



IETF-120 Hackathon



Interface to In-Network Functions (I2INF) Project

July 20-21, 2024, Vancouver

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IETF-120 Interface to In-Network Functions (I2INF) Project

Champion: Jaehoon (Paul) Jeong (SKKU)



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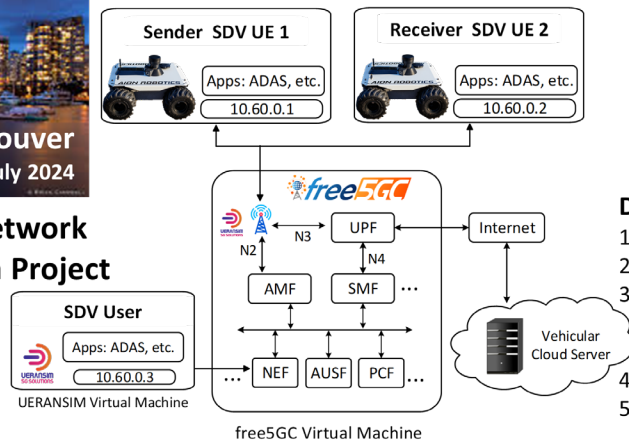
Professors:

- Jaehoon (Paul) Jeong (SKKU)
- Yiwen (Chris) Shen (SKKU)
- Younghan Kim (SSU)
- Yong-Geun Hong (DJU)
- Joosang Youn (DEU)

Students:

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- Ju Won Hong (SKKU)
- EunJin Hwang (DJU)
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Architecture



Objectives

- Demonstrate Interface to In-Network Functions (I2INF).
- Set up In-Network Computing Functions for mobile objects such as Software-Defined Vehicles and Unmanned Aerial Vehicles (UAV) in terms of the configuration and monitoring of In-Network Functions.

What to pull down to set up an environment:

- OS: Ubuntu 20.04
- Free5GC VM: version 3.4.1
- UERANSIM VM (UE & RAN): version 3.2.6
- ROS2: Iron Irwini version
- GitHub Repository:
<https://github.com/jaehoonpauljeong/I2INF>

Demonstration for free5GC Communication

1. Clone Ubuntu server as Free5GC VM and UERANSIM VM.
2. Modify hostname and IP Address on Free5GC VM.
3. Install Golang, MongoDB, All 5G network functions (e.g., AMF, UPF, etc.), WebConsole on Free5GC VM and test the functions.
4. Register UE's information on Free5GC Core WebConsole
5. Set yaml file parameters of UE1 and UE2 and start them. (UERANSIM: free5gc-gnb.yaml & free5gc-ue.yaml)
6. Install ROS2 and check the connectivity with 5G Core.
7. Run ROS2 on each UE and Send and receive message between SDV UE1 and SDV UE2.

