



**OLF NETWORKING**  
Developer & Testing Forum

# Enhancing End-to-End Intent Processing via ONAP- Nephio Collaboration

China Mobile

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<https://lfnetworking.org>



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**Intent, Gen AI, Autonomous Network**

2

Introduction to Intent Projects in ONAP

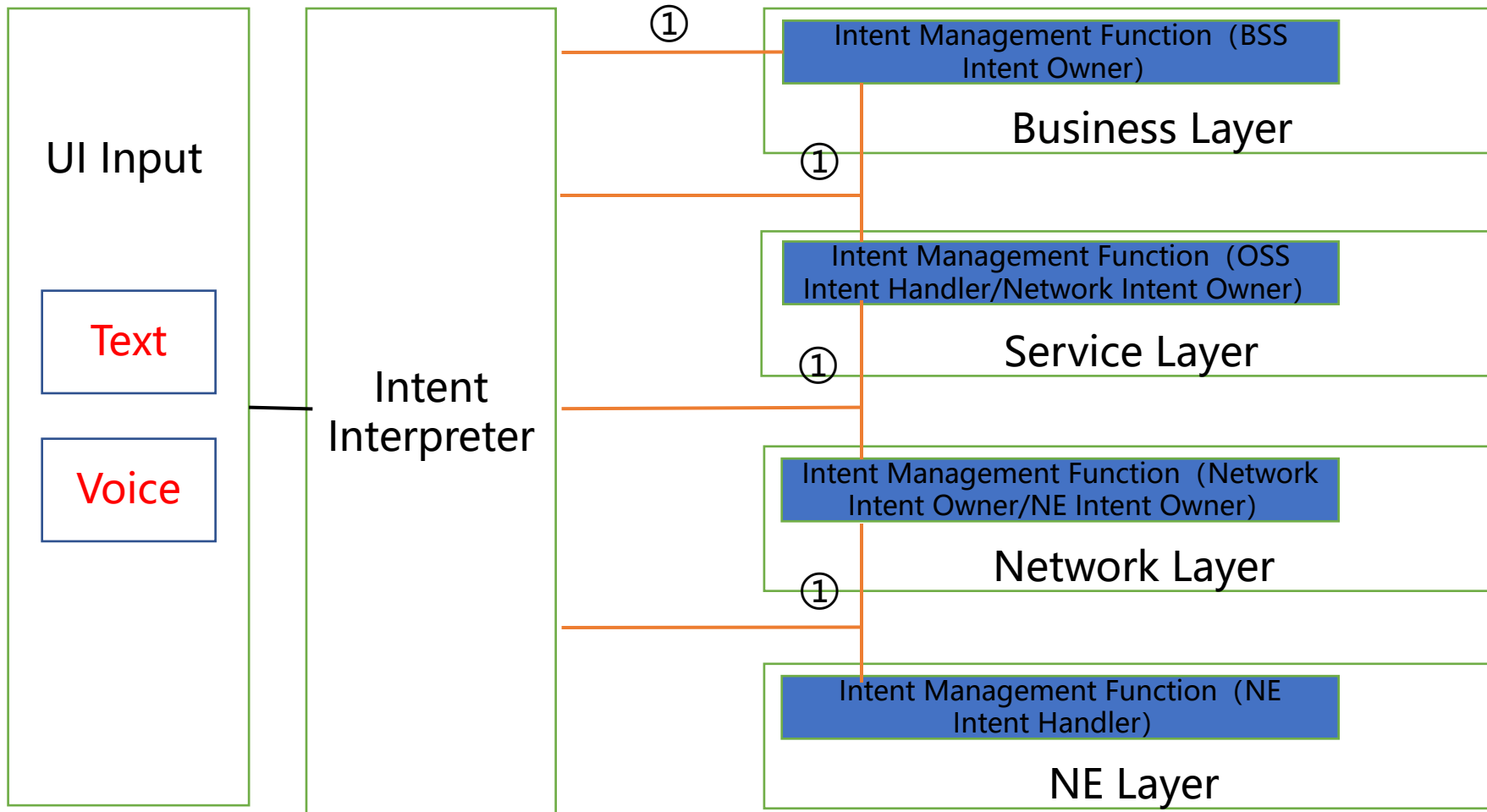
3

Research on Intent-Based Integration of ONAP and Nephio

4

Conclusion and Discussion

# Autonomous network intent management framework



- ONAP primarily focuses on intent processing in the Business Layer and Service Layer.
- Nephio can play a significant role in the intent processing within the Network Layer and NE Layer.

# General Introduction to generative AI

**Generative AI is a type of artificial intelligence technology that can produce various types of content, including text, imagery, audio, and synthetic data. The recent buzz around generative AI has been driven by the simplicity of user interfaces and its ability to create high-quality text, imagery, and videos in a short time.**

## **How Does Generative AI Work?**

- Generative AI can identify the patterns and structures within existing data to generate new and original content.

## **Generative AI can help address these challenges**

- Processing large volumes of data and generating different outcomes based on various scenarios, reducing complex manual processes and interventions.
- Leveraging complex automation to increase efficiencies.
- Generating actionable insights based on historic trends, demand profiles, and supplier performance.
- Combining internal data with external data to craft better negotiation strategies.

