VLAN use case for in-vehicle network

Japan Automotive Software Platform and Architecture

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Objectives of using VLAN in in-vehicle networks

1: Priority Control
→ Originally, AUTOSAR wanted to use priority control, so it treated VLAN as an option for PCP.

2: Domain Isolation
→ Since an in-vehicle network has several domains, such as Powertrain, Body, Chassis, Infotainment, and so on, it would be convenient if these domains and the time domain could be managed together using VLANs. (2024 November Plenary)

3: Security Measures
→ VLAN can protect the in-car domain from cyber-attacks from the out-car domain.
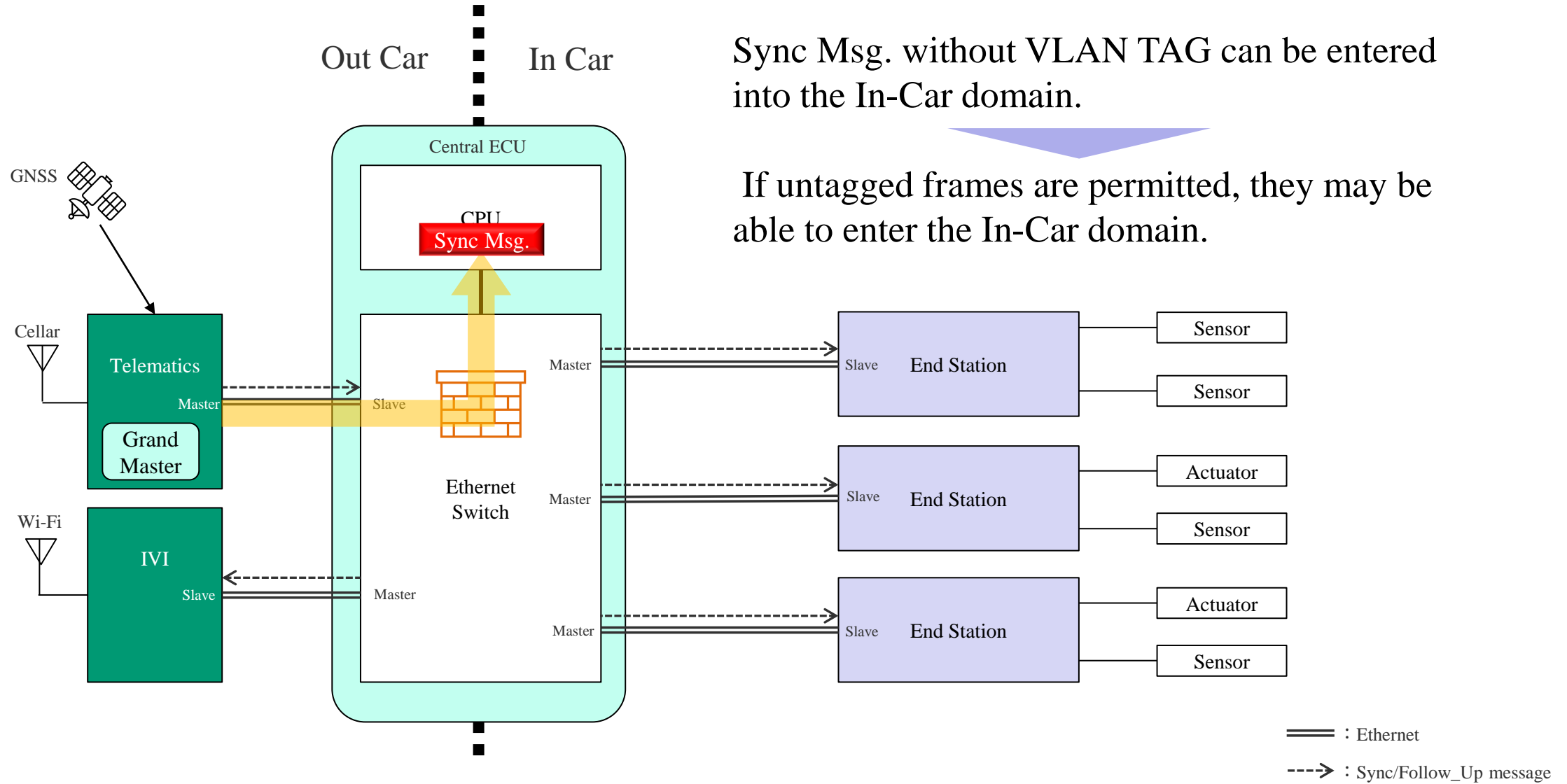→ The next page will explain in detail.

