Intent-driven Closed-loop Autonomous Networks

ONAP - TM Forum meeting on Intent based automation
6th April, 2022

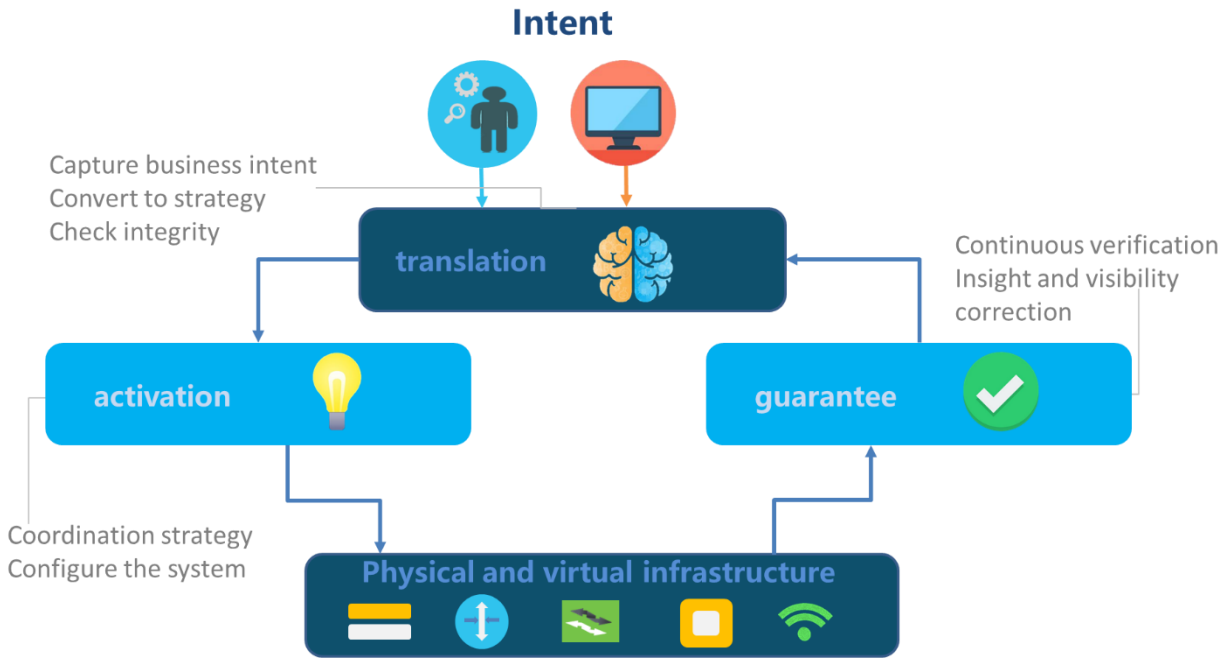
ONAP team members:
Dong Wang (China Telecom)
Keguang He; Lin Meng (CMCC)
Henry Yu; Chuanyu Chen (Huawei)

Outline

1. Overview of Intent-based Networking
2. Implementation of IBN in ONAP
3. Discussion and Collaboration with TM Forum

Intent-based Networking (IBN)

- Intent-based networking (IBN) is a self-driving network that uses **decoupling network control logic** and **closed-loop orchestration techniques** to automate application intents.
- An IBN is an intelligent network, which can **automatically convert, verify, deploy, configure, and optimize** itself to achieve target network state according to the intent of the operators, and can **automatically solve abnormal events** to ensure the network reliability.



A high-level framework of Intent-based Networking

- ITU-T Y.IBN-reqts "Scenarios and requirements of Intent-Based Network for network evolution".
- L. Pang, C. Yang, *et.al*, "A Survey on Intent-Driven Networks," in *IEEE Access*, vol. 8, pp. 22862-22873, 2020.

Collaborations among Academics, SDOs and ONAP

Academics

IEEE

- A Survey on Intent-Driven Networks
- A Brief Survey and Implementation on Refinement for Intent-Driven Networking

Academic exchanges

Open-source

ONAP
OPEN NETWORK AUTOMATION PLATFORM

Align with Multi-SDO

Autonomous Networks Multi-SDO Initiative

Who we are

SDO	Group/Project	SDO	Role
3GPP	SA5	IETF	WG on AN
CCSA	TC7	ITU-T	FG-AN
ETSI	ENI, F5G, MEC, NFV, PDL, TC INT/AFI, ZSM	Linux Foundation*	ONAP
GSMA	Future Networks	NGMN	Automation
IEEE	Future Networks	TM Forum	AN Project

*Open Source Community

SDOs

IETF

IETF/IRTF:

- Intent-Based Networking - Concepts and Definitions
- Intent Classification

ETSI

ETSI ZSM/ENI:

- ZSM 011 Intent-driven autonomous networks; Generic aspects
- ENI 008 InTent Aware Network Autonomicity (ITANA)

tmforum

TMF:

- IG1234 Intent Oriented Customer Engagement (IoCE) Guide
- IG1253 Intent in Autonomous Networks

3GPP

3GPP SA5:

- TS 28.312 Intent driven management services for mobile networks
- TR 28.812 Study on scenarios for Intent driven management services for mobile networks

ITU

ITU-T:

- Scenarios and Requirements of Intent-Based Network for network evolution
- functional architecture of NGN evolution by adoption of Intent-Based Network

CCSA

CCSA:

- 2015B58 Network Intelligent Capability Enhancement for SDN/NFV: Study of Key Technologies of Intent Network

