Proposal for splitting IEEE 802.1Qcc into several PAR's

Supporting new TSN features in a decentralized and centralized controlled network

Franz-Josef Goetz, Siemens AG
Juergen Schmitt – Siemens AG
Marcel Kiessling – Siemens AG

.1Qcc PAR

Scope of the project:

This amendment describes new protocols, procedures and managed objects for bridges and end stations, which are compatible with existing mechanisms, and provide:

- 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.
- Mechanisms that allow Stream Reservation class (SR class) parameters to be configured
- 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.
- User Network Interface (UNI) for routing and reservations.

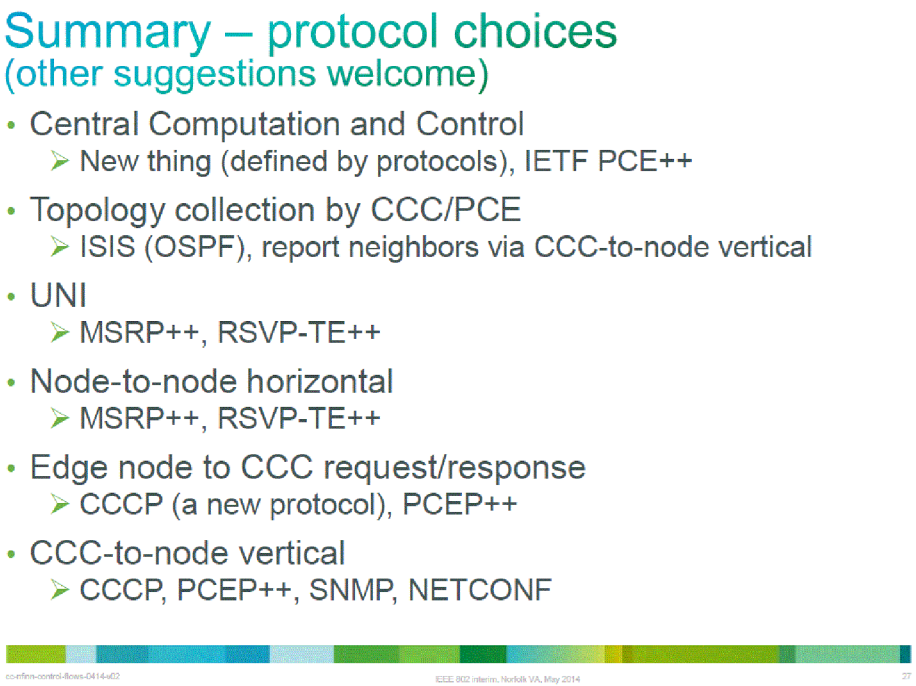
It seems .1Qcc is focusing on
"User Network Interface (UNI) for routing and reservations"

The current .1Qcc draft shows three concepts but this presentation is focused ONLY on two:

1. Fully Distributed Model

2. Centralized Network *based on .1Qca*

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

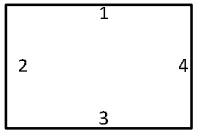


AVB: Decentralized controlled Network with Registration & Reservation based on RSTP

SIEMENS

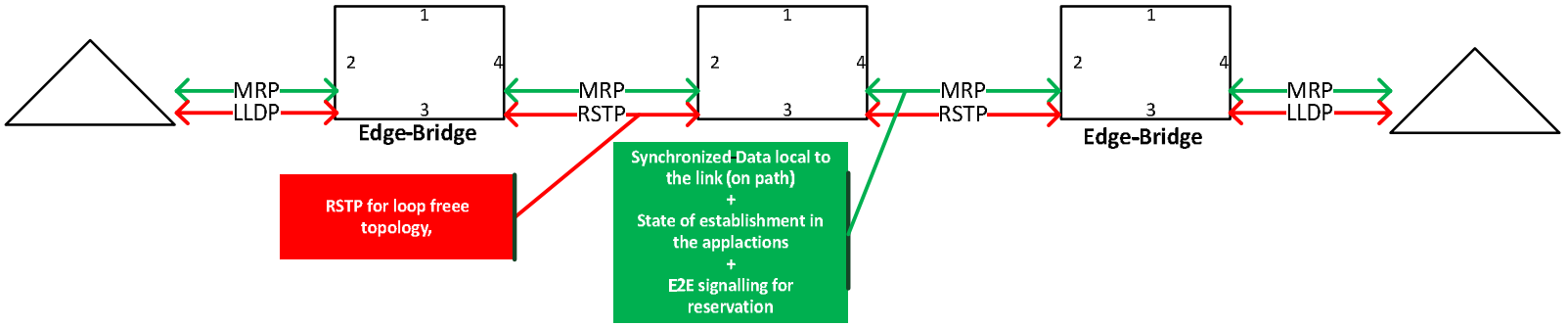
1. Fully Distributed Model (specified with AVB)

Endstation



AVB Bridge

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



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

SIEMENS

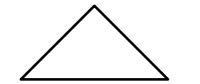
TSN has introduced new features like (seamless) redundancy based on path computing. To support (seamless redundancy in a decentralized controlled network additional protocols are necessary:

- 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
- 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 VID(s) for the data plane
- MMRP (optional) to configure the forwarding behavior for unregistered MAC addresses
- MSRP to register the Stream Attributes (e.g. SR-DA, Tspec,..)
- SRP to do stream reservation

