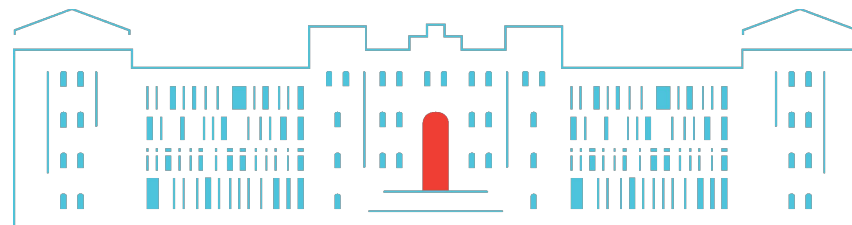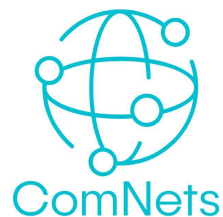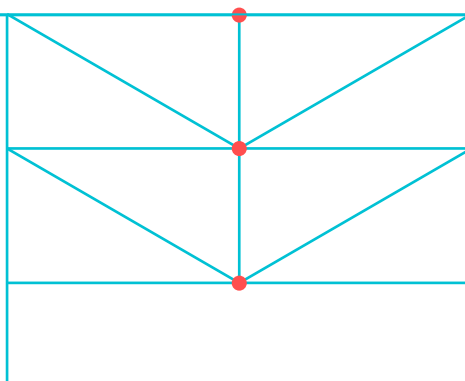# Quality of Service Extension Block to Bundle Protocol

TUHH
Technische Universität Hamburg

ComNets

TUHH
Institute of Communication Networks

Teresa Algarra Ulierte

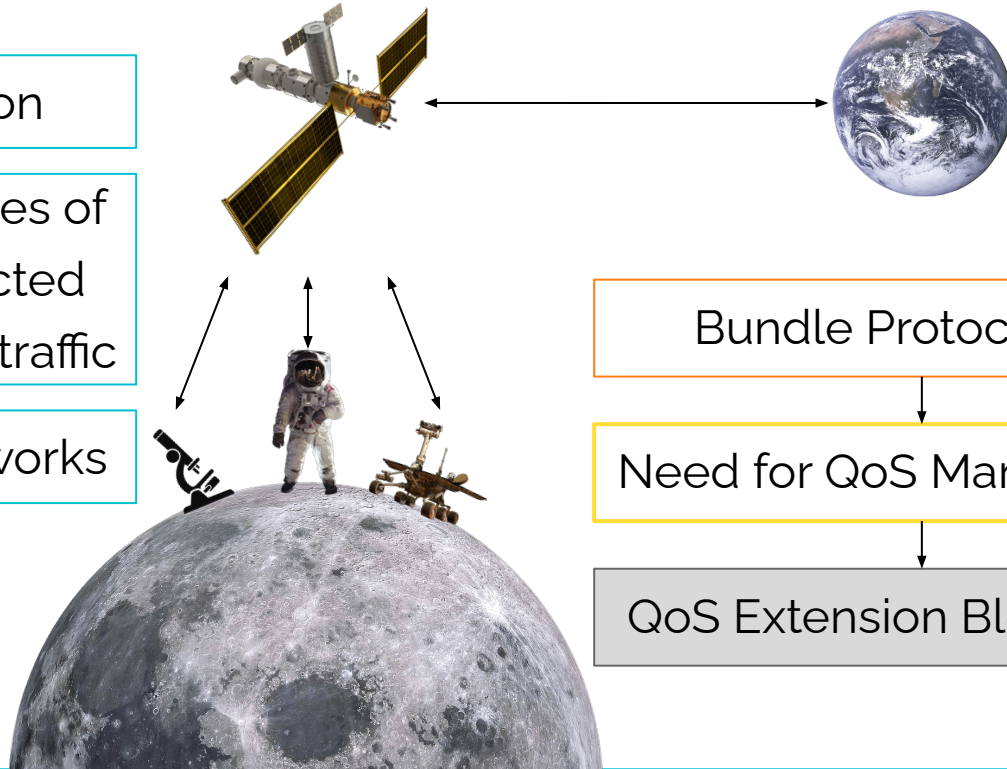Felix Flentge
Andreas Timm-Giel
Koojana Kuladinithi