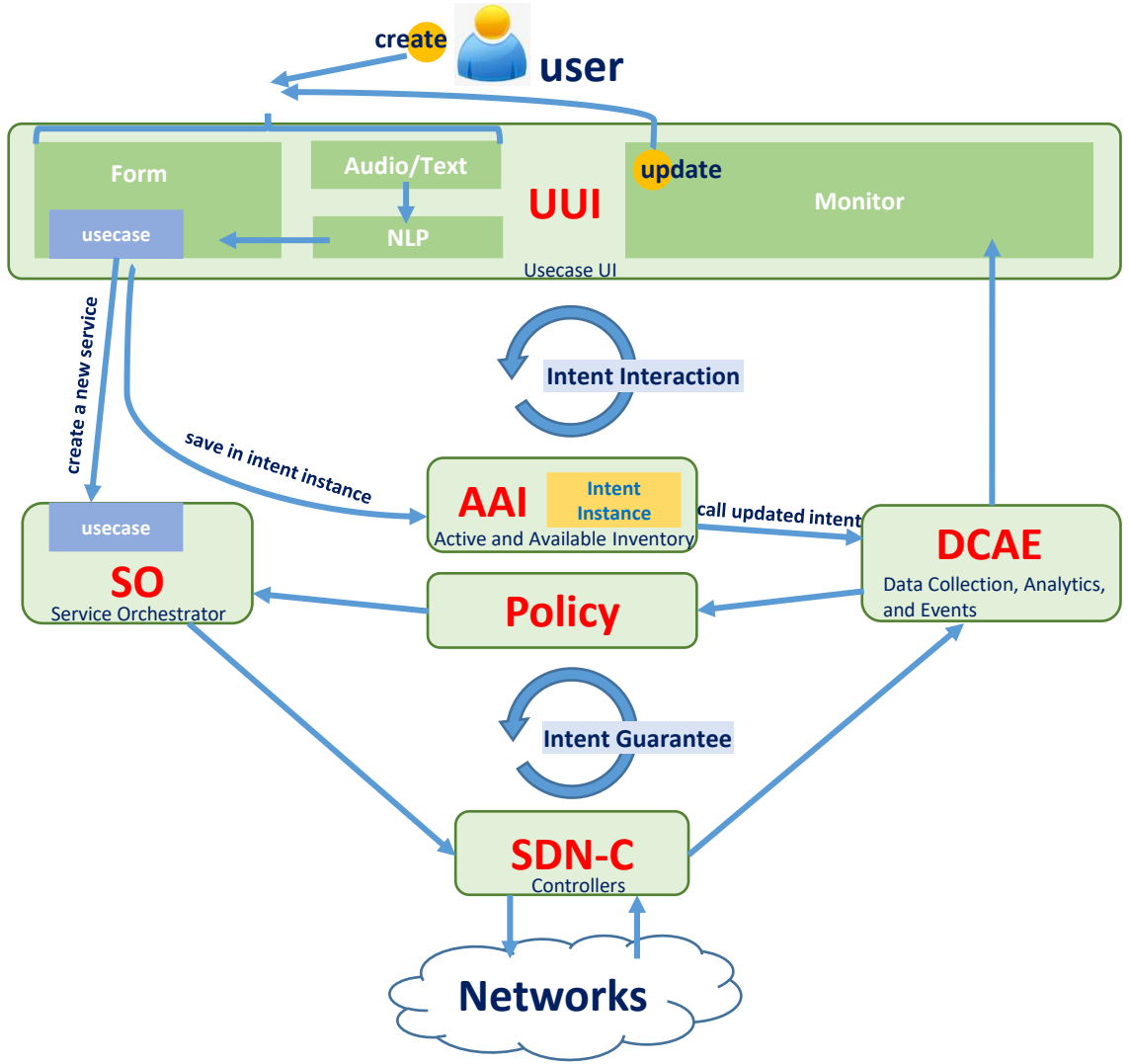
Architecture of Intent-driven Closed-loop Autonomous Networks based on ONAP Projects

Key Functions and Developments of Intent-based Networking in ONAP:

- ✓ **REQ-453/ONAPARC-641** Smart Operator Intent Translation in UUI based on IBN - R8 5G Slicing Support
- ✓ **REQ-861/ONAPARC-701** Smart Intent Guarantee based on IBN - R9 Intent Instance
- ✓ **REQ-1074/ONAPARC-729** Smart Intent Guarantee based on Closed-loop in R10
- ✓ **REQ-1075/ONAPARC-730** Network Services without Perception for Users based on IBN
- ➢ Maintain and Enhancement of Intent-driven Closed-loop Autonomous Networks in R11

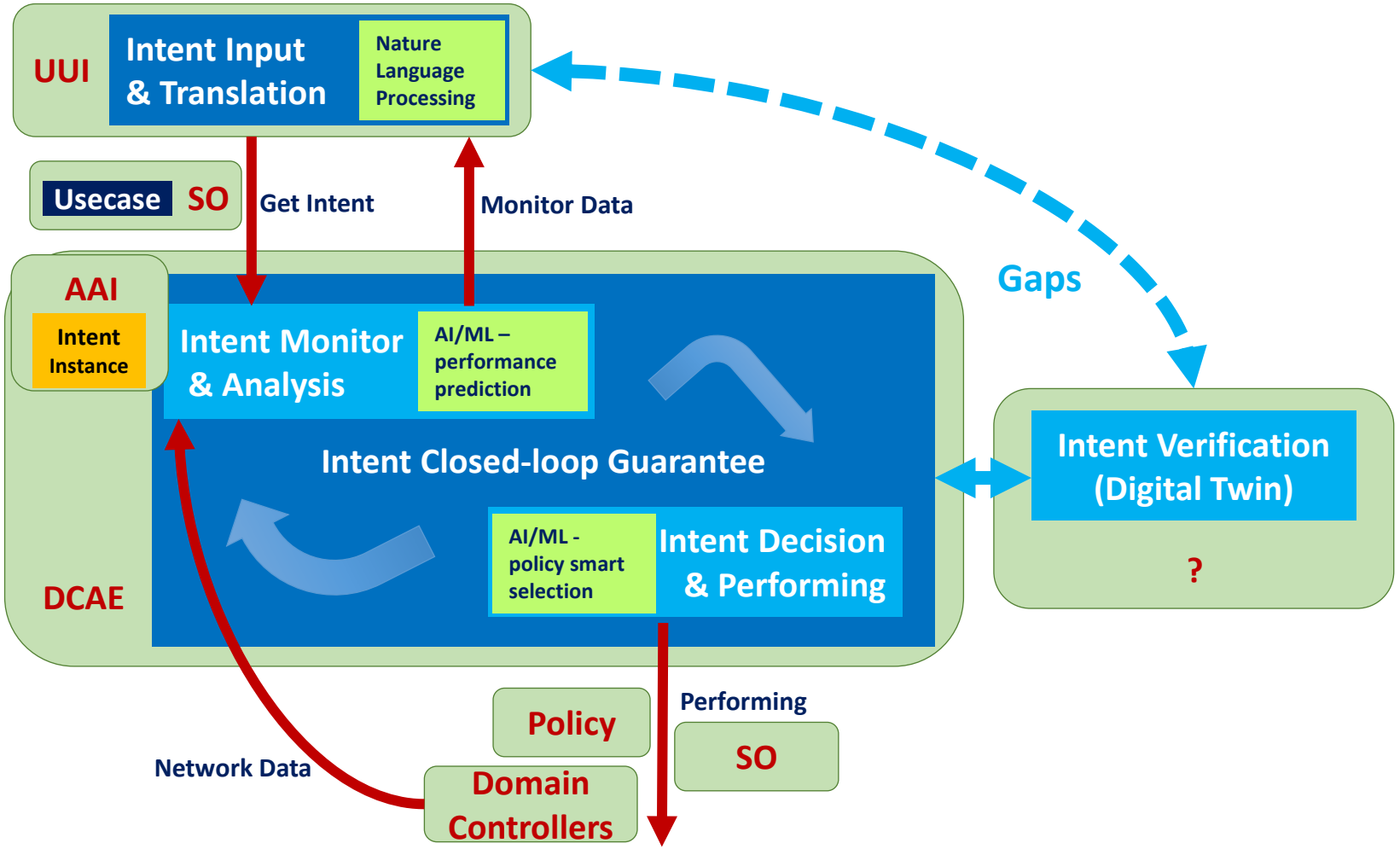
Collaborations and Outputs with SDOs (ETSI ZSM / ITU-T):

