



Ministry of Science and ICT



# I2ICF Side Meeting



## A Use Case of Interface to In-Network Computing Functions (I2ICF) for Cooperative Intelligent Transportation Systems (C-ITS)

(draft-ahn-opsawg-i2icf-cits-00)

July 23, 2025

Madrid in Spain

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# Motivation of This Draft

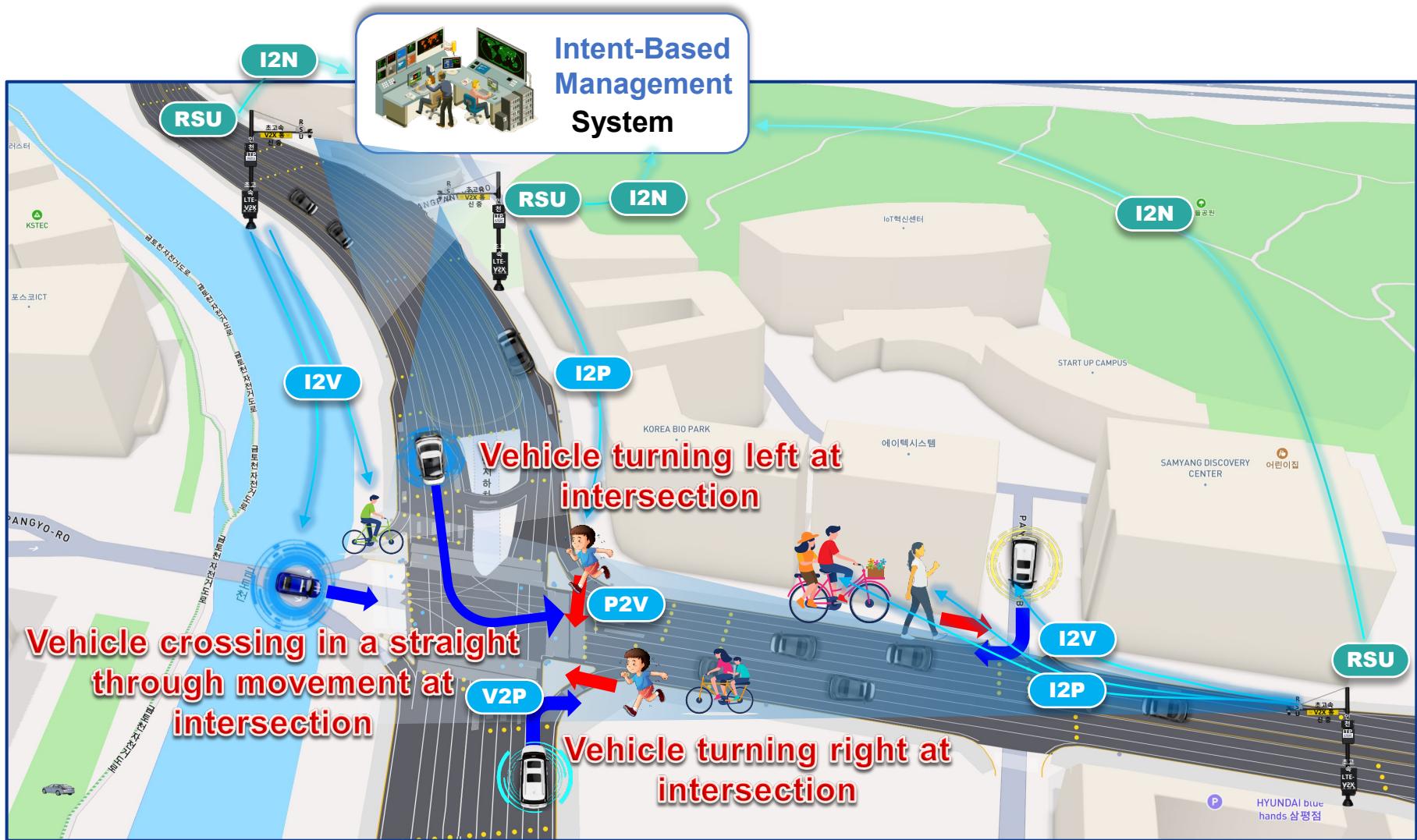
## ❖ draft-ahn-opsawg-i2icf-cits-00

- This draft defines the use case of In-Network Computing Functions (I2ICF) for cooperative intelligent transportation systems.
  - doc link : <https://datatracker.ietf.org/doc/draft-ahn-opsawg-i2icf-cits/>
- This draft specifies a structured **framework for orchestrating, managing, and monitoring ICFs in C-ITS**
  - For example, in the context of Vehicle-to-Everything (V2X) communications, efficient management of Vehicle-to-Vehicle (V2V) communications and their integration with C-ITS can greatly benefit from in-network computing.
  - By leveraging ICFs, it becomes possible to optimize real-time communication, streamline traffic management, and enhance data processing and security services at the network edge.