07.11.2024

Earth-Moon Link Challenges

Congestion

Different types of interconnected devices and traffic
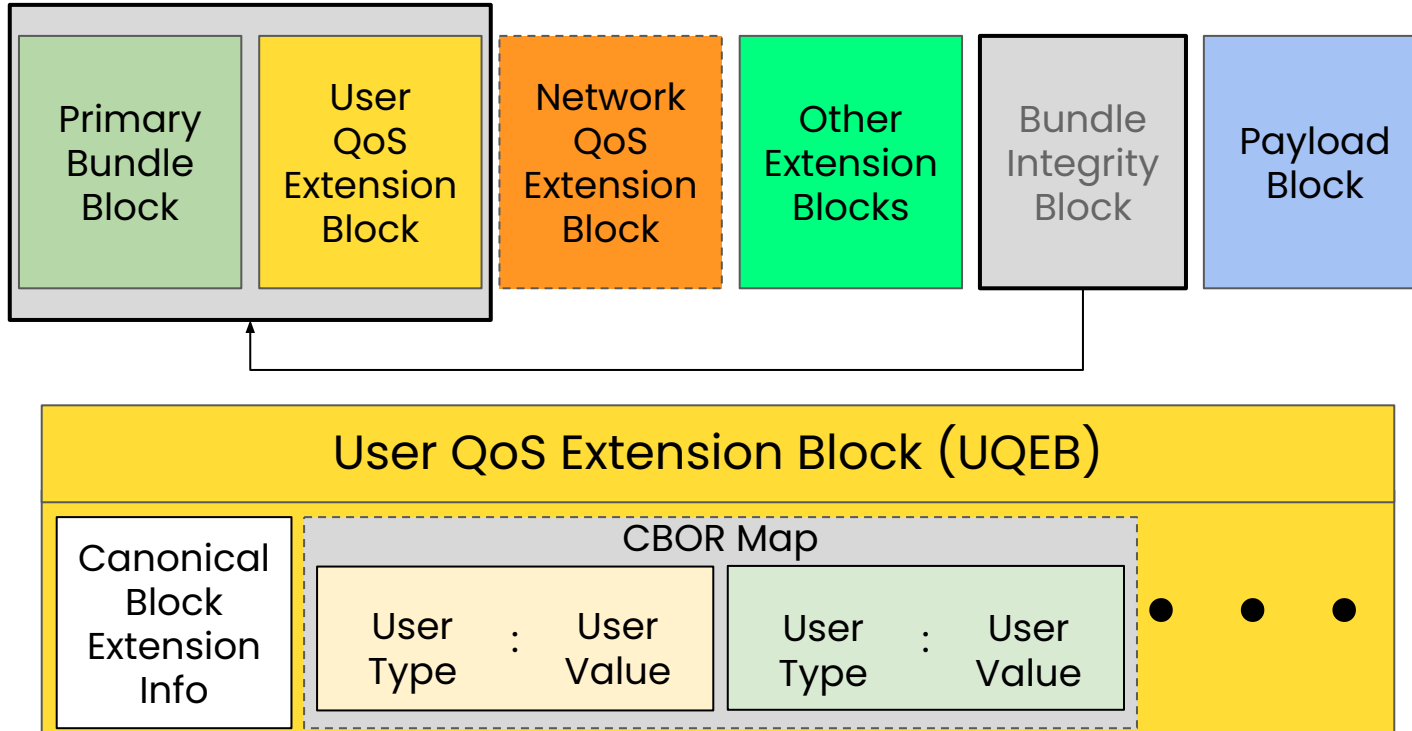
Several networks

Bundle Protocol (BP)

Need for QoS Management

QoS Extension Block to BP

QoS BP Extension Proposal

Burleigh, S., K. Fall, and E. Birrane, III. "RFC 9171: Bundle Protocol Version 7." (2022).

User QoS Extension Block
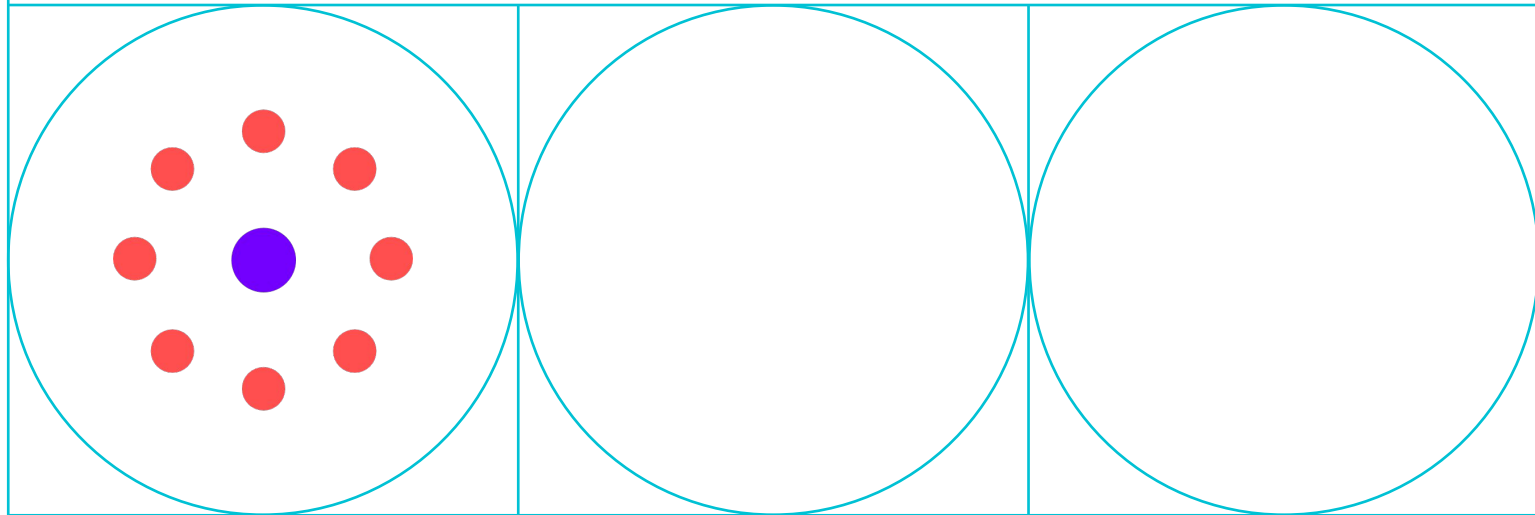
User QoS Extension Block (UQEB)