# Use cases of Generative AI in Telecom

## Network Planning

Predicting requirement and identifying areas that require increased capacity.



## Network Operation Monitoring and Management

Monitoring and managing networks by analyzing massive real-time network data



## Network Optimization

Analyzing data in network logs and automatically identifying issues such as network congestion or signal interference



## Generative AI in Telecom

## Resource Allocation

Can assist operators in more effectively allocating resources, reducing costs



## Proactive Maintenance

Can anticipate when equipment is likely to fail, enabling telecom operators to perform maintenance before a failure occurs



## Customer Service chatbot

Enhancing customer service by creating virtual agents to assist customers in resolving inquiries and issues.



# Elevating network intelligence through AI-based intent automation

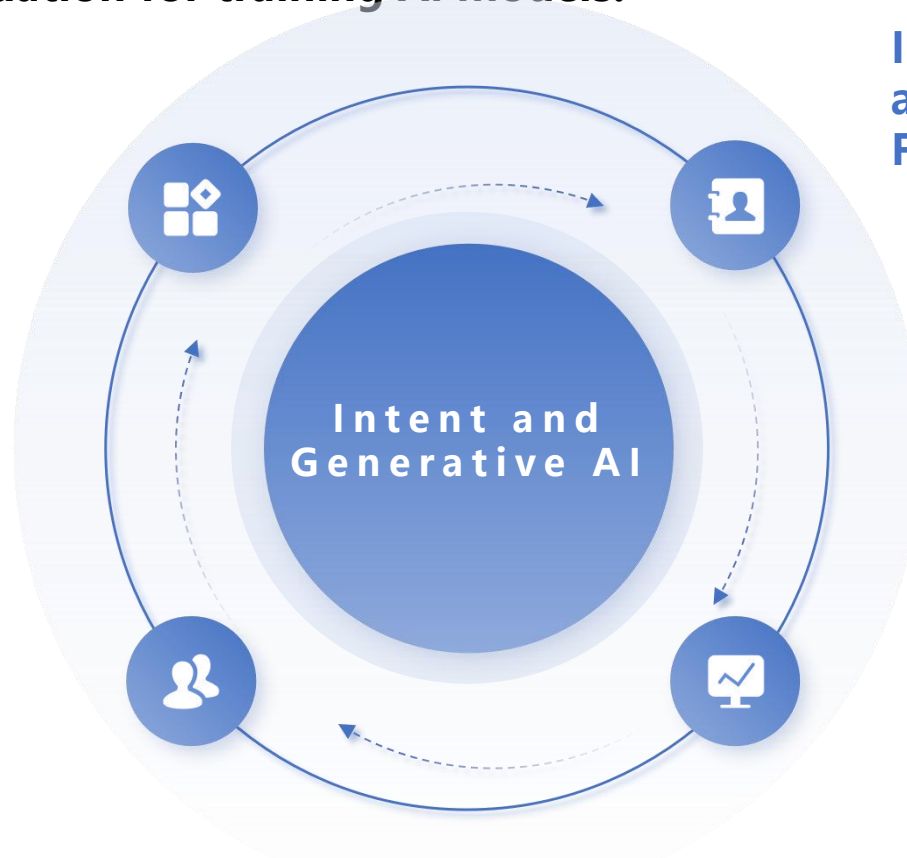
**Intent and AI complement each other in autonomous network solutions. AI will replace/supplement traditional algorithms, addressing the complex optimization tasks faced by intent. And intent will enhance the use of AI and sometimes become the foundation for training AI models.**

## Intent Recognition and Parsing

Generative AI can assist the system in more accurately identifying and parsing user intent and requirements.

## Personalized Service Customization

By learning and analyzing users' historical data and behavior patterns, Generative AI can provide personalized network feature configuration solutions for different users



## Intelligently Matching and Configuring Features

Generative AI can intelligently match appropriate network features and perform corresponding configurations based on user intent.

## Context Awareness and Selfadaptation

Recognizing and understanding changes in user intent across different contexts, and intelligently adjusting the deployment and configuration

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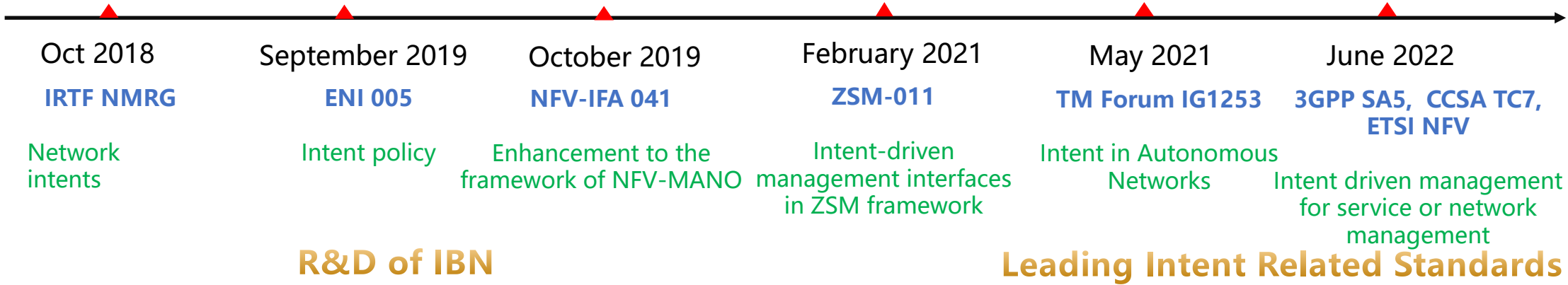
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# Intent-Related Standards Development



- Research the intent use case, intent model and intent management of autonomous network.
- Improve interoperability between components/systems via standardised intent description.
- Make all intents (especially machine-machine intents) in the system operate in the same way.
- Decompose the complex intent into sub intents of different dimensions.
- Support use case related to intents to demonstrate our requirements.

