IETF-123 I2ICF Side Meeting

Interface to In-Network Computing Functions (I2ICF): Framework

(draft-jeong-opsawg-i2icf-framework-00)

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Motivation of this Draft

- **Interface to In-Network Computing Functions (I2ICF)**
  - The draft defines **a Framework** for configuring and monitoring Moving Objects (e.g., Robotic AI Agents) via **Interface to In-Network Computing Functions (I2ICF)** by a user in Cloud.
    - **In-Network Computing Functions (ICF) within Moving Objects**
      - **Perception Functions, Reasoning Functions, Action Functions, and Autonomy Functions**
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- **Main Contents of this Draft**
  - In-Network Computing Functions (ICFs) as Service Functions
  - Framework Components
  - Interfaces in the I2ICF Framework

Service Functions of Moving Objects

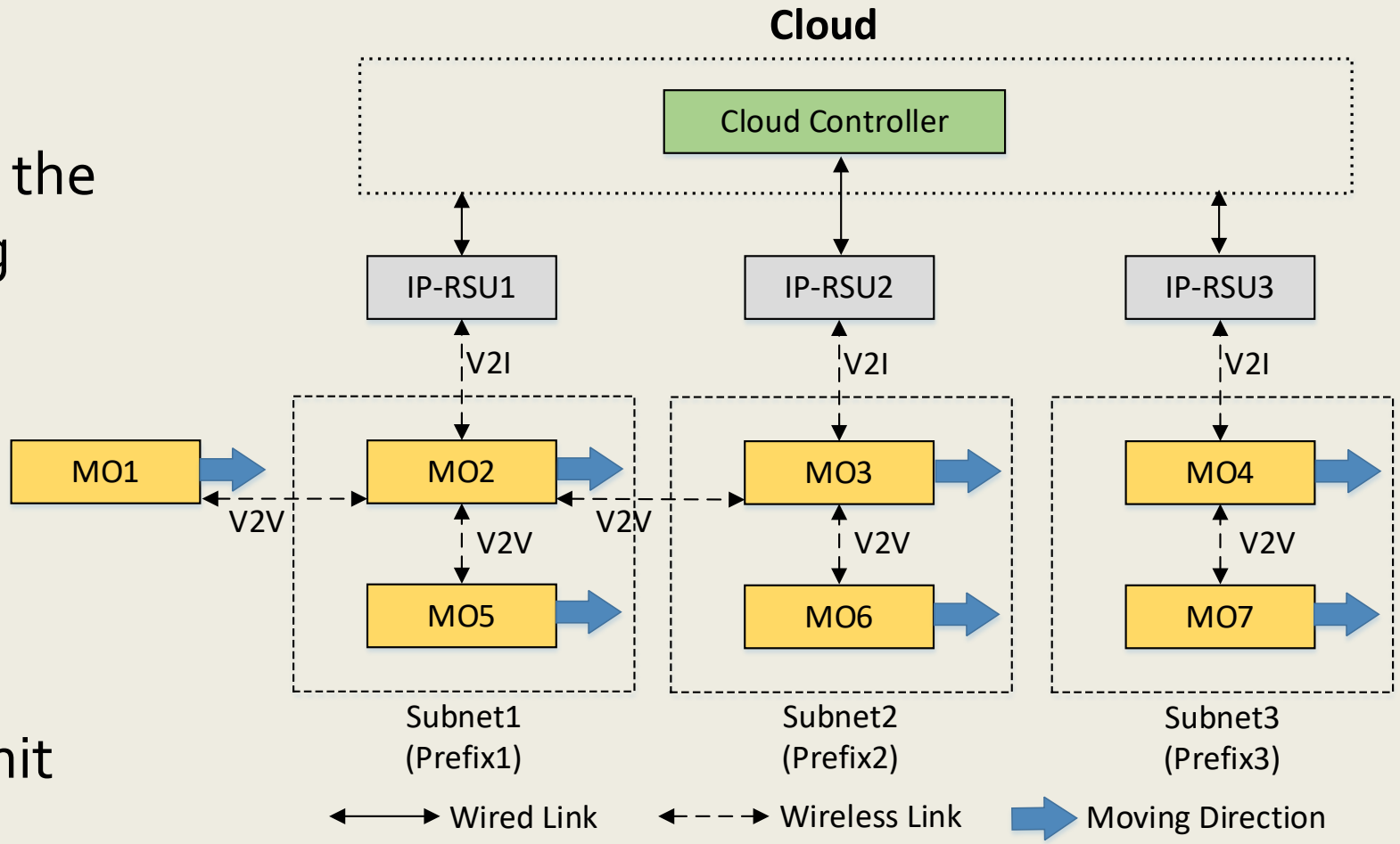
Robot Car

Drone

- **Perception Functions:** Sensing by Sensors (e.g., Camera)
- **Reasoning Functions:** AI Inference
- **Action Functions:** Message Delivery (e.g., Camera Video Data), Moving Robot, and Transaction (e.g., Logging and Monitoring Data Delivery)
- **Autonomy Functions:** Autonomous Navigation and Actuation