Key	Value
Traffic Prioritization	00
Required Reliability	01
Latest-Only Delivery	02
Bundle Storage	03
Reserved for Future Use	04 — 23
Unassigned	$24 - 2^{64} - 1$

For 1-Byte CBOR Tiny Field Encoding compact representation

UQEB Values

Key	Value
Traffic Prioritization	
Required Reliability	
Latest-Only Delivery	
Bundle Storage	

UQEB Values: Traffic Prioritization

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Key

Traffic Prioritization

Required Reliability

Latest-Only Delivery

Bundle Storage

Value

Information Type	Values
Critical	0
High Priority	1 – 12
Low Priority	13 – 23
Unassigned	24 – 2^64–1

Esper, Jaime. Draft LunaNet Interoperability Specification. No. NASA/TP–20210021073/Rev. 2. National Aeronautics and Space Administration, 2022.

Traffic Prioritization Workflow

No changes
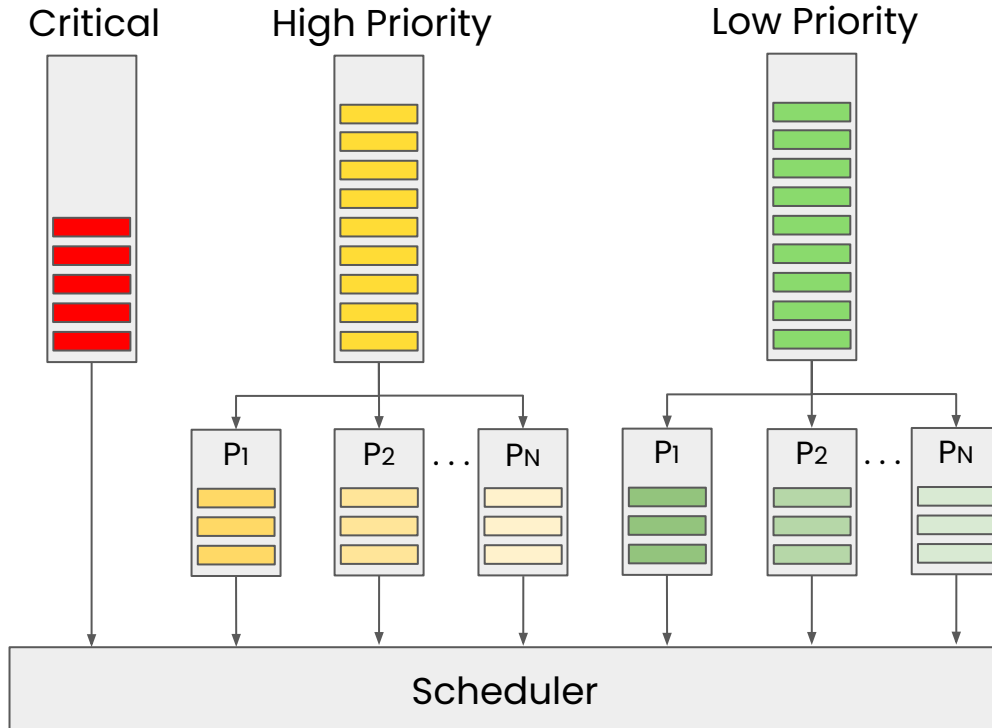
"High Priority" will only be serviced if "Critical" is empty, and "Low Priority" will only be accessed if both "Critical" and "High Priority" are empty

Weighted queueing is implemented within each type to avoid data starvation

UQEB Values: Reliability

The reliability parameter only indicates the selection or configuration of CLA with respect to ARQ capabilities that the system should have.

Key

Traffic Prioritization

Required Reliability

Latest-Only Delivery

Bundle Storage

Value

Information Type		Values
Reliable	ARQ	0
	ARQ if possible	1
	Reserved for future use	2 – 11
Unreliable	Reserved for future use	12 – 21
	No ARQ if possible	22
	No ARQ	23
Unassigned		24 – 2^64–1

UQEB Values: Latest-Only Delivery

No changes

Key

Traffic Prioritization

Required Reliability

Latest-Only Delivery

Bundle Storage

Value

Information Type	Values
All valid	0
Latest-only	1
Reserved for future use	2 – 23
Unassigned	24 – 2^64-1

Binary flag

Baumgärtner, Lars. "Dtnmqtt: A Resilient Drop-In Solution for MQTT in Challenging Network Conditions", 2024.

