Update of TSN use cases

Japan Automotive Software Platform and Architecture

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Next Generation High-Speed Network WG

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Objective

- Provide use cases to create the Automotive Profile.
  - ✓ Create use cases
  - ✓ Extract Requirements
  - ✓ Profiling

	Use cases from JASPAR (November 2019 plenary)
UC1	Connected-Car with 5G network
UC2	Functional Safety
UC3	Real-time communication
UC4	Security
UC5	In-Vehicle Traffic Types

http://www.ieee802.org/1/files/public/docs2019/dg-nomura-UseCases-1119-v02.pdf

Current Status of JASPAR Use Cases

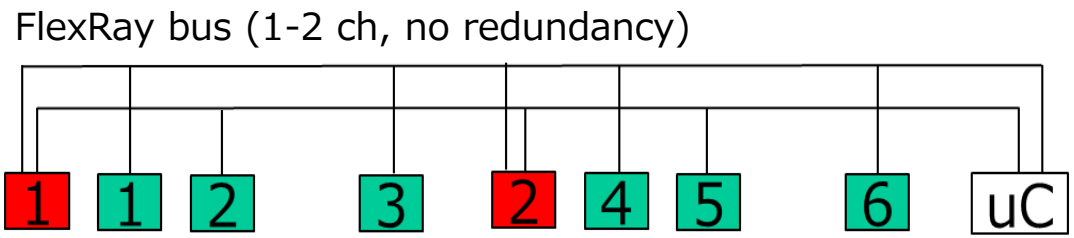
	UCs from JASPAR (Nov.2019)	Current discussion in JASPAR	Proposal for use cases
UC1	Connected-Car with 5G network	Extract requirements for in-vehicle network based on 3GPP standards	new Use case
UC2	Functional Safety	Study applicability of TSN standards to communication failure mode of ISO 26262	Additional issue to **Auto Use Cases 01/05**
UC3	Real-time communication	Study applicability of TSN standards as alternatives of FlexRay	new Use case
UC4	Security	Clarify requirements to defend from DoS/DDoS and study applicability of 802.1Qci	Additional issue to **Auto Use Case 01**
UC5	In-Vehicle Traffic Types	Clarify requirement of applications/services and relate traffic types and upper layer protocols	Additional issue to **Auto Use Case 04**
UC6		New UCs are in progress	

UC3. Requirements for real time IVN communication

To give an example, we define chief requirements for real time in-vehicle communication based on recommended applications for FlexRay.

	FTB (Fault Tolerant Bus)	RTB (Real Time Bus)	EDB (Event Driven Bus)
Characteristics	Safety-relevant communication which requires high real time property and reliability	Wide-band and reliable communication for cyclic control	Communication for plug and play and a large number of simultaneous connections
Application	Safety critical systems, such as Steer-by-wire, Brake-by-wire	High-speed integration control systems for driving, such as Engine control, ABS	Systems which require optionality but no real time property
Reliability	To prevent whole stop by primary failure (one node failure is allowable)	To provide reliability equivalent to CAN	To provide reliability equivalent to CAN
Link speed	5Mbit/s or 10Mbit/s	2.5Mbit/s or 5Mbit/s	2.5Mbit/s
Network cycle	From 1ms to 5ms	From 2ms to 10ms	From 4ms to 16ms
Payload	16Byte or 32Byte (static)	16Byte or 32Byte (static)	16Byte (static)
Number of devices	Up to 6	Up to 41	Up to 41
Startup	To guarantee Startup in case of primary failure of the bus		

Requirement specification of RTB (Real Time Bus)



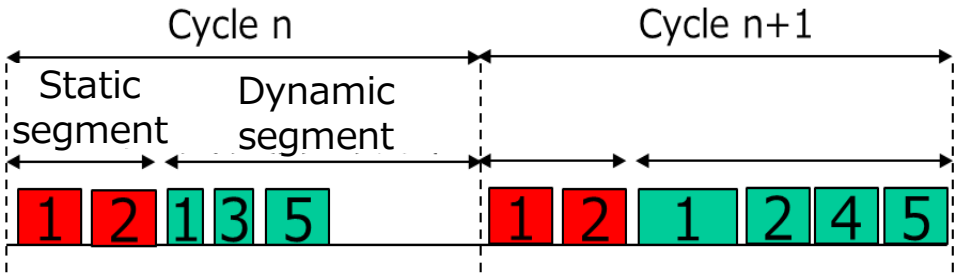
Chief requirement specification

TDMA based on the synchrony of all nodes

Communication cycle	: from 2 ms to 10 ms
Bit rate	: from 2.5 Mbit/s to 5 Mbit/s
Maximum num of devices	: 41*
Redundancy	: Startup can commence at a single failure

* Max. # of devices depends on # of channels and network topology.

