- Attributes can get modified at every Hop
- Changes along the Path between source and sink has to be signaled very fast
- Attribute disappears if source withdraws or times-out
- Beside cyclic Link-To-Link synchronization, event based PDUs are necessary

Main focus:

- End-to-End signaling
- Monitoring the route between source and sink
- Fast signaling of changes along the road to source and sink
- Signal the source and the sink what they get if they go along the route

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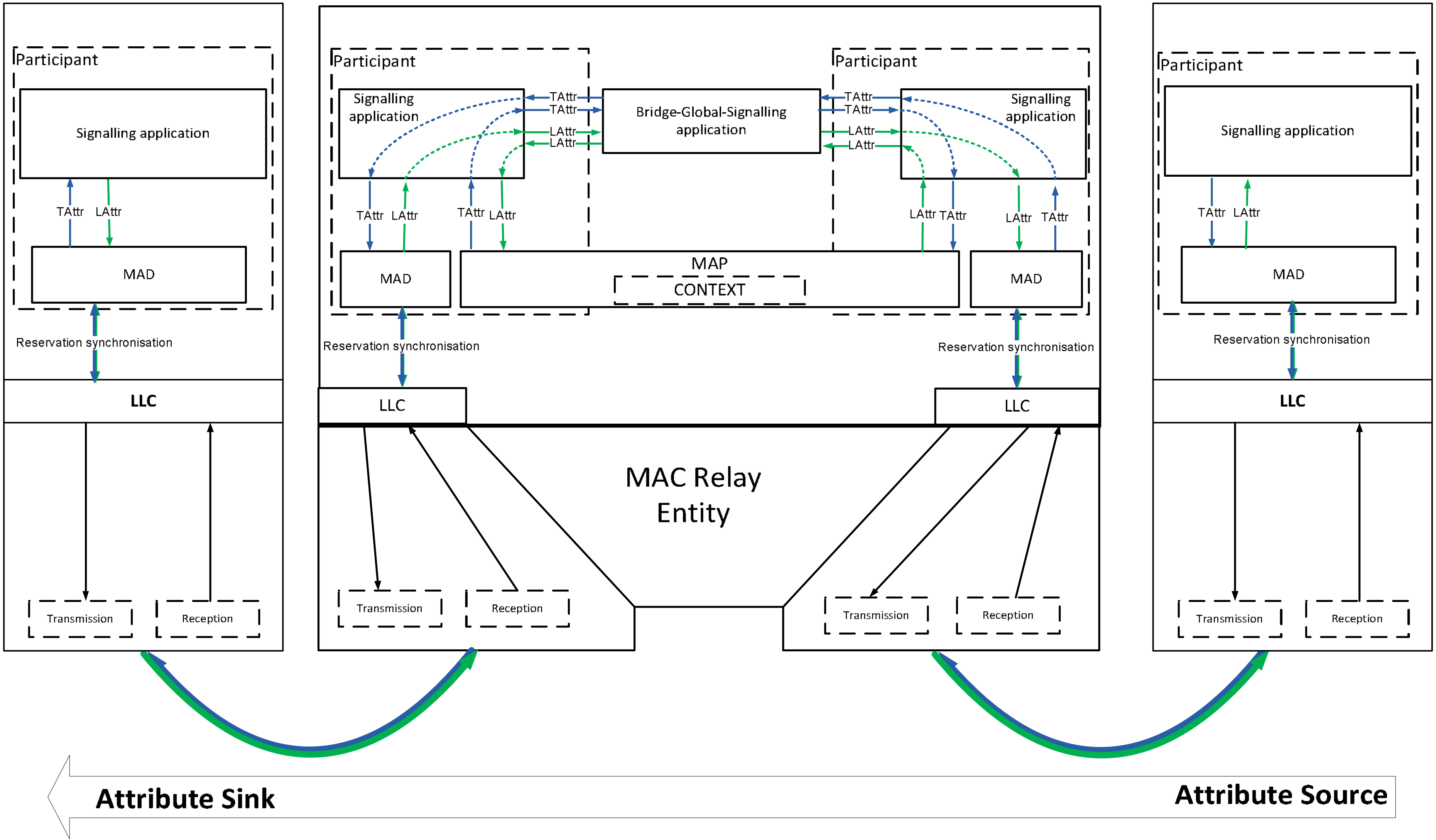
Basic MSP Architecture



