802.1DD Architecture

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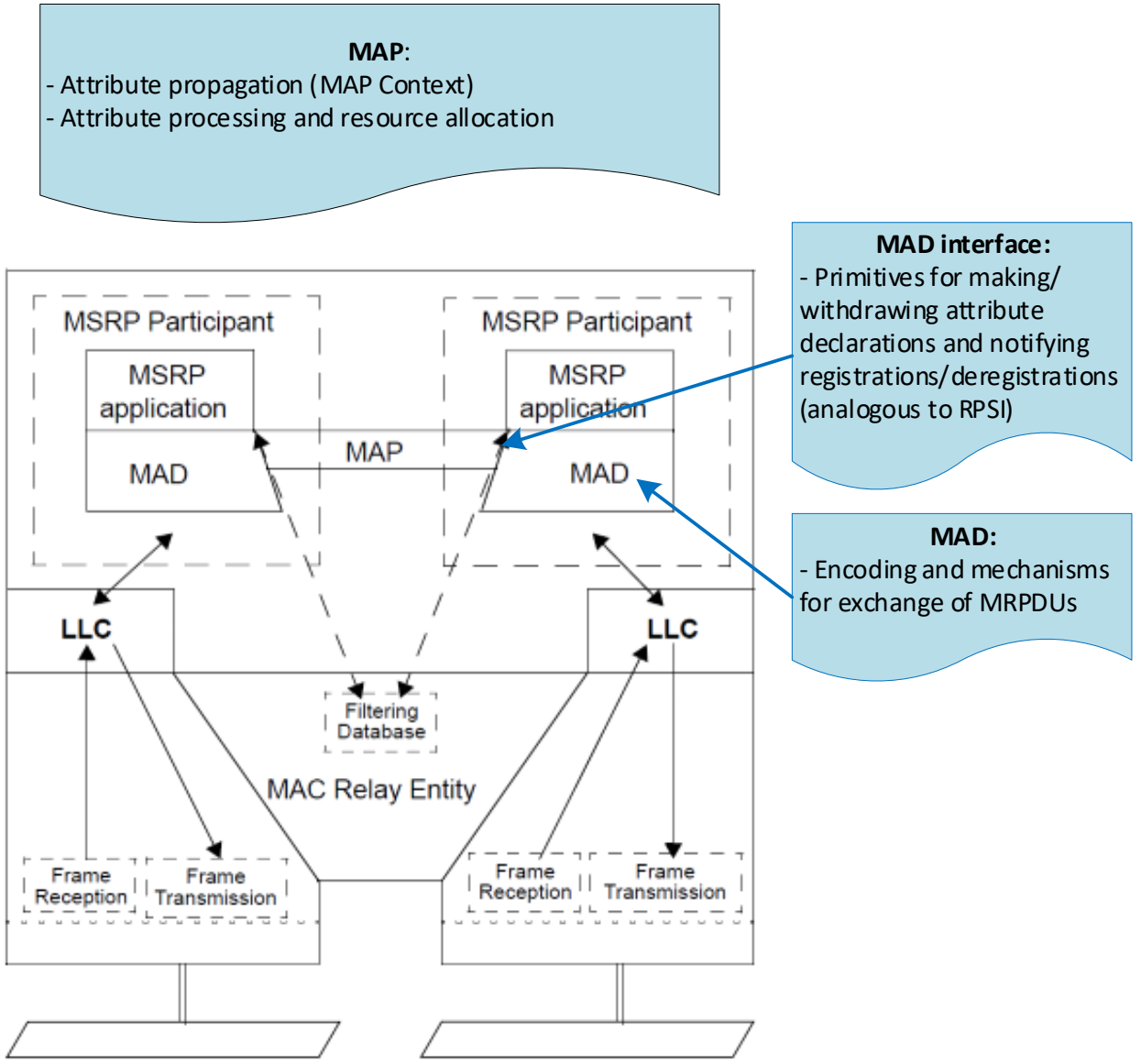
v01