- ✓ **ETSI ZSM PoC 003**: Automation of Intent-based cloud leased line service
- ✓ **ITU-T**: Scenarios and Requirements of Intent-Based Network for network evolution; functional architecture of NGN evolution by adoption of Intent-Based Network; signalling architecture of Intent-Based Network for network evolution



Architecture of Intent-driven Closed-loop Autonomous Networks

Enable AI/ML for Intent-driven Autonomous Networks in ONAP



AI/ML Abilities for Intent-driven Autonomous Networks in ONAP

Key Features

AI/ML Algorithms

- ☐ Nature Language Processing
- ☐ STT (Speech to Text)
- ■ Prediction
- ■ Decision-making

AI/ML Frameworks

- ➢ TenserFlow
- ➢ PyTorch

AI/ML Platform

- ✓ Acumos AI

Acumos AI

https://www.acumos.org/

Outline

1. Overview of Intent-based Networking
2. Implementation of IBN in ONAP
3. Discussion and Collaboration with TM Forum

2.1-1 Intent Translation in UUI for E2E Slicing (R8)

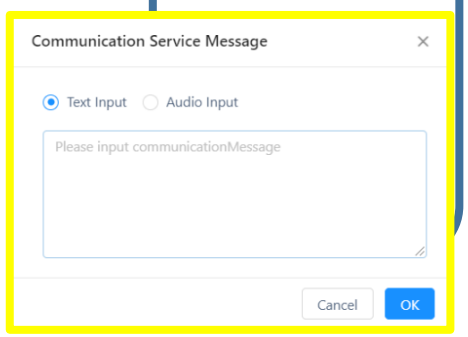
UUI

Target of R8: translate from human inputs to slice parameters based on NLP in UUI, and then run the E2E slicing usecase in ONAP.

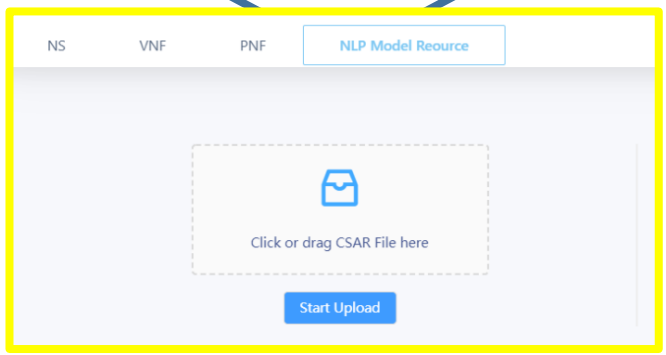
Input

Text

Voice



Nature Language Processing

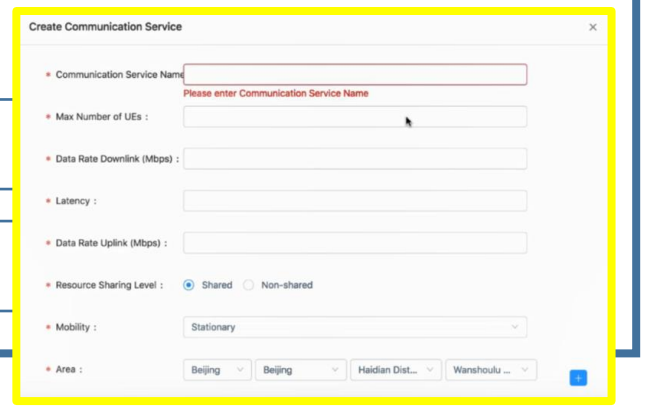


Parameter1: scenario (eMBB/mMTC/uRLLC)

