

IETF-121 I2INF Side Meeting



Interface to In-Network Functions (I2INF): Problem Statement ([draft-jeong-opsawg-izinf-problem-statement-02](#))

November 6, 2024

Dublin in Ireland

**Jaehoon Paul Jeong, Yiwen Shen, Yoseop Ahn, Younghan Kim,
Elias P. Duarte Jr., Kehan Yao**

Email: {pauljeong, chrisshen, ahnjs124}@skku.edu, younghak@ssu.ac.kr,
elias@inf.ufpr.br, yaokehan@chinamobile.com



Interface to In-Network Functions (I2INF)

❑ Interface to In-Network Functions (I2INF)

- ❑ I2INF aims at making a standard framework and its interfaces for In-Network Functions like Programmable Network Devices (PNDs).
 - ❑ <https://datatracker.ietf.org/doc/draft-jeong-opsawg-izinf-problem-statement/>
- ❑ I2INF will work on the standardization of **Interface YANG Data Models (DMs):**
 - ❑ In-Network Function (INF) Capability
 - ❑ Registration Interface, Consumer-Facing Interface, NSF-Facing Interface, and Monitoring Interface



Interface to In-Network Functions (I2INF)

- ❑ **Goal:** Standardization of I2INF for Computing in the Network (COIN)
 - ▣ Interface to In-Network Functions (I2INF): **Problem Statement**
 - ▣ <https://datatracker.ietf.org/doc/draft-jeong-opsawg-izinf-problem-statement/>
 - ▣ A **Framework** for the Interface to In-Network Functions (I2INF)
 - ▣ <https://datatracker.ietf.org/doc/draft-jeong-opsawg-izinf-framework/>
 - ▣ **Use Cases** of Interfaces of In-Network Functions in Data Center Networking
 - ▣ <https://datatracker.ietf.org/doc/draft-ywj-opsawg-izinf-data-center-networking/>