Recap

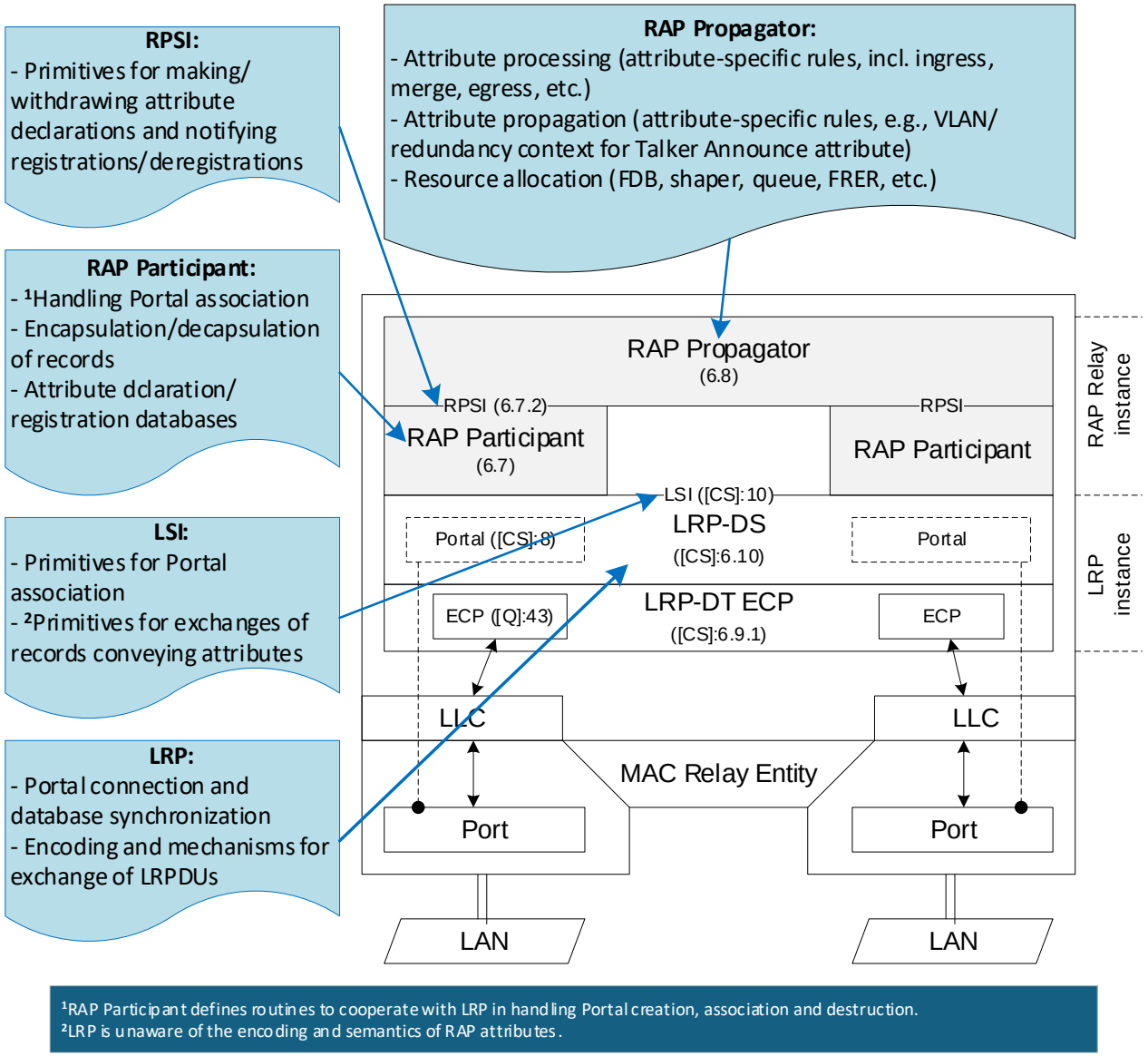
History of Stream Reservation in IEEE 802.1 (P802.1DD)

