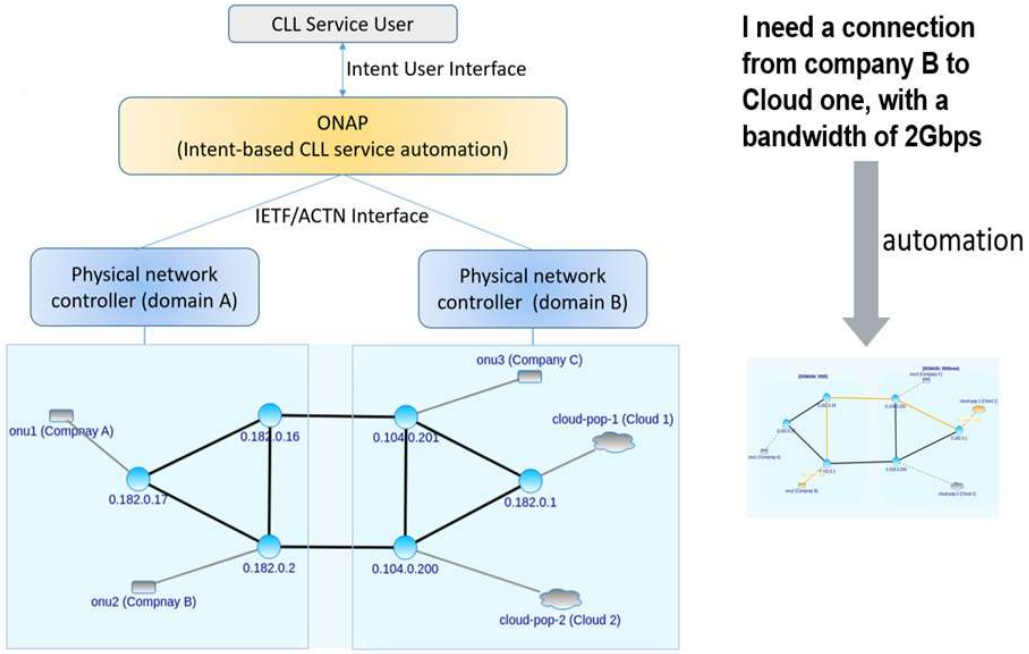
ENI PoC #18

Intent-driven Operating for User-Centric Cloud-Network Convergence Services

Rapporteur: China Telecom,
Huawei
AsiaInfo
BUPT
Xidian University

PoC Background



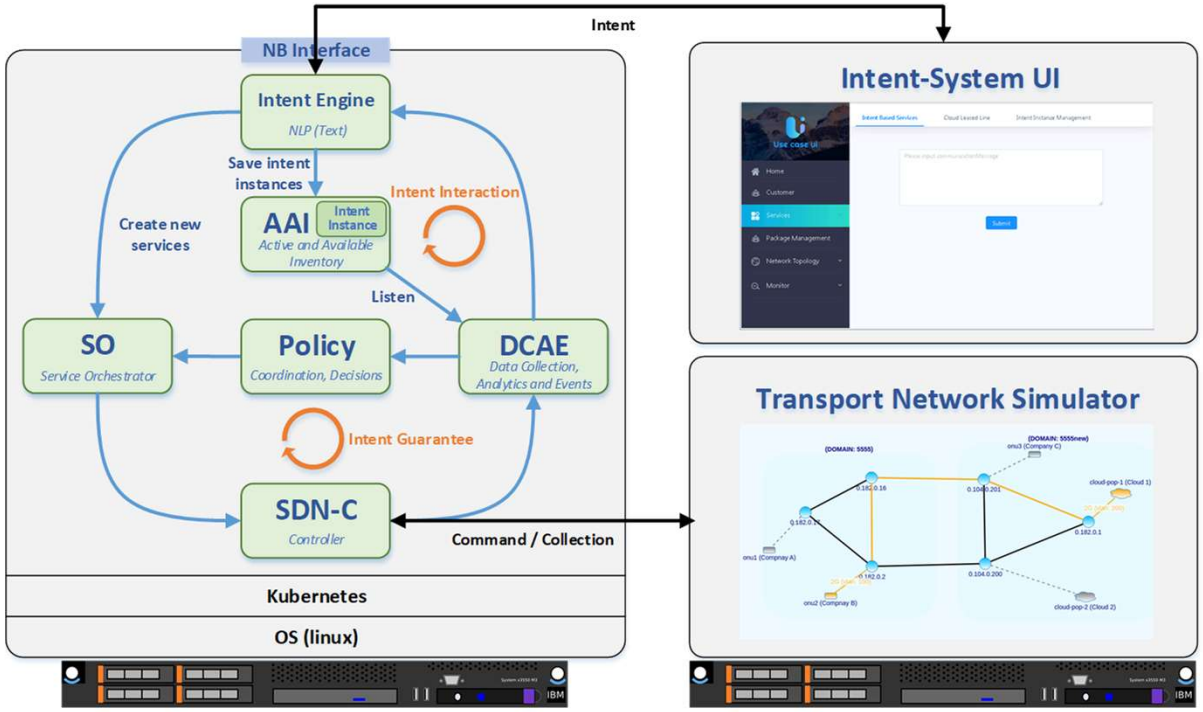
Short Description: This PoC will provide an intent-based cloud private line (CPL) service, which can connect cloud service users to edge or cloud data centres, and edge or cloud data centres to each other, with deterministic connection performance. In this PoC, we will demonstrate intent translation (NLP models) and intent instance creation to fulfil users' intent. In particular, in the proposed CPL service, this PoC aims to verify that when the network state changes or the users' intent changes, the intent requirements can still be satisfied by the ENI system. The closed-loop automation mechanism continuously validates and monitors the conditions of the network against the intent specification to ensure compliance with the intent.