ETSI ENI	GR ENI 013 Intent Policy Model Gap Analysis
ETSI NFV	GS NFV-IFA 050 Intent Management Service Interface and Information Model Specification
3GPP SA5	Actively contribute to 3GPP R17 and R18
TMF	Actively contribute to autonomous network and intent project
CCSA	Study on intent management technologies of autonomous network
	Study on intent management technologies of mobile core networks
	Technical Requirements for Network Function Virtualisation Management
	Technology requirements for intent management of 5G core network
	Intent management technology requirements of autonomous networks



# Intent Related Requirements

## *REQ-1267*

Provide a general intent model and a general intent interface to ensure that all intents (especially machine machine intents) operate according to the same expression and process.

## *REQ-1408*

Optimize the intent interaction process, introduce AI related technologies, and implement more interfaces such as intent report.

## *REQ-1492*

By introducing intent related technologies to address the challenge of increasing service complexity in incident management and providing standardized requirements for event management processes.

**Top Achievement Award Results:** Tie

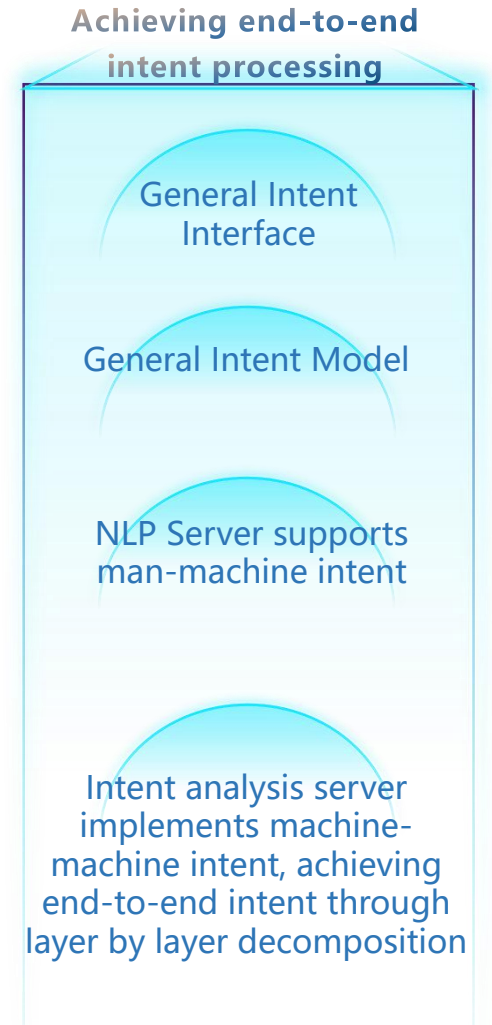
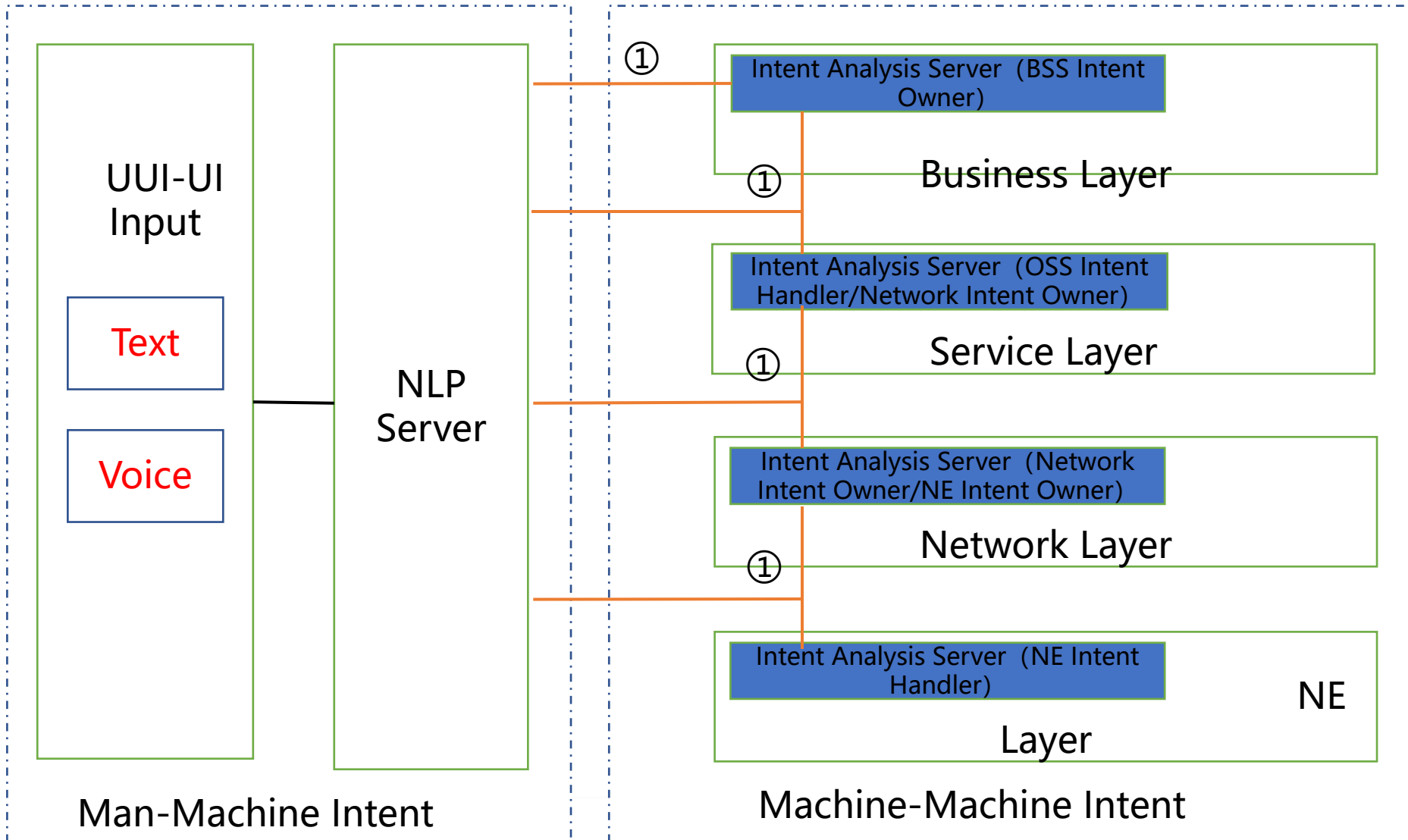
Demo winners:

**A General Implementation with Intent based network in ONAP**

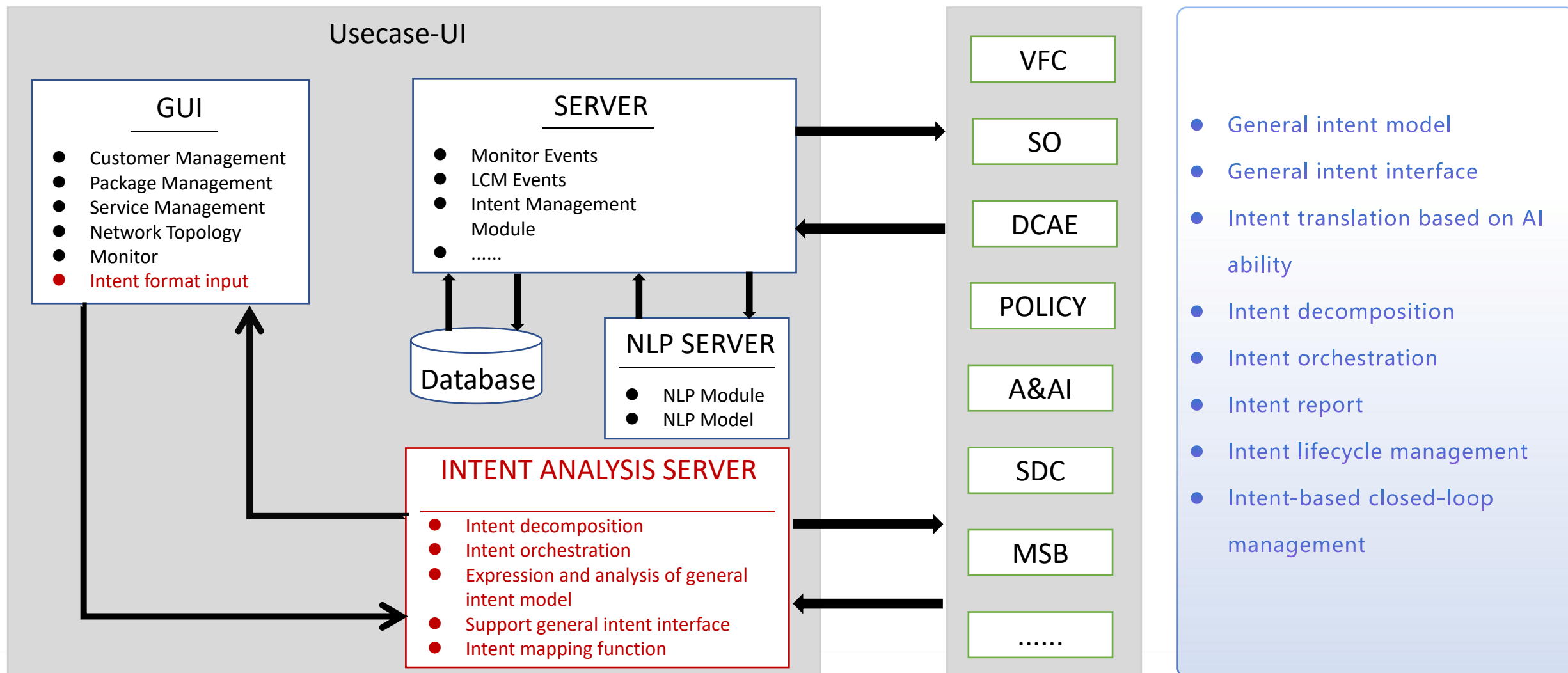
@ Lingli Deng @ **Keguang He** @ Chuanyu Chen  
@ Dan Xu @ Shuting Qing @ zhen zhang

