

IETF-121 Hackathon



Interface to In-Network Functions (I2INF) Project

November 2-3, 2024, Dublin

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Members: Yoseop Ahn, Bien Aime Mugabarigira, Mose Gu,
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Why is This Work important?

- **Advancement of Network Technologies and Emergence of Various Network Technologies**
 - Increasing complexity and cost of network management
- According to [**Cisco 2024 Global Networking Trends Report**](#)
 - 75% of network administrators feel limitations of manual network management.
 - Over 60% of IT leaders plans to introduce network automation solution with Artificial Intelligence (AI).

IETF-121 Interface to In-Network Functions (I2INF) Project



Champion: Jaehoon (Paul) Jeong (SKKU)

IETF-121 Interface to In-Network Functions (I2INF) Hackathon Project

Professors:

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

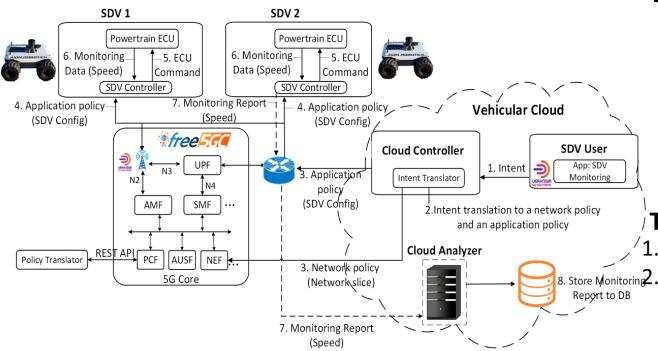
Researchers:

- Jung-Soo Park (ETRI)
- Yunchul Choi (ETRI)
- Jun Ho Ko (TTA)

Students:

- Yoseop Ahn (SKKU)
- Bien Aime Mugabarigira (SKKU)
- Mose Gu (SKKU)
- Juwon Hong (SKKU)
- Jiwon Suh (SKKU)
- Nobuo Aoki (SOKENDAI)

Architecture



Objectives

- To demonstrate Interface to In-Network Functions (I2INF).
- To set up a comprehensive framework for intent-based management of networks, security, and applications in Software-Defined Vehicles (SDVs) within 5G networks.

Future Work

- The design and implementation of an intent translator is required for correct and efficient intent translation.
- The construction of data analytics models (e.g., Machine Learning and Deep Learning models) for on-line diagnosis of SFs in SDVs for safety and security.

What to pull down to set up an environment:

- OS: Ubuntu 18.04
- Free5GC VM: version 3.4.1
- UERANSIM VM (UE & RAN): version 3.2.6
- ROS version: Melodic
- GitHub Repository:
<https://github.com/jaehoonaauljeong/I2INF>

