IETF-122 Hackathon

Interface to In-Network Computing Functions (I2ICF) Project

March 15-21, 2025, Bangkok

Champion: Jaehoon (Paul) Jeong

Members: Yoseop Ahn, Byoungman Robert An, Xudong Wang

Department of Computer Science and Engineering at SKKU

Korea Electronics Technology Institute

Email: {pauljeong, ahnjs124, wangxudong28}@skku.edu, bman@keti.re.kr

IETF-122 Interface to In-Network Computing Functions (I2ICF)

Champion: Jaehoon (Paul) Jeong (SKKU)

IETF-122 Interface to In-Network Computing Functions (I2ICF) Hackathon

Professors:

- Jaehoon (Paul) Jeong (SKKU)
- Yiwen (Chris) Shen (AJU)

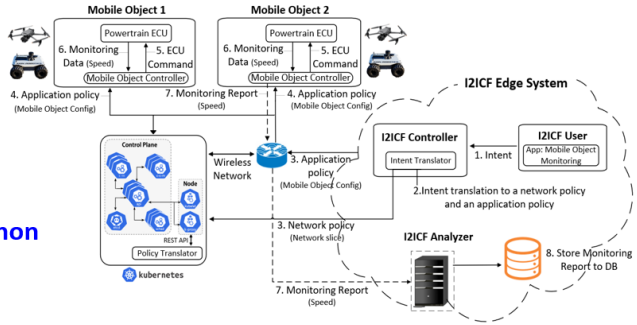
Researchers:

- Jung-Soo Park (ETRI)
- Yunchul Choi (ETRI)
- Byoungman Robert An (KETI)

Students:

- Yoseop Ahn (SKKU)
- Xudong Wang (SKKU)
- Bien Aime Mugabarigira (SKKU)
- Mose Gu (SKKU)
- Juwon Hong (SKKU)
- Jiwon Suh (SKKU)

Architecture



Objectives

- To demonstrate Interface to In-Network Computing Functions (I2ICF).
- To build a comprehensive framework for intent-based management of networks, security, and applications in Mobile Objects (e.g., SDV and Drone) within the Kubernetes environment.

Future Work

- We plan to use In-Context Learning and Prompt Tuning to design and implement the intent translator.
- The development of data analytics models, including Machine Learning and Deep Learning, for real-time diagnosis of Service Functions (SFs) in Mobile Objects to enhance safety and security.

What to pull down to set up an environment:

- OS: Ubuntu 18.04 & 20.04
- Kubernetes: Microk8s v1.32.2
- ROS version: Melodic
- GitHub Repository: https://github.com/jaehoonpauljeong/I2ICF/tree/main/IETF-122