UQEB Values: Bundle Storage

Key

Traffic Prioritization

Required Reliability
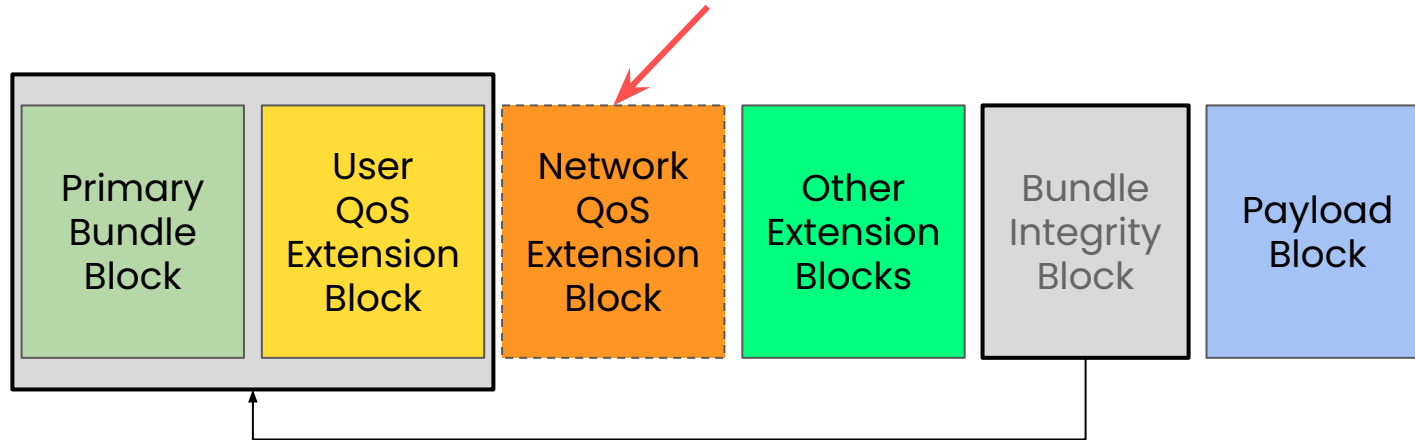
Latest-Only Delivery

Bundle Storage

Value

Information Type	Values
CLASS1	0
CLASS2	1
CLASS3	2
Reserved for future use	2 – 23
Unassigned	24 – $2^{64}-1$

If a bundle does not have a bundle storage class assigned, the class is taken as CLASS3 by default.

Baumgärtner, Lars. "Dtnmqtt: A Resilient Drop-In Solution for MQTT in Challenging Network Conditions", 2024.

Network QoS Extension Block

QoS BP Extension Proposal

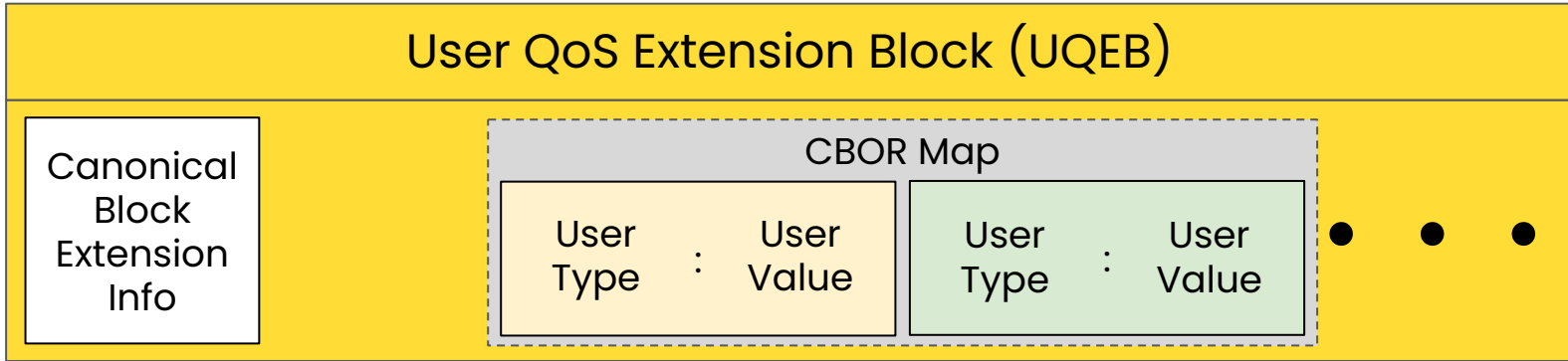| Primary Bundle Block | User QoS Extension Block | Network QoS Extension Block | Other Extension Blocks | Bundle Integrity Block | Payload Block |
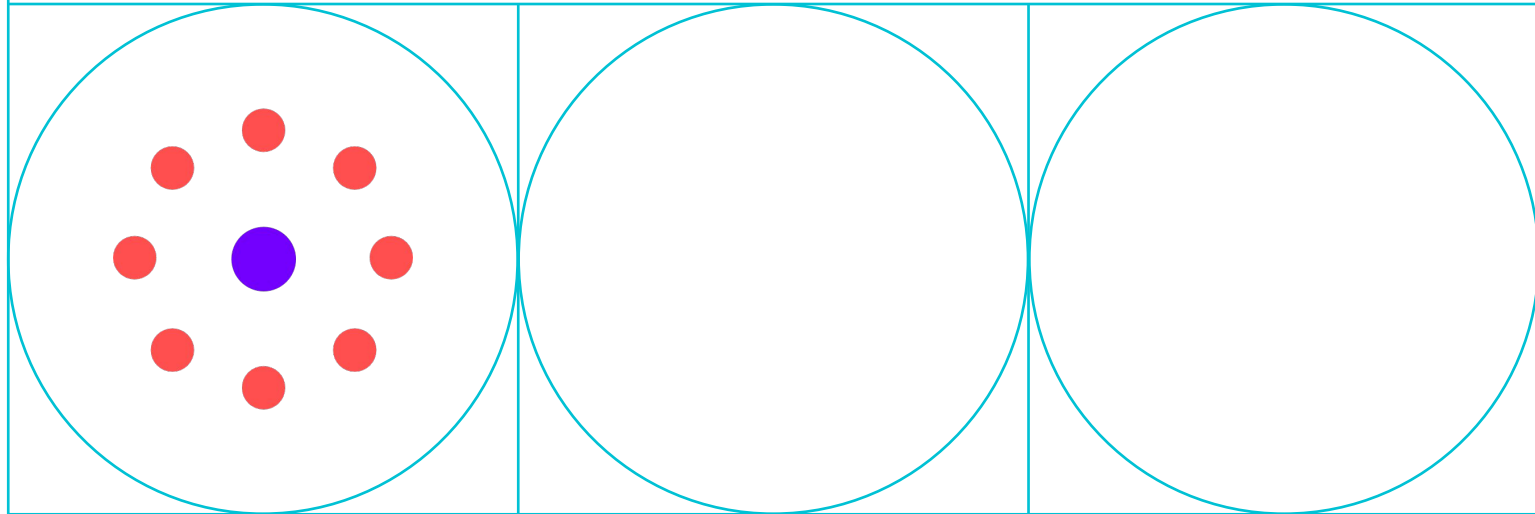
NQEB could translate UQEB into internal policy and optimize the decision process for the intermediate blocks of a network