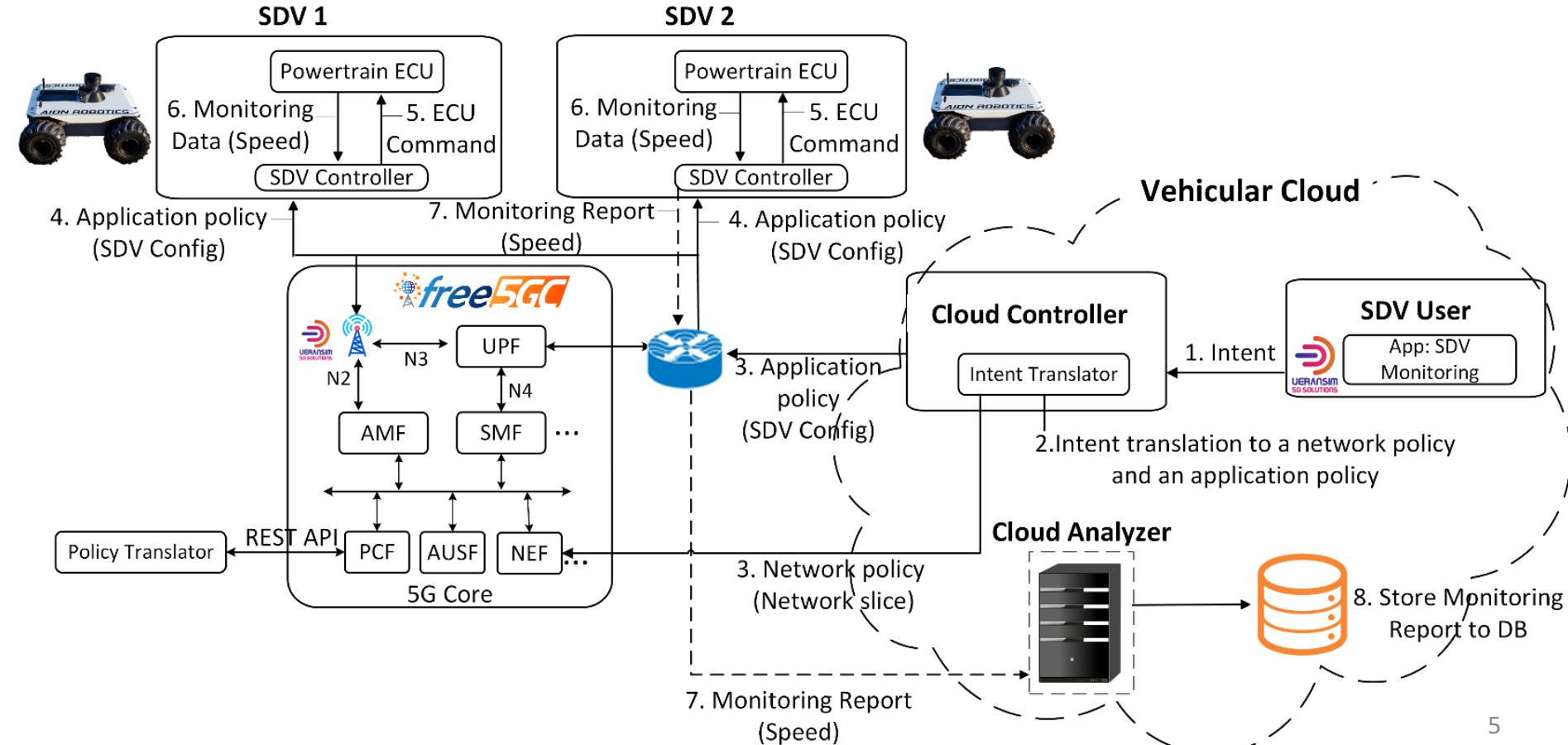
The Workflow of the 5G-Based I2INF Testbed

1. SDV User sends an intent to the Cloud Controller.
2. The intent is translated into Network and Application Policies by Intent Translator within the Cloud Controller.
3. The translated Network Policy is delivered to the 5G core network components.
4. The translated Application Policy for SDV configuration is delivered to the target SDV Controllers.
5. Each SDV Controller applies the received application policy to the Powertrain ECU, adjusting the vehicle's operational parameters accordingly.
6. The SDVs monitor operational data (e.g., speed and direction), and send this data to their SDV Controllers.
7. The SDV Controllers compile this data into monitoring reports, which are then sent to the Cloud Analyzer.
8. The Cloud Analyzer processes the monitoring reports to evaluate the functionality and performance of the applied policies and store it in the database for analysis.