Motivation of this Draft



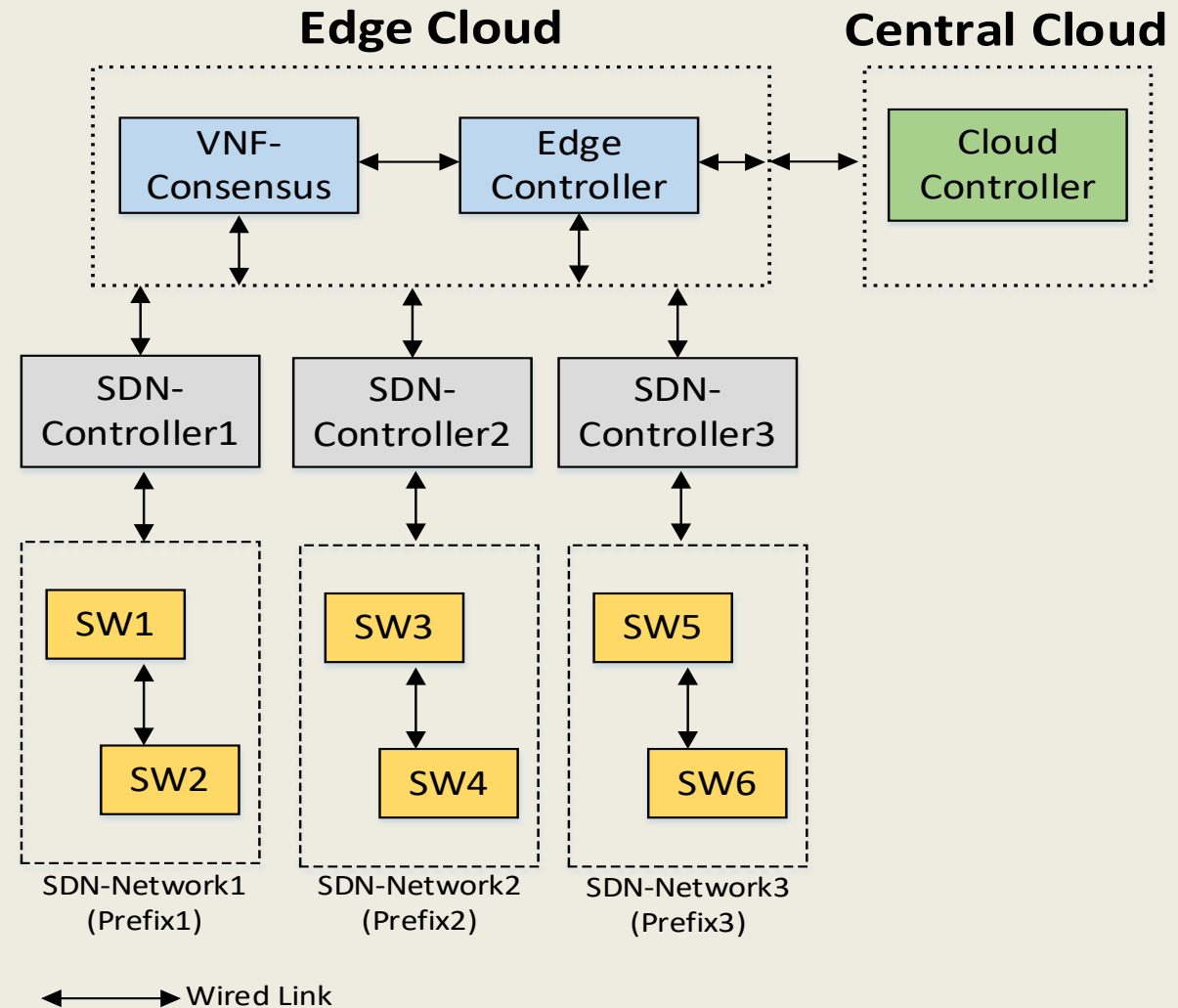
- ❑ **draft-jeong-opsawg-izinf-problem-statement-02**
 - ▣ This draft defines the [In-Network Computing Functions and Problems for Interface to In-Network Functions \(I2INF\)](#) for In-Network Functions (INFs).
 - ▣ This draft investigates the need for a standard framework with the interfaces for INFs, in terms of applications with the need to run AI in the network and interoperability among multi-vendor INFs.
 - ▣ AI can, for instance, enable the creation of dynamic, adaptable network/security policies, which are particularly important in the cloud-edge-core-continuum.
 - ▣ AI can learn from telemetry data collected from multiple networks and reach conclusions that can be applied globally or to individual networks.

I2INF Framework for INF Management:

(e.g., VNF-Consensus, Failure Detector, and Reliable Broadcast)

- This framework shows a **VNF-Consensus Architecture in an Edge Cloud** for I2INF framework to synchronize the SDN Controllers for flow table information in the same Edge Cloud.