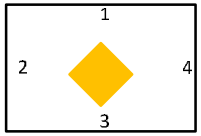
TSN: Decentralized controlled Network with Path Computation, Registration & Reservation

SIEMENS

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

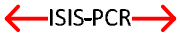


Endstation

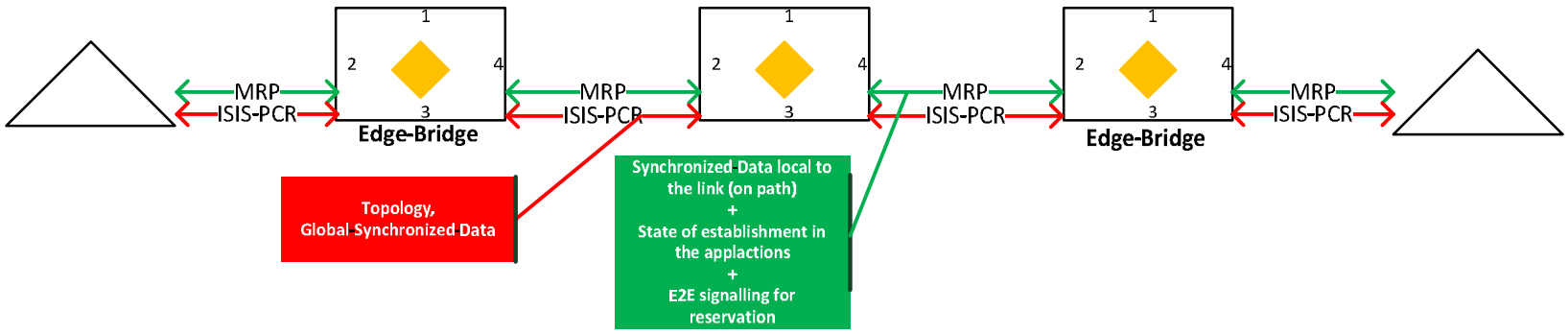


BLCE (= Bridge-Local-Computing-Engine, distributed network control)

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



Intermediate-System-to-Intermediate-System



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

SIEMENS

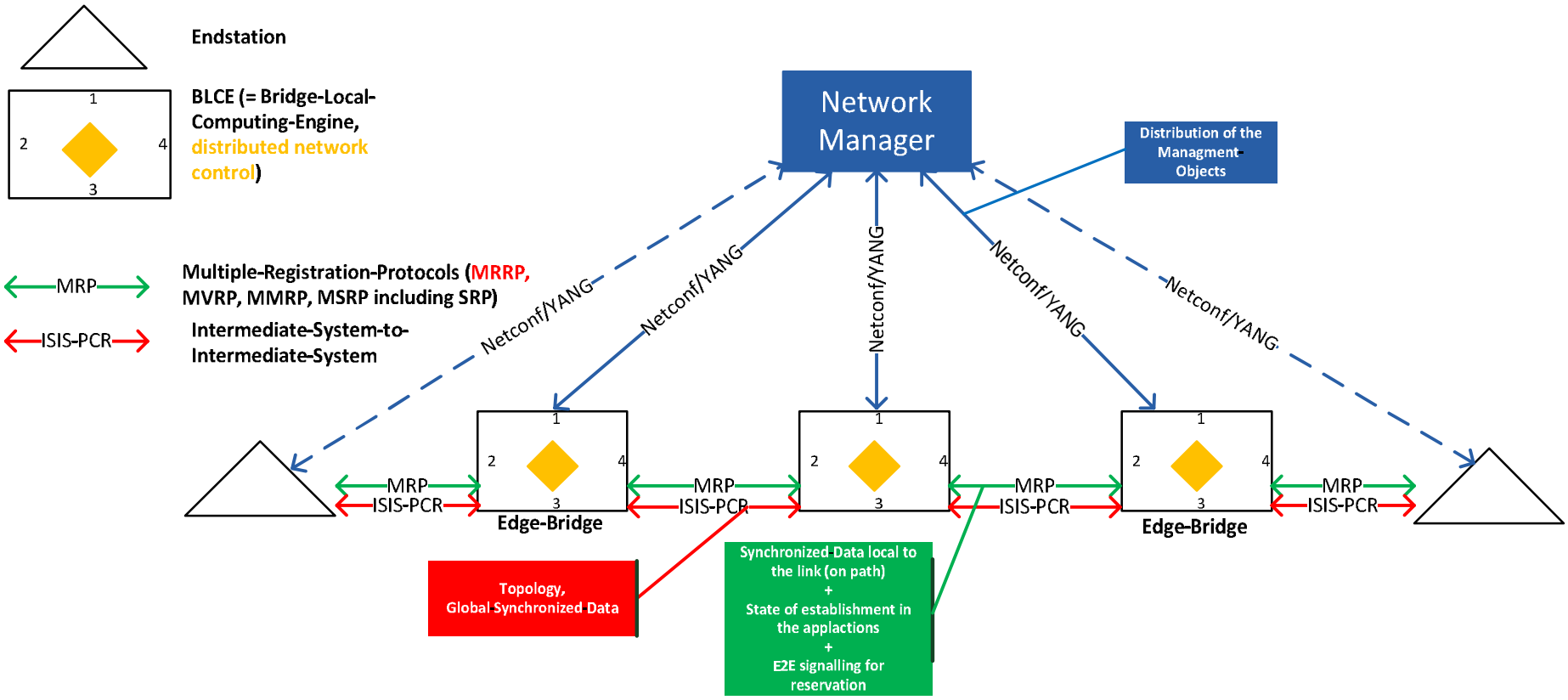
BUT in TSN we need mechanisms that allow Stream Reservation class (SR class) parameters to be configured because TSN has introduced new shaper, pre-emption, CT, … (in comparison to AVB we have predefined traffic classes)

