



IETF-122 Hackathon



Interface to In-Network Computing Functions (I2ICF) Project

March 15-21, 2025, Bangkok

Champion: Jaehoon (Paul) Jeong

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Professors:

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

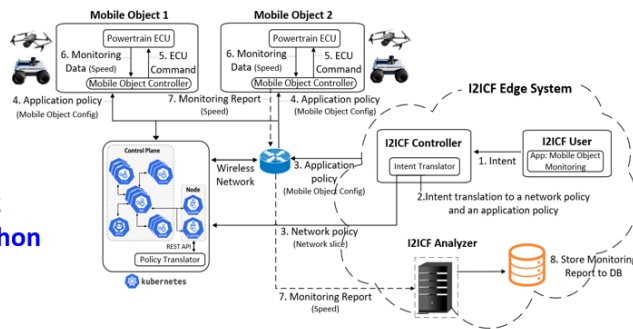
Researchers:

- 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)
- Zhiqiang Shen (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 a data analytics model, 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>

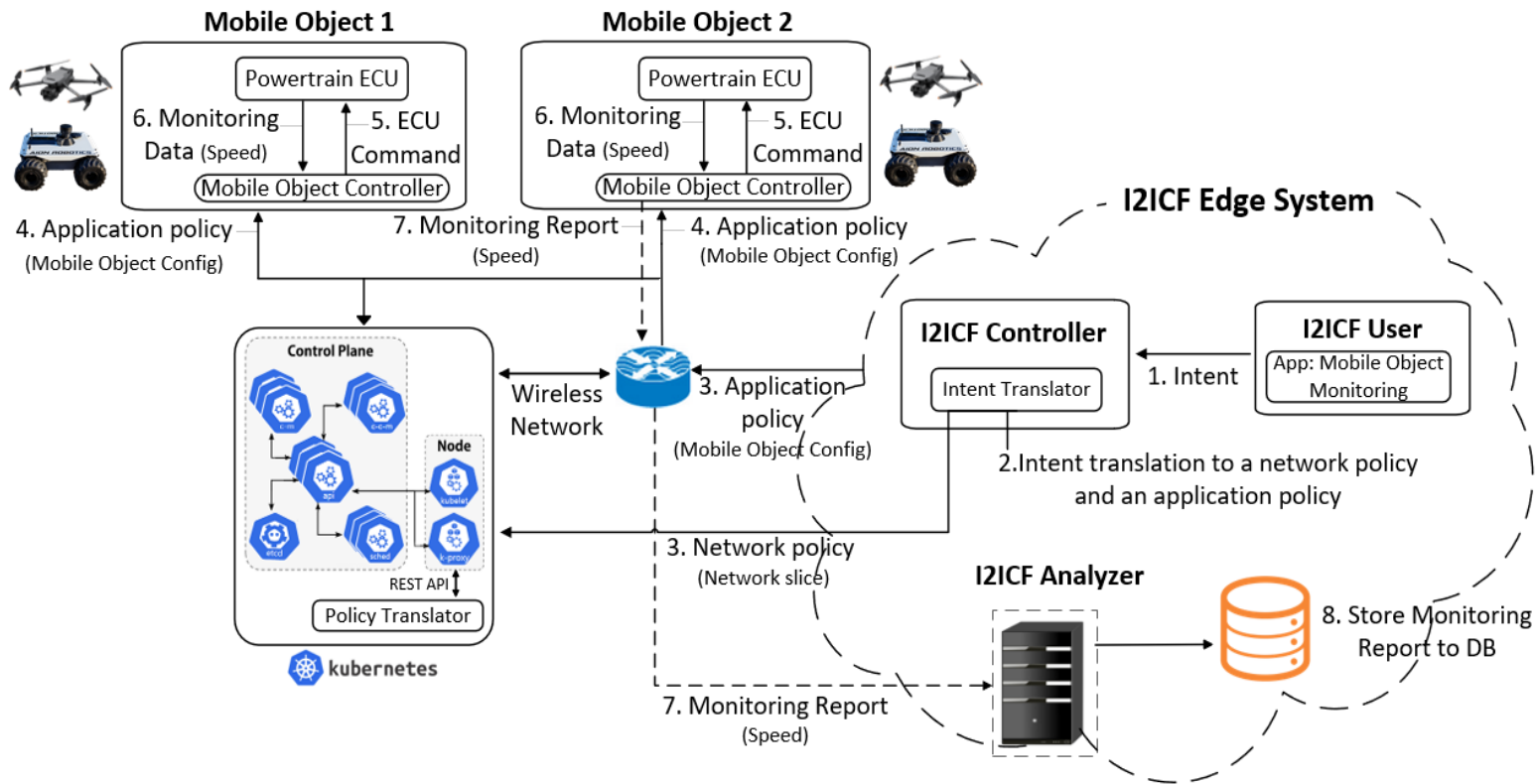
Workflow of the I2ICF Testbed on Kubernetes