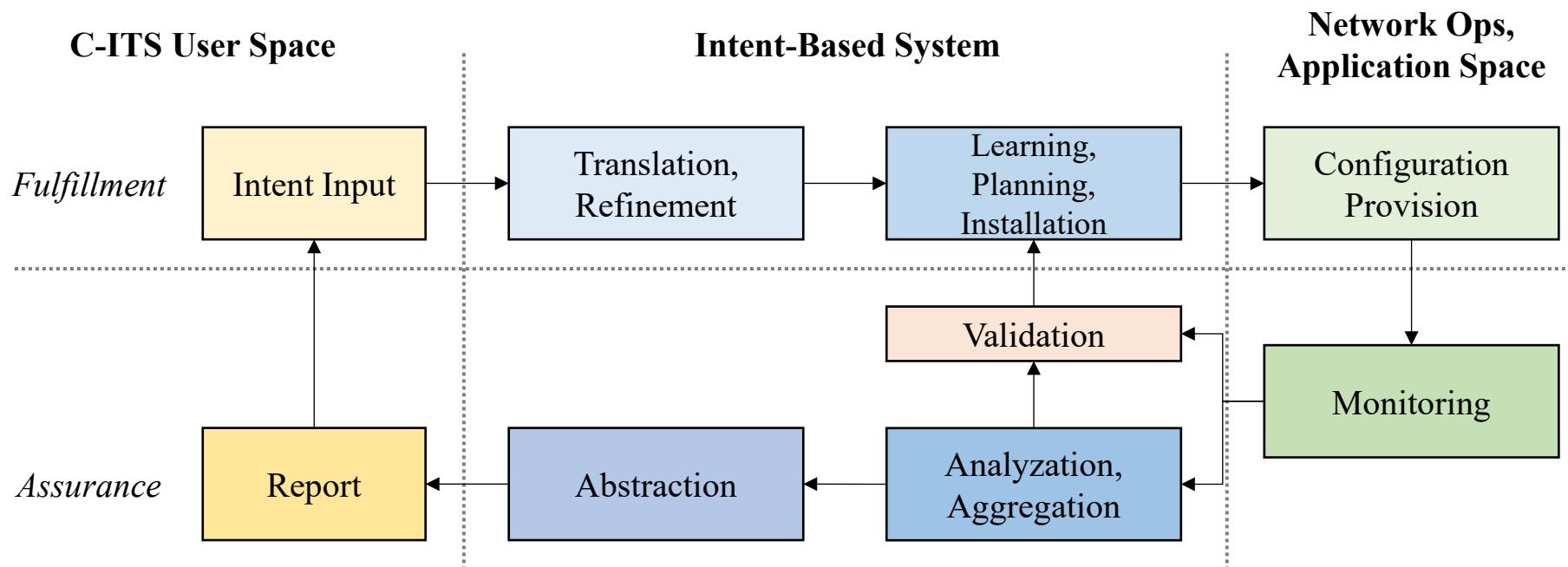
## ❖ Main contents of this draft

- Intent-Based Management System in C-ITS (included in IETF 123rd)
- Framework components, Interfaces in the I2ICF
- Use cases
- Security considerations