PoC goals and PoC member

	Organization name	ISG ENI participant (yes/no)	Contact (Email)	PoC Point of Contact (see note 1)	Role (see note 2)	PoC Components
1	China Telecom	yes	Zhen Li liz779@chinatelecom.cn Dong Wang wangd5@chinatelecom.cn	X	network operator	Design, development and integration of intent-driven user-centric cloud-network convergence services
2	Huawei	yes	Henry Yu henry.yu1@huawei.com		infrastructure provider	Design and development of cloud-network convergence environment
3	AsiaInfo	yes	Lei Shi shilei8@asiainfo.com		infrastructure provider	Deployment of demo environment
4	Beijing University of Posts and Telecommunications (BUPT)	yes	Xiqing Liu liuxiqing@bupt.edu.cn Shi Yan yanshi01@bupt.edu.cn Yaohua Sun sunyaohua@bupt.edu.cn		university	Enhancement of network AI model and algorithm for network optimization
5	Xidian University	no	Chungang Yang cgyang@xidian.edu.cn		university	Design of intent-driven services and enhancement of intent translation based on NLP model.

- **PoC Project Goal #1: The PoC will demonstrate that the intent instance can be created to meet the intent requirements of the users.**
- **PoC Project Goal #2: The PoC will demonstrate that the ENI system can still meet the intent requirements of the user, when the network state changes or the users' intents changes.**

PoC Architecture



- **Intent translation and intent instance creation. The user expresses an intent of creating a cloud-network convergence service. This intent is then automatically fulfilled by provisioning the corresponding services and allocating the required resources.**

- **Intent interaction. The already fulfilled intent can be modified by the user. The new intent can be automatically fulfilled by provisioning the corresponding services and allocating the required resources.**

- **Intent guarantee. The Intent-based system monitors the parameters of the cloud-network convergence service (e.g., bandwidth usage), and automatically triggers the closed-loop actions (e.g., increase max bandwidth) in order to guarantee the intent.**

PoC Milestones and Current Progress

New use case for Intent-driven Operating for User-Centric Cloud-Network Convergence Services	ENI 001 Use Cases	Propose new use case on Operating for User-Centric Cloud-Network Convergence Services	03/2024

PoC Milestone	Stages/Milestone description	Target Date	Additional Info
P.S	PoC Project Start	June 2023	Presentation at ENI#26 plenary meeting
P.TP.1	PoC User Story finalization	July 2023	Finalization of the high-level description of the scenario.
P.TP.2	PoC Test Plan 1	September 2023	AI based Intent translation and intent instance creation of the cloud-network convergence scenario.
P.D1	Poc Demo	September 2023	Demo at TMF Catalyst meeting
P.C.1	PoC Expected Contribution 1	September 2023	Contribution to ENI 015
P.TP.3	PoC Test Plan 2	December 2023	Users' intent modification and fulfilment of the scenario.

Current

PoC Milestones and Current Progress

C23.0.467

Catalyst Project Goal :

a. Enhance the intent interaction between customers and operators so as to **perceive the users' real-time requirements**, and **translate the users' requirements** to the configuration of current network. Some new ideas and techniques could be considered, like ChatGPT/GPT-4, GSMA Open Gateway, Slicing/SLA.

b. Enhance the **closed-loop autonomous services of Orchestration and Management platform** by Native AI and Big data. This work could refer to the architecture and functions of ONAP.