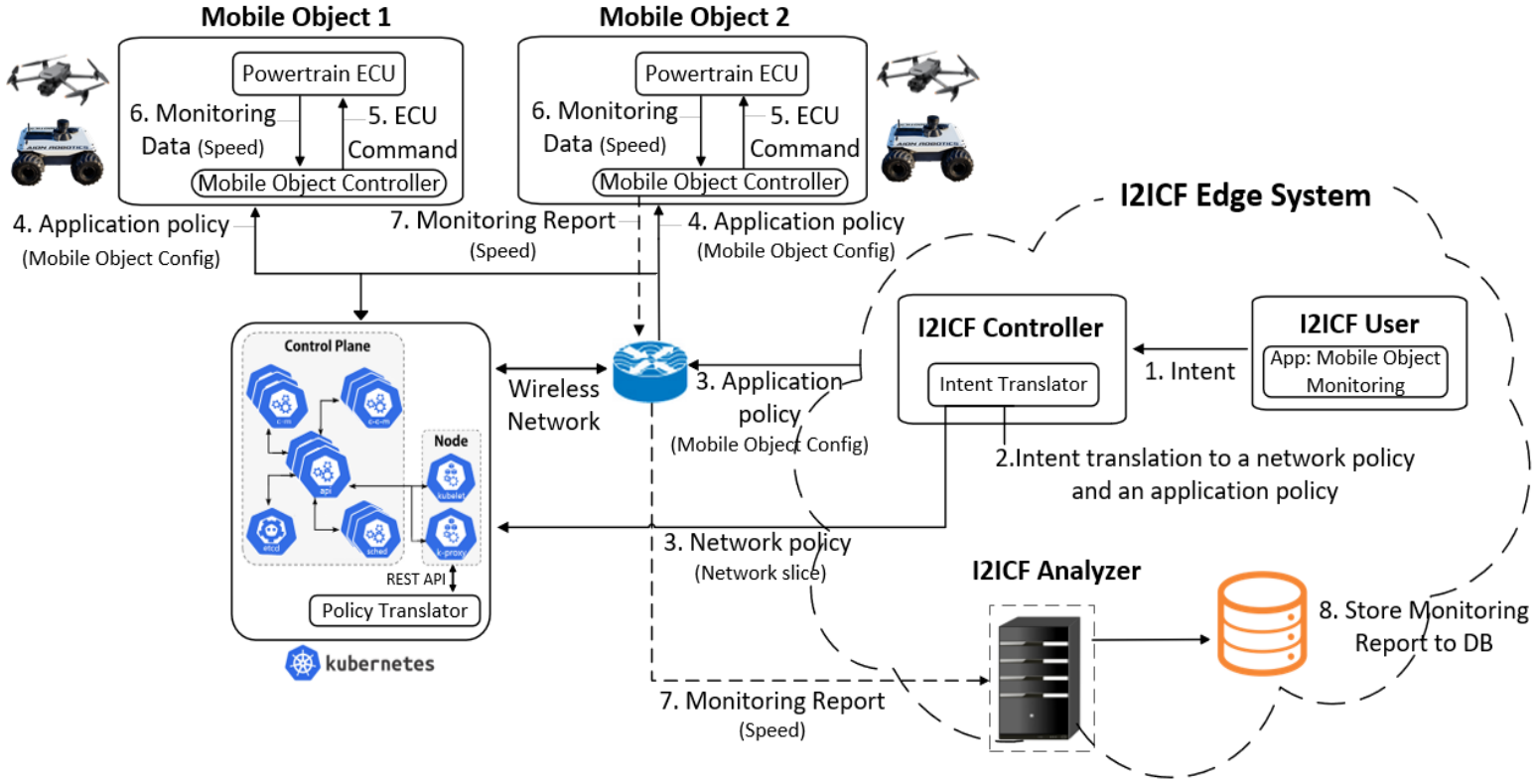
Workflow of the I2ICF Testbed on Kubernetes

1. I2ICF User sends an intent to the I2ICF Controller.
2. The I2ICF Controller's Intent Translator converts the intent into Network and Application Policies.
3. The translated Network Policy is forwarded to the wireless network components.
4. The translated Application Policy for Mobile Object configuration is sent to each Mobile Object Controller.
5. Each Mobile Object Controller enforces the received application policy on the Powertrain ECU, adjusting the operational parameters as needed.
6. The Mobile Objects continuously monitor operational data (e.g., speed and direction) and transmit it to their Mobile Object Controllers.
7. The Mobile Object Controllers set this data into Monitoring Report and forward them to the I2ICF Analyzer.
8. The I2ICF Analyzer processes the monitoring report to assess the performance of the applied policies and stores the results in a database for further analysis.