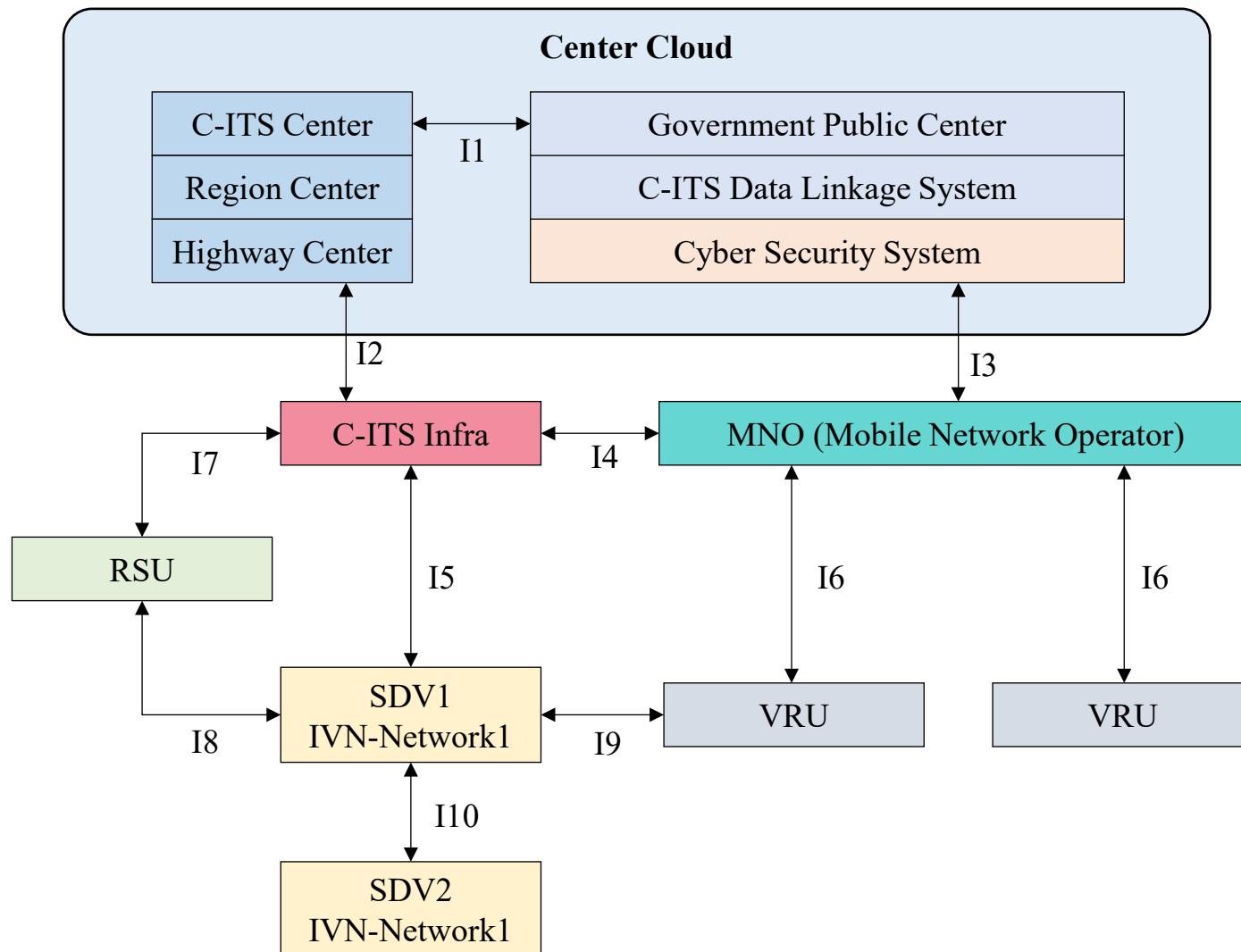
# Intent-Based Management System in C-ITS



# The Life Cycle of IBS for C-ITS Management



# I2ICF Framework and Interfaces



# I2ICF Framework and Interfaces

## ❖ Framework Components

Components	Description
Central Cloud	A system that comprehensively <b>controls the entire C-ITS environment</b> . It manages information from various C-ITS centers, including regional centers and highway centers, and facilitates and oversees the connection between C-ITS data from the Government Public Center and end users.
C-ITS Center	The C-ITS Center is a comprehensive term that encompasses both the Region Center and the Highway Center. It serves as the <b>central hub for managing and coordinating intelligent transportation systems</b> across various environments, including urban regions and highways.
Region Center	The Region Center refers to local centers established at key locations. These regional centers are <b>connected to Road-Side Units (RSU) and function as one of the C-ITS Centers</b> .
Highway Center	The Highway Center operates similarly to the Region Center but is managed separately due to the unique characteristics of highways, which span <b>multiple regions rather than being confined to a single city</b> .

# I2ICF Framework and Interfaces

## ❖ Framework Components

Components	Description
Government Public Center	The Government Public Center is a <b>C-ITS information provision system managed by the government</b> . Due to the nature of road traffic infrastructure, it is challenging for <b>private companies to manage this data effectively</b> , and concerns over <b>reliability</b> make it difficult for users to utilize privately managed data.
C-ITS Data Linkage System	The C-ITS Data Linkage System is a platform designed to <b>provide C-ITS data to external users</b> . By offering data through methods such as Open APIs, this system connects C-ITS infrastructure information with users, enabling seamless access to real-time traffic and transportation data.
Cyber Security System	The Cyber Security System is responsible for <b>managing the security of communications</b> between Software-Defined Vehicles (SDV), Vulnerable Road Users (VRU), RSU, Mobile Network Operators (MNO), and C-ITS infrastructure.
C-ITS Infra	The C-ITS Infrastructure is a system designed to <b>collect and provide various types of information</b> , including traffic signal data, roadside environment information, VRU data, and RSU data.