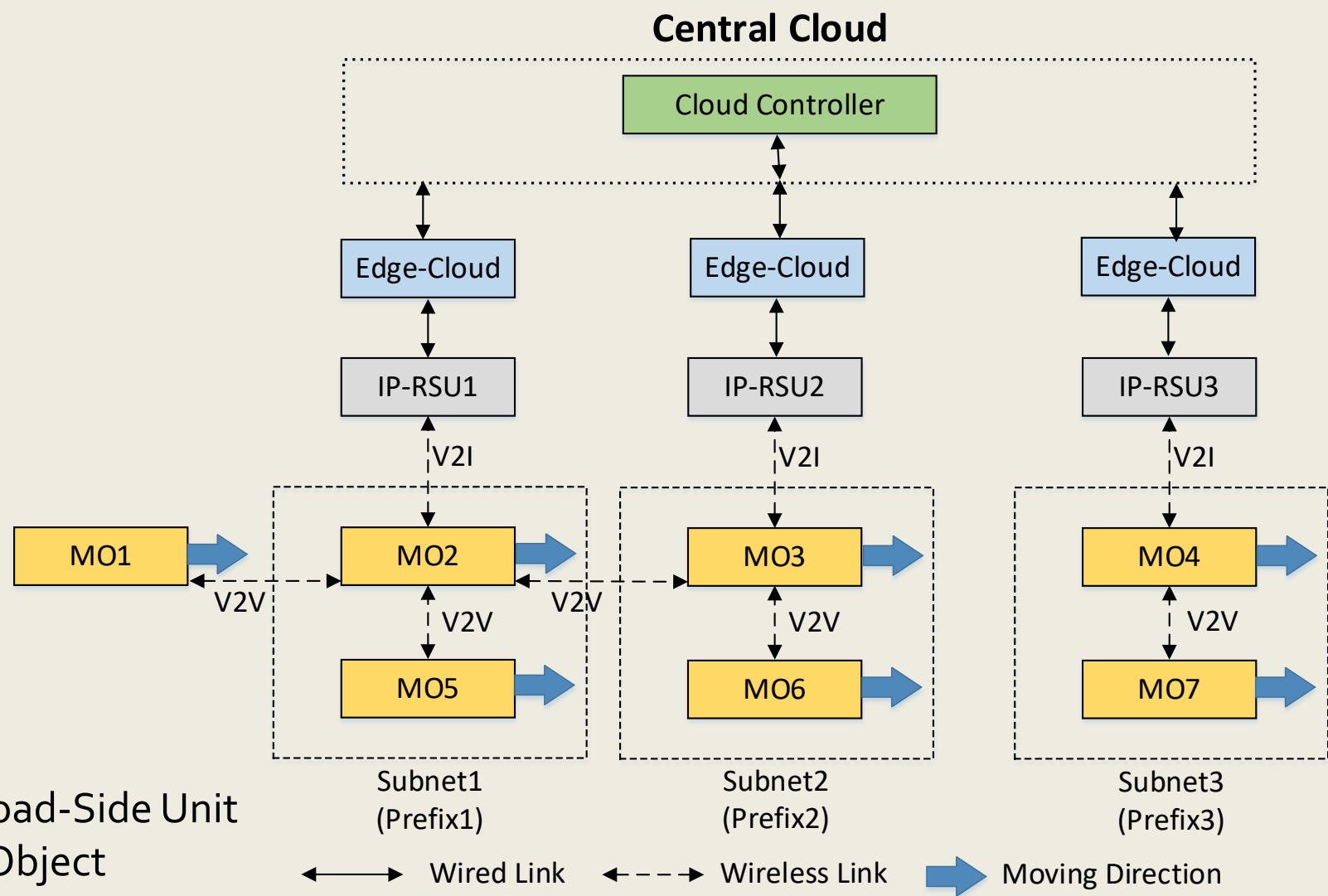
VNF: Virtual Network Function
SW: Switch





I2INF Framework for INF Management

(e.g., Mobile Objects (MOs) like Software-Defined Vehicles)



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



In-Network Computing Functions (1/4)

- ❑ **The State of the Art in Computing in Network (COIN)**
 - ▣ **In-Network Computing Functions (INCF)** are proposed by COINRG with Network Softwarization (e.g., NFV and SDN).
- ❑ **Services in COIN**
 - ▣ **Providing New COIN Experiences**
 - ▣ Mobile application offloading and Extended Reality (XR) and immersive media.
 - ▣ **Supporting New COIN Systems**
 - ▣ In-Network Control, Time-Sensitive Application, Large Volume Applications, and Industrial Safety.



In-Network Computing Functions (2/4)

❑ Services in COIN (Con't)

▣ Improving Existing COIN Capabilities

- ▣ Content Delivery Networks (CDN), Compute-Fabric-as-a-Service (CFaaS), and Virtual Networks Programming (e.g., P4 programs and OpenFlow rules).

▣ Enabling New COIN Capabilities

- ▣ Distributed AI Training among distributed endpoints for large-scale problems.



In-Network Computing Functions (3/4)

❑ Services in NFV-COIN

▣ NFV Failure Detection

- ▣ It gets monitoring data from SDN Switches via SDN Controller and detects the failure of communication links.