- **Top Achievement Award:** General intent model and general intent interface requirements
- **S3P Improvements:** Usecase UI Project

# ONAP Intent Project Top Level View

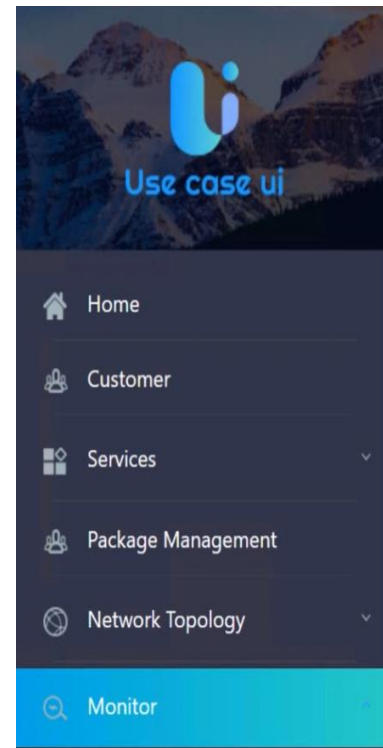
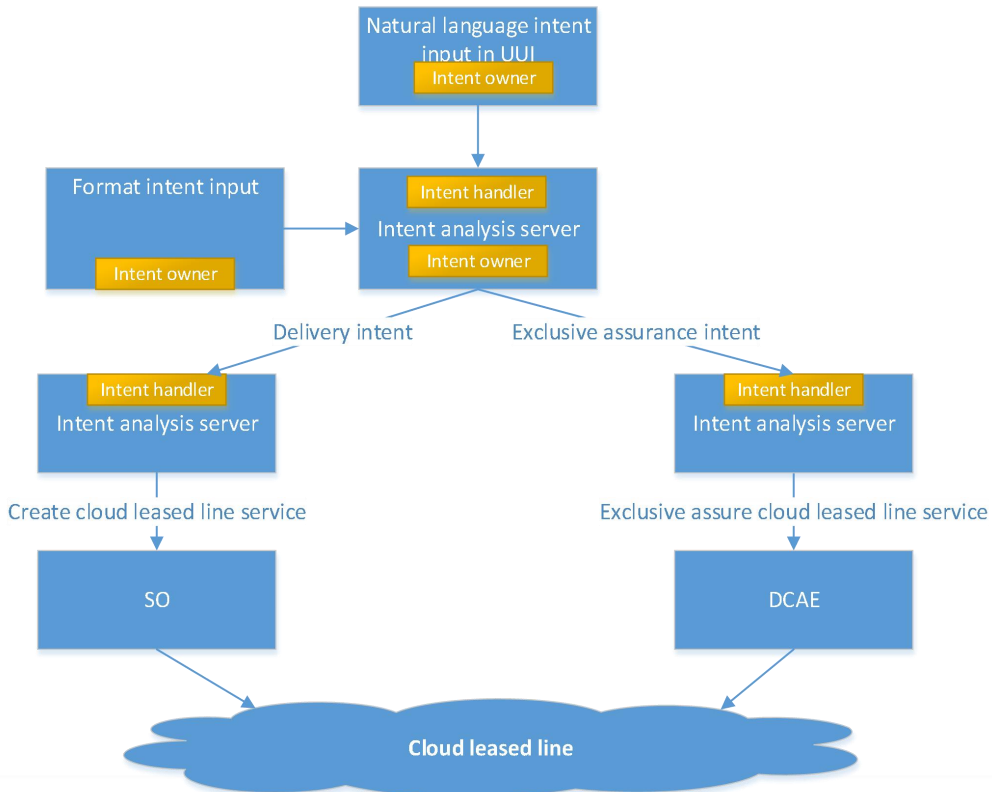


# ONAP Intent Architecture Design



# Use case description

- **User Requirement:** Operators provide intent based cloud leased line services, and provide corresponding assurance measures based on user requirements.
- **Delivery Expectation:** Configure the cloud leased line with a bandwidth of 1G.
- **Exclusive Assurance Expectation:** When the bandwidth utilization rate exceeds 80%, the bandwidth will be expanded by 60% to ensure the user experience; when the traffic returns to normal (the utilization rate is 30%), the service bandwidth will be restored to 1G.