TDMA in FlexRay

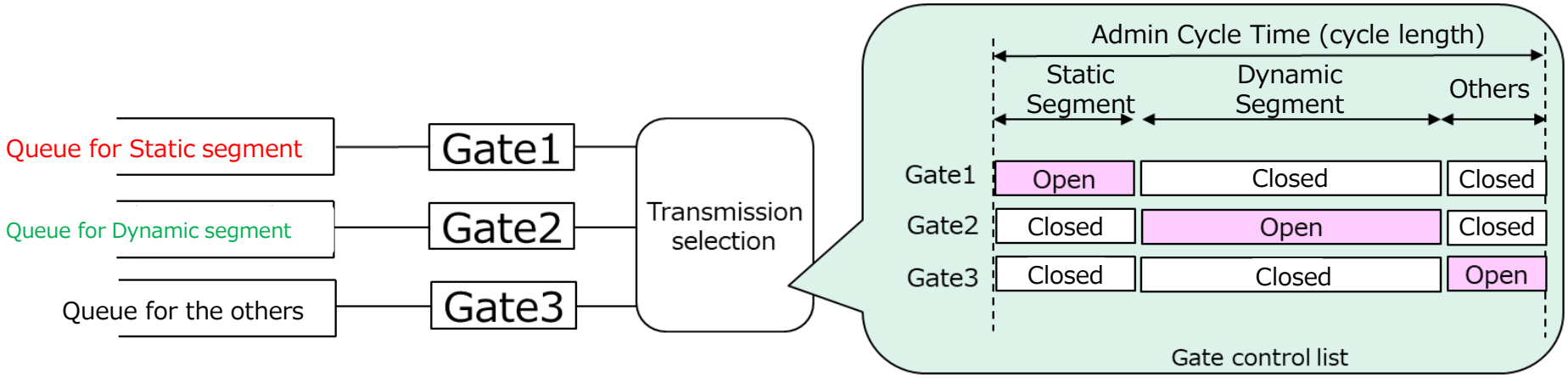


Static segment: Static TDMA is used to arbitrate transmissions.
A fixed frame is transmitted in a static slot.
A node within static segment can transmit frames at regular cycle.
Static segment is mainly used for safety-relevant applications.

Dynamic segment: Dynamic mini-slotting based scheme is used arbitrate transmissions. The order of transmission is decided in advance. Transmission of a frame is performed on demand. The length of dynamic slot is variable according to the frame length.

Proposed profile (Realization of FlexRay)

- By using Synchronization of all nodes (IEEE 802.1AS) and Scheduled Traffic (IEEE 802.1Q), we can realize Static segment and Dynamic segment of FlexRay over Ethernet.

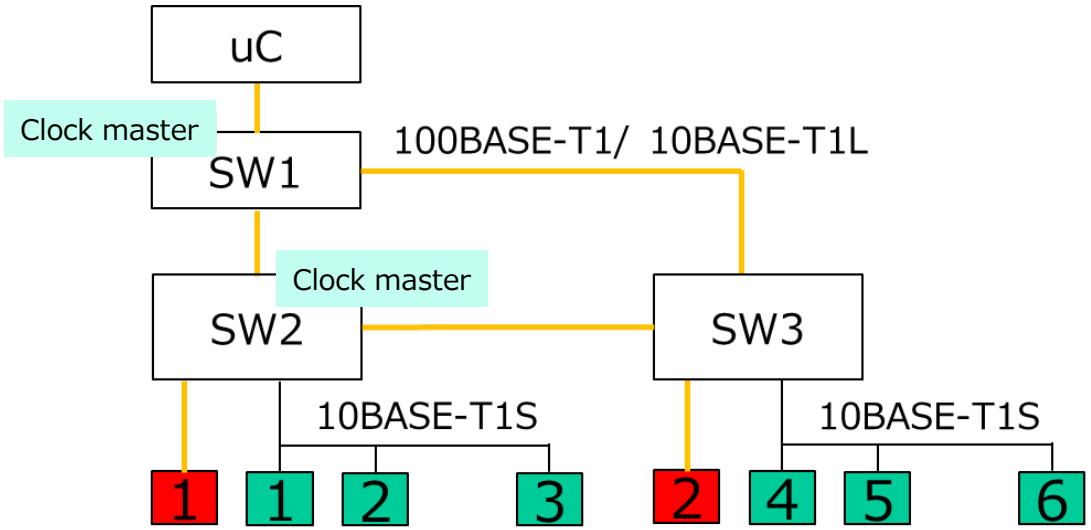


	RTB (Real Time Bus)	Proposed profile
Link speed	2.5 Mbit/s or 5 Mbit/s	＞10 Mbit/s (higher than FlexRay)
Network cycle	From 2 ms to 10 ms	From 2 ms to 10 ms (equivalent to FlexRay)
Payload	16 bytes or 32 bytes (static)	Variable
Number of devices	Up to 41 (*)	More than FlexRay

* Max. # of devices depends on # of channels and network topology.

Advanced profile (Requirement of redundancy)

- Requirement of redundancy for RTB: Startup can commence at a single failure.
- Assumed network has ring topology which consists of multi-port bridges (SW1, SW2 and SW3) and 1-port end-stations.
- To make communication path for time-synchronization redundant (clock master port selection by BMCA) and place multiple clock masters enables Startup at failure of any single node.



* The impossibility of Startup at failure of a bridge or a clock master is allowable, the redundancy of clock master and redundant path for time-synchronization are not necessary.

Conclusions and future works

- We discussed a profile for the realization of real time communication in FlexRay over Ethernet as a new use case. This profile is based on UC3, which was shown in Plenary of Nov. 2019.

- Future works
  - To realize Fault Tolerant Bus (FTB) in FlexRay, we will study the applicability of FRER(Frame Replication Elimination for Reliability) in IEEE 802.1CB.
  - We are updating UC1 through UC5 and also considering new use cases (UC6,…).
  - We are discussing the protocols shown in the current Draft from a viewpoint of Functional Safety.