Automotive Use Case without gPTP

Out Car   In Car

GNSS

Cellar

Telematics

Wi-Fi

IVI

Central ECU

CPU

Ethernet
Switch
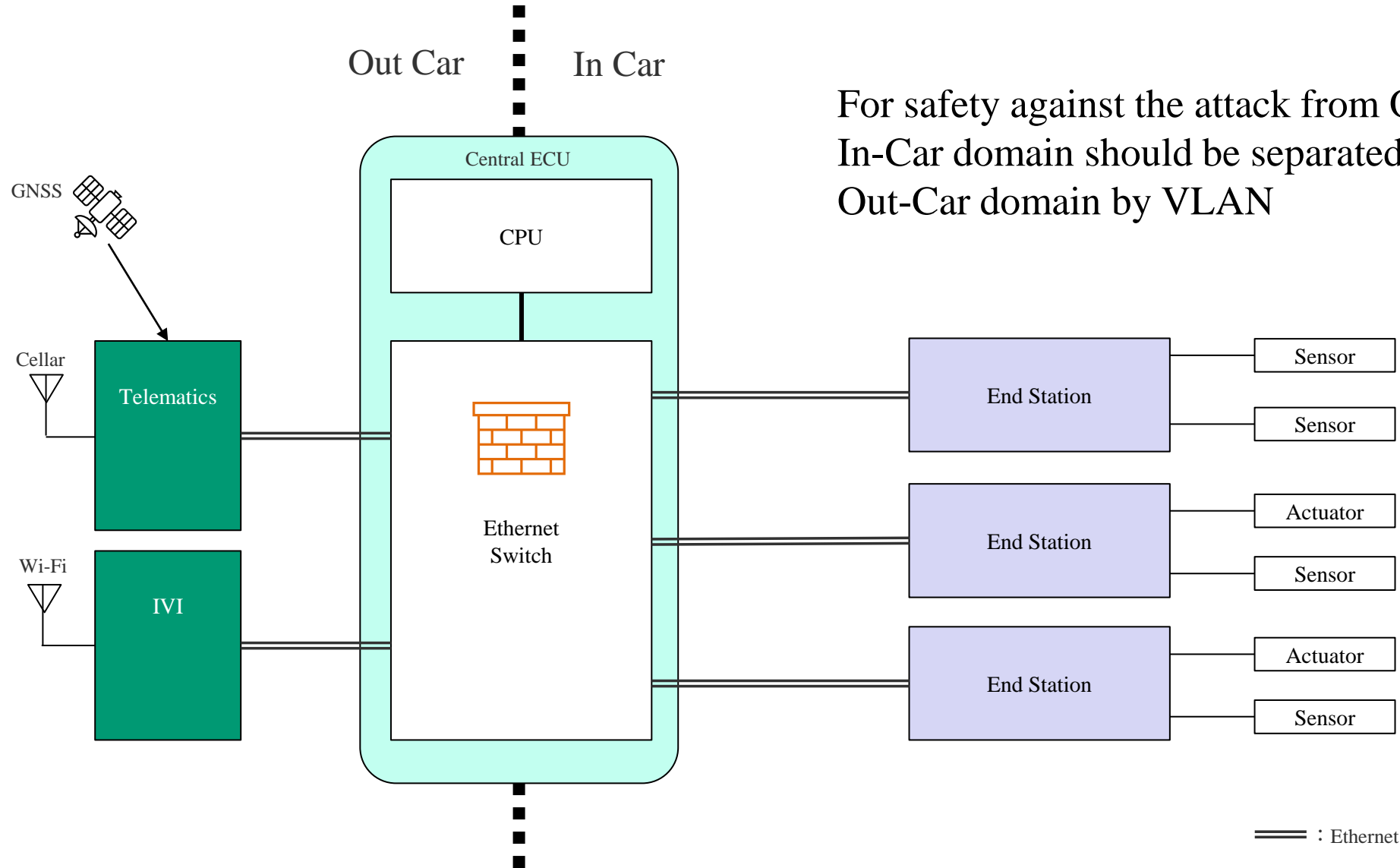
For safety against the attack from Out-Car,
In-Car domain should be separated from
Out-Car domain by VLAN

End Station

Sensor

Sensor

End Station

Actuator

Sensor

End Station

Actuator

Sensor

════ ： Ethernet

In principle, only VLAN-tagged frames are permitted for automotive use cases.

Automotive Use Case with gPTP

Out Car | In Car

Central ECU

GNSS

CPU
Sync Msg.

Cellar

Telematics
Master

Grand Master

Wi-Fi

IVI
Slave

Slave

Ethernet Switch

Master

Master

Master

Sync Msg. without VLAN TAG can be entered into the In-Car domain.

If untagged frames are permitted, they may be able to enter the In-Car domain.

Slave   End Station   Sensor / Sensor

Slave   End Station   Actuator / Sensor

Slave   End Station   Actuator / Sensor

══ ：Ethernet

---> ：Sync/Follow_Up message

VLANs are not a perfect solution, but a VLAN wall is necessary from the perspective of defense in depth.

Automotive Use Case Summary

- VLAN should separate the out-car domain to protect the in-car domain from cyber attacks.

- While VLAN is not a perfect security solution, the VLAN wall is necessary from a defense-in-depth perspective.

  ⟹ only VLAN-tagged frames can be used in the In-vehicle network.

- If untagged frames are permitted, the above assumptions are violated.

- It won't immediately fail, but new security measures and justification will be needed.

Conclusions of Japanese Automotive Industry

- Since the purpose is to unify the specifications so as not to cause problems for suppliers, it is not an absolute requirement for car manufacturers to use VLANs.

- Therefore, in principle, we will follow the IEEE 802 standards for time synchronization protocols.

- However, because AUTOSAR allows VLANs as an option, measures to avoid specification discrepancies are necessary.

- JASPAR will make a document calling attention to this point and share it with the industry.