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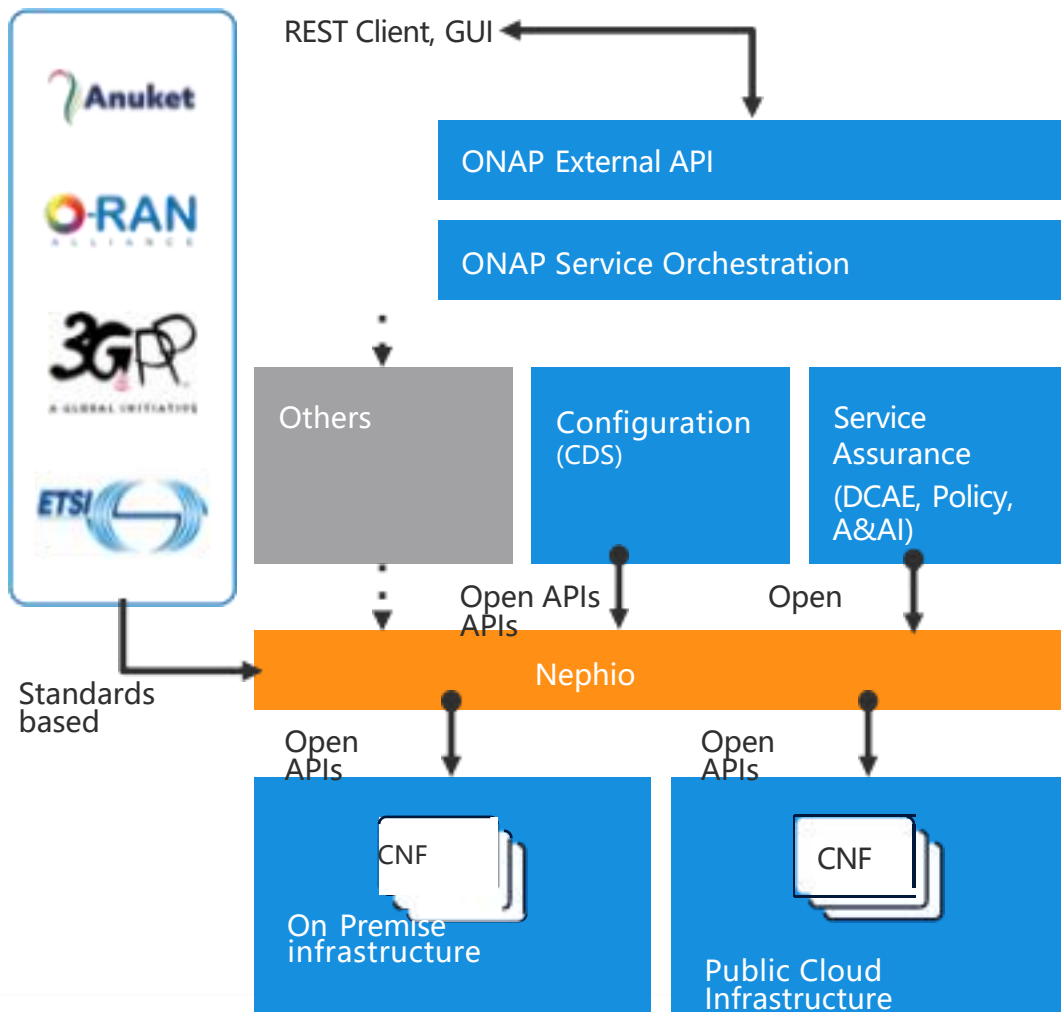
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**Proposal on Intent-Based Integration of ONAP and Nephio**

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Conclusion and Discussion

# Intent-Based Integration of ONAP and Nephio

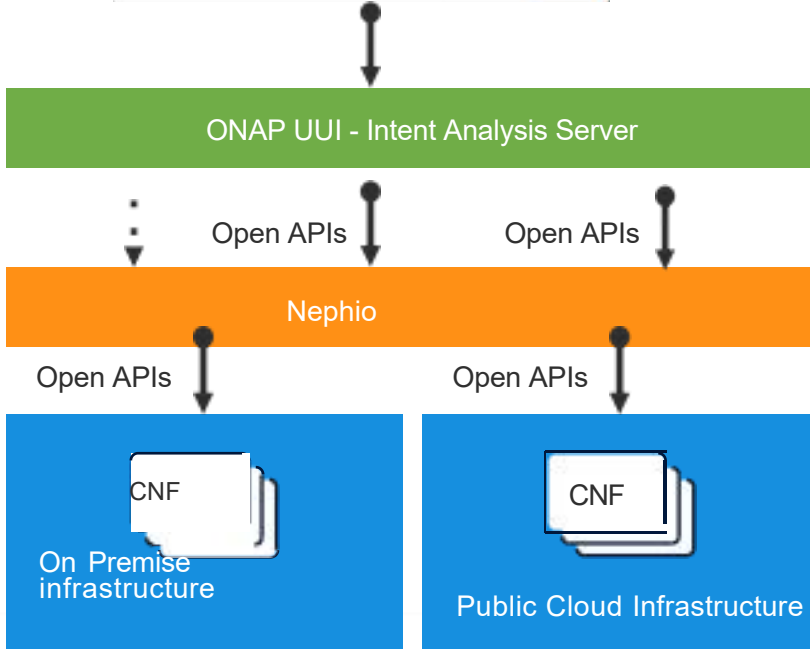
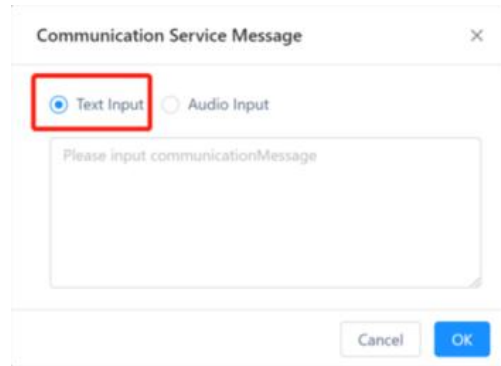