# I2ICF Framework and Interfaces

## ❖ Framework Components

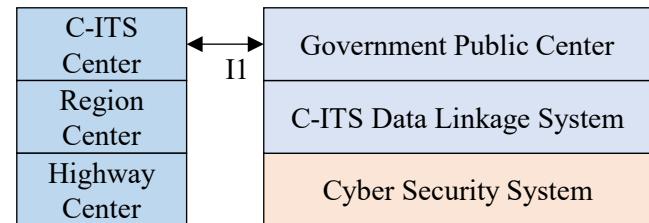
Components	Description
RSU	The RSU is a device that <b>connects the C-ITS Infrastructure with SDVs</b> . Through the RSU, SDVs can transmit and receive data between vehicles via V2V and between vehicles and infrastructure via V2I.
SDV1, SDV2	An SDV (Software-Defined Vehicle) consists of two main communication interfaces (External Communication Interface : Enables communication with external systems such as RSUs (Roadside Units), other vehicles (V2V), and infrastructure (V2I/V2N), supporting seamless interaction within the C-ITS ecosystem, and Internal Vehicle Network (IVN) Interface)
IVN-Network1, 2	These networks are part of the In-Vehicle Network (IVN), which facilitates communication within the vehicle.
VRU	A VRU refers to users who can communicate either with an MNO or directly with SDVs.
MNO	An MNO is a <b>service provider that owns and manages wireless communication infrastructure</b> , including network towers, core networks, and data centers.

# I2ICF Framework and Interfaces

## I2ICF Interfaces

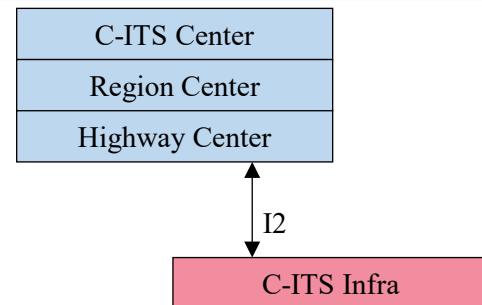
### Interface 1

This is the registration interface between the ITS Center and the Government Public Center. It facilitates the **exchange of C-ITS infrastructure data**, such as traffic information and real-time road conditions, ensuring the Government Public Center can provide accurate and trustworthy data to external users.



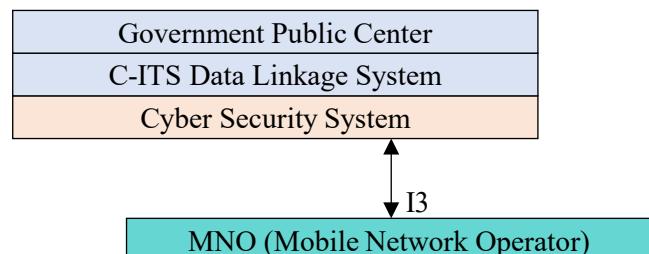
### Interface 2

This interface connects the C-ITS Center with the C-ITS Infra. It is **responsible for distributing infrastructure data**, such as traffic signal information, road environment data, and RSU status, from the C-ITS Center to the C-ITS Infra for real-time processing and delivery to connected vehicles.



### Interface 3

This is the data exchange interface between the Government Public Center and the MNO (Mobile Network Operator). It **enables the secure transmission of C-ITS data to MNOs**, allowing mobile networks to deliver critical traffic and safety information to VRUs and vehicles.



# I2ICF Framework and Interfaces

## I2ICF Interfaces

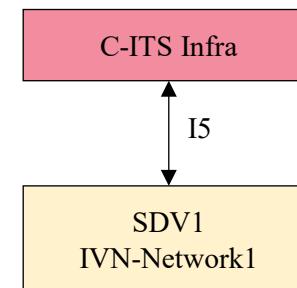
Interface 4

This interface connects the C-ITS Infra with the MNO. It **supports the sharing of network resources and real-time communication** between infrastructure components and mobile networks.



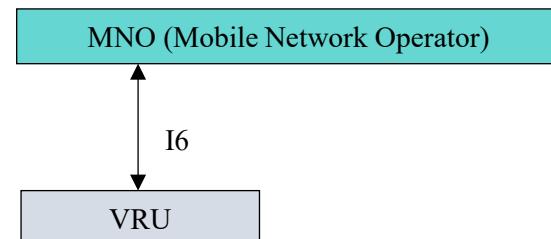
Interface 5

This is the communication interface between the C-ITS Infra and SDVs. It **enables bidirectional data exchange, allowing SDVs to receive real-time infrastructure information** (e.g., traffic signals, road hazards) and transmit vehicle status data back to the infrastructure.