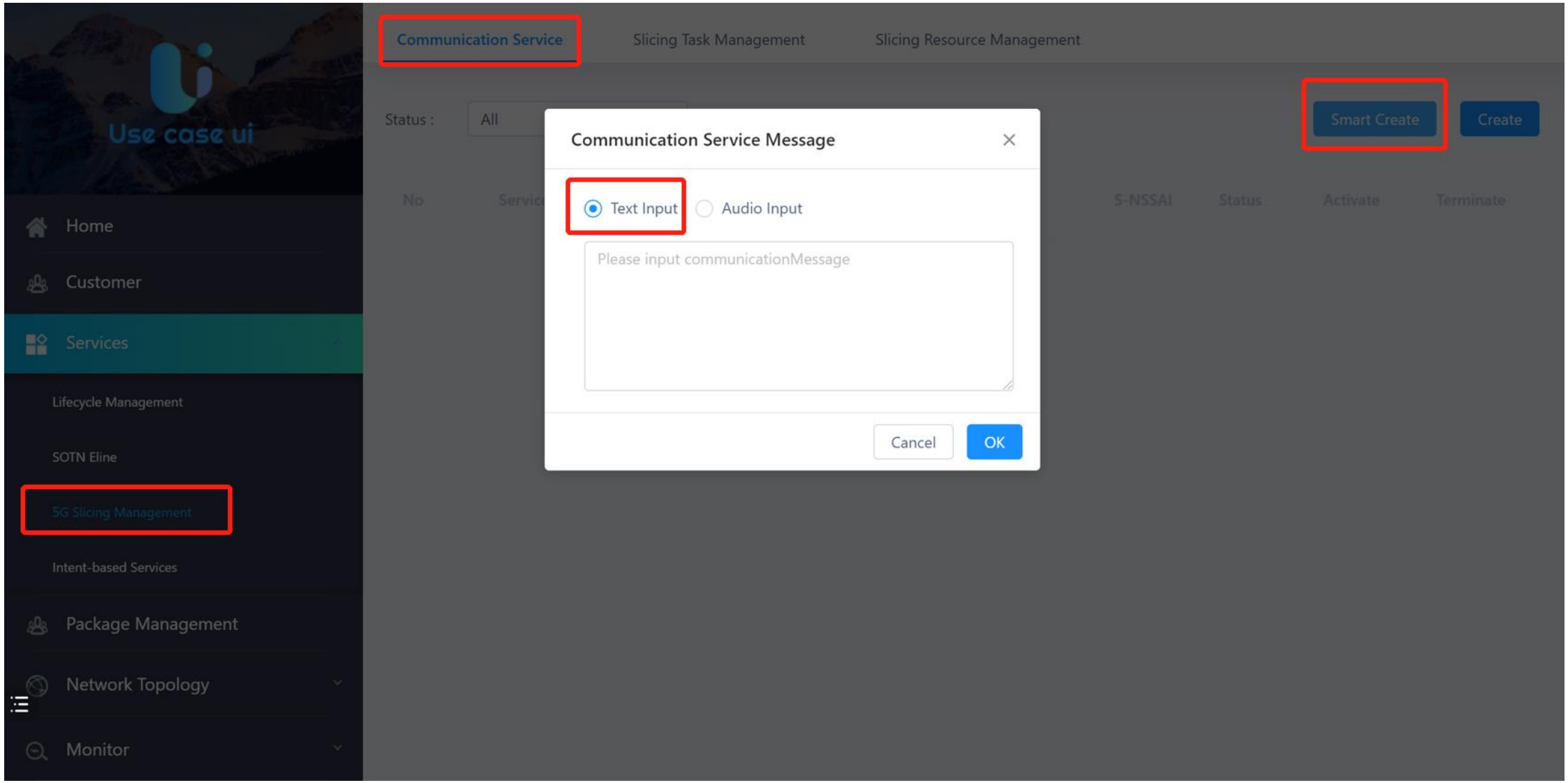
Parameter2: throughput

Parameter3: latency

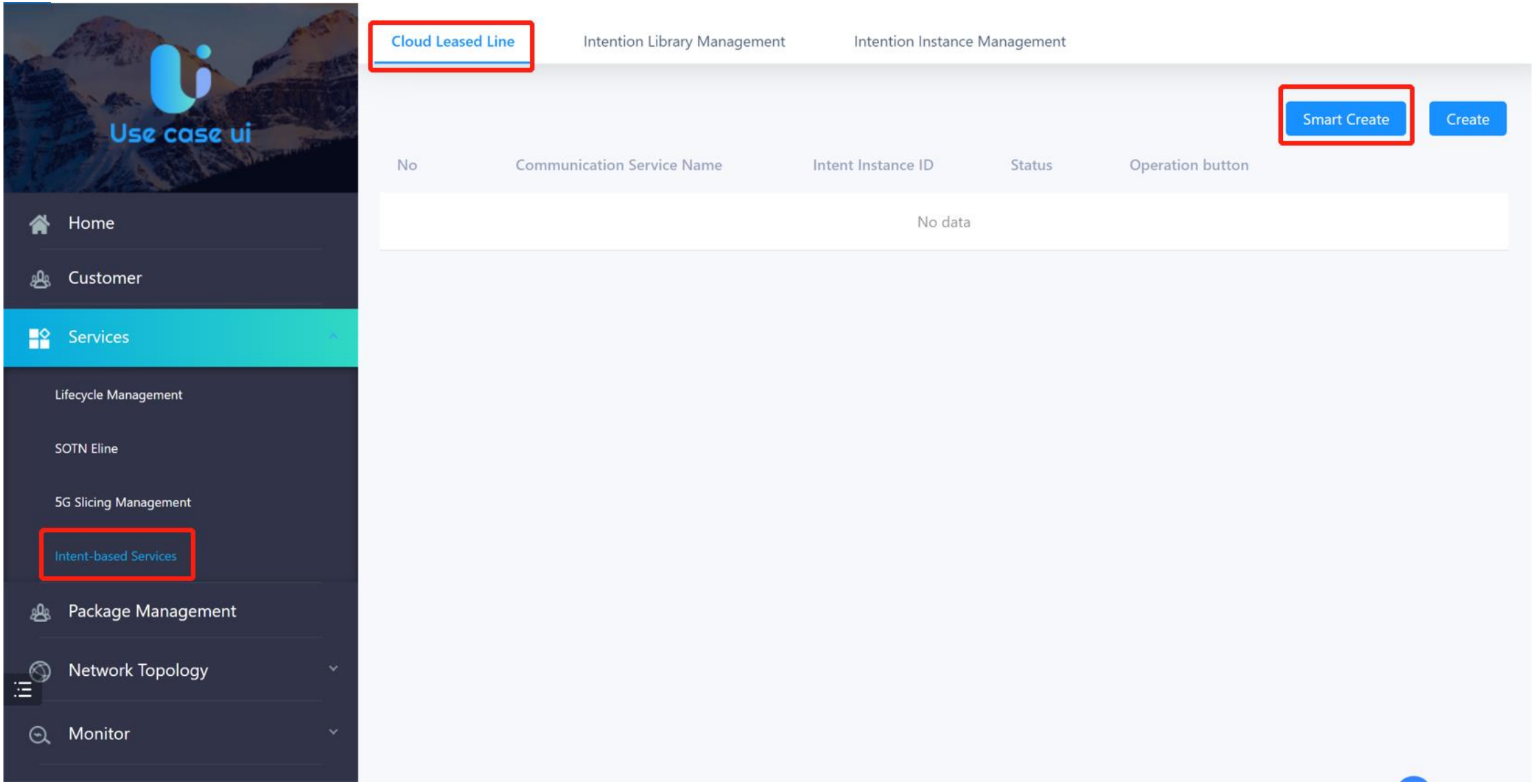
Parameter4: reliability



2.1-2 Screenshot of Smart Create for E2E Slicing (R8)



2.1-3 Screenshot of Smart Create for CCVPN (R9)