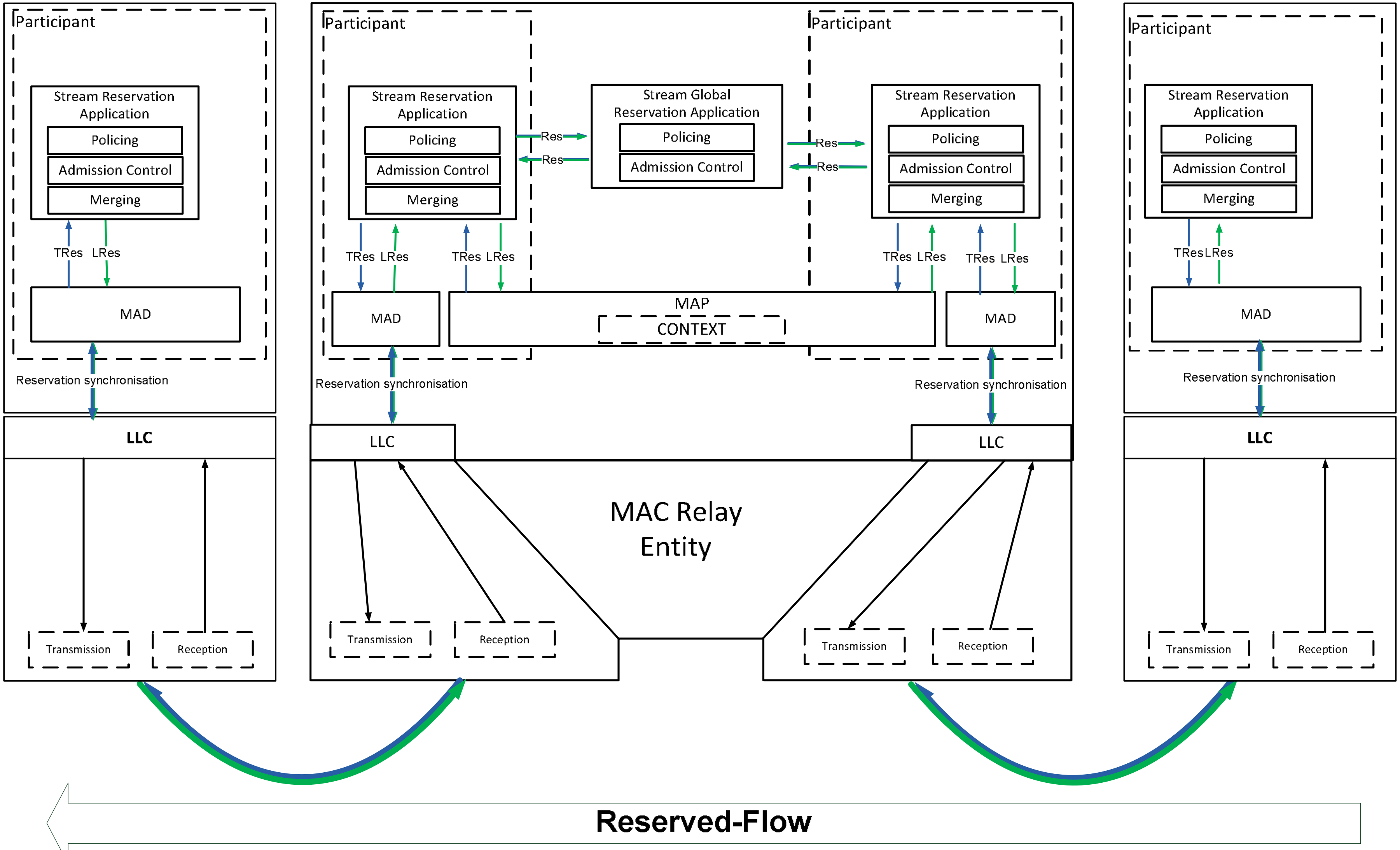
One Signaling Application (out of others) is MSSP (Multiple Stream Signaling Protocol)

Used to:

- propagate the dynamic properties of a stream along the path (Upstream AND Downstream).
  E.g.:
  - Accumulated Latency (Downstream)
  - Required Latency (Upstream)
  - Min. receive Interval (Upstream)
  - Effective receive Interval (Downstream)
  - Stream send state (Ready/Failed) (Downstream)
  - Stream receive state (Ready/Failed/ReadyFailed) (Upstream)

- Use the event based messages to by-pass the slow cyclic Link-To-Link synchronization to signal disruptive events on the path (e.g. Link-Down due to wire break)

MSSP Architecture
(Multiple Stream Signaling based on the MSP-Architecture)