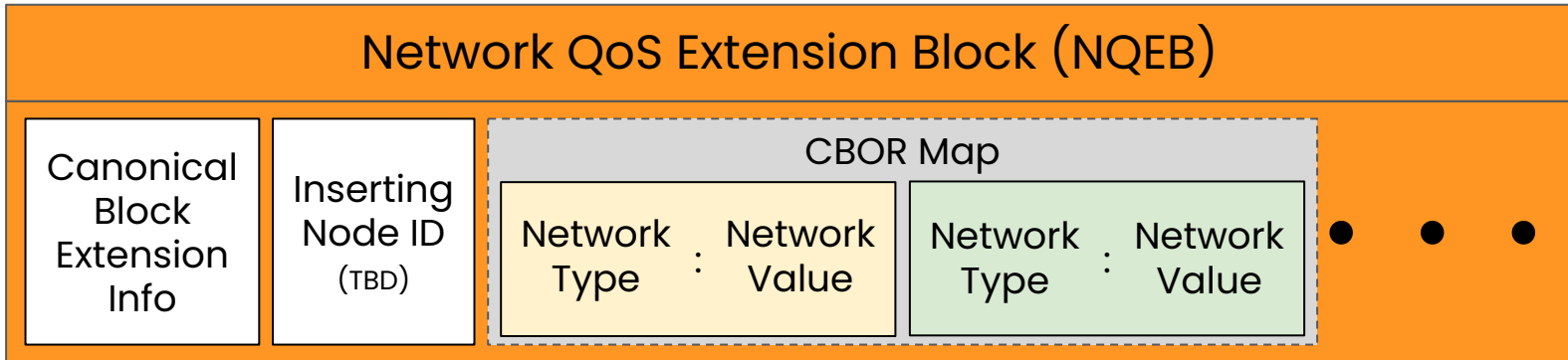All values are reserved for local use to give the individual networks maximum flexibility