▣ Virtual Network Function (VNF) Consensus

- ▣ It performs the synchronization of the control planes of multiple SDN Controllers (e.g., flow table sharing).

▣ NFV Reliable Broadcast

- ▣ It performs reliable and in-order delivery of broadcasted data packets with a VNF-Sequencer.



In-Network Computing Functions (4/4)

❑ In-Network Computing Functions

▣ Observation 1

- ▣ Functionalities of each service need to be decomposed into Application Functions (AFs) and Network Functions (NFs).

▣ Observation 2

- ▣ The management and configuration of those AFs and NFs is a functionality that must be provided by a service coordinator in the context of COIN-based network services.

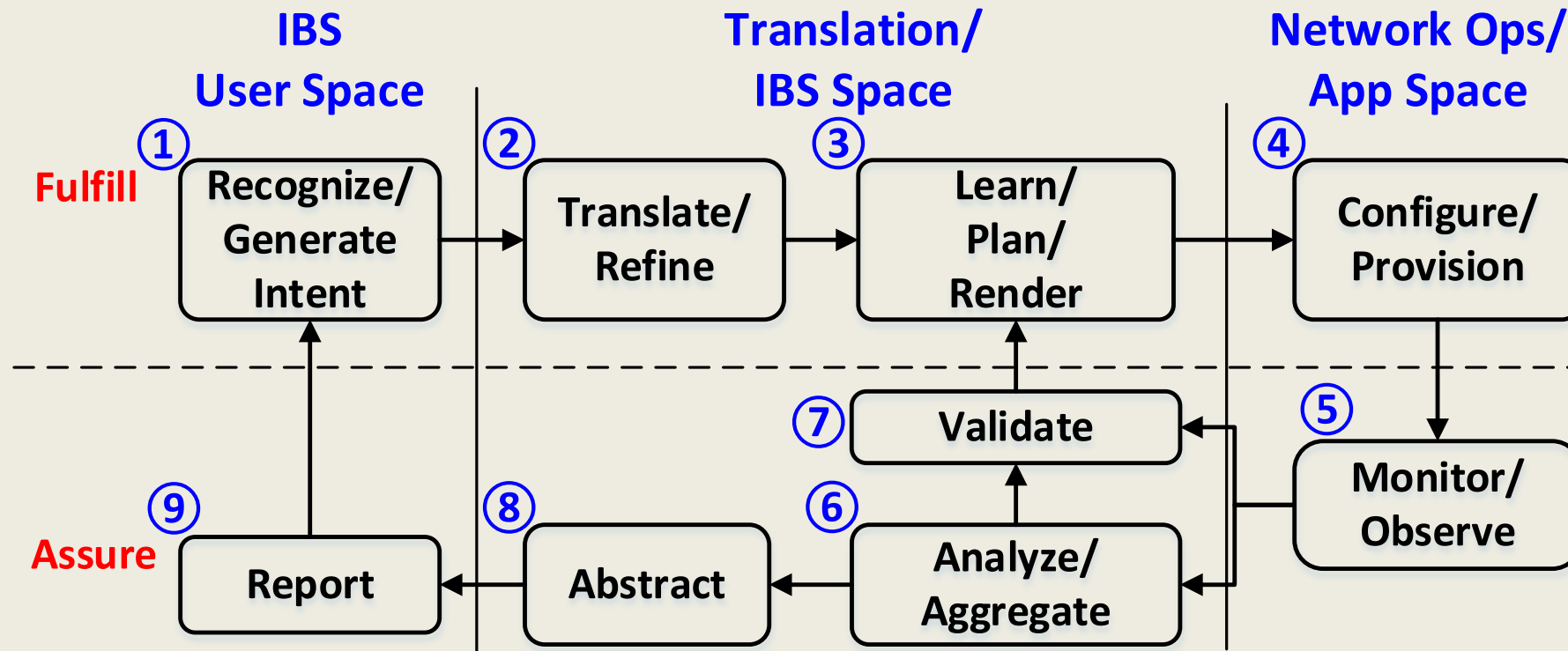
▣ Observation 3

- ▣ There is currently no framework or interfaces defined as standards specifying the life cycle of COIN-based services.