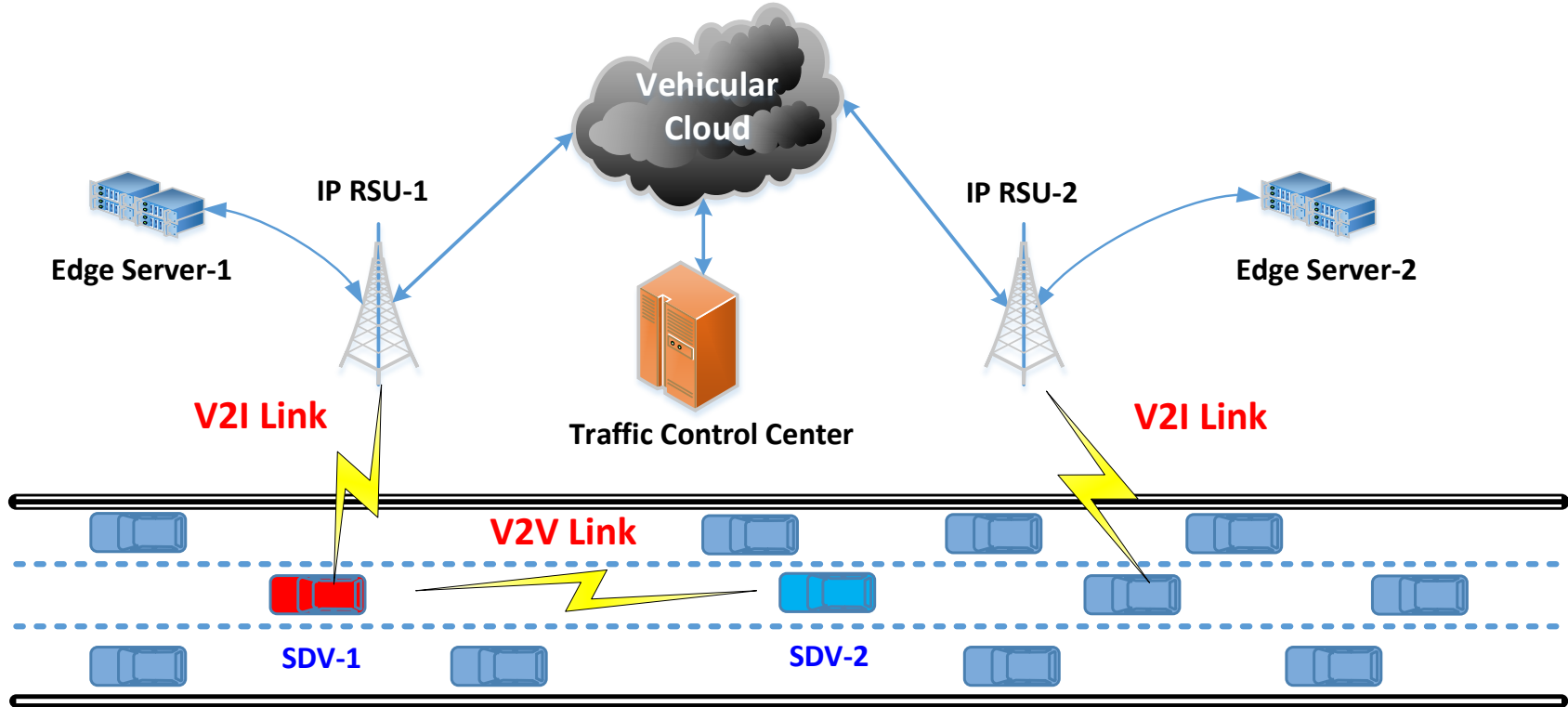
Future Work:

- Development and advancement of the V2X Scenario through 5G network.
- Interaction between Free5GC as 5G Cloud/Edge and AUTOSAR in Matlab Simulink as SDV with Cloud-Native.
- Control two Robot cars using ROS2 through 5G network.