- part of the .1QCC PAR
  Managed Objects are required to configure traffic classes for a time sensitive network

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

SIEMENS

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



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

SIEMENS

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

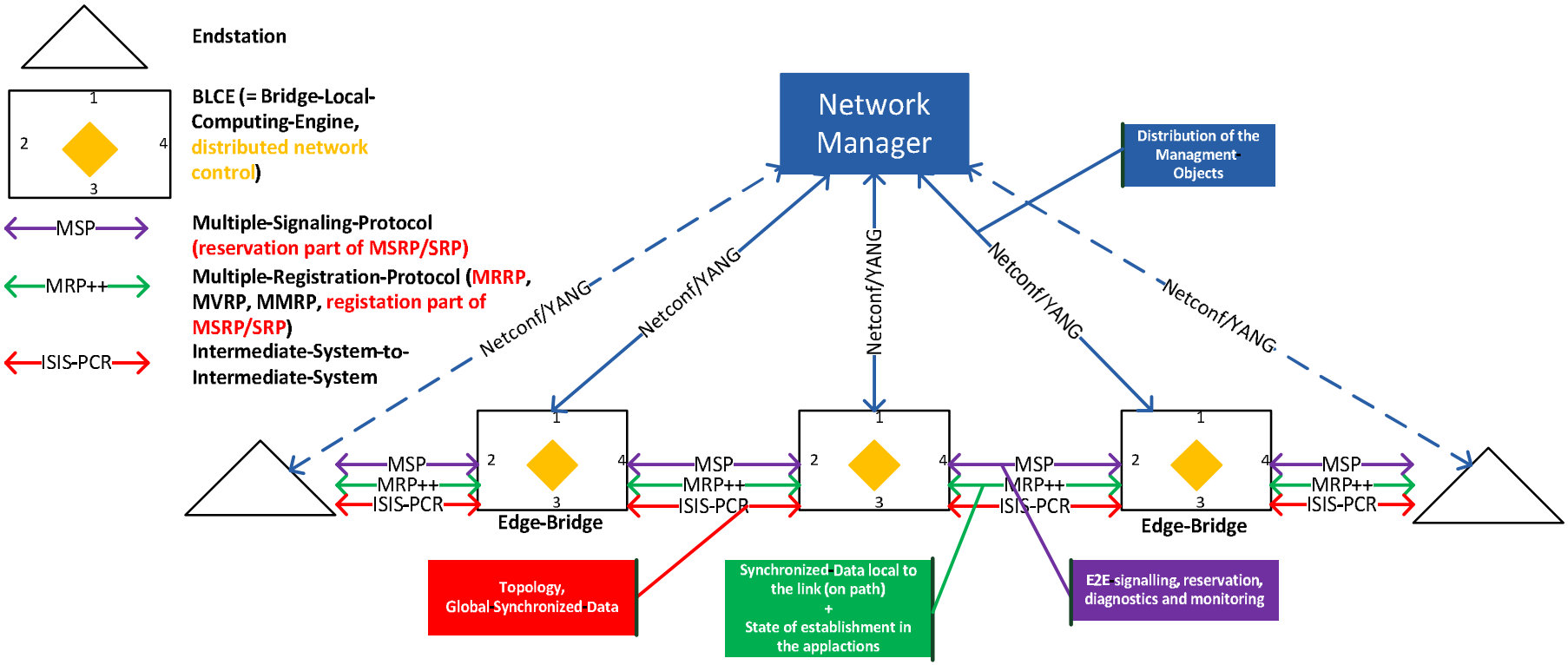
- *Support for more streams. The current worst case limit is less than 500 streams; there are use cases hat require two orders of magnitude greater than this.*
- *Inclusion of additional parameters and mechanisms in the stream reservation protocol that support additional applications, such as higher 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) we are continuing overloading MRP *(more MRP PDU's, more applications,…)*

Proposal:
Splitting Registration and Reservation into MRP++ for registration and MSP for reservation (more details see pages 20 … 24)

Decentralized controlled Network with Path Computation, Registration & Reservation