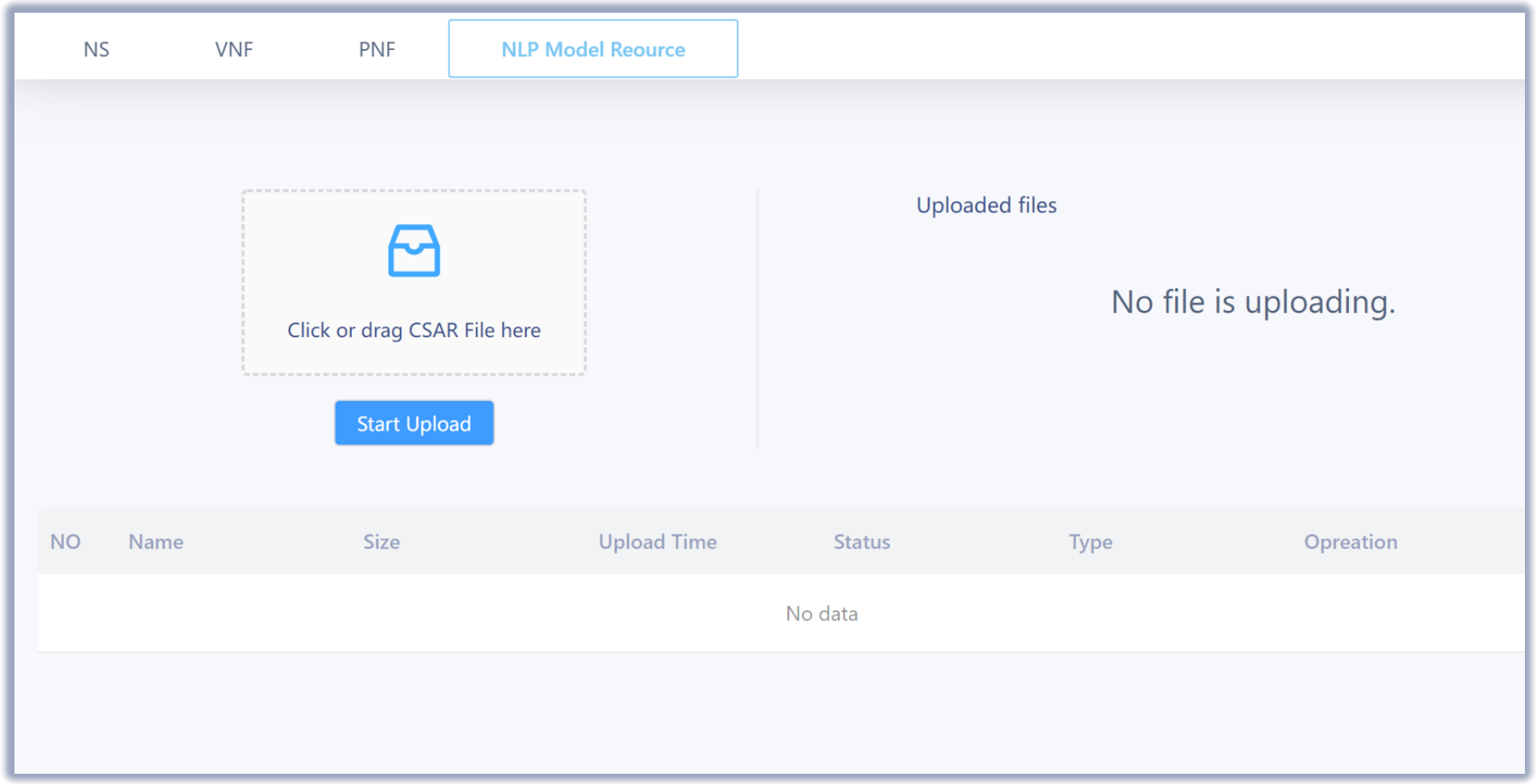


2.1-4 NLP Model Management (R8-R9)

Key Features

NLP Model Management

- ☐ Upload model
- ☐ Delete model
- ☐ Active/Inactive model
- ■ Select model for different usecases in same AI framework and microservice



Screenshot of NLP Model Management

2.1-5 Network Services without Perception for Users (R10)

UUI

Target: translate from human inputs to network parameters based on NLP in UUI, choose a suitable usecase and then run the usecase in ONAP.

Input

Text

Voice

Nature Language Processing

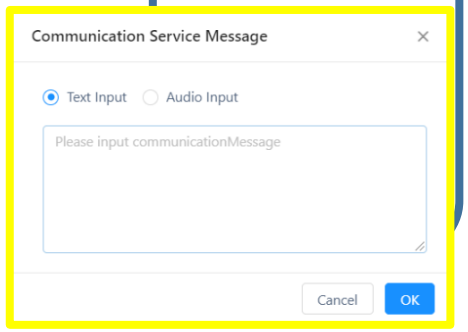
Parameter1: network service (5G / Fixed network)

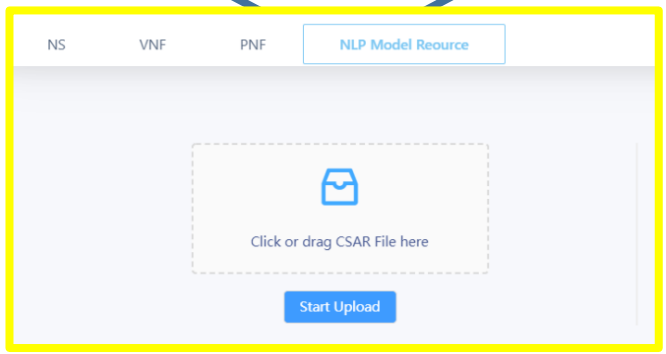
Parameter2: scenario

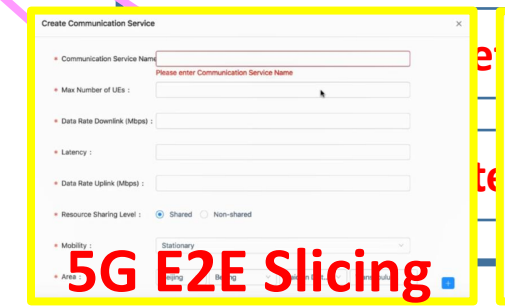
Parameter3: throughput

Parameter4: latency

...