Usecase UI

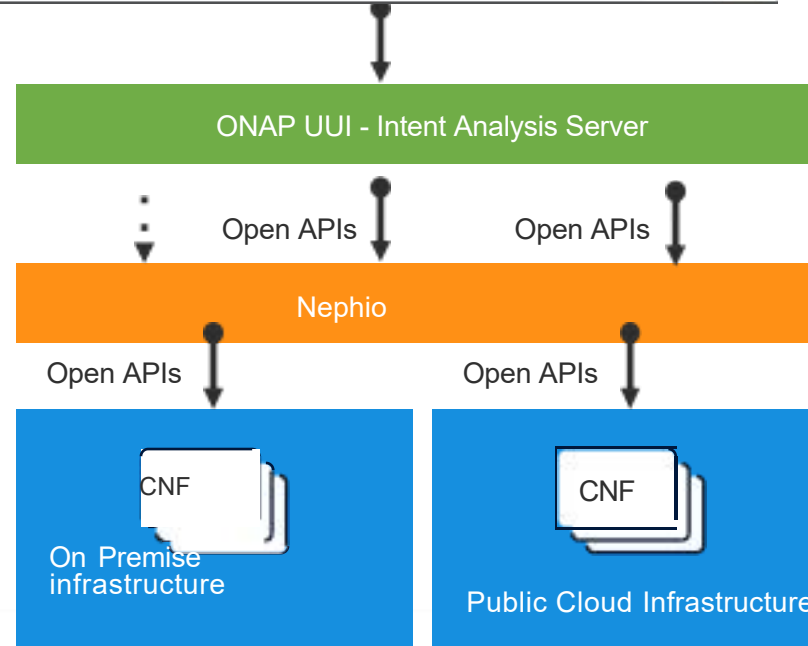
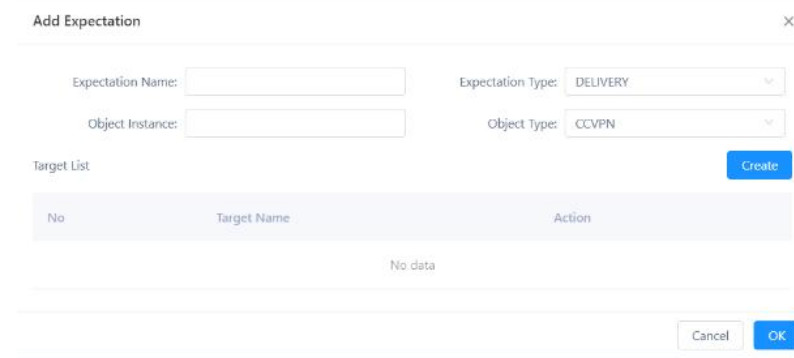
- The UUI component of ONAP provides an intent input interface, supports Intent-related External APIs, and offers capabilities for processing both human-machine and machine-machine intents.
- By utilizing the Usecase UI to invoke the interfaces provided by Nephio, can enhance Nephio's intent processing capabilities.

# Intent-Based Integration of ONAP and Nephio

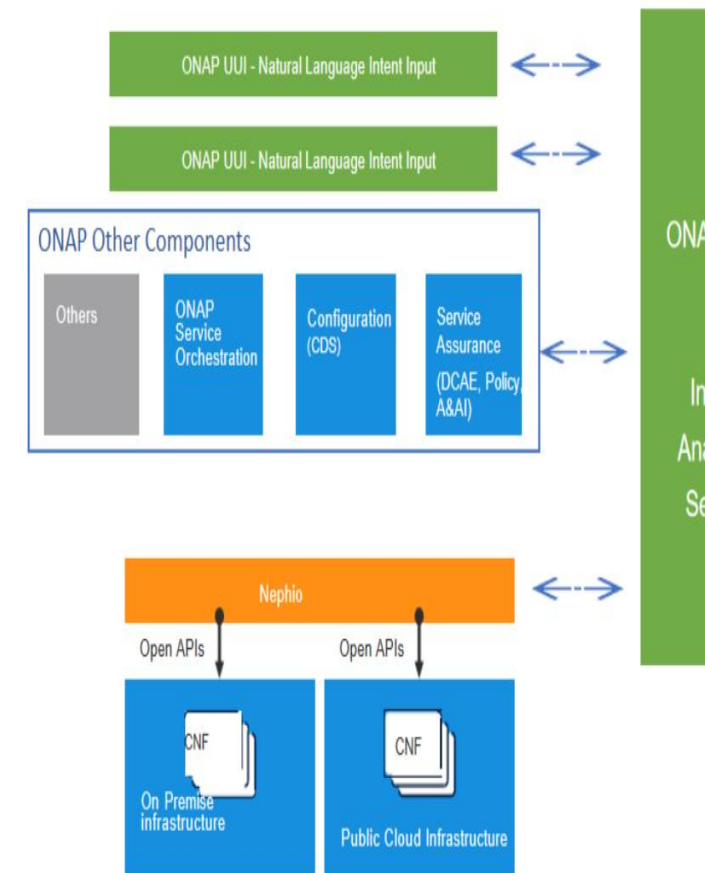
## UI-UI: Provide natural language intent interaction capabilities