- First approach was SRP
  - SRP was developed for AVB
- To accelerate progress it was decided to use MRP as base for SRP
  - => MSRP + MMRP + MVRP in 802.1Q
- Extended functionalities like TAS (Qcc project) were added
- 802.1Qcc project
  - Focus only on centralized stream management (MSRPv1 only on first link)
  - Further features have been postponed to a future release of MSRPv2 which became LRP/RAP
    - Larger amount of streams
    - Redundancy (with reservation on already established paths
    - Larger streams (e.g. more parameters depending on shapers)
    - Proxy concept for centralized stream configuration (see Norman Finn‘s presentation: https://www.ieee802.org/1/files/public/docs2018/dd-finn-RAP-LRP-MSRP-Qcc-0918-v03.pdf)
- LRP project (802.1CS) for enhancing performance and introducing proxy concept
- RAP project (P802.1Qdd) for stream reservation as LRP application
- RAP removed from 802.1Q to be developed as a standalone standard P802.1DD (equivalent to 802.1CS)

MSRP Architecture



Current RAP Architecture



Industrial Requirements

- Industrial usecases
  - Number of Streams (>1k)
  - Fast stream establishment (MRP is a “slow protocol”)
- To fulfill these usecases, a new protocol was required

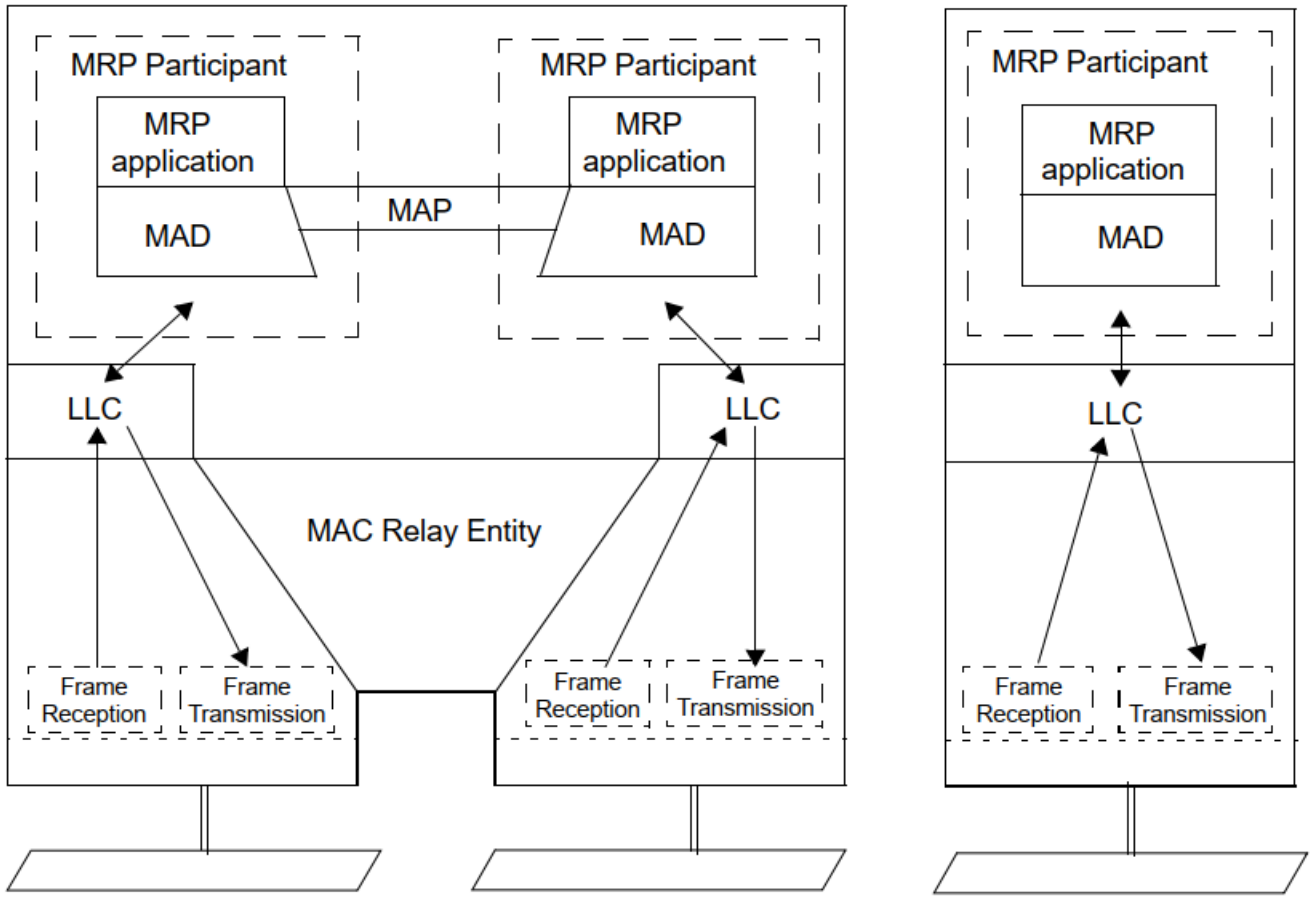
802.1CS - LRP was developed to enable the industrial requirements