Intent-Based Networking (IBN)

- ❑ **Intent-Based System (IBS)** can be based on **RFC 9315** (Intent-Based Networking - Concepts and Definitions).



The Life Cycle of IBS for Intent Management



Problem Statement (1/5)



- ❑ **The goal of an Intent-Based System (IBS)**
 - ❑ To enforce the service corresponding to a user's intent with an appropriate application in a target network in terms of functionality and quality.

- ❑ **Enforcement Procedure of an Intent**
 - ❑ ① **Intent Translation**
 - ❑ An intent needs to be translated into either a network policy and an application policy by an intent translator.



Problem Statement (2/5)



❑ Enforcement Procedure of an Intent (Con't)

❑ ② Delivery of Network and Application Policies

- ❑ The network policy and application policy needs to be delivered to a network controller and an application controller.

❑ ③ Network Policy Translation

- ❑ The network controller translates the network policy into the network rules for network entities (i.e., NFs).

❑ ④ Application Policy Translation

- ❑ The application controller translates the application policy into the application rules for application entities (i.e., AFs).



Problem Statement (3/5)



- ❑ **Data Models for INF Capability and Registration Interface (RI)**
 - ❑ The **Capability Data Model** for INFs (i.e., NFs and AFs) are required to describe the INF capabilities for usage.
 - ❑ A **Registration Interface** is required for a vendor to register the INF Capability to an INF Controller.
 - ❑ **YANG Data Models for INF Capabilities and Registration Interface** should be specified to make a registration message for the Vendor's Management System (VMS).



Problem Statement (4/5)

❑ Data Model for Consumer-Facing Interface (CFI)

- ❑ An IBS user needs an interface to deliver its intent to an IBS Controller (e.g., Cloud Controller).
- ❑ The IBS Controller translates the intent into a network policy and an application policy with an intent translator.
- ❑ It dispatches the policies to appropriate destinations (e.g., NF Controller and AF Controller) with a dispatcher.
- ❑ This interface is called a Customer-Facing Interface (CFI) for the IBS User.
- ❑ **A YANG Data Model for the Customer-Facing Interface** should be specified.



Problem Statement (5/5)

- ❑ **Data Model for Service Function-Facing Interface (SFI)**
 - ❑ Both an NF Controller and an AF Controller need an **SF-Facing Interface** to deliver the network and application rules to the appropriate NFs and Afs, respectively.
- ❑ **Data Models for Monitoring Interface (MI) and Analytics Interface (AI)**
 - ❑ **Monitoring Interface** collects monitoring data from either an NF or an AF to a Data Collector.
 - ❑ **Analytics Interface** delivers analysis results to either an NF Controller or an AF Controller.



Planning for WG Scope



❑ WG Phase 1

- ❑ I2INF Problem Statement and Use Cases
- ❑ I2INF Framework
- ❑ A YANG Data Model for INF Capability
- ❑ A YANG Data Model for Registration Interface

❑ WG Phase 2 (Re-charter)

- ❑ YANG Data Models of Consumer-Facing Interface, INF-Facing Interface, Monitoring Interface, and Analytics Interface



Next Steps

- ❑ This draft will include use cases for I2INF as follows:
 - ❑ A Use Case of I2INF for Data Center Networking
 - ❑ <https://datatracker.ietf.org/doc/draft-ywj-opsawg-i2inf-data-center-networking/>
 - ❑ A Use Case of I2INF for Edge Cloud
 - ❑ A Use Case of I2INF for Mobile Object
- ❑ I2INF Group will prepare a Non-WG-Forming BoF in the IETF 122 in Bangkok in March, 2025.
- ❑ If I2INF Group will prepare IETF-122 Hackathon Project to clarify (i) the I2INF Problem Statement & Use Cases and (ii) the I2INF Framework.