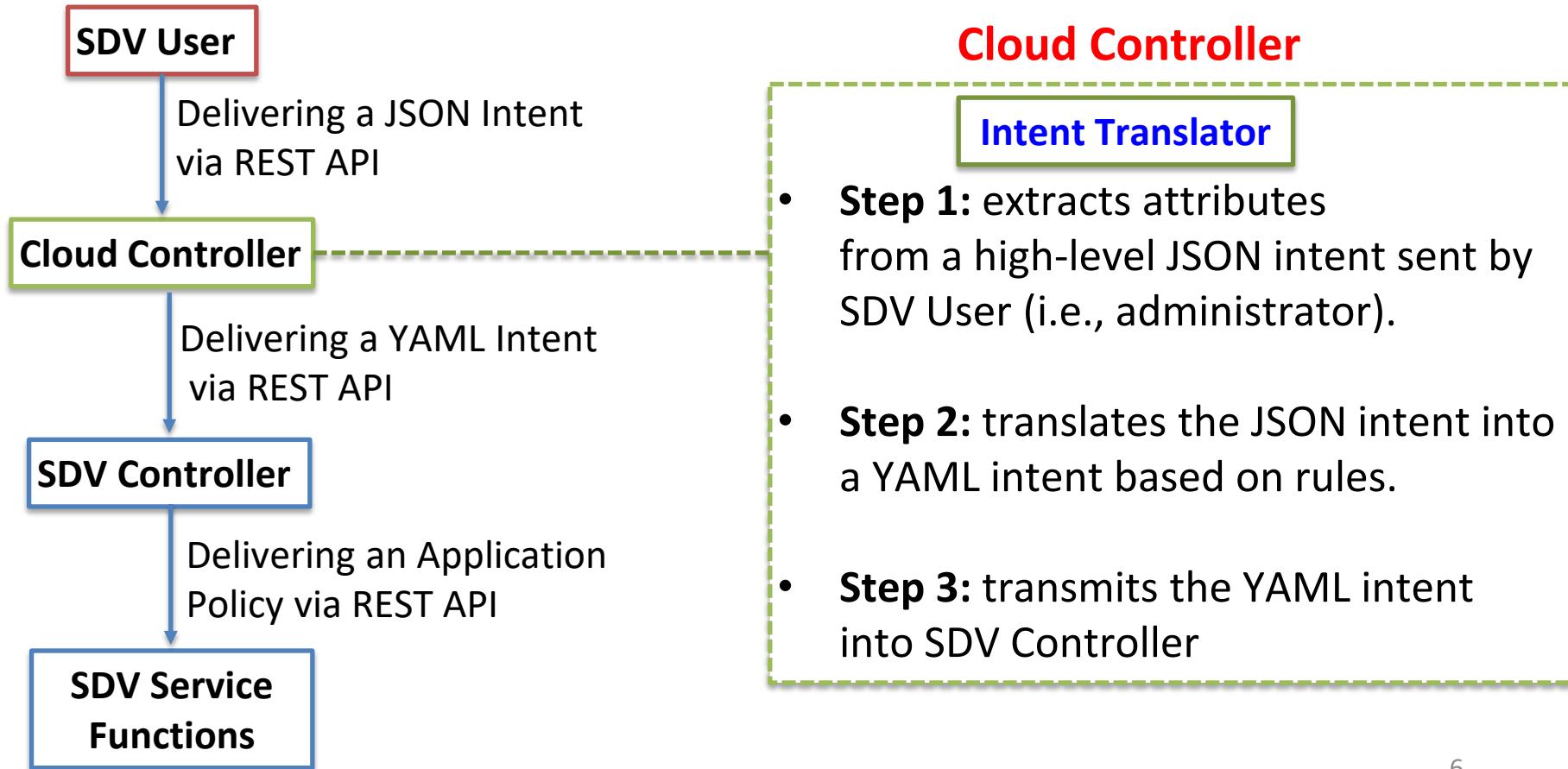
Goal of Hackathon Project

- The goal is to demonstrate the Feasibility of Intent Translation in Interfaces to In-Network Functions (I2INF) and its Framework.
 - **Intent Translation and Policy Provisioning**
 - Creation of a YAML Intent based on 3GPP 28.312 and its Deliverance to Software-Defined Vehicles (SDVs).
- Internet Drafts for the I2INF Project
 - <https://datatracker.ietf.org/doc/draft-jeong-opsawg-i2inf-problem-statement/>
 - <https://datatracker.ietf.org/doc/draft-jeong-opsawg-i2inf-framework/>
 - <https://datatracker.ietf.org/doc/draft-jeong-opsawg-intent-based-sdv-framework/>