Summary

- As for providing link-local transport services for exchanging attributes of a stream reservation protocol, the combination of RAP Participant and LRP is **comparable** to MAD, but they use **different mechanisms**.
- LRP was developed driven by RAP to fulfill the industrial requirements for smart manufacturing (Industrie 4.0)

Functionality

Question: Why not replace MAD with LRP?



Why LRP is not a drop-in replacement for MAD (1)

- MAD has an attribute-based interface, LRP has a data-record-based interface
- MAD is a single application interface, LRP provides a multiple application interface
- LRP has a session-oriented concept, MAD does not

Why LRP is not a drop-in replacement for MAD (2)

- Functionality provided by MRP would be no longer present
  - Q-2020 Clause 10.2 states:
    - The MAD component executes MRP (10.6, 10.7), generating MRP messages for transmission and
  - Q-2020 Clause 10.7:

10.7 Protocol specification

The operation of MRP as executed by the MRP Attribute Declaration (MAD, 10.2) component of an MRP Participant is represented by the following state machines:

a) A per-Attribute Applicant state machine (10.7.7)
b) A per-Attribute Registrar state machine (10.7.8)
c) A LeaveAll state machine for the Participant as a whole (10.7.9)
d) A PeriodicTransmission state machine for the Participant as a whole (10.7.10)

Functionalities provided by LRP/RAP that are not available with MRP/MSRP

- Additional functionality (necessary for smart manufacturing / Industrie 4.0) added
  - Larger amount of Streams
  - Redundant streams
  - RA-classes for additional shapers
  - Proxy-support

Detailed view at location of functionality

Functionality	LRP	RAP		MAD	MSRP w/o MAD
Attribute encoding	- [1)]	X		-	X [6)]
Attribute state machines	-	X		X [9)]	-
Attribute transmission	X [1)]	-		X [9)]	-
Attribute to port mapping	- [4)]	X		X [5)]	-
Attribute database	-	X		X	-
Attribute propagation	-	X		-	MAP [8)]
Attribute processing	-	X		-	X
Database consistency *7	X	-		X	-
incoming attr cleanup (on disconnect)	- [2)]	X		X [3) 9)]	-
outgoing attr cleanup (on disconnect)	-	X		-	X
Resource allocation	-	X		-	X

[1)] LRP knows only data-records
[2)] LRP (only) notifies about portal disconnect
[3)] MRP provides per attribute events
[4)] LRP data-records are bound to a portal, connection between portal and port is int responsibility of the RAP Application
[5)] MRP attributes are created port specific
[6)] Base PDU encoding is defined in MRP
[7)] LRP uses a checksum-based approach to ensure consistency while MRP uses cyclic retransmissions. Of course, there are differences in quantity but in the end both provide some sort of consistency.
[8)] MAP is defined in MRP but claims to be application specific
[9)] MAD component of MRP

Combination of LRP with MSRP w/o MAD

Functionality	LRP	MSRP w/o MAD	Comment
Attribute encoding	-	X	
Attribute state machines	-	-	==> MISSING
Attribute transmission	X	-	
Attribute to port mapping	-	-	==> MISSING
Attribute database	-	-	==> MISSING
Attribute propagation	-	MAP	==> partially MISSING
Database Consistency *7	X	-	
incoming attr cleanup (on disconnect)	-	-	
outgoing attr cleanup (on disconnect)	-	X	==> MISSING
Resource allocation	-	X	