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



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

SIEMENS

BUT

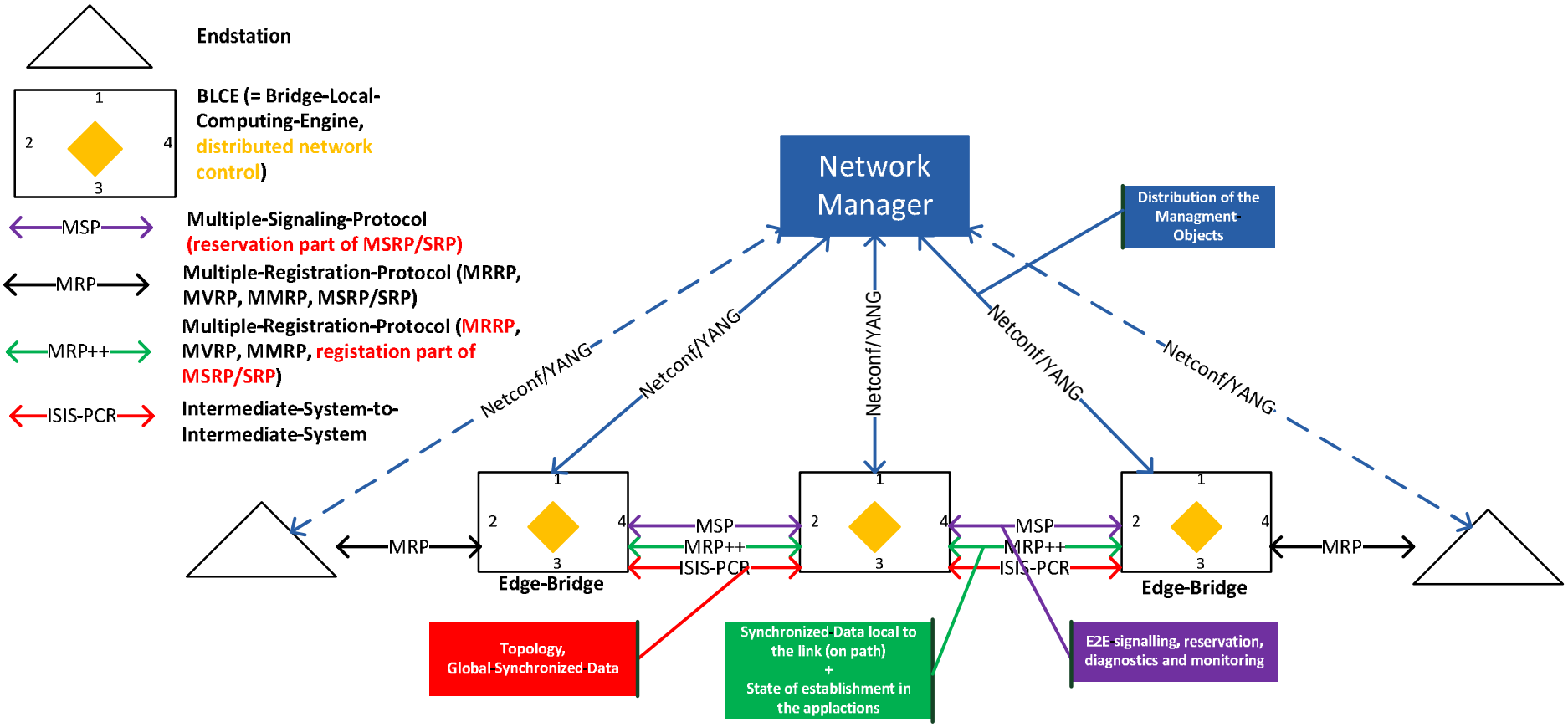
we have to be compatible to the current version of MRP (MRRP, MVRP, MMRP, MSRP/SRP)

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 (for TSN to support redundancy)



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

SIEMENS

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:

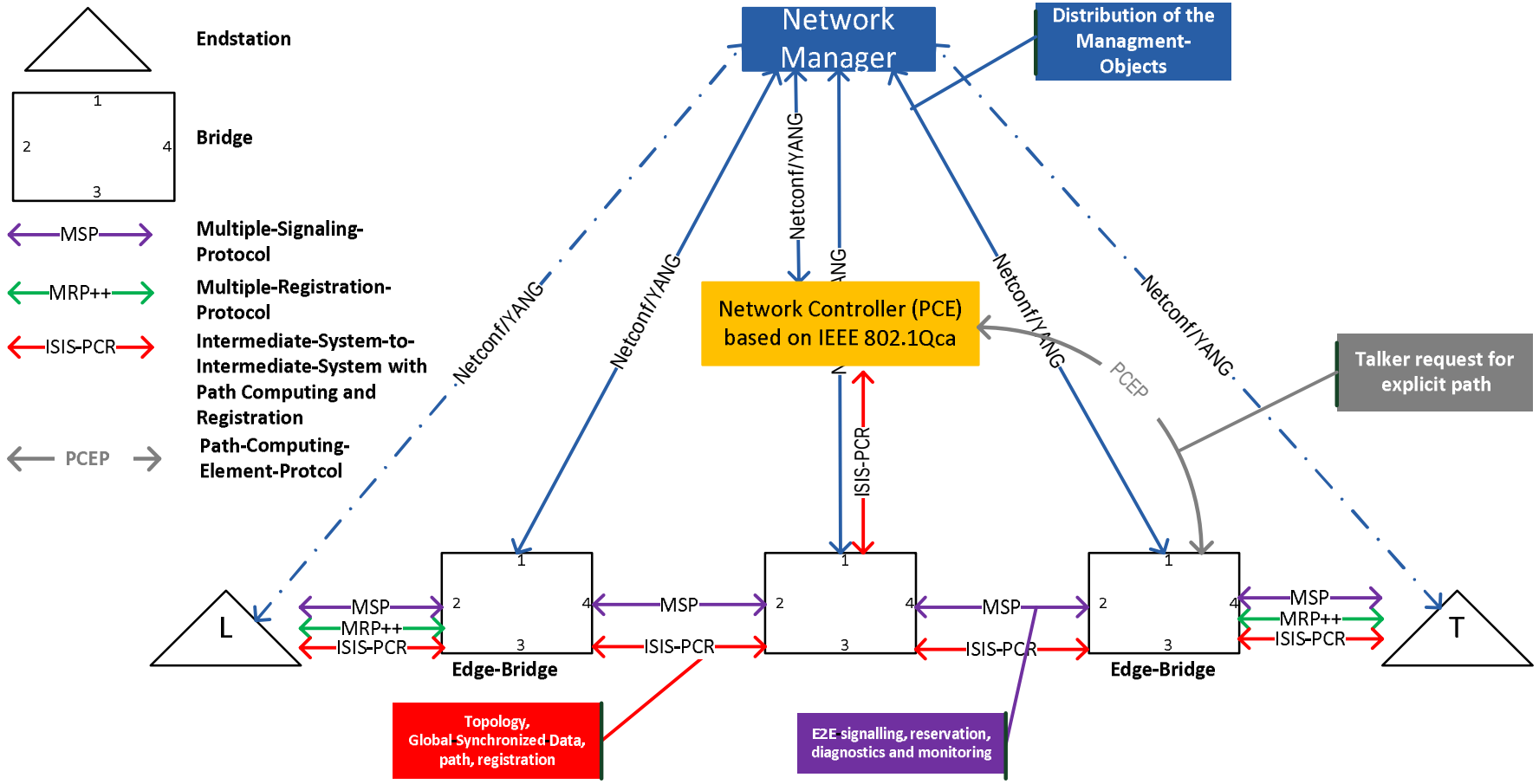
- Using PCEP (Path-Computing-Element-Protocol specified in IETF) to
  - request / response for path-computing

- Using ISIS-PCR to distribute
  - Stream specification
  - and the path for a Stream path

- Using MSP for Stream reservation (E2E signaling)

Centralized controlled Network with Path Computation, Registration & Reservation

SIEMENS



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

SIEMENS

BUT

to support SCHEDULING (TAS- time-aware-shaper) we have to introduce the new SCHEDULING-Function into PCE's and (if necessary) we have to expand the current version of PCEP to PCEP++.

Proposal:

- Using PCEP++ to
  - request / response for path-computing and for scheduling the stream

- Using ISIS-PCR to distribute
  - Stream specification
  - and the path for a Stream path

- Specifying a protocol (must be discussed) for distributing the window size for each scheduled traffic class and also distributing the information like which streams are scheduled

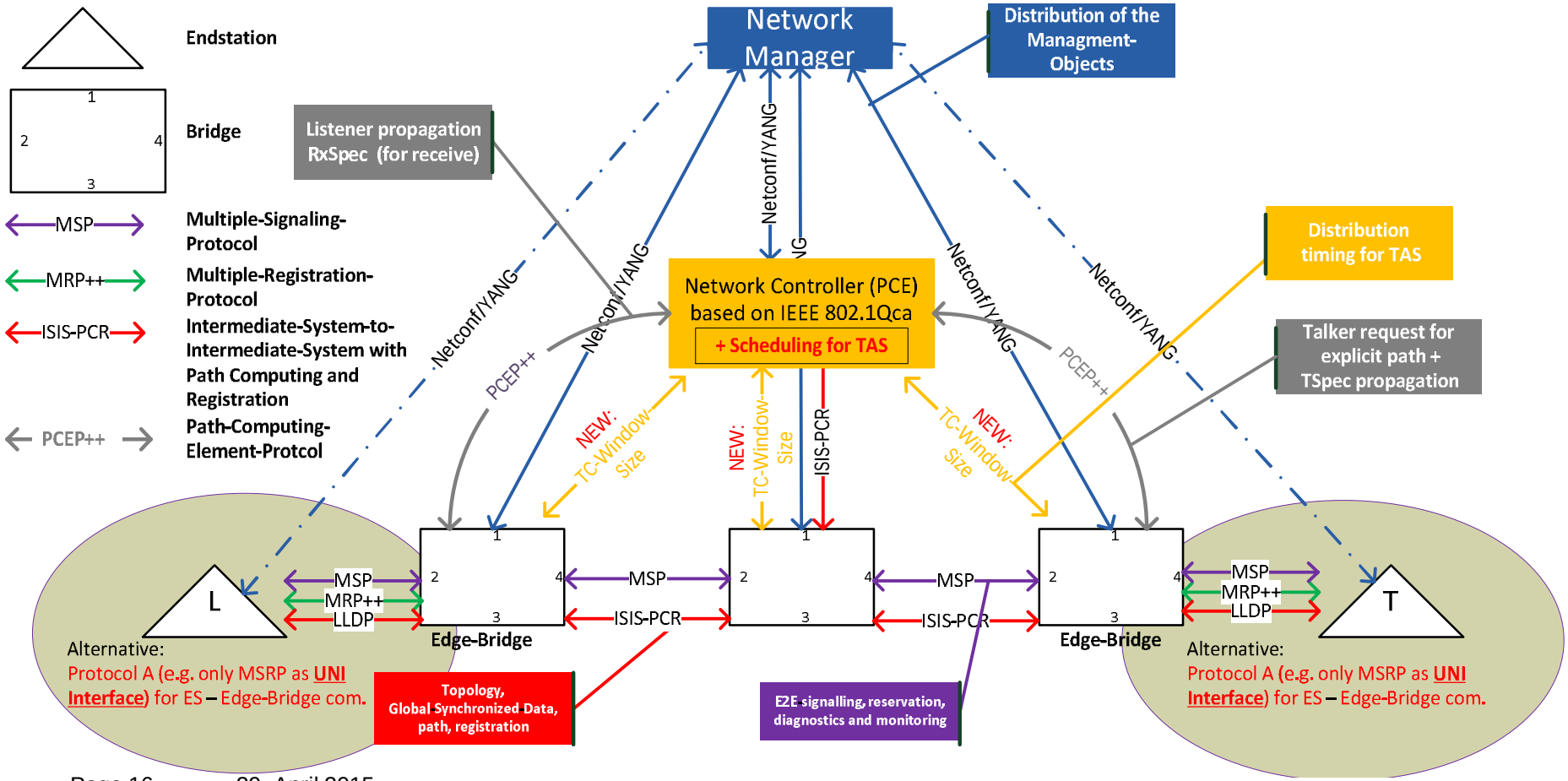
- Using MSP for Stream reservation (also looking that the Stream is scheduled)