Conclusion for decentralized and centralized Approaches

General

- *Ongoing task in .1Qcc*
  - *Adding to existing MRP data objects for control (TLV's) to support new TSN features like redundancy*
  - *Specifying new Managed Objects which required to configure traffic classes*
- *New work item:*
  - Splitting Registration and Reservation into MRP++ for registration and MSP for reservation

For the "Centralized Network / Distributed User Model" and also for the Fully Centralized Model" there are 4 proposals:

- *Proposal 1 - Using ISIS-PCR also for registration -> will overload ISIS-PCR (scaling issue)!*
- *Proposal 2 - Introducing PCEP for path computing request / response and using MRP++ for "Explicit Tree" registration*
- *Proposal 3 - Supporting "SCHEDULING"*
- *Proposal 4 - Network-Controller with PCE functionality*
- *Proposal 5 - Implementation proposal for the "Fully Centralized Model"*

New Work item for Proposal 2,3,4,5:

- *Standardizing PCEP and its data objects for Ethernet (supporting also optional "Scheduled Traffic") within IEEE 802.1*
- *Splitting MRP and its applications in registration (MRP++) and reservation (MSP)*

=> Discussion: How to proceed?

Thank you for your attention!

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Backup

The following slides contain further details!

Motivation splitting Registration and Reservation in MRP++ (MRPv2) and MSP

Motivation for V2 MRP (Multiple Registation Protocol) and V1 MSP (Multiple Signaling Protocol)

	MRP v1	**MRP v2** "transport-protocol" for applications like MVRP, MMRP, MSRP, ...
Pro (also Supported by new Version)	**Cons**	**Features**
Distribution of network attributes over context	No fragmentation - limits the number of attributes. This problem is partly solved by spending one seperate frame for each application or application instance. The disadvantige of the current solution that high computing power is required for serialization and dserialization.	+' Support Fragmentation '+' One MRP frame for all applications (including all attribute lists and states) '+' Sperate checksum for each attribute list
One basic machnism for different applications (MVRP, MMRP,...)	Very complex and intransparent state machines -> difficult to synchronize implementations from different vendors	+' Simplified state machine and synchronization mechanism
Common architecture (aplication-->instance-->attribute)		
	MSRP combines registration and reservation, the attribute size (advertise) is very large and extended the MAP mechanism and introduced four packed events exclusiv for MSRP	+' MSRPv2 is only a registration protocol to register stream attributes (e.g. TSpec, TC, SR-DA, SR-ID, VID, ...)
	The pack mechanism form MRP is not practical (only for special use cases)	+' By introducing fragmentation the packed mechnism is no longer necessary
		+' Extending existing apllications (MVRP, MMRP, MSRP) to support redundancy and seamless redundancy on precalculated trees '+' If necessary add a new application like MRRP
		+' Optional suport for higher layers like IP (e.g. transport higher layer addresses, QoS specifier, ..) by e.g. using TLV's
		+' Managed Objects
		+' TLV's are used to specify the MRP attributes
		+' The mechanism to synchronize the attribute list on a link is compareable to the synchronziation mechanism used by ISIS (ISIS-like)
		MSP ("RSVP like") ("MSP is a seperate transport-protocol" for e.g. stream reservation)
	MSRP combines registration and reservation, the attribute size (advertise) is very large and extended the MAP mechanism and introduced four packed events exclusiv for MSRP	+' MSSP (Multiple Stream Signaling Protocol) is a applicaiton for MSP which is used for stream reservation, e2e signalling and diagnostic. The context, which is required for forwarding the signal / reservation, is either built by MRP or ISIS-PCR
		+' Optional suport for higher layers like IP (e.g. transport higher layer addresses, QoS specifier, ..) by e.g. using TLV's
		+' Managed Objects

Support for more streams. The current worst case limit is less than 500 streams; there are use cases that require two orders of magnitude greater than this.

Support for higher layer streaming sessions, such as Real-Time Protocol (RTP)-based sessions