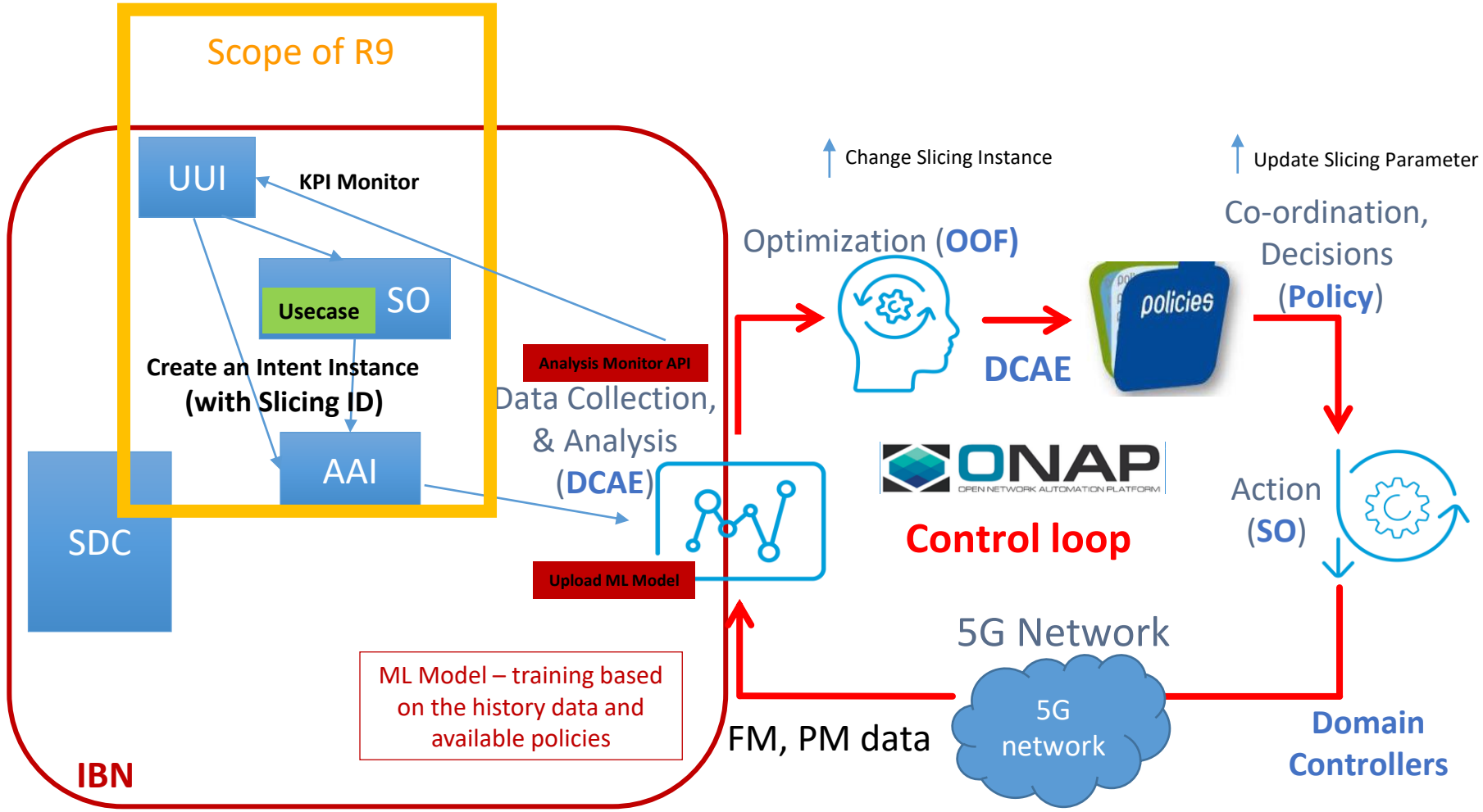




5G E2E Slicing

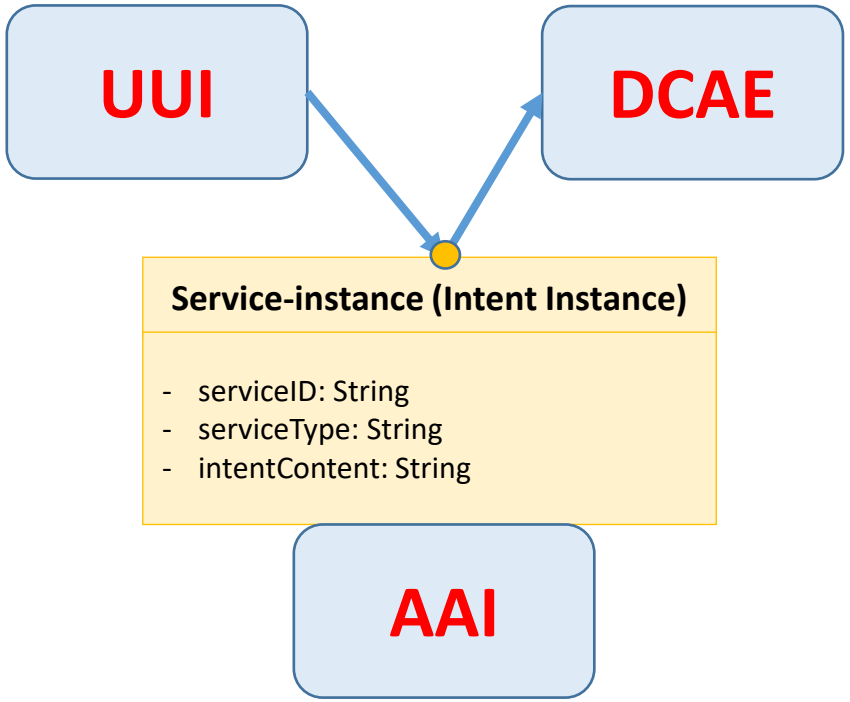
CCVPN

2.2-1 Intent-driving E2E Slicing Closed-loop (R9-R10)



2.2-2 Intent Instance in AAI (R9)

Functions: Intent Instance is created to save the users' **real-time intent** (network parameters) and connected service ID (CCVPN service ID / E2E Slicing CSI ID) in AAI.



serviceType: 'CCVPN', 'E2ESlicing'

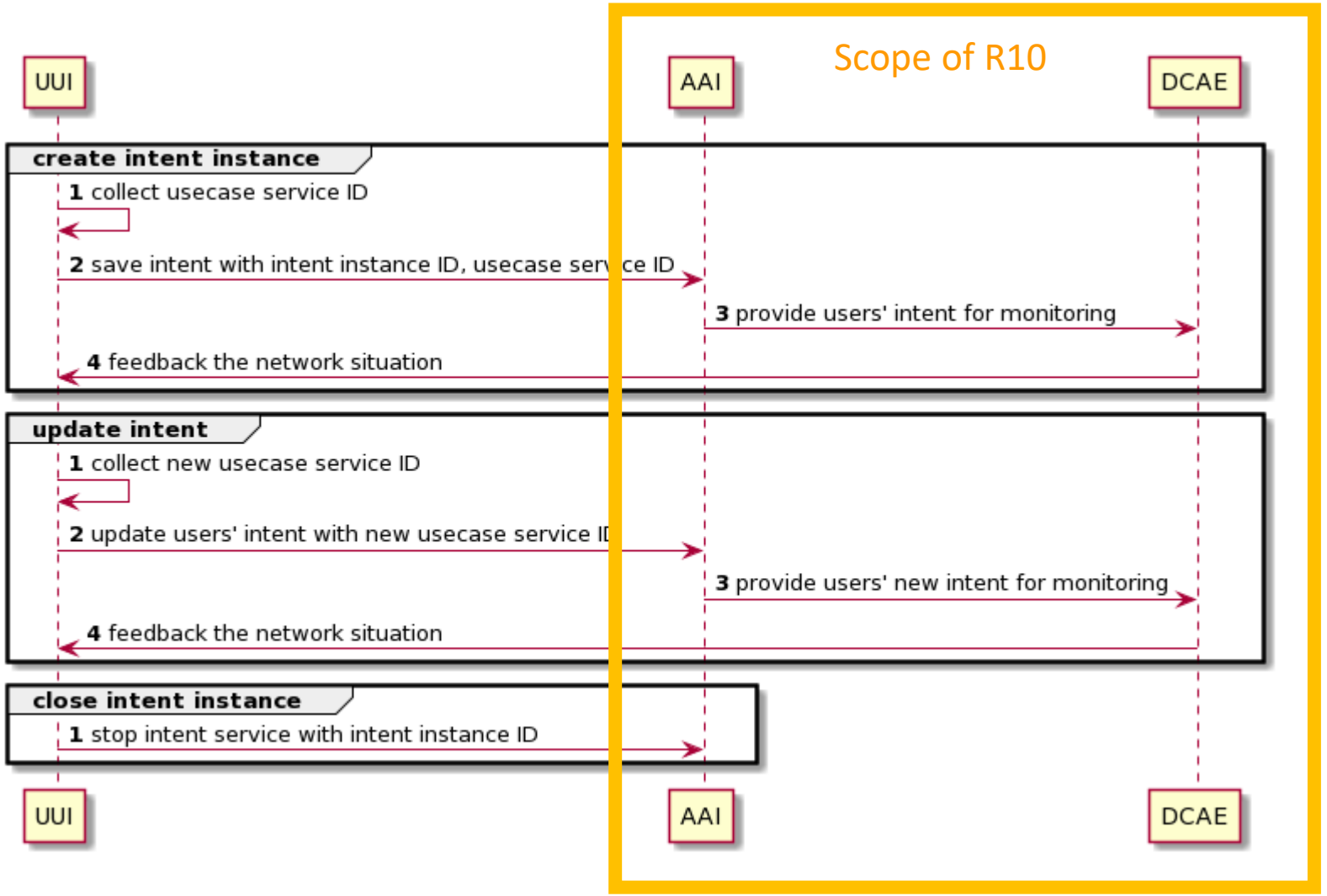
Intent Instance Applied in AAI:

1. Intent Instance is created to save the users' real-time intent in Active and Available Inventory. The other records related to the intents are not real-time, which are saved in the independent database in UUI, and will be saved in CPS in further releases.

2. The target of Intent-based Networking is to develop to support multiple usecase services, so it is not a sub-node of any usecase in AAI. And the IBN will be expect to provide network services without perception for users. Multiple usecase services could be changed by IBN instead of the users.