Interface 6

This interface connects the MNO with both VRUs and SDVs. It is used to **deliver real-time safety messages**, navigation updates, and other critical data. It also allows VRUs and SDVs to send status or emergency signals back to the network.

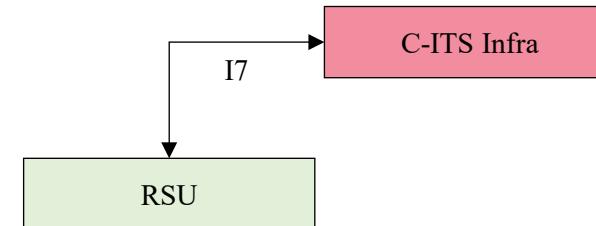


# I2ICF Framework and Interfaces

## I2ICF Interfaces

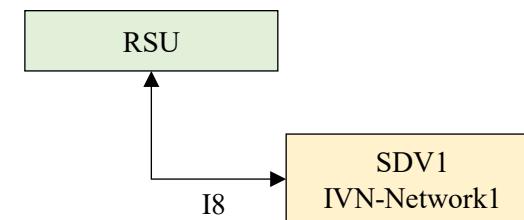
Interface 7

This is the management interface between the RSU and the C-ITS Infra. It **facilitates the configuration, monitoring, and management of RSUs** to ensure stable communication between roadside infrastructure and vehicles.



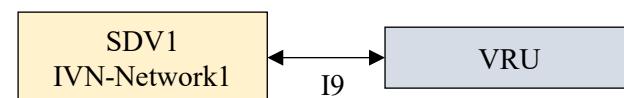
Interface 8

This interface supports V2I communication between SDVs through the RSU. It **allows SDVs to exchange critical information** such as speed, direction, and emergency signals, enabling collision avoidance and cooperative driving.



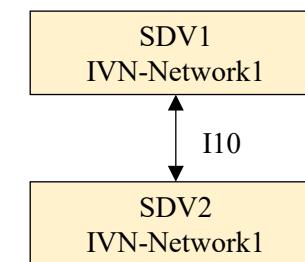
Interface 9

This is the communication interface between SDVs and VRUs. It **ensures that vulnerable road users receive immediate safety notifications** from nearby vehicles and infrastructure.