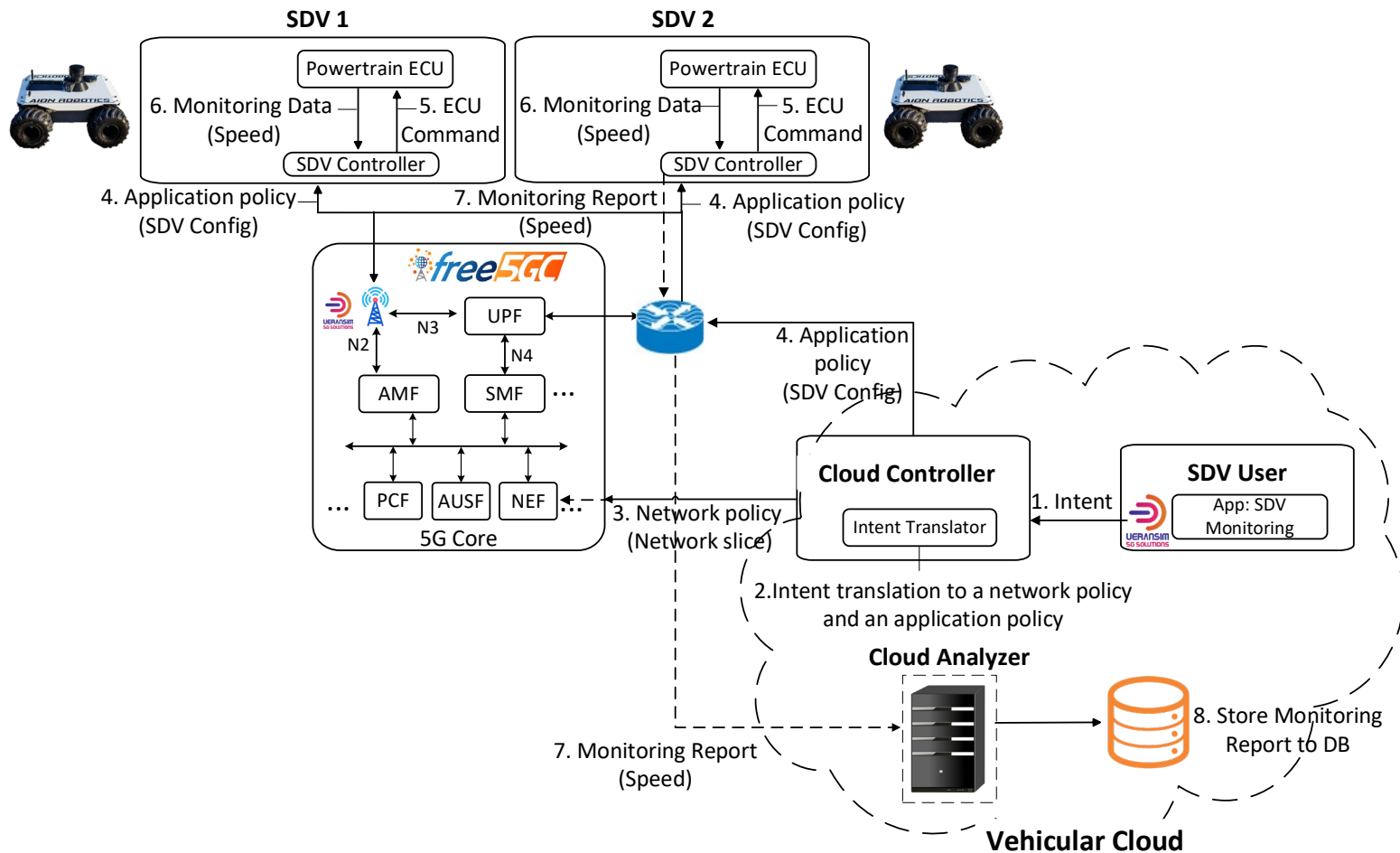
Goal of Hackathon Project

- The goal is to demonstrate the feasibility of the Framework and Interfaces to In-Network Functions (I2INF).
 - In-Network Functions (INF)
 - P4 Switch, NFV Failure Detector, and Firewall, etc.
- Internet Draft for the I2INF Project
 - An Intent-Based Management Framework for Software-Defined Vehicles in Intelligent Transportation Systems
 - <https://datatracker.ietf.org/doc/draft-jeong-opsawg-intent-based-sdv-framework/>

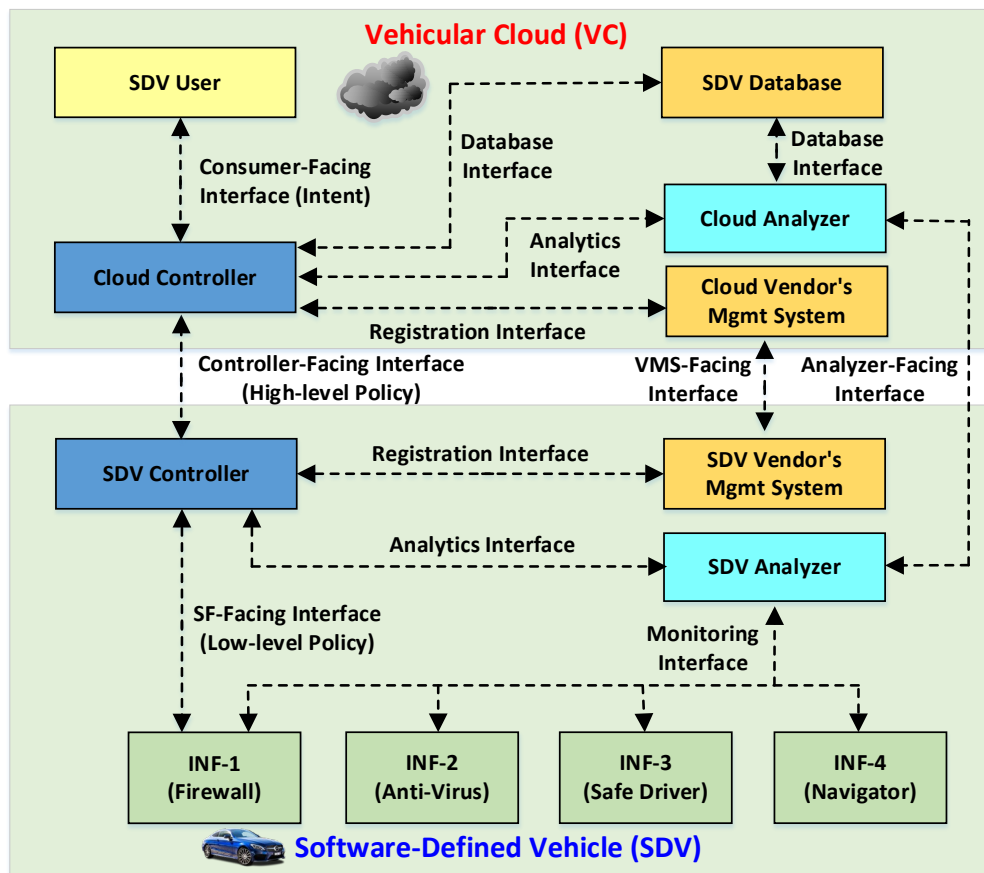
Intelligent Management for Mobile Objects (MNs) (e.g., Software-Defined Vehicles (SDVs) and Drones)