Interface to In-Network Functions (I2INF) for SDVs



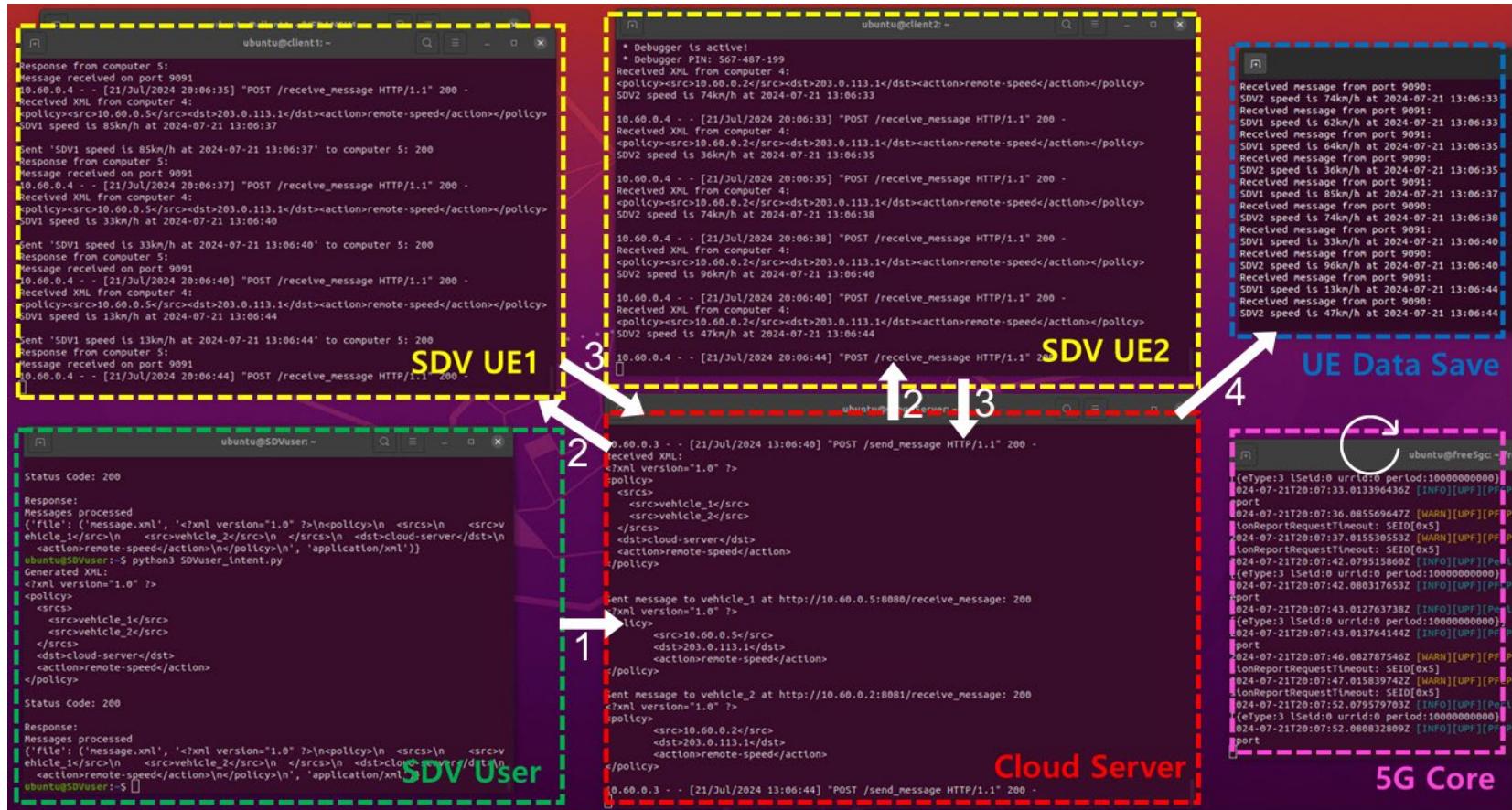
Flow Diagram of Intent Translator



What we learned

- We implemented an Intent Translator for I2INF Framework for Software-Defined Vehicles (SDV) in Wireless Networks.
- We demonstrated Intent-Based Networking (IBN) for the configuration and monitoring of SDVs through the I2INF Framework.

