TSN for automotive SDN
～ Update of Use cases

Japan
Automotive
Software
Platform
and
Architecture

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Next Generation High-Speed Network WG

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JASPAR, General incorporated association

Objective

- Provide use cases to create the Automotive Profile.
    - ✓ Create Use Case Scenarios
   - ✓ Extract Requirements
    - ✓ Specify Profiles

Use cases from JASPAR (Nov. 2019, Jul. 2020 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

http://www.ieee802.org/1/files/public/docs2020/dg-Nomura-JASPAR-Use-Cases-0720-v03.pdf

New proposal of JASPAR Use Cases

	UCs from JASPAR	Current discussion in JASPAR	Proposal for use cases
UC6	SDN (Software Defined Networking)	Study applicability of SDN to Dynamic construction of in-vehicle Ethernet with TSN	new Use case

Contribution to clause 7, 9 and 13 of DG draft
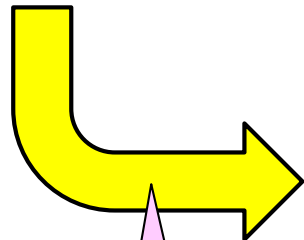
7. Life Cycle

7.1 Introduction

<< Editor's note: This clause is a suggestion based on the presentation *Suggestions for Automotive Profile outline* http://www.ieee802.org/1/files/public/docs2019/dg-finn-auto-prof-outline-0119-v02.pdf , presented 15 Jan 2019 at the IEEE 802.1 interim in

Possible content could include:

• The network behavior changes gre

1. Component manufacture / test
2. Manufacturing
3. Start-up sequence
4. Normal operation
5. Software updates
6. Fail-safe operation
7. In-shop maintenance

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9. Traffic Separation

9.1 Introduction

<< Editor's note: This clause is a suggestion based on the presentation *Suggestions for Automotive Profile outline* http://www.ieee802.org/1/files Jan 2019 at the IEEE 802.1 interim in

Possible content could include:

1. Separation by VLAN
   • Separating groups of functional u
2. Topology separation
   • Multiple versions of the active top
   • SPB+PCR, configuration, network
3. Physical separation
   • Separating groups of functional u
4. Connectivity by router
   • Selectively connecting different gr
5. Connectivity by application gateway

13. Protocols

13.1 Introduction

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Possible content could include:

1. Other IEEE 802 protocols required
   • One section for each protocol. 802.1AX? LLDP? Ether OAM? CFM?
2. Configured reservations for TSN flows
   • This will certainly be required. Where do addresses come from? (9.1?)
3. Reservations made by network controller
   • ~~Pick one: NETCONF? RESTCONF? SNMP?~~ Application controller?
4. Reservations made by peer-to-peer protocols
   • Or not. If allowed, RAP? MSRP? A variant of either?

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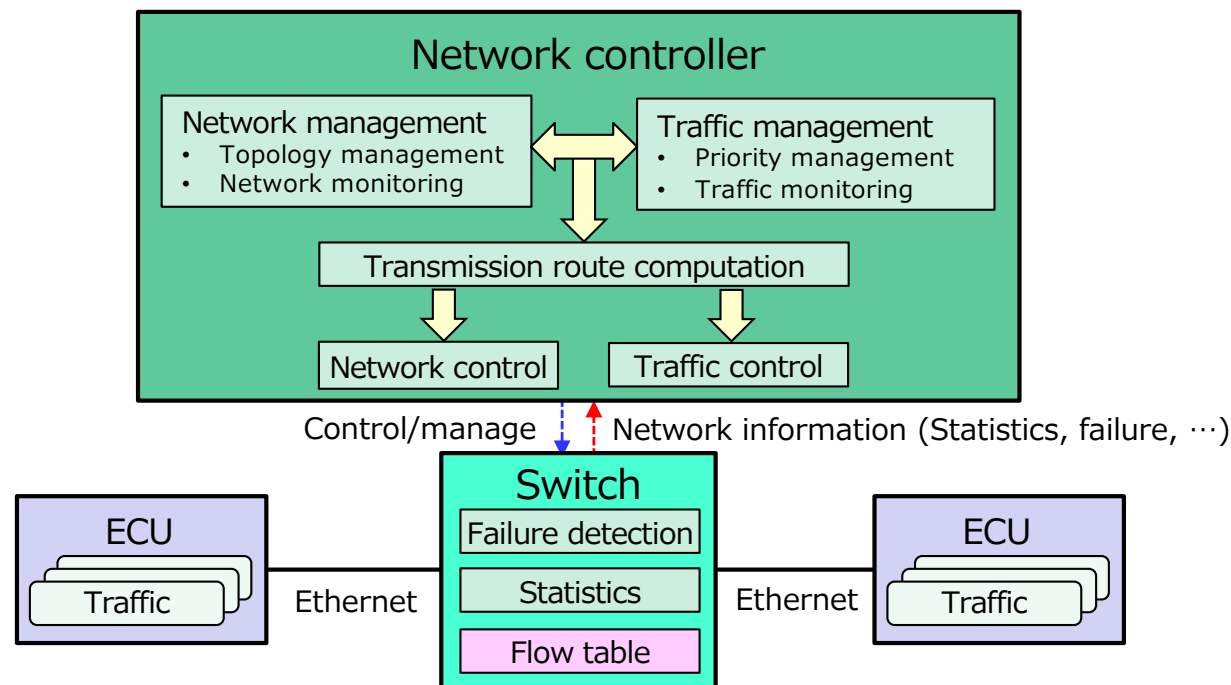# UC6. Dynamic construction of in-vehicle Ethernet