I2ICF Framework for ICF Management
(e.g., Moving Objects (MOs) like Robotic AI Agents)

- This framework shows Wireless and Wired Networks in a Cloud for the I2ICF framework having Moving Objects (MOs).

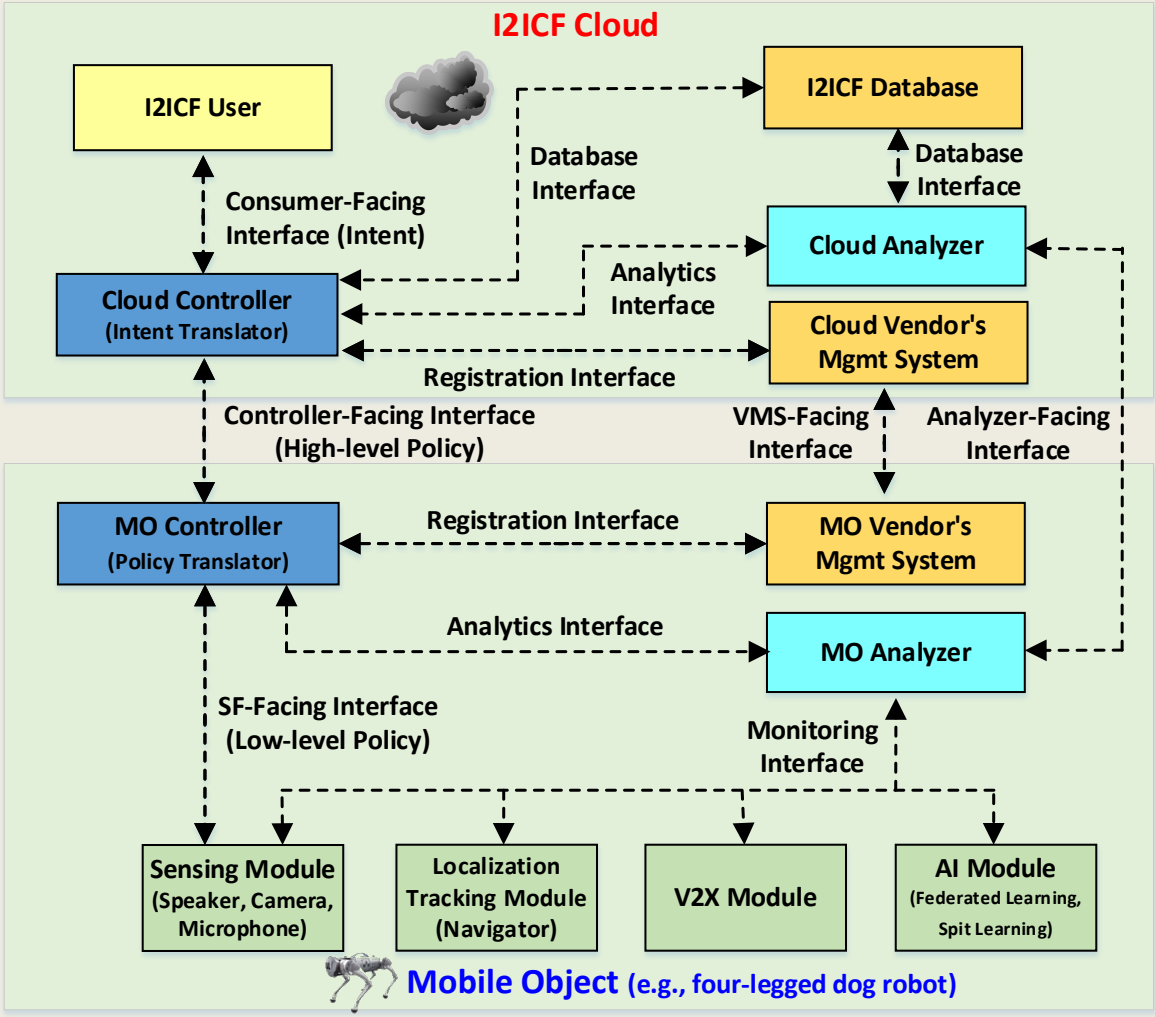


Wireless and Wired Networks in the Cloud for I2ICF Framework

IP-RSU: IP Road-Side Unit
MO: Moving Object

I2ICF Framework for ICF Management
(ICFs in Moving Object)

- For the automatic network configuration of MOs, an **Intent-Based Management** is required between the Cloud and MOs.
- This framework shows an **I2ICF framework as an IBS for an MO**. The framework consists of the Cloud and MOs.