Centralized controlled Network with Path Computation, Registration & Reservation

SIEMENS

2b. NEW: Centralized Network *based on .1Qca* + *Scheduling* / Distributed User Model

Question: - Is MSP for e2e signaling required? "YES"
- Is PCEP++ for Layer 2 in scope?
- Is the Scheduling protocol in scope?



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

SIEMENS

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

Proposals for new PARs (1)

Today:

MRP – Multiple Registration Protocol
(framework for all MPR applications (e.g. MVRP, MMRP, ...) to register network attributes)

- **MRRP – Multiple Relation Registration Protocol**
  (used to register relation ID's and to nail down the path in combination with BLCE's)
- **MVRP – Multiple VLAN Registration Protocol**
  (used to register VID's – e.g. data plane for Streams)
- **MMRP – Multiple MAC Registration Protocol**
  (used to register MAC addresses or "Group Filtering Behavior")
- **MSRP – Multiple Stream Reservation Protocol**
  (used to register streams and make the reservation)

PAR- Proposal for .1Qcc

PAR 1: New definition of .1Qcc

- Maintenance for the existing MSRP protocol to support the new TSN features (+ Managed Objects - not clear for the editor of the proposal)

PAR- Proposals for MRP++ and MSP

PAR 2: MRP++

- **MRRP – Multiple Relation Registration application**
  (used to register relation ID's and to nail down the path in combination with BLCE's)
- **MVRP – Multiple VLAN Registration application**
  (used to register VID's – e.g. VID used for Streams)
- **MMRP – Multiple MAC Registration application**
  (used to register "Group Filtering Behavior" or to register MAC addresses)
- **MSRP – Multiple Stream Registration application**
  (used to register (no reservation) streams)

MRP++ - Multiple Registration Protocol
(Transport protocol for all MPR applications to register network attributes)

PAR 3: MSP

- **MSSP – Multiple Stream Signalling application**
  (used to Do stream reservation)
- **MRSP – Multiple Rate Constrained Traffic Signalling application**
  (used for service reservation – also required for a converged network like TSN)

MSP - Multiple Signalling Protocol (related to RSVP)
(Transport protocol for all MSP applications to do reservations)

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

SIEMENS

END!

This presentation set is just a proposal to

- improve performance or registration and reservation,
- increase supported number of streams,
- support scheduled traffic classes,
- support the new TSN features (like (seamless) redundancy, reduced latency, configurable traffic classes, …)
- improve performance of services (e.g. synchronization over redundant path),
- improve the interoperability (to .1Qca, RSVP specified in IETF, …)
- improve the interoperability (to .1Qca, PCE and PCEP specified in IETF, …)

and to make progress in the IEEE TSN project especially in .1Qcc project.