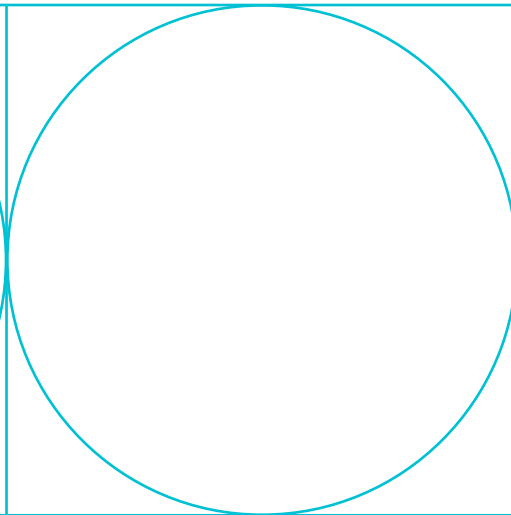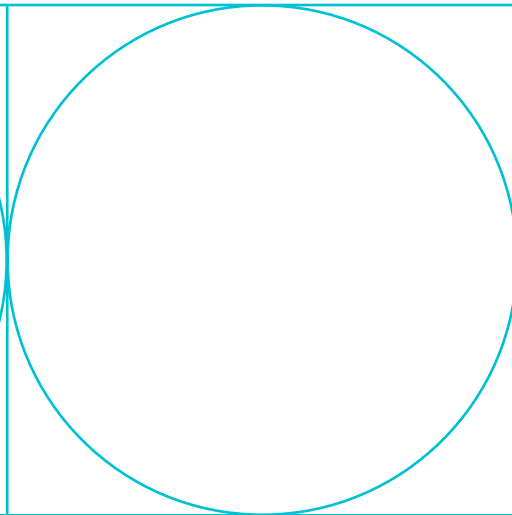Burleigh, S., K. Fall, and E. Birrane, III. "RFC 9171: Bundle Protocol Version 7." (2022).
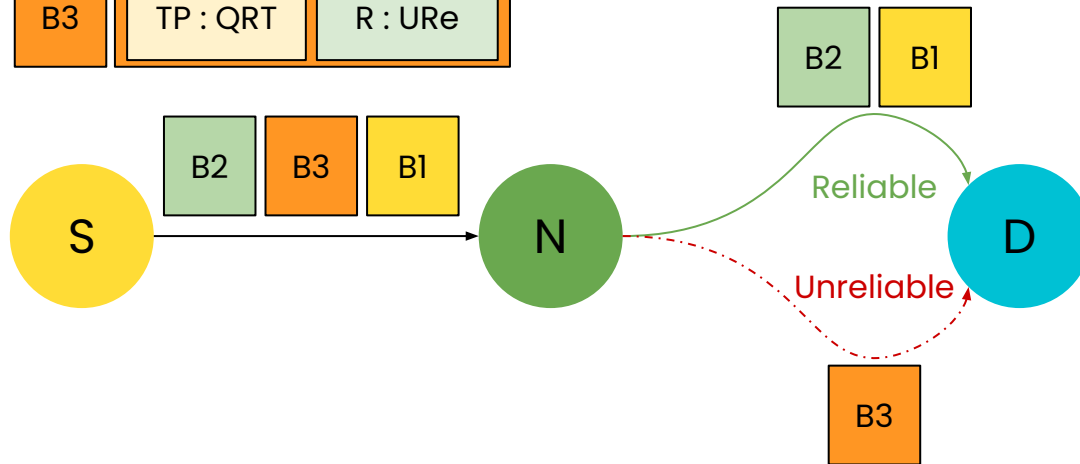
Network QoS Extension Block Design

User QoS Extension Block (UQEB)

Canonical Block Extension Info	CBOR Map		
	User Type : User Value	User Type : User Value	● ● ●

Network QoS Extension Block (NQEB)

Canonical Block Extension Info	Inserting Node ID (TBD)	CBOR Map		
		Network Type : Network Value	Network Type : Network Value	● ● ●

Burleigh, S., K. Fall, and E. Birrane, III. "RFC 9171: Bundle Protocol Version 7." (2022).

Examples

UQEB Usage Example
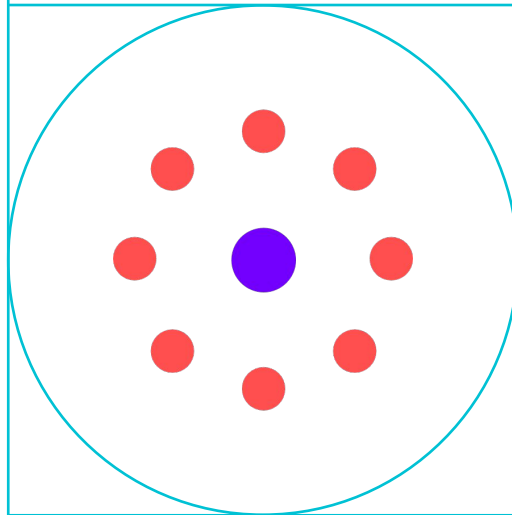
B1	TP : QRT	R : Re
B2	TP : S&F	R : Re
B3	TP : QRT	R : URe
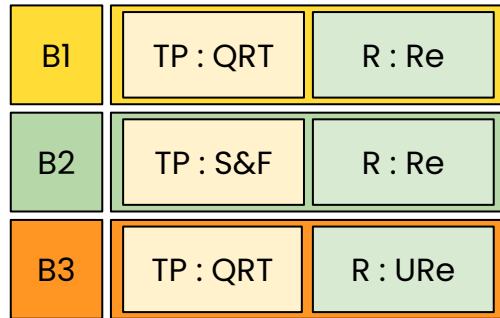
Bx	- Bundle number x
D	- Destination
N	- Node
QRT	- Quasi-Real-Time
R	- Reliability
Re	- Reliable Tranmission
S	- Source
S&F	- Store-and-Forward
TP	- Traffic Priority
URe	- Unreliable Transmission