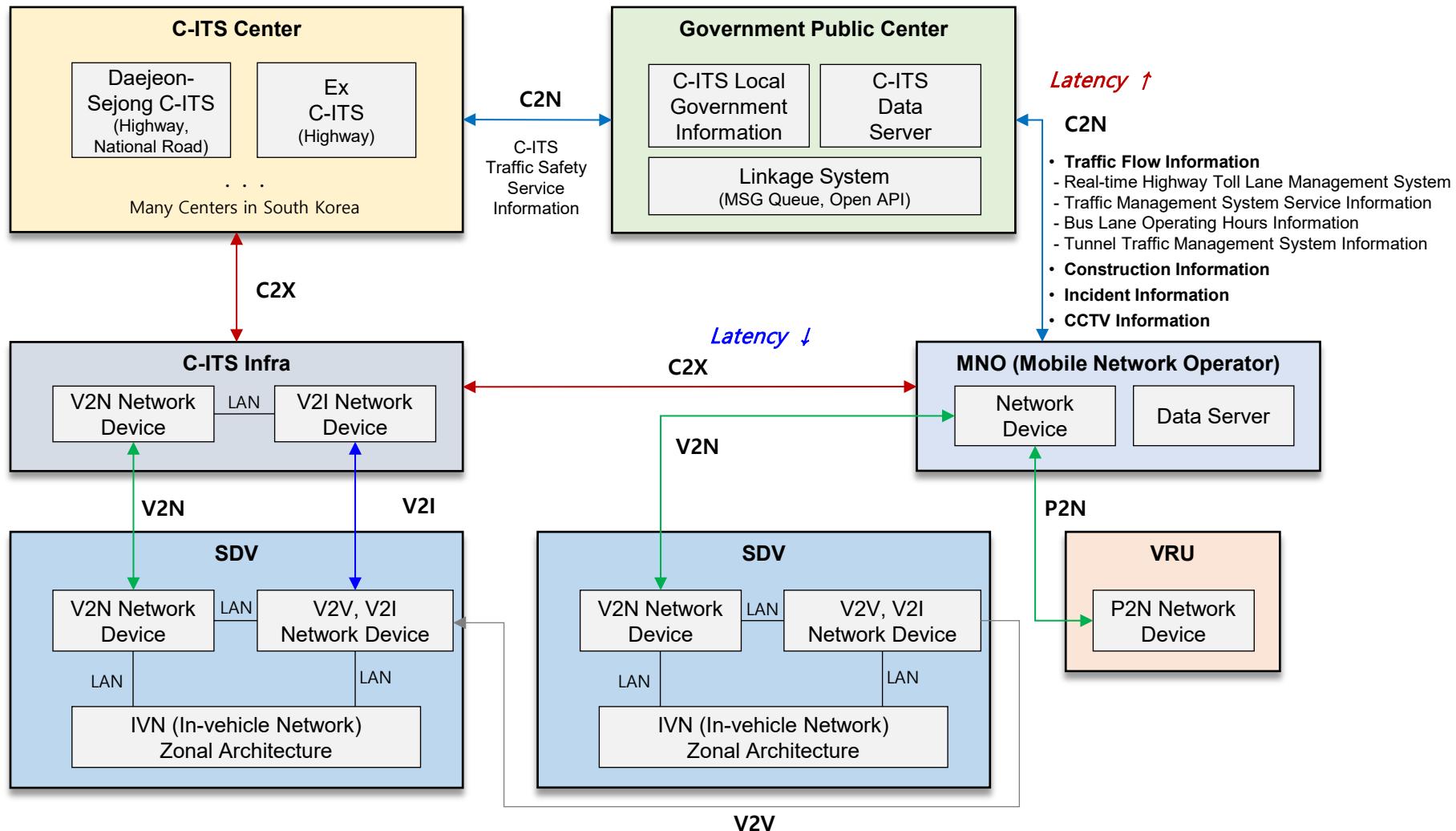
Interface 10

This is the external and internal communication interface between multiple SDVs. It **enables secure and efficient communication** within the vehicle's zonal architecture, facilitating seamless data exchange between various internal systems and supporting autonomous driving functions.