Demonstration of an I2INF Framework



Demonstration of an Intent Translator

Intent-Translator

Create-Intent

Creating Application Intent

User Label (String, required)

Expectation ID (String, required)

Expectation Verb (Enum: DELIVERED, ENSURE, required)

Object Type (String, required)

Target Metric (String, required)

Speed Value (String, optional)

Priority (Integer, 1-100, required)

Observation Period (Integer, in seconds, required)

Report Reference (String, required)

Submit

JSON Intent

SDV User

```
totlab@user1:~/intent_translator-main/backend$ python3 manage.py runserver
Watching for file changes with StatReloader
Performing system checks...
System check identified no issues (0 silenced).
November 02, 2024 - 11:44:46
Django version 4.2.16, using settings 'intranslator.settings'
Starting development server at http://127.0.0.1:8000/
Quit the server with CONTROL-C.

Received request body: b'{"user_label": "Retrieve SDV Speed", "expectation_id": "1", "expectation_verb": "ENSURE", "object_type": "RAN", "context_attributes": [{"contextAttribute": "TargetSDV", "contextCondition": "IS_EQUAL_TO", "contextValueRange": ["SDV_002"]}], "target_metrics": [{"targetName": "Speed", "targetCondition": "IS_REPORTED", "targetValueRange": ["100"]}], "priority": "1", "observation_period": "60", "report_reference": "IntentReport_001"}'
```

Cloud Controller

```
Cloudlab@cloudserver:~/I2INF/IETF-121/CloudServer$ python3 CloudController_5GCore.py
Running on IP: 10.60.0.2
* Serving Flask app 'CloudController_5GCore'
* Debug mode: on
WARNING: This is a development server. Do not use it in a production deployment. Use a production WSGI server instead.
* Running on http://10.60.0.2:5000
Press CTRL+C to quit
* Restarting with stat
Running on IP: 10.60.0.2
* Debugger is active!
* Debugger PIN: 290-268-226

=====Intent from User=====
Received intent:
{'context_attributes': [{'contextAttribute': 'TargetSDV', 'contextCondition': 'IS_EQUAL_TO', 'contextValueRange': ['SDV_002']}], 'expectation_id': '1', 'expectation_verb': 'ENSURE', 'object_type': 'RAN', 'observation_period': '60', 'priority': '1', 'report_reference': 'IntentReport_001', 'target_metrics': [{"targetName": "Speed", "targetCondition": "IS_REPORTED", "targetValueRange": ["100"]}], 'user_label': 'Retrieve SDV Speed'}
```