S → [B2 B3 B1] → N

N → D (Reliable): B2 B1

N → D (Unreliable): B3

NQEB Usage Example

D - Destination
E - Entry Gateway
N_x - Network number x
NP - Network Priority
N - Node
R - Reliability
S - Source
TP - Traffic Priority
X - Exit Gateway
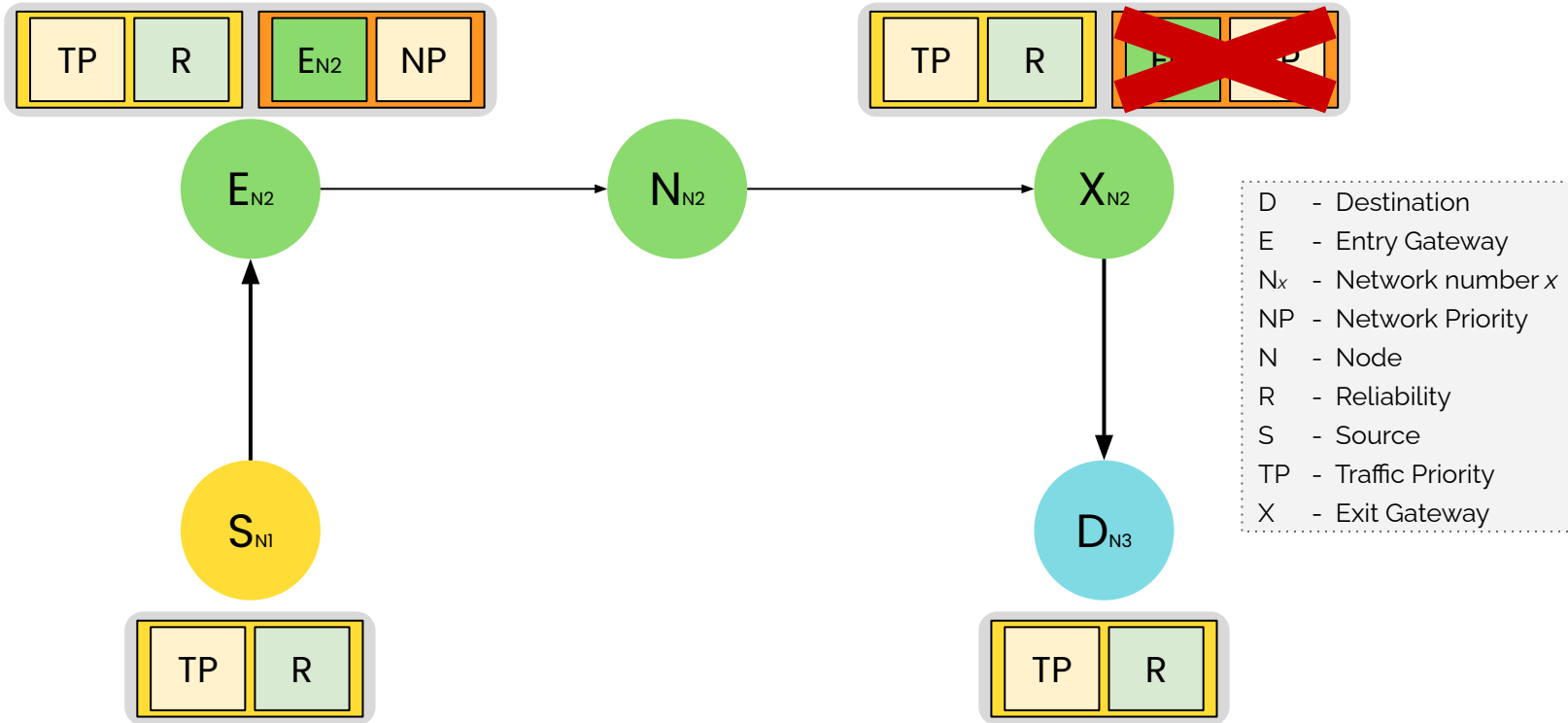
Conclusion & Next Steps
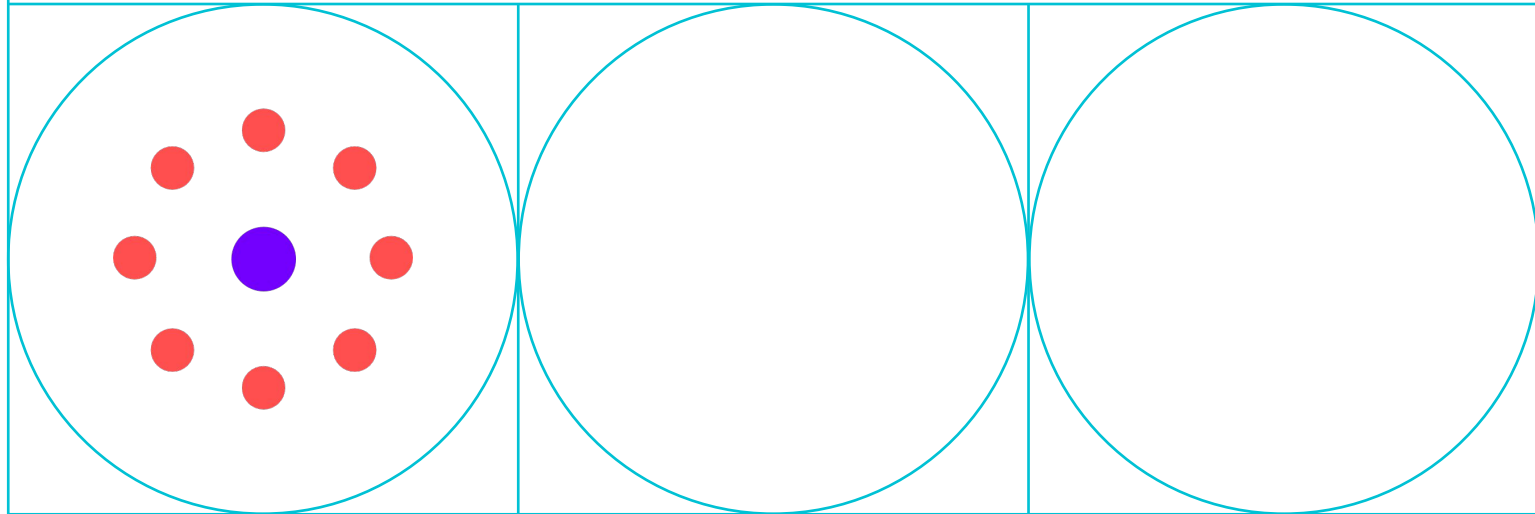
Conclusion
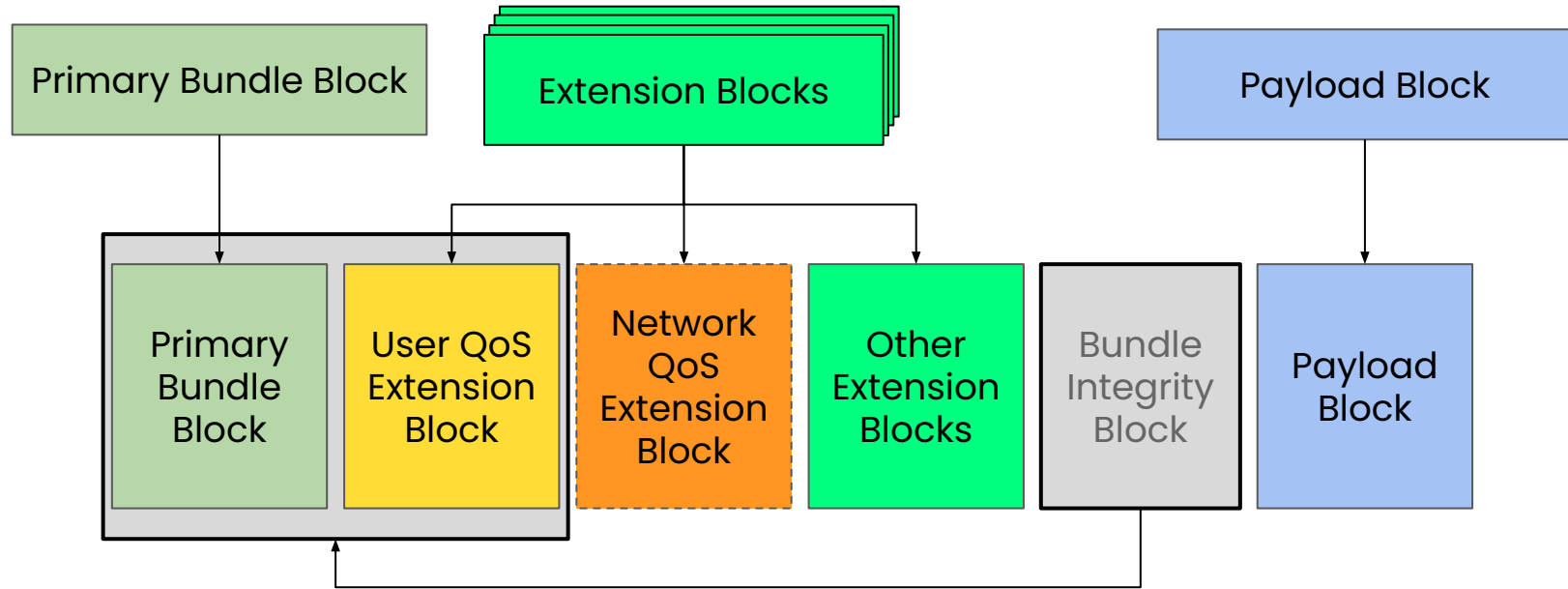
Orange Book Timeline