CHAMPIONS: CHINA TELECOM, China Unicom 中国联通, SLTMOBITEL The Connection

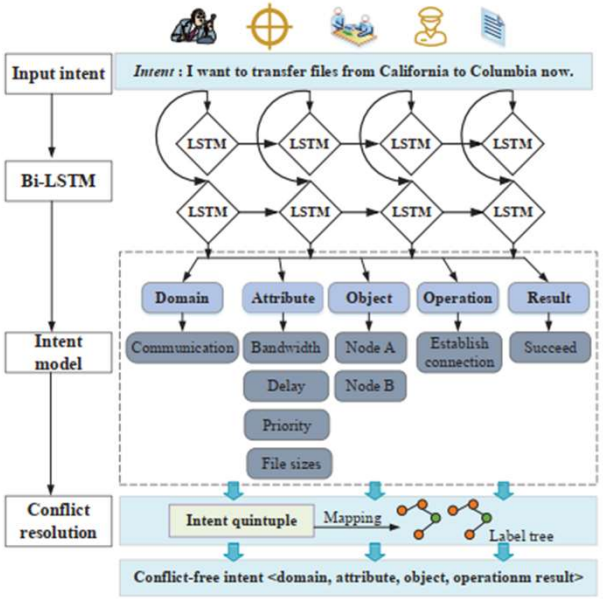
PARTICIPANTS: AsiaInfo 亚信科技, CLARITY, HUAWEI

UNIVERSITIES: 北京郵電大學, 西安电子科技大学 XIDIAN UNIVERSITY, 浙江大学 ZHEJIANG UNIVERSITY

PoC Milestones and Current Progress

Intent Input and Translation

- **Closed-loop processes such as network parameter adjustment scheme, intent verification and policy delivery can be generated based on the intent model designed in advance.**



Exogenous intents: refer to the intent of network administrators, service providers, end users, etc. to manage network resources and propose network service requirements through external interfaces, which usually need to be translated based on natural language processing and other technologies.

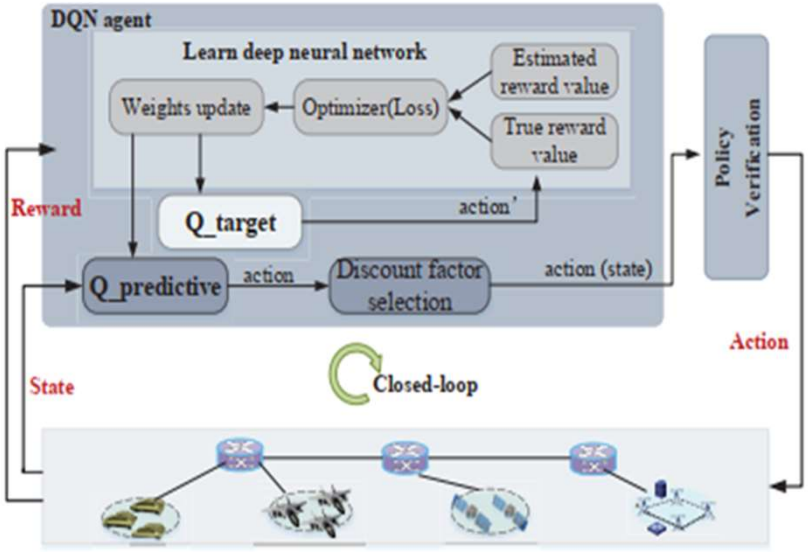
Endogenous intents: refer to the intents generated independently during network operation, such as maintaining network operating state and automatically recovering network faults.

- ✓ Intent translation module translates the intent expressed in natural language through Bi-directional Long Short-Term Memory (Bi-LSTM) and morphological rules, and outputs the intelligible and regularized intent expressed by the network.
- ✓ Secondly, the intent translation module analyzes the accuracy and completeness of the translated intent through intent verification and conflict decomposition, and continuously monitors possible conflicts.
- ✓ NLP techniques such as CoT-T5 and Flan-T5 are being studied and tested in our lab.

PoC Milestones and Current Progress

Intelligent Policy Mapping

- **The translated intents will be sent to the Intelligent policy mapping module, where the conflict management module will evaluate the potential conflicts, optimize the overall network performance, and generate a conflict-free policy set.**



First, query whether there is a policy in the policy library that meets the current intent requirements. If yes, proceed to the next step. Otherwise, the fuzzy decision tree is used to generate a new policy or to adjust the existing policy to expand the policy repository.

The network state is taken as the input S of the neural network, and DQN or other reinforcement learning algorithm obtains the configuration reward of the policy through neural network analysis. Then, according to the Q learning principle, the action with the maximum value is output as the next action to be done.

We formulate the configuration of conflict policies as an optimization problem under complex constraints. If the selected policy can be successfully executed under the intent constraint, the network environment state is modified, and the agent receives a reward R; If the execution is not successful, state S maintains its phase and repeats step 2 until the reward converges.

The network gives feedback to the action and gets the next state S'.

Thanks!