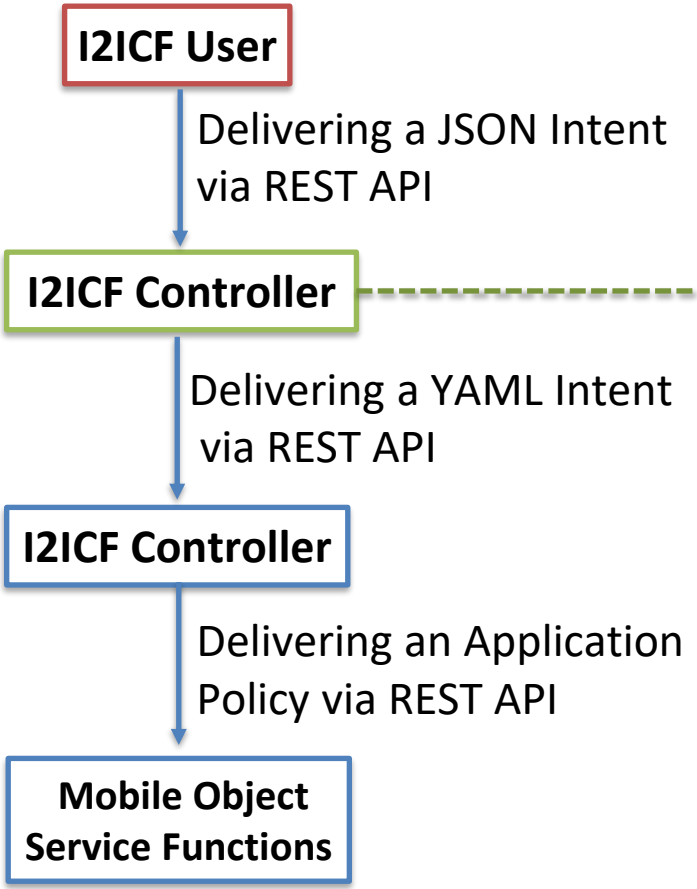
Goal of Hackathon Project

- The goal is to showcase Viability of Intent Translation in Interfaces to In-Network Computing Functions (I2ICF) and its Framework.
  - **Intent Translation** and **Policy Provisioning**
    - Creation of a YAML Intent based on 3GPP 28.312 and its Deliverance to Mobile Objects.
- Internet Drafts for the I2ICF Project
  - https://datatracker.ietf.org/doc/draft-ahn-opsawg-i2icf-cits/
  - https://datatracker.ietf.org/doc/draft-ywj-opsawg-i2icf-data-center-networking/
  - https://datatracker.ietf.org/doc/draft-jeong-opsawg-i2icf-framework/
  - https://datatracker.ietf.org/doc/draft-jeong-opsawg-i2icf-problem-statement/

Interface to In-Network Computing Functions (I2ICF) for Mobile Objects



Flow Diagram of Intent Translator



I2ICF Controller

Intent Translator

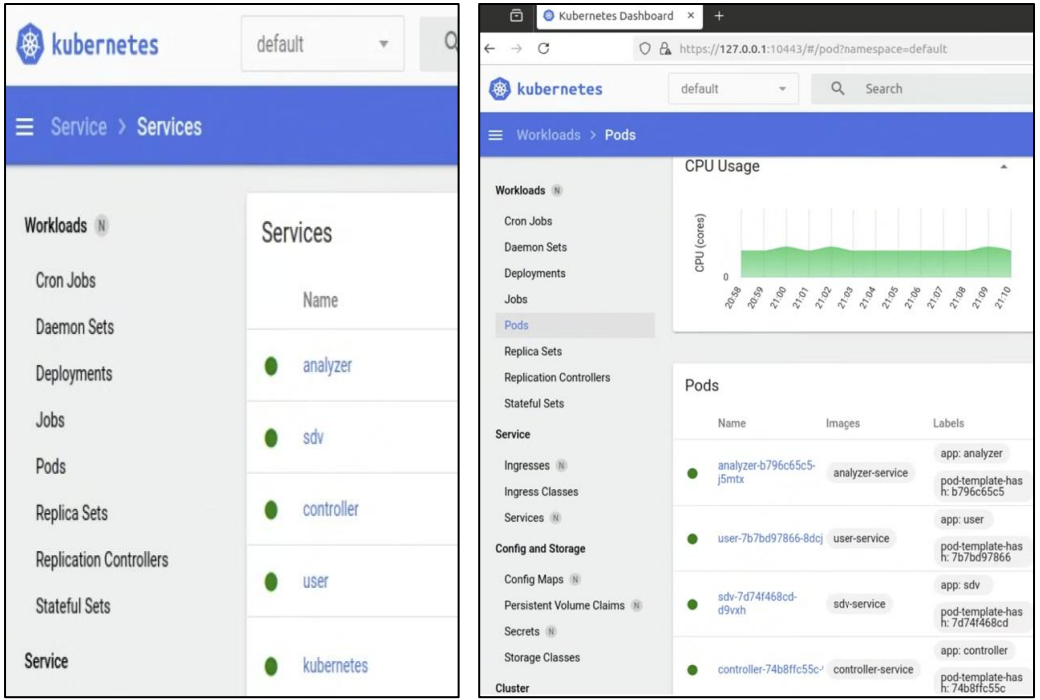
- **Step 1:** Extracts attributes from a high-level JSON intent sent by I2ICF User (i.e., administrator).
- **Step 2:** Translates the JSON intent into a YAML intent based on rules.
- **Step 3:** Transmits the YAML intent into I2ICF Controller

What we learned

- We implemented an Intent Translator for I2ICF Framework for Mobile Objects in Wireless Networks.

- We demonstrated Intent-Based Networking (IBN) for the configuration and monitoring of Mobile Objects through the I2ICF Framework.