I2ICF Framework for Moving Objects

I2ICF Framework for ICF Management

- The Cloud consists of the components below:
  - **I2ICF User**

    The software that is used by I2ICF administrators to deliver network intents to MO Controllers.
  - **Cloud Controller**

    The main component that is responsible for the management and control of other system components of the central/edge cloud, including security.

I2ICF Framework for ICF Management

- The Cloud consists of the components below:
  - **I2ICF Database**

    The database that manages the information of MOs, including the configuration and status of networks, security, and AI applications in MOs.
  - **Cloud Analyzer**

    The component that gathers and evaluates monitoring data from MO Analyzers to ensure the functionality and performance of SFs.

I2ICF Framework for ICF Management

- An IBS in an MO is composed of components below:
  - **MO Controller**

    Controls and manages other elements of the MO framework to ensure proper policy execution and system behavior, which is essential for operating a Robotic AI Agent.
  - **Vendor's Management System**

    The component that provides virtualized SF images such as object recognition, path planning, and control modules, which are commonly used in Robotic AI Agents.

I2ICF Framework for ICF Management

- An IBS in an MO is composed of components below:
  - **MO Analyzer**

    The component that collects and analyzes monitoring data from SFs to observe their activity and performance, enabling diagnostics in robotic systems.
  - **Service Function (SF)**

    The component that can be a virtual network function (VNF), cloud native network function (CNF), or physical network function (PNF) of a specific service, including AI-based perception, reasoning, or control functions in a Robotic AI Agent.

Interfaces in the I2ICF

- **The interfaces in the I2ICF are composed as below:**
  - **Consumer-Facing Interface**

    The interface between I2ICF User and Cloud Controller.
  - **Controller-Facing Interface**

    The interface between Cloud Controller and MO Controller for the transmission of high-level policies corresponding to translated intents.
  - **Service Function (SF)-Facing Interface**

    The interface between MO Controller and an SF for the transmission of translated lower-level policies.

Interfaces in the I2ICF

- **The interfaces in the I2ICF are composed as below:**
  - **Registration Interface**

    The interface used to transfer information about SF capabilities and access control for the registration of the SF with either Cloud Controller or MO Controller.
  - **Monitoring Interface**

    The interface between the SF and MO Analyzer used to collect the SF monitoring data and is employed to identify the issues related to networks, security, systems, and AI applications as the SFs.
  - **Analytics Interface**

    The interface for the transmission of policy reconfigurations or feedback produced as a result of analyzing the SF monitoring data.

Interfaces in the I2ICF

- **The interfaces in the I2ICF are composed as below:**
  - **Analyzer-Facing Interface**

    The interface between MO Analyzer and Cloud Analyzer for the exchange of the analysis of networks, security, and AI applications as SFs.
  - **VMS-Facing Interface**

    The interface between MO VMS used to exchange SF feature information, such as SF container images.
  - **Database Interface**

    The interface for exchanging data of an I2ICF Database. This is an interface between I2ICF Database and Cloud Controller, or between I2ICF Database and Cloud Analyzer.

Summary

- This document proposes an I2ICF framework as an Intent-Based System (IBS) for Moving Objects (MOs).
- Through this IBS, the SFs (i.e., Afs and NFs) in the MOs can be better configured and managed, especially in intelligent systems such as Robotic AI Agents.
- Based on the proposed framework, both virtualized AFs and NFs can be efficiently orchestrated for flexible updates and resource reconfigurations, supporting adaptation in autonomous robotic environments.

Next Steps

- This draft will be enhanced to accommodate use cases for I2ICF as follows:
  - A Use Case of Cooperative Intelligent Transportation Systems (C-ITS)
  - A Use Case of Moving Objects (e.g., Robots and SDVs)
- I2ICF Group will prepare a WG-Forming BoF in the IETF 124 in Montreal.
- I2ICF Group will prepare IETF-124 Hackathon Project to clarify the I2ICF Framework and Interfaces.