Interface to In-Network Functions (I2INF) for SDVs



An I2INF Framework for Software-Defined Vehicles



What we learned

- We implemented **an I2INF Framework for Software-Defined Vehicles (SDV)** in 5G Mobile Networks with Free5GC and UERANSIM.
- We demonstrated **Intent-Based Networking (IBN)** for the configuration and monitoring of SDVs through the I2INF Framework.

Demonstration of an I2INF Framework

The diagram illustrates the I2INF Framework architecture, showing four main components connected to a central SDV User:

- SDV UE1** (top left): A terminal window showing network traffic and speed data. It receives messages from computer 5 and sends speed data to computer 5. The speed data is 85km/h at 2024-07-21 13:06:37, 33km/h at 2024-07-21 13:06:40, and 33km/h at 2024-07-21 13:06:44.
- SDV UE2** (top right): A terminal window showing network traffic and speed data. It receives messages from computer 4 and sends speed data to computer 4. The speed data is 74km/h at 2024-07-21 13:06:33, 36km/h at 2024-07-21 13:06:35, and 47km/h at 2024-07-21 13:06:44.
- Cloud Server** (bottom left): A terminal window showing network traffic and speed data. It receives messages from vehicle 1 and vehicle 2 and sends speed data to vehicle 1 and vehicle 2. The speed data is 85km/h at 2024-07-21 13:06:37, 33km/h at 2024-07-21 13:06:40, and 33km/h at 2024-07-21 13:06:44.
- 5G Core** (bottom right): A terminal window showing network traffic and speed data. It receives messages from vehicle 1 and vehicle 2 and sends speed data to vehicle 1 and vehicle 2. The speed data is 85km/h at 2024-07-21 13:06:37, 33km/h at 2024-07-21 13:06:40, and 33km/h at 2024-07-21 13:06:44.

The central **SDV User** (bottom center) is a terminal window showing network traffic and speed data. It receives messages from vehicle 1 and vehicle 2 and sends speed data to vehicle 1 and vehicle 2. The speed data is 85km/h at 2024-07-21 13:06:37, 33km/h at 2024-07-21 13:06:40, and 33km/h at 2024-07-21 13:06:44.