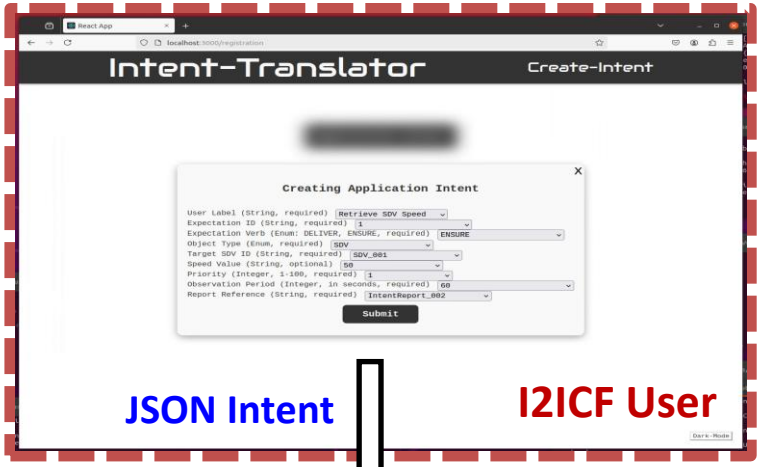
Demonstration of an I2ICF Framework

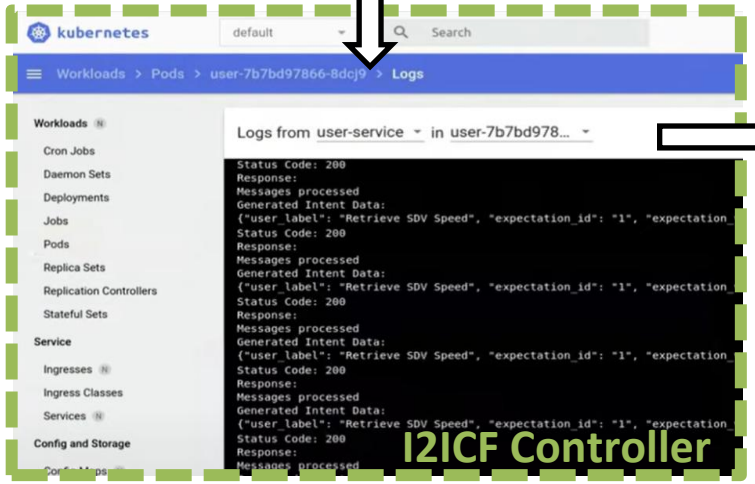


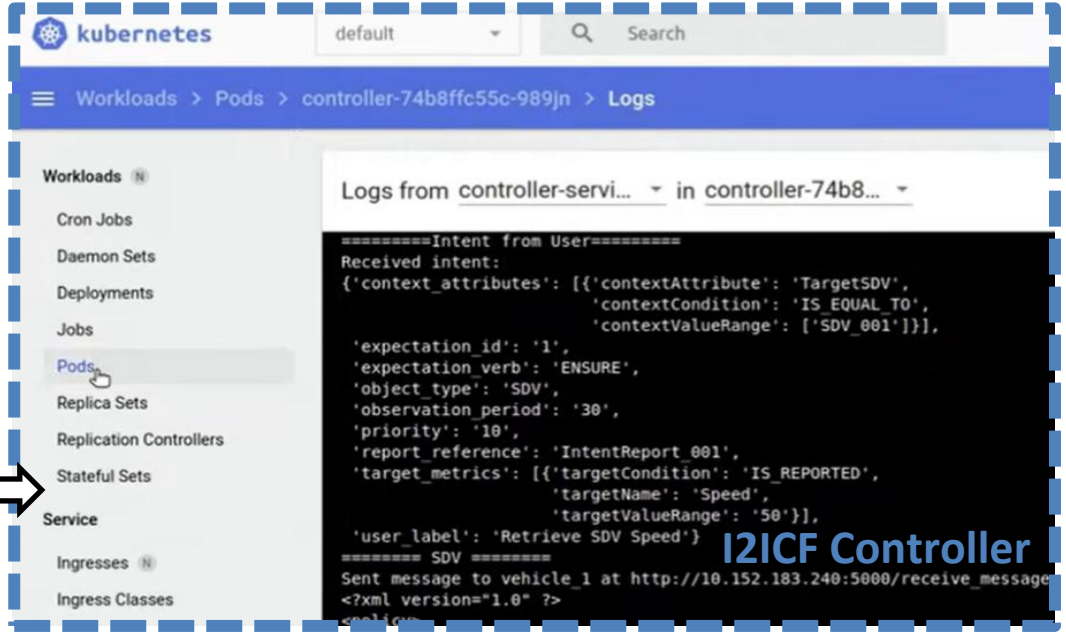
I2ICF Services and Pods on Kubernetes

Logs of each I2ICF Service

Demonstration of an Intent Translator



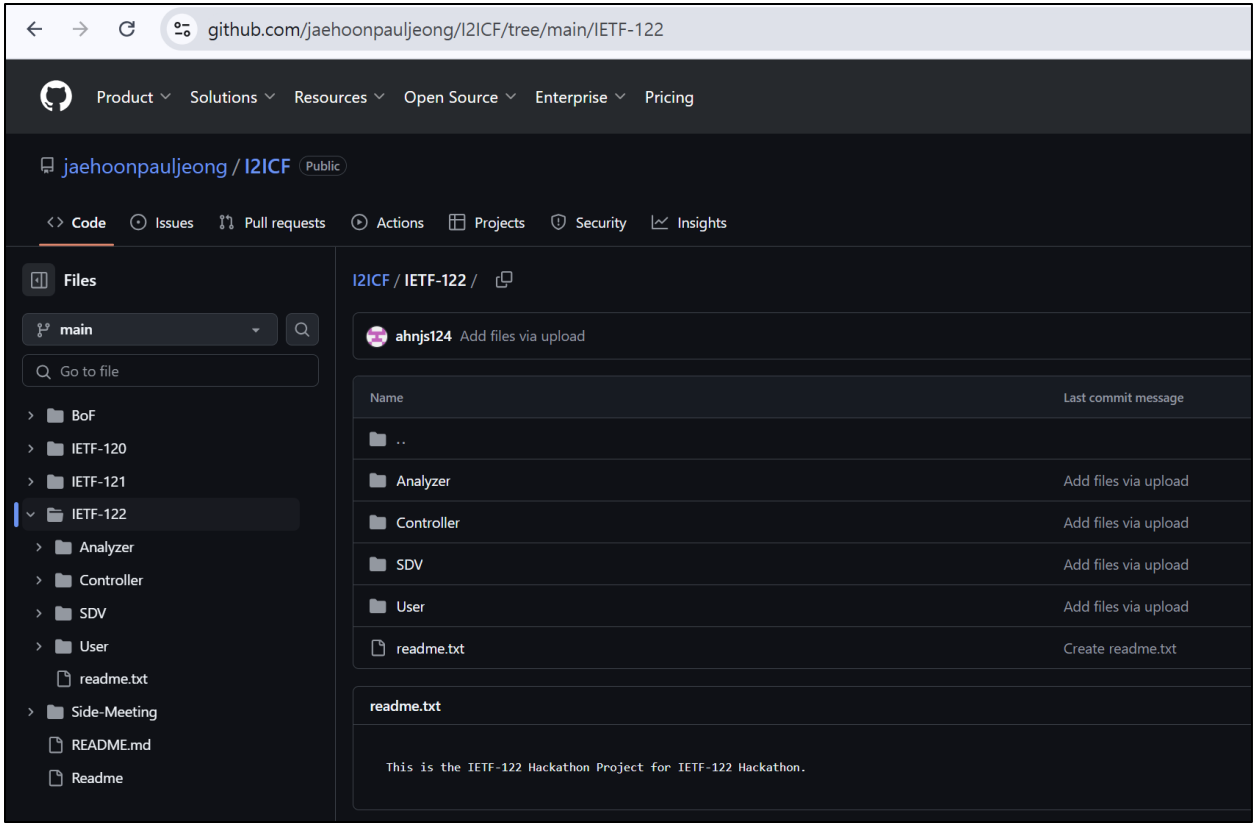




YAML Intent

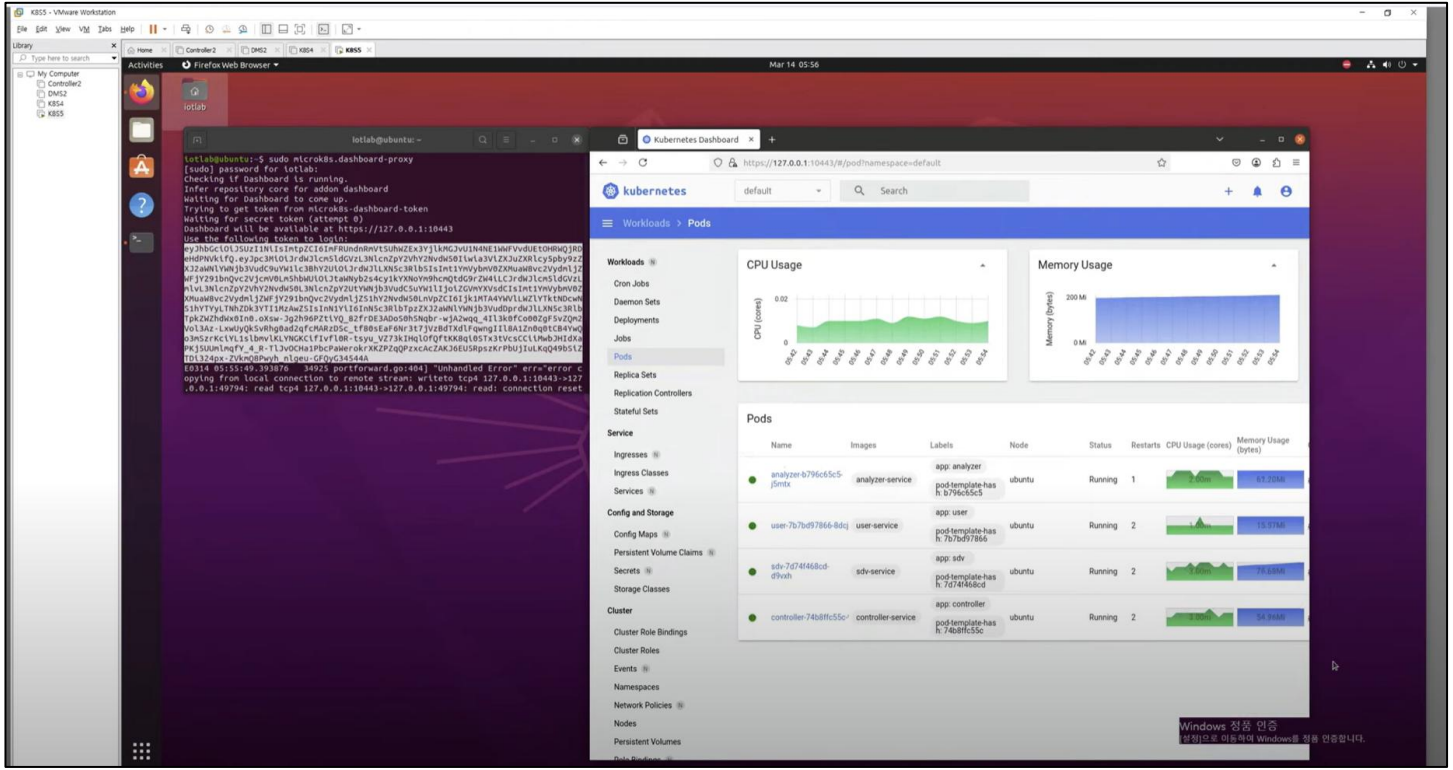
Open-Source Project for I2ICF

[URL] https://github.com/jaehoonpauljeong/I2ICF/tree/main/IETF-122



Demonstration Video Clip for I2ICF

[URL] https://www.youtube.com/watch?v=hZgnWIQzXbE



Next Steps

- We explored the implementation and design of **an Intent Translator** for the I2ICF Framework within **IBN-Based System** in wireless networks.

- In IETF 123, we will develop **an Intent Translator** that advances from a Rule-based scheme to an AI-based scheme (e.g., Large Language Model: LLM) on Kubernetes Container Orchestration System.

- Also, we will design **YANG Data Models for the Main I2ICF Interfaces.**
  - Refer to https://datatracker.ietf.org/doc/draft-jeong-opsawg-i2icf-framework/

I2ICF Hackathon Team

- **Professors:**
  - **Jaehoon (Paul) Jeong (SKKU)**
  - **Yiwen (Chris) Shen (AJU)**
- **Researchers:**
  - **Jung-Soo Park (ETRI)**
  - **Yunchul Choi (ETRI)**
  - **Byoungman Robert An (KETI)**
- **Students:**
  - **Yoseop Ahn (SKKU), Xudong Wang (SKKU), Mugabarigira Bien Aime (SKKU), Mose Gu (SKKU), Jiwon Suh (SKKU), Juwon Hong (SKKU), Nobuo Aoki (SOKENDAI)**

Hackathon Team Photo