YAML Intent

SDV Controller

Open-Source Project for I2INF

[URL] <https://github.com/jaehoonpauljeong/I2INF/tree/main/IETF-121>

github.com/jaehoonpauljeong/I2INF/tree/main/IETF-121

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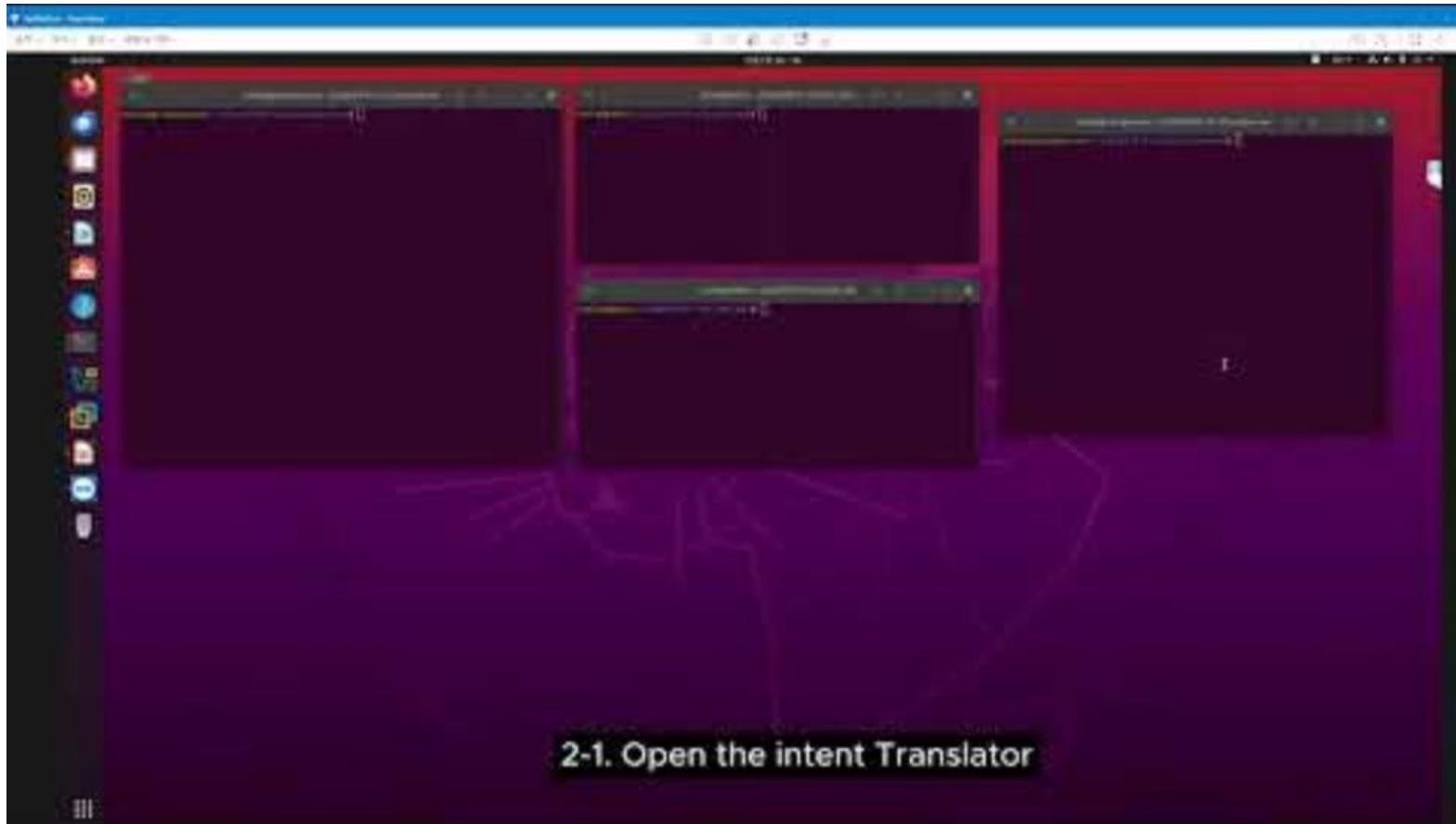
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Name	Last commit message	Last commit
...		
CloudServer	Add files via upload	2 days
SDV_UE1	Add files via upload	2 days
SDV_UE2	Add files via upload	2 days
SDVuser	Add files via upload	2 days
readme.txt	Create readme.txt	5 days
readme.txt		

Demonstration Video Clip for I2INF

[URL] https://www.youtube.com/watch?v=AAGVGPI6E9s&ab_channel=Joseph



Next Steps

- We learned how to design and implement **an Intent Translator** for the I2INF Framework for **IBN-Based System** in wireless networks.
- In IETF 122, we will develop **an Intent Translator** that advances from a Rule-based scheme to an AI-based scheme (e.g., Large Language Model: LLM).
- Also, we will design **YANG Data Models for the Main I2INF Interfaces**.
 - Refer to <https://datatracker.ietf.org/doc/draft-jeong-opsawg-i2inf-framework/>

I2INF Hackathon Team

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Hackathon Team Photo