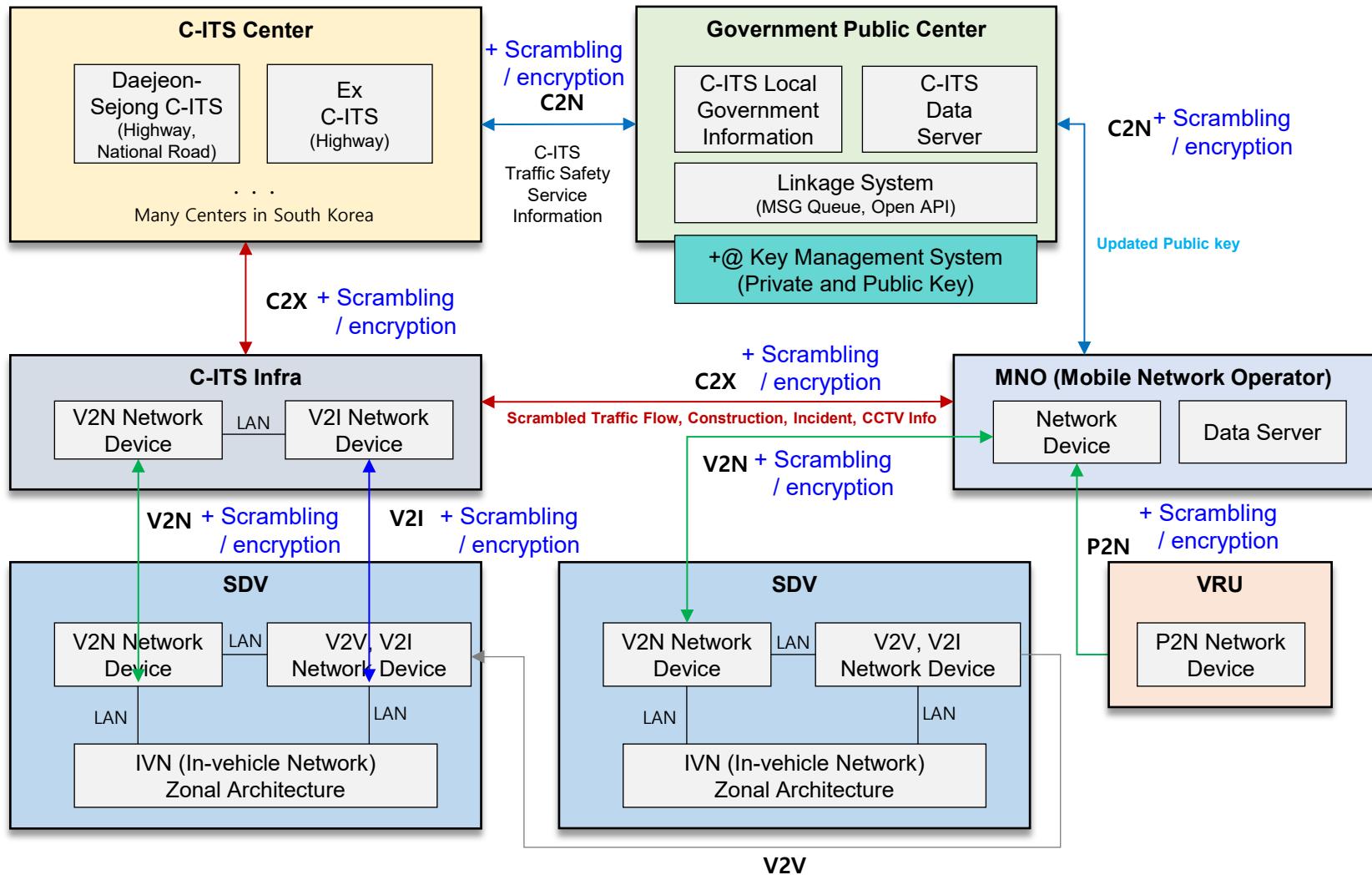
# Use Cases of I2ICF for C-ITS

## Data Processing, Streamline Traffic Management



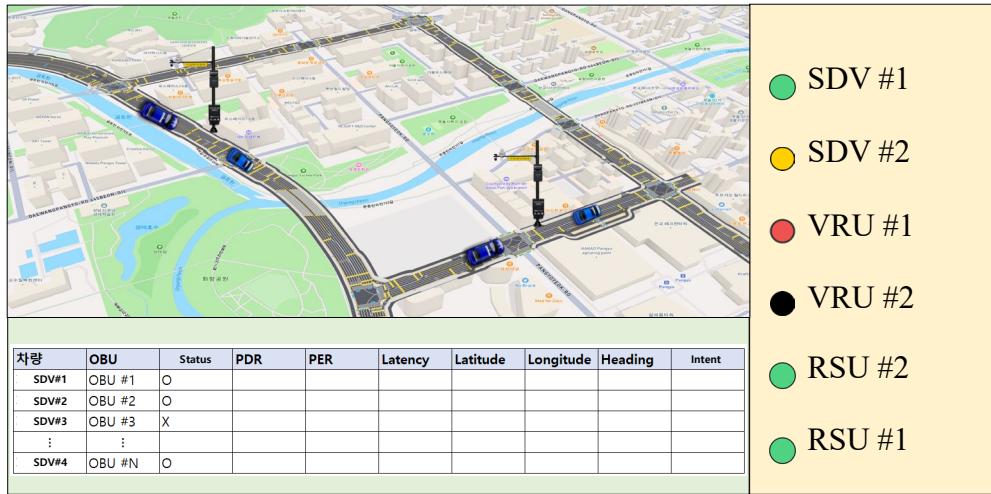
# Use Cases of I2ICF for Security C-ITS

## Cybersecurity Consideration



# Implementation of Rea-time IBS for ICFs in C-ITS

## Application



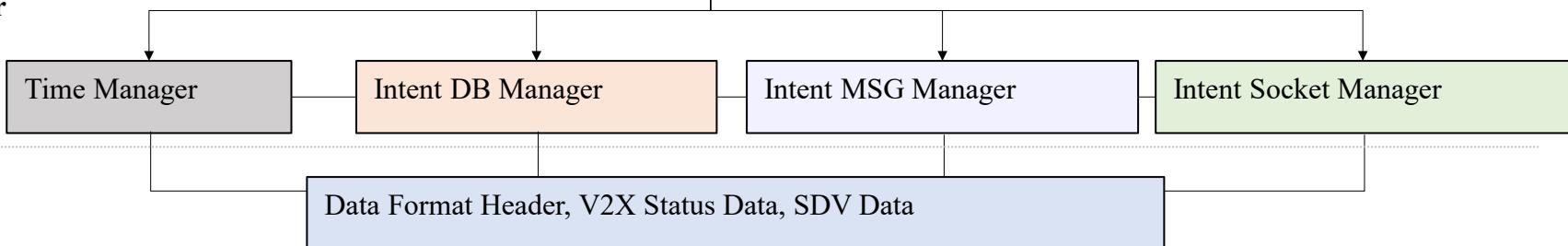
## Real-time IBS of ICF for C-ITS Data Tx/Rx