Open-Source Project for I2INF

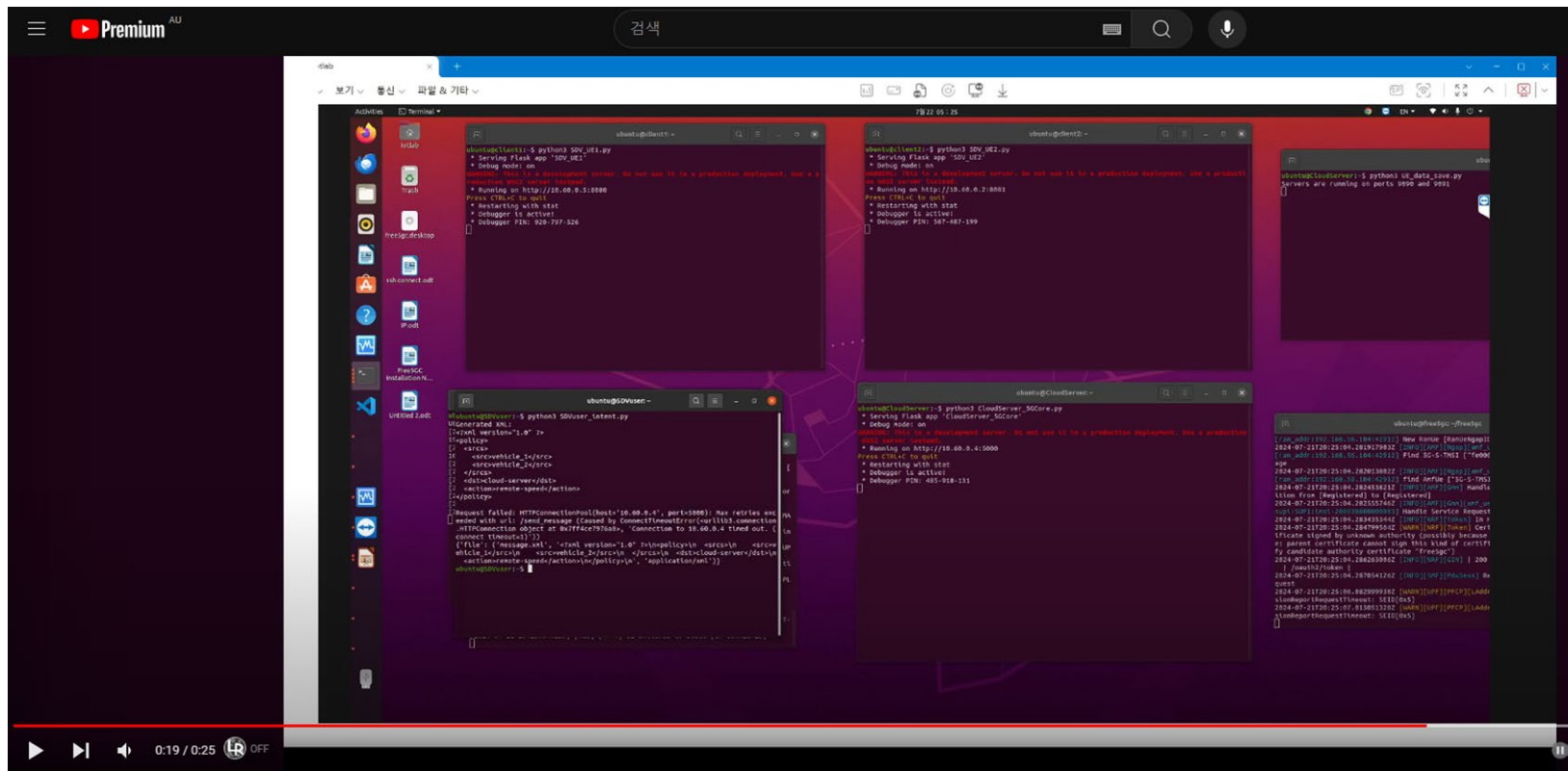
[URL] <https://github.com/jaehoonpauljeong/I2INF>

The screenshot shows the GitHub web interface for the repository `jaehoonpauljeong / I2INF`. The browser address bar displays `github.com/jaehoonpauljeong/I2INF/tree/main/IETF-120`. The repository's file browser view is active, showing the `IETF-120` directory. The left sidebar lists the file structure, including subdirectories `CloudServer`, `SDV UE1`, `SDV UE2`, `SDVuser`, and `free5gc`, along with `Readme` and `README.md`. The main content area displays a commit history table for the `IETF-120` directory, showing a series of 'Add files via upload' commits by user `ahnjs124` 15 minutes ago for each subdirectory, and a 'Create Readme' commit 4 hours ago.

Name	Last commit message	Last commit date
..		
CloudServer	Add files via upload	15 minutes ago
SDV UE1	Add files via upload	15 minutes ago
SDV UE2	Add files via upload	15 minutes ago
SDVuser	Add files via upload	15 minutes ago
free5gc	Add files via upload	15 minutes ago
Readme	Create Readme	4 hours ago

Demonstration Video Clip for I2INF

[URL] <https://youtu.be/Lf9hhI6ABcc>



In-Network Functions(I2INF)

Next Steps

- We learned how to design and implement **a Framework for Interface to In-Network Functions (I2INF) for SDVs in 5G Mobile Networks.**
- In IETF 121, we will design and develop **an Intent Translator** for the I2INF Framework for **IBN-Based System** in the 5G networks.
- Also, we will design **YANG Data Models for the Main I2INF Interfaces.**

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Hackathon Team Photo