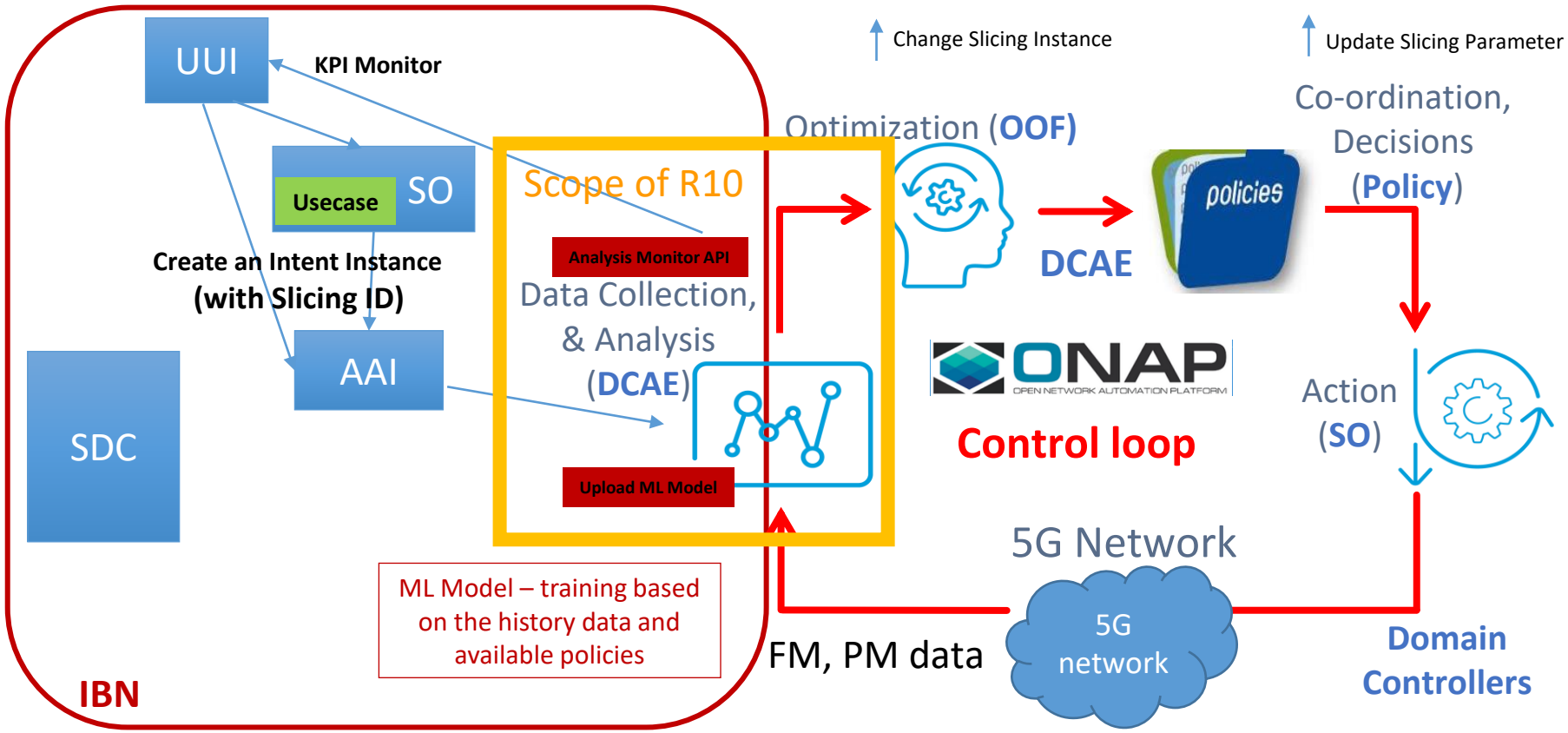
3. DCAE keeps calling the intent from AAI for monitoring.

2.2-3 Workflow of Intent Management (R9-R10)

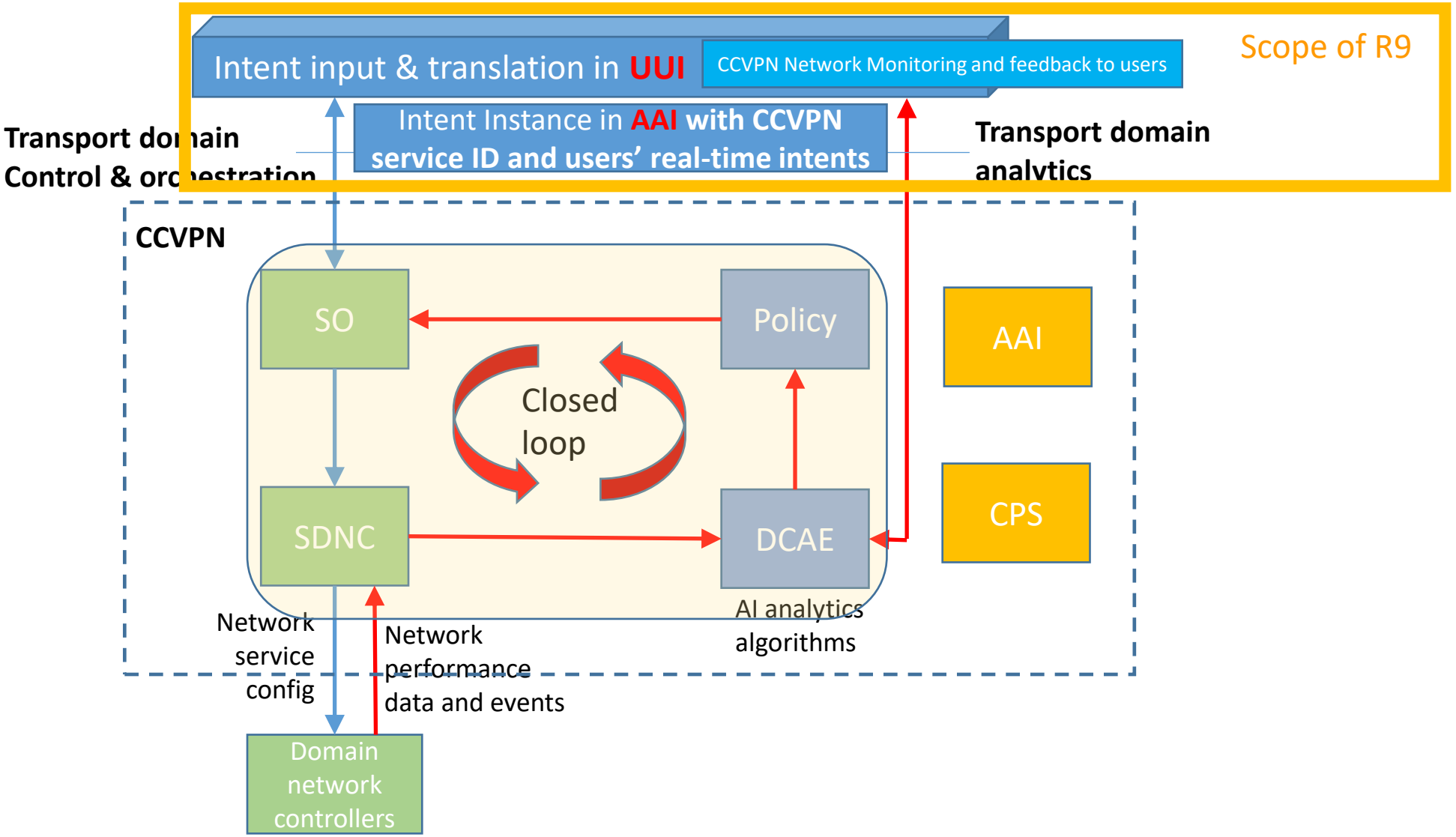


*1. A usecase service ID includes the service instance ID of CCVPN or CSI ID of E2E Slicing, which is collected in UUI after creating a new service.