Deterministic stream reservation convergence -> request for performance

Data model for splitting the existing MSRP to MSRP on MRP++ and MSSP on MSP

New
Static Information
Dynamic Information

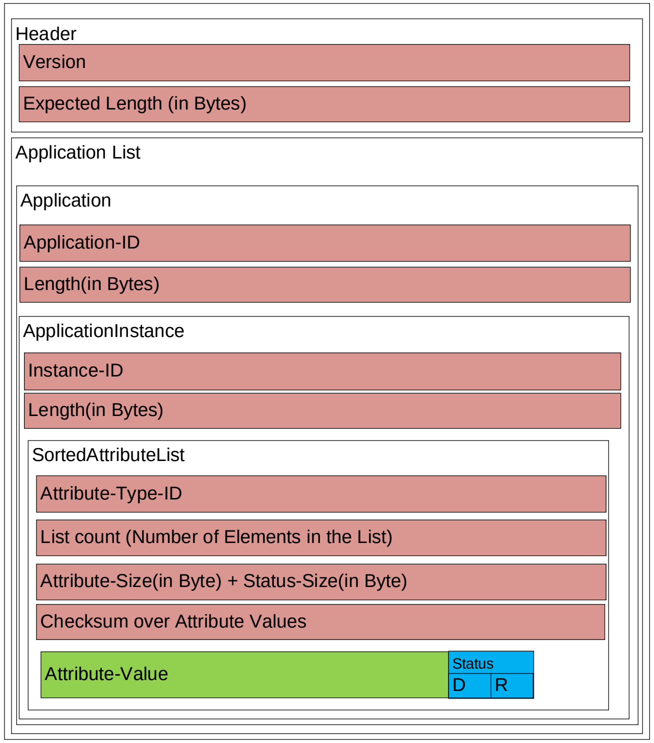
	Talker Advertise		Talker Failed		Listener		Domain
MSRP on MRP	StreamID	Talker Sys-ID	StreamID	Talker Sys-ID	StreamID	Talker Sys-ID	StreamClassID
		Unique-ID		Unique-ID		Unique-ID	StreamClassPriority
	DataFrameParameters	Dest-Address	DataFrameParameters	Dest-Address	FourPackedEvent	Ready / ReadyFailed / AskingFailed / Ignore	StreamClassVid
		VID		VID			
	Tspec	MaxFrameSize	Tspec	MaxFrameSize			
		MaxInterval		MaxInterval			
	PriorityAndRank	DataFramePriority	PriorityAndRank	DataFramePriority			
		Rank		Rank			
	AccumulatedLatency	portTxMaxLatency	AccumulatedLatency	portTxMaxLatency			
			FailureInformation	BridgeID			
				FailureCode			

	Talker Advertise		Listener		Domain
MSRPv2 on MRP++	StreamID	Talker Sys-ID	StreamID	Talker Sys-ID	StreamClassID
		Unique-ID		Unique-ID	StreamClassPriority
	DataFrameParameters	Dest-Address	Rspec	MinRecvInterval	StreamClassVid
		VID	Listener ID	Listener Sys-ID	
	Tspec	MaxFrameSize			
		MaxInterval			
	PriorityAndRank	DataFramePriority			
		Rank			
MSSP on MSP	StreamID	Talker Sys-ID	StreamID	Talker Sys-ID	
		Unique-ID		Unique-ID	
	AccumulatedLatency (Calculated downstream)	portTxMinLatency	RequiredLatency (Calculated upstream)	portRxMinLatency	
		portTxMaxLatency		portRxMaxLatency	
	State	ok?	AccumulatedRspec	AccMinRecvInterval	
	List<FailureInformation>	BridgeID	State	Ready / ReadyFailed / Failed	
		FailureCode	List<FailureInformation>	BridgeID	
				FailureCode	

SIEMENS

MRP++ Frame Format

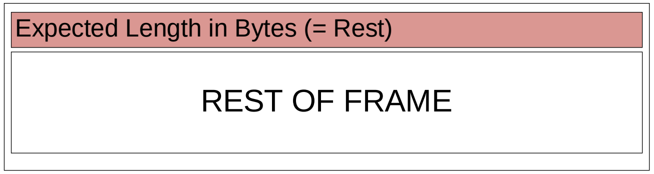
Frame:



MRP-PDU	→ Header, ApplicationList
Header	→ Version, ExpectedLength
Version	→ UINT8
ExpectedLength	→ Length
Length	→ UINT16
ApplicationList	→ Application*
Application	→ ***ApplicationId***,Length,ApplicationInstance*
ApplicationId	→ ID
ID	-> UINT8
ApplicationInstance	→ InstanceID,Length,SortedAttributeList*
InstanceID	→ UINT16
SortedAttributeList	→ ListHeader,ListBody
ListHeader	→ ***AttTypeId***,ListCount,***AttributeSize,***Checksum
AttTypeId	→ ID
ListCount	→ UINT8
AttributeSize	→ UINT8
Checksum	→ Fletcher-16
ListBody	→ Attribute*
Attribute	→ Value,State
Value	→ ***Attribute value defined by Application***
State	→ Declarator, Registrar
Declarator	→ BIT
Registrar	→ BIT

Red: TBD(unsure)
Green: Defined By Application
**** := 0 - N***

Fragment:


Expected Length in Bytes (= Rest)
REST OF FRAME