- I2ICF User sends an intent to the I2ICF Controller.
- The I2ICF Controller's Intent Translator converts the intent into Network and Application Policies.
- The translated Network Policy is forwarded to the wireless network components.
- The translated Application Policy for Mobile Object configuration is sent to each Mobile Object Controller.
- Each Mobile Object Controller enforces the received application policy on the Powertrain ECU, adjusting the operational parameters as needed.
- The Mobile Objects continuously monitor operational data (e.g., speed and direction) and transmit it to their Mobile Object Controllers.
- The Mobile Object Controllers set this data into Monitoring Report and forward it to the I2ICF Analyzer.
- 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.

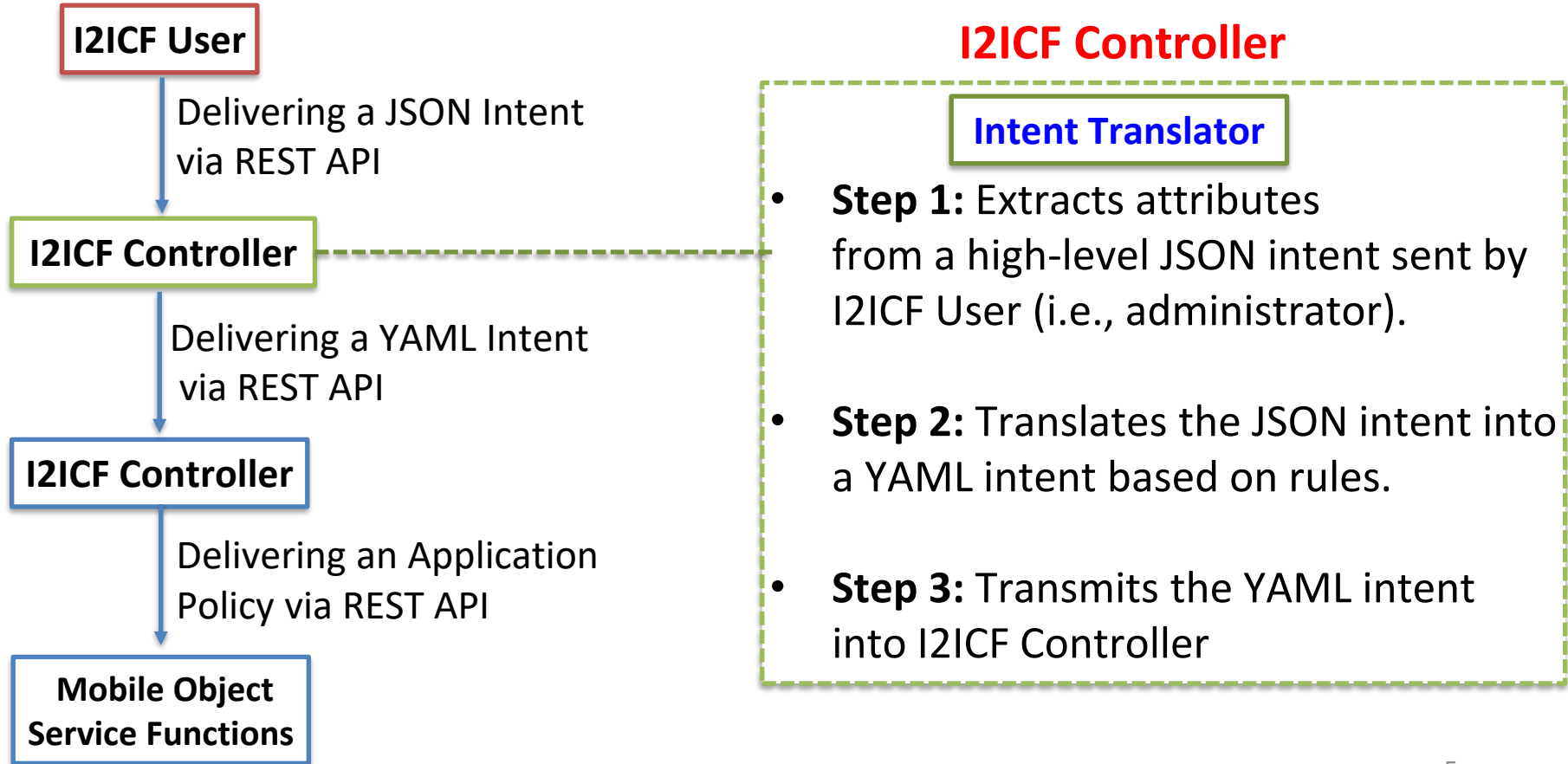
Goal of Hackathon Project

- 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



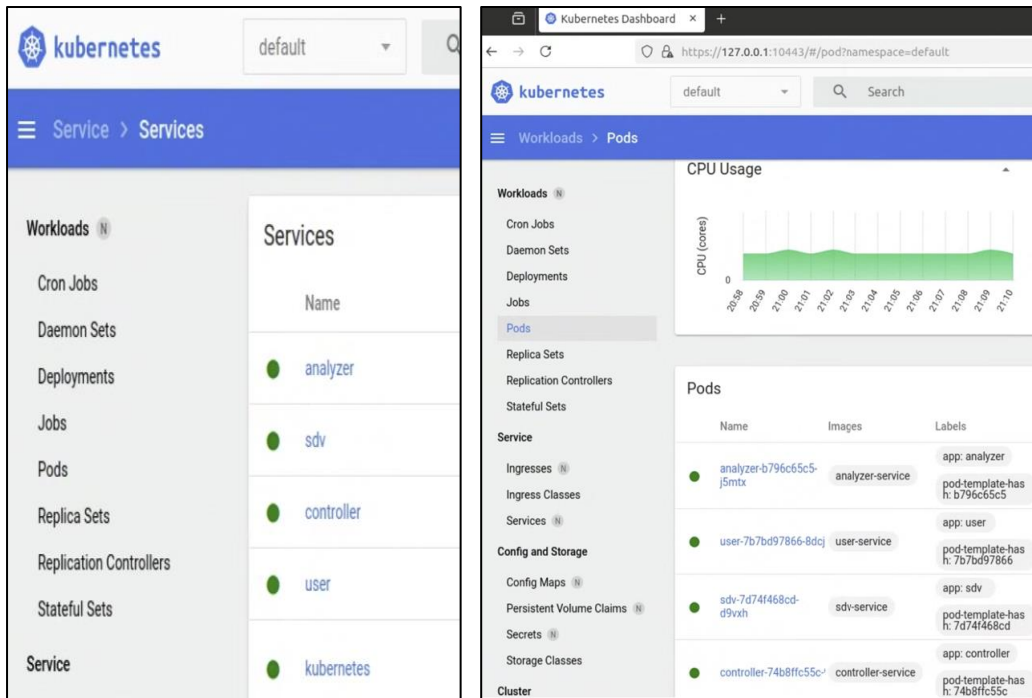
Flow Diagram of Intent Translator



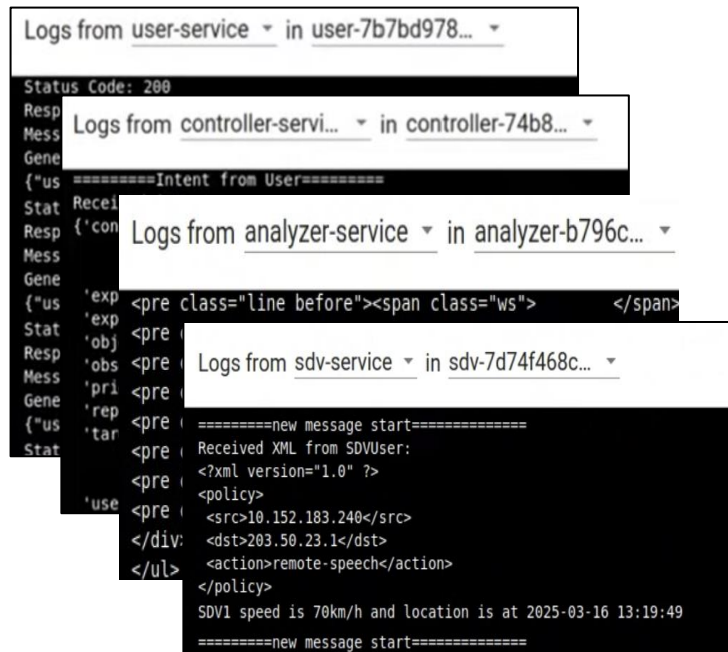
What we learned

- 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

Intent-Translator Create-Intent

Creating Application Intent

User Label (String, required) Retrieve SDV Speed

Expectation ID (String, required) 1