Conclusion

- MAD and LRP interfaces are not identical
  - MAD is cyclic
  - LRP is event-triggered
- LRP+SRP is not enough to replace MSRP
- MSRP functionality is only a subset of RAP
  - Missing functionality must be specified above MAD level

Backward compatibility

Proposed solution for compatibility in current RAP draft

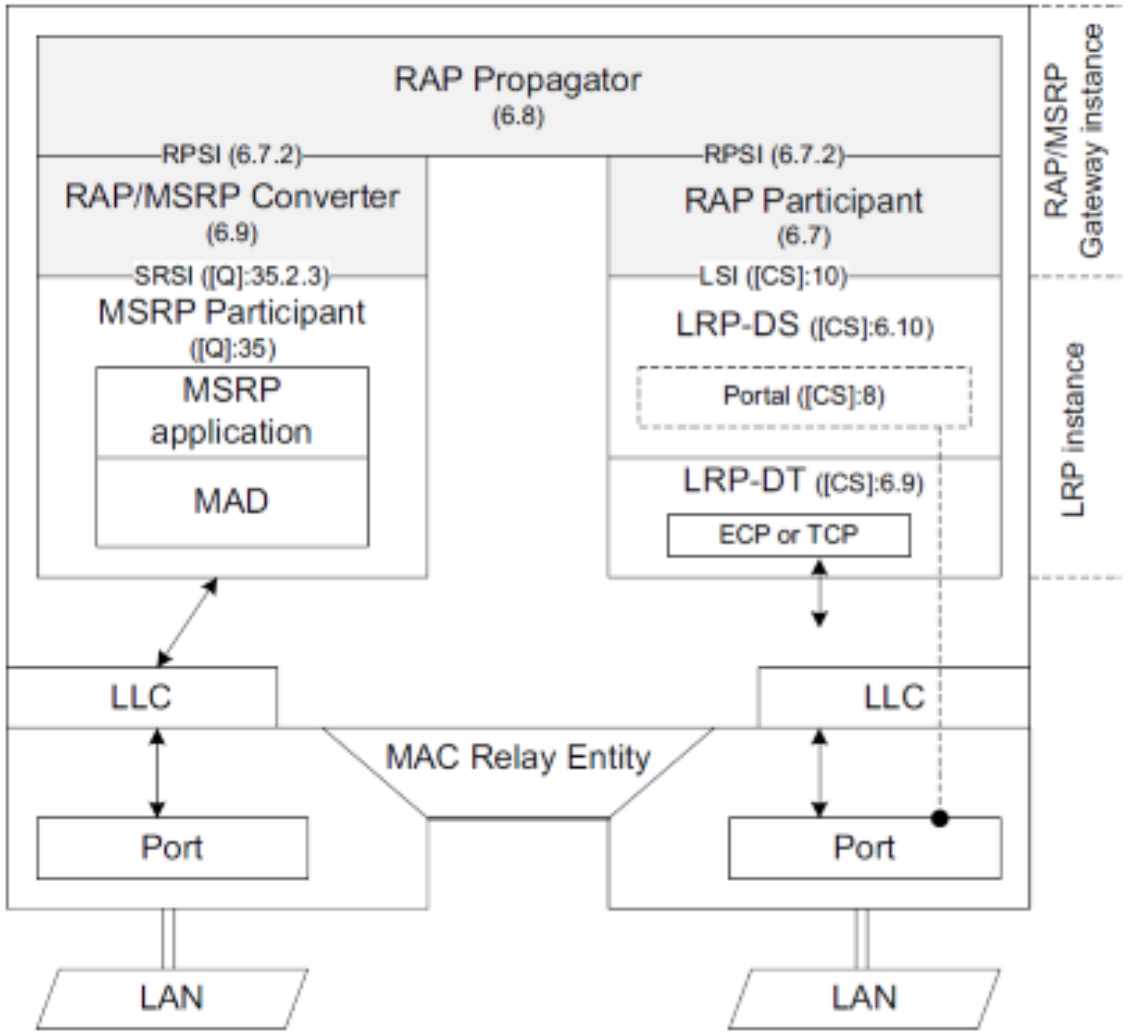


Figure 6-3—Operation of RAP in a RAP/MSRP Gateway