- Study on Application of **SDN** to In-vehicle Network
  - Requirements
    - **Fail operational**
      Need to **build network** capable of supporting "fail operational", which keeps system operation after an initial failure **(dynamic network updates, such as rerouting to avoid failure path, etc.)**

    - **In-vehicle function enhancements**
      Need to **build network** capable of supporting function enhancements via OTA (Over the Air)
      (dynamic network updates, such as exceeding design limit.)
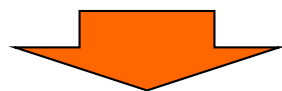
◆ **Incorporate SDN (Software Defined Networking)**, which enables dynamic network construction, **into in-vehicle Ethernet.**
◆ Construct in-vehicle Ethernet dynamically by centralized control and management of networks and traffic.
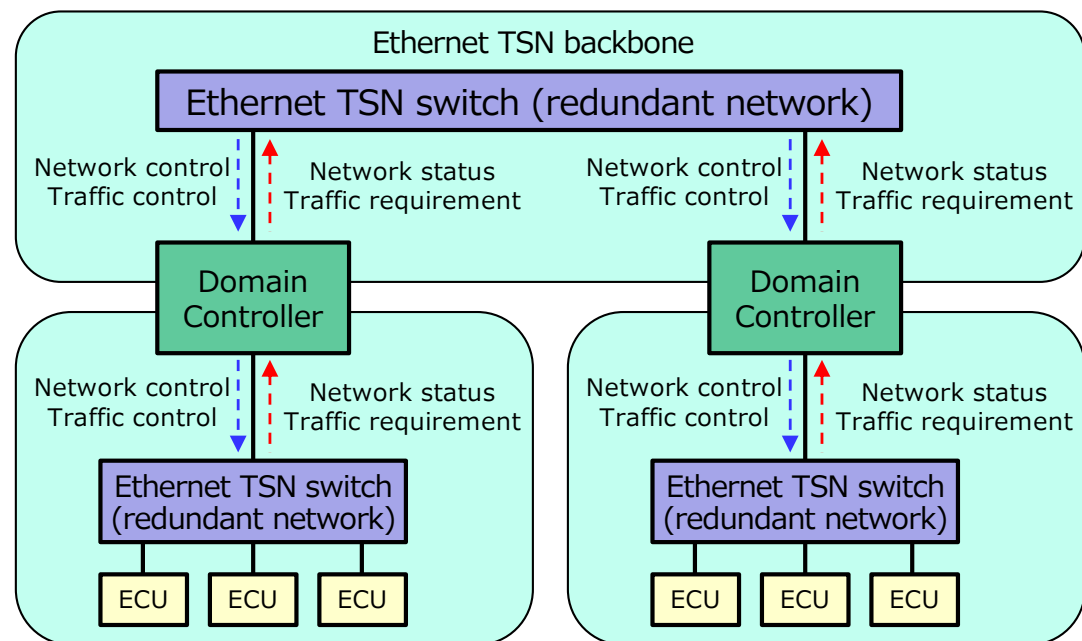
⭐ Overview of structure with SDN

- Network controller
  - **Conduct centralized control and management of networks and traffic** based on collected network information
- Switch
  - **Control traffic flow** based on "flow table"
  - Inform network controller of **detected failures and traffic statistics** periodically.

Examples of dynamic construction of IVN

- Need to implement **TSN on Ethernet (802.1AS-2020, etc)** capable of **synchronizing time between all nodes** over a backbone network.

- Need to **secure the redundancy** by a backup controller during the failure of a network controller since both of networks and traffic are controlled centrally by the network controller.

- Need to **dynamically update the network according to a change in traffic requirement** by function enhancement and function re-layout.

Ethernet TSN backbone

Ethernet TSN switch (redundant network)

Network control
Traffic control
Network status
Traffic requirement

Network control
Traffic control
Network status
Traffic requirement

Domain Controller

Domain Controller

Network control
Traffic control
Network status
Traffic requirement

Network control
Traffic control
Network status
Traffic requirement

Ethernet TSN switch (redundant network)

Ethernet TSN switch (redundant network)

ECU ECU ECU

ECU ECU ECU

Centralized control and management of backbone/domain network

We are discussing requirements and related TSN protocol for in-vehicle SDN.