Expectation Verb (Enum: DELIVER, ENSURE, required) ENSURE

Object Type (Enum, required) SDV

Target SDV ID (String, required) SDV_001

Speed Value (String, optional) 50

Priority (Integer, 1-100, required) 1

Observation Period (Integer, in seconds, required) 60

Report Reference (String, required) IntentReport_002

Submit

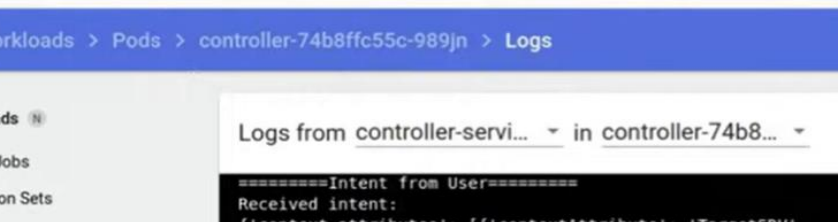
JSON Intent

I2ICF User

I2ICF User

[illegible]

YAML Intent



Kubernetes

default

Search

Workloads > Pods > controller-74b8ffc55c-989jn > Logs

Workloads

Cron Jobs

Daemon Sets

Deployments

Jobs

Pods

Replica Sets

Replication Controllers

Stateful Sets

Service

Ingresses

Ingress Classes

Logs from controller-servi... in controller-74b8...

```

=====Intent from User=====
Received intent:
{\'context_attributes\': [{\'contextAttribute\': \'TargetSDV\',
                          \'contextCondition\': \'IS_EQUAL_TO\',
                          \'contextValueRange\': [\'SDV_001\']}],
 \'expectation_id\': \'1\',
 \'expectation_verb\': \'ENSURE\',
 \'object_type\': \'SDV\',
 \'observation_period\': \'30\',
 \'priority\': \'10\',
 \'report_reference\': \'IntentReport_001\',
 \'target_metrics\': [{\'targetCondition\': \'IS_REPORTED\',
                    \'targetName\': \'Speed\',
                    \'targetValueRange\': \'50\'}],
 \'user_label\': \'Retrieve SDV Speed\'}

===== SDV =====
Sent message to vehicle_1 at http://10.152.183.240:5000/receive_message
<?xml version="1.0" ?>

```

12ICF Controller

Open-Source Project for I2ICF

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

The screenshot shows the GitHub web interface for the repository `jaehoonpauljeong / I2ICF`. The page is viewed on the `main` branch, specifically the `IETF-122` directory. The left sidebar shows the file tree with `IETF-122` selected. The main content area displays a table of files and folders in the `IETF-122` directory, along with a `readme.txt` file. The `readme.txt` content is visible at the bottom of the page.

Name	Last commit message
..	
Analyzer	Add files via upload
Controller	Add files via upload
SDV	Add files via upload
User	Add files via upload
readme.txt	Create readme.txt

readme.txt

This is the IETF-122 Hackathon Project for IETF-122 Hackathon.

[URL] <https://www.youtube.com/watch?v=hZgnWlQzXbE>

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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/>

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Hackathon Team Photo