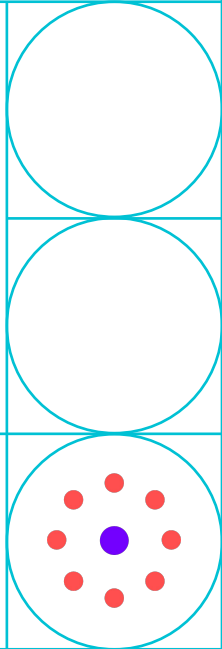| CCSDS Orange Book Schedule	
Schedule Milestones	**Original Completion Date**
Project Approved	01/03/2024
Project Start Date	01/03/2024
Internal WG Review	
First Draft Circulated to WG	15/04/2024
First Draft Comments Due	02/06/2024
Second draft circulated to WG	01/10/2024
Second Draft Comments Due	01/12/2024
Final WB Submitted to AD for Further Processing	01/02/2025
External Milestones	
Secretariat Document Processing	01/04/2025
CMC Approval	01/06/2025
Total Time to Complete (in months)	**15**

Proposed in CCSDS Autumn Meeting 2023

↓

First draft in CCSDS Spring Meeting 2024

↓

Second draft in CCSDS Autumn Meeting 2024

Questions?

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Koojana Kuladinithi (TUHH)

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Technische Universität Hamburg