파일명	크기	파일 ...	최종 수정	권한	소유자/...
Rx_OBU_VEH-ID202120002_20241204-16-07-57_20241204-16-59-25.248secs.csv	18.63...	Micros..	2024-12-04 오후 4:50:33	rw-rw...	keti keti
Rx_OBU_VEH-ID202120002_20241205-13-09-51_20241205-14-19-59.379secs.csv	30.05...	Micros..	2024-12-05 오후 2:13:09	rw-rw...	keti keti
Rx_OBU_VEH-ID23120008_20241202-14-05-05_20241202-14-51-08.2759secs.csv	4.53...	Micros..	2024-12-02 오후 2:51:17	rw-rw...	keti keti
Rx_OBU_VSH-ID23120008_20241203-14-05-11_20241203-14-33-39.919secs.csv	4.70...	Micros..	2024-12-03 오후 2:51:17	rw-rw...	keti keti
Rx_OBU_VEH-ID23120008_20241203-14-57-02_20241203-14-57-05.3secs.csv	1.806	Micros..	2024-12-02 오후 2:57:07	rw-rw...	keti keti
Rx_OBU_VEH-ID23120008_20241202-14-58-55_20241202-14-59-01.6secs.csv	903	Micros..	2024-12-02 오후 3:29:03	rw-rw...	keti keti
Rx_OBU_VEH-ID23120008_20241202-15-12-42_20241202-15-12-44.2secs.csv	1.806	Micros..	2024-12-02 오후 3:12:46	rw-rw...	keti keti
Rx_OBU_VSH-ID23120008_20241202-15-14-27_20241202-15-16-20.113secs.csv	957.9...	Micros..	2024-12-02 오후 3:16:22	rw-rw...	keti keti
Rx_OBU_VEH-ID23120008_20241202-15-14-28_20241202-15-16-17.109secs.csv	970.2...	Micros..	2024-12-02 오후 3:16:20	rw-rw...	keti keti
Rx_OBU_VEH-ID23120008_20241202-15-52-57_20241202-17-49-50.7013secs.csv	62.18...	Micros..	2024-12-02 오후 5:49:59	rw-rw...	keti keti
Rx_OBU_VEH-ID23120008_20241202-15-52-59_20241202-17-49-48.7009secs.csv	62.22...	Micros..	2024-12-02 오후 5:49:55	rw-rw...	keti keti
Rx_OBU_VEH-ID23120008_20241203-10-32-09_20241203-15-38-31.1838secs.csv	82.13...	Micros..	2024-12-03 오후 3:38:43	rw-rw...	keti keti
Rx_OBU_VEH-ID23120008_20241203-15-39-31_20241203-17-33-24.6833secs.csv	163.3...	Micros..	2024-12-03 오후 3:38:50	rw-rw...	keti keti
Rx_OBU_VEH-ID23120008_20241203-15-39-32_20241203-17-33-22.6830secs.csv	30.36...	Micros..	2024-12-03 오후 3:38:28	rw-rw...	keti keti
Rx_OBU_VEH-ID23120008_20241203-15-39-32_20241203-17-33-22.6830secs.csv	60.60...	Micros..	2024-12-03 오후 3:38:29	rw-rw...	keti keti

## Service

Intent Service

## Manager



## Message

Data Format Header, V2X Status Data, SDV Data

# Summary and Next Steps

## ❖ Summary

- This document introduces **a structured framework** for their registration, configuration, management, and monitoring.
- It evaluates extended **use cases**, including V2X communication, wherein ICFs facilitate the efficient orchestration of V2V networks, **seamless integration with C-ITS, and interoperability with MNOs**.
- This document underscores the pivotal role of ICFs in **strengthening cybersecurity** measures for both private and public data within such interconnected ecosystems.
- This document includes the [Intent-Based Management System](#) in C-ITS

## ❖ Next Steps

- This draft will be enhanced to accommodate use cases for I2ICF as follows:
  - A Use Case of C-ITS Networking
  - A Use Case of Real-Time Data Processing for SDV
  - A Use Case of E2E Communication for Cooperative Driving
  - A Use Case of Enhanced Cybersecurity for C-ITS and MNO Integration
  - A Use Case of Edge Computing for Latency-Sensitive Applications
  - [Implementation of Rea-time IBS for ICFs in C-ITS](#)

# Unframed Perspective

"틀에서 벗어난 시각으로 미래를 이끌어 간다"



This work was supported by Institute of Information & Communications Technology Planning & Evaluation (IITP) grant funded by the Korea Ministry of Science and ICT (MSIT) (No. 2022-0-00199, 5G-NR-V2X performance verification for connected Autonomous Driving).

This work was in part supported by Institute of Information & Communications Technology Planning & Evaluation (IITP) grant funded by the Korea Ministry of Science and ICT (MSIT) (No. RS-2024-00398199 and RS-2022-II221015).