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

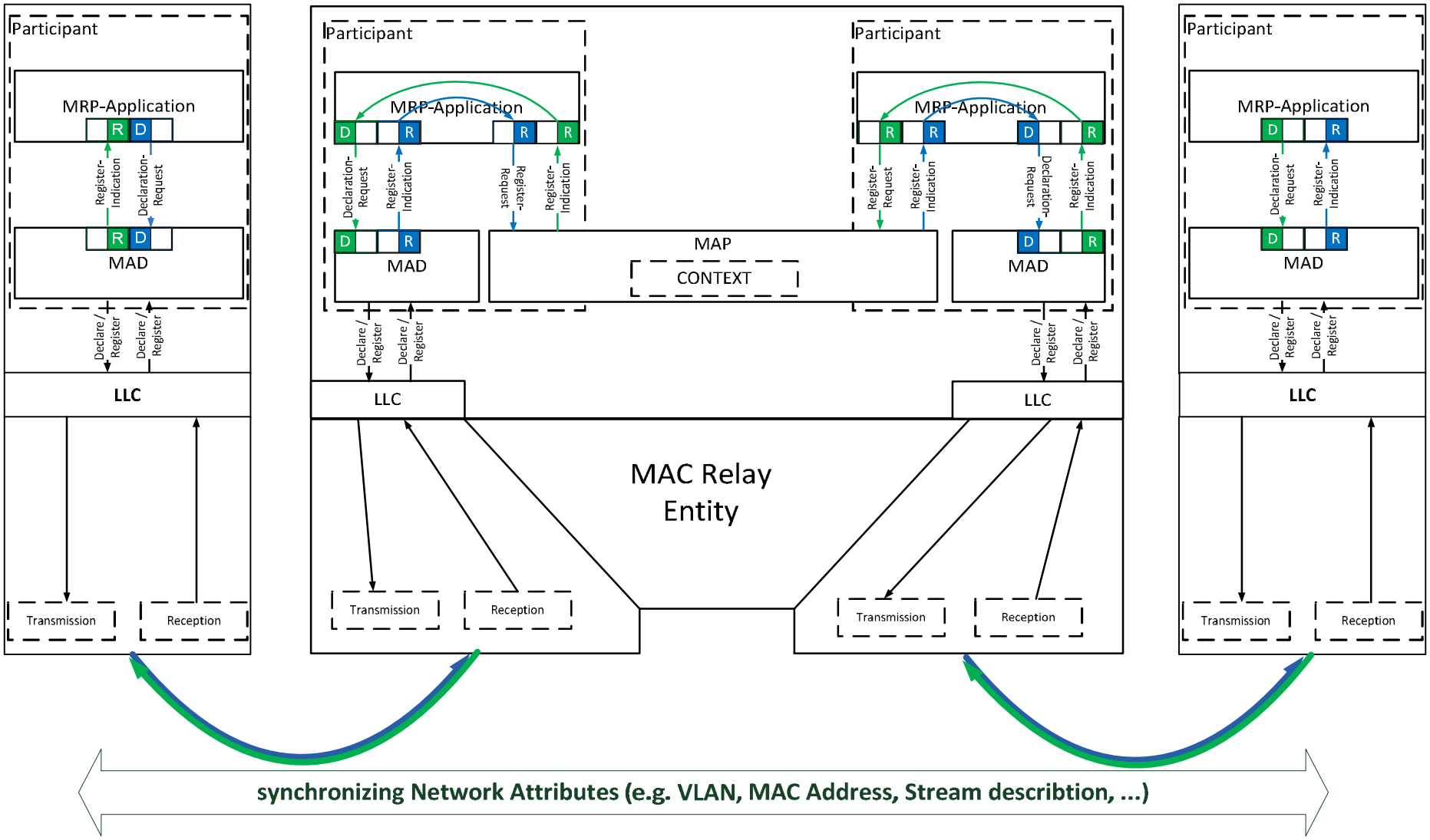
SIEMENS

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	

MRP++ Architecture

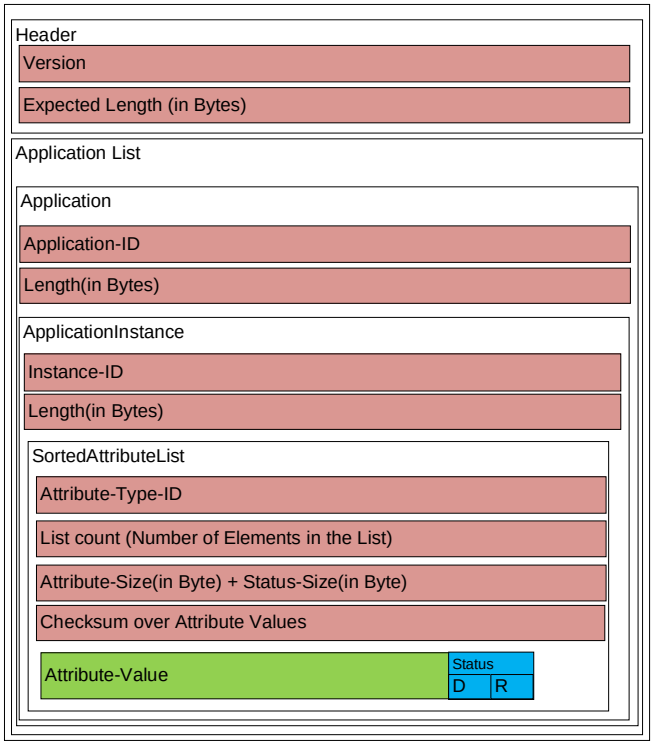


MRP++ States

State	R	D	Action	Discription
Empty	0	0	delete	No Attribute
Declared	0	1	---	Declare / annouce a "New Attribute"
Registered	1	0		"New Attribute" registered
Established (Registered & Declared)	1	1	ready	"Attribute" registered and declared

MRP++ Frame Format

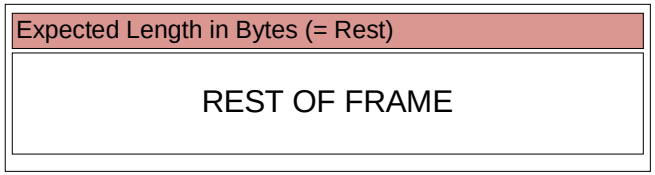
Frame:



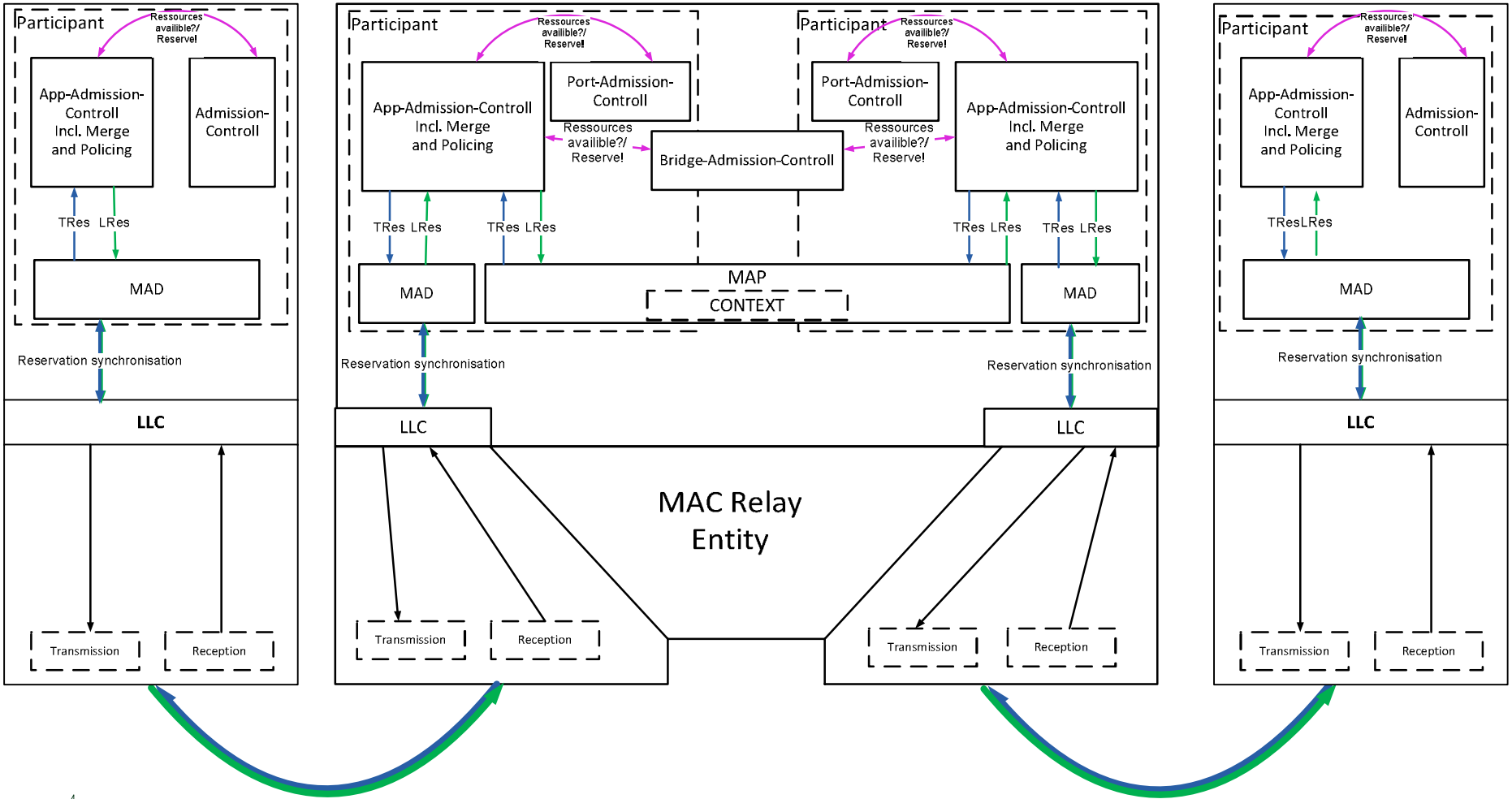
MRP-PDU	→ Header, ApplicationList
Header	→ Version, ExpectedLength
Version	→ UINT8
ExpectedLength	→ Length
Length	→ UINT16
ApplicationList	→ Application*
Application	→ ***ApplicationId***,Length,ApplicationInstance*
ApplicationId	→ ID
ID	-> UINT8
ApplicationInstance	→ InstanceID,Length,SortedAttributeList*
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:



MSP Architecture



(Just for interest)
Proposals for other new PARs

SIEMENS

Other PAR-Proposals

PAR 4: „device level“ YANG modules

- „This specifies YANG modules for 802.1Q Clause 12. This is the bottom level YANG (per bridge).“

PAR 5: „service level“ YANG modules

- This is high level YANG (topology-wide)
- There is an IETF I-D on this topic:
  https://datatracker.ietf.org/doc/draft-clemm-i2rs-yang-network-topo
  If we assume this I-D will proceed to RFC, 802.1's role would be to specify an "augment" to this module for 802.1Q bridges. The augment should connect the top-level to the bottom-level.

Thank you for your attention!

Franz-Josef Goetz

PD TI ATS TM 4 2

Gleiwitzer Str. 555

90475 Nürnberg

Phone: +49 (911) 895-3455

E-Mail: franz-josef.goetz@siemens.com