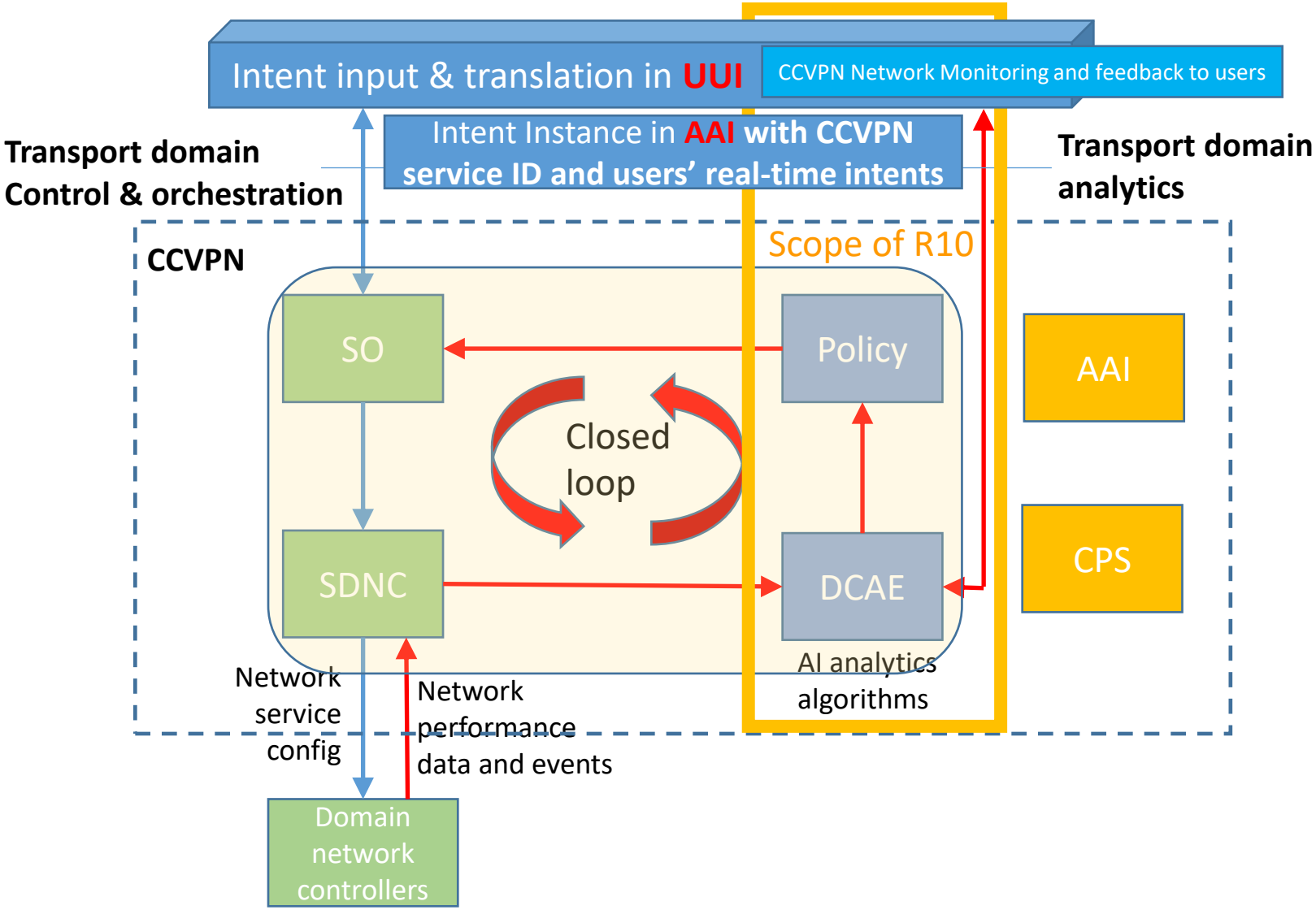
2.2-4 Smart Intent Guarantee by Closed-loop (R10)



2.3-1 Intent-driving CCVPN Closed-loop (R9-Intent Instance)



2.3-2 Intent-driving CCVPN Closed-loop (R10-Intent Guarantee)



Outline

1. Overview of Intent-based Networking
2. Implementation of IBN in ONAP
3. Discussion and Collaboration with TM Forum

Collaborations

1. Align with TM Forum IG1253?

TM Forum Introductory Guide

Intent in Autonomous Networks

2. Contribute to IG1253E End-to-end use cases?

IG1253 Intent in Autonomous Networks v1.1.0

tmforum

24.Appendix E: Future work

The following topics need some further documentation and examples and will be addressed in future phases of the Autonomous networks project.

Topic	Description
End-to-end use cases	The document IG1253E is planned to be added in future releases. It is dedicated to use all techniques and concepts from IG1253 and its sub-documents to show end-to-end autonomous operation.

3. Submit a Catalyst proposal in 2023?

Reference IGs/Catalysts from TM Forum

TMF IGs related to Intents

- IG1253_Intent_in_Autonomous_Networks_v1.1.0
- IG1253A_Intent_Common_Model_v1.1.0
- IG1253B_Intent_Extension_Models_v1.0.0
- IG1253C_Intent_Life_Cycle_Management_and_Interface_v1.1.0
- IG1253D_Intent_Manager_Capability_Profiles_v1.0.0

- IG1234_Intent_Oriented_Customer_Engagement_Guide_v2.0.0
- IG1259_Study_of_Telecom_Industry_Intent_Meta_Modeling_Approaches_v1.0.0

- IG1161A_Hybrid_Intent_Management_Platform_Flyer
- IG1161B_Hybrid_Intent_Management_Platform_Business_Overview
- IG1161C_Hybrid_Intent_Management_Platform_Technical_Overview

TMF projects joined by China Telecom in recent years

IGs

- ✓ IG1190 AIOps Service Management
- ✓ IG1274 End-to-End AIOps Lifecycle Process

Catalysts

- ➢ C20.0.22 AIOps Autonomous Service Assurance
- ➢ C22.0.338 Intelligent operation of 5G cloud-network convergence services for vertical industries
- ➢ C20.0.06 5G Greener telco
- ➢ C21.0.185 Smart IDC - Intelligent Energy Saving for Data Centers

Thanks!