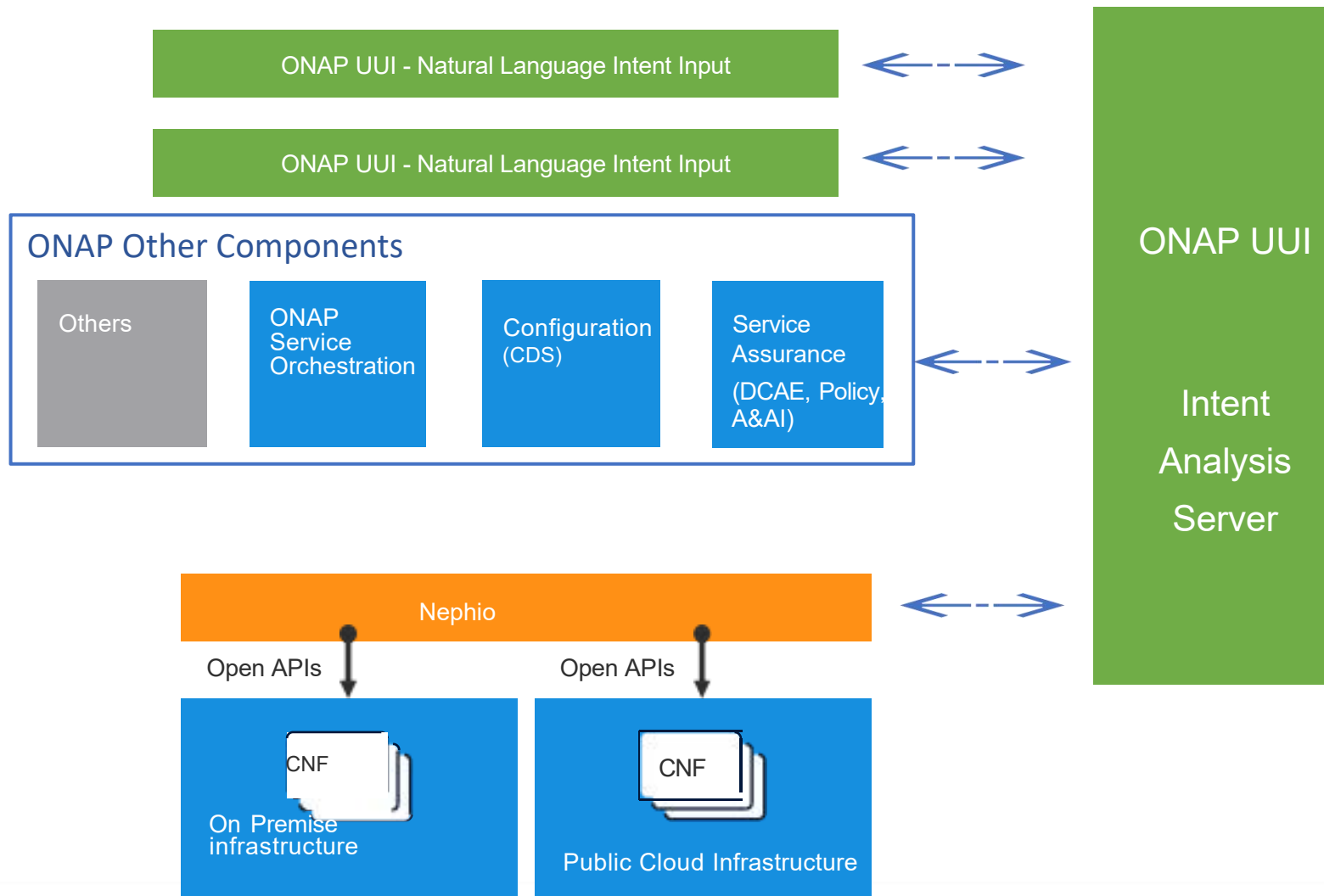
## UI-UI: Provide formatted intent interaction capabilities



## UI-UI: Assist ONAP components in intent interaction



# Intent-Based Integration of ONAP and Nephio



- The Intent Analysis Server module of the ONAP UI component can be further enhanced to assist other ONAP components, such as Service Orchestration, Configuration, DCAE, Policy, etc., in providing intent processing capabilities.
- It also collaborates with Nephio for intent-based interactions.



# Potential Challenges in the Intent-Based Integration of ONAP and Nephio

## Enhancement Needed in Customer Experience

The interaction functionality of the intent input interface is relatively simple and cannot provide personalized services.

## Intent Model Transformation

Addressing the conversion between different Intent models

## Intelligent Generation of Intent Reports

Integration and fusion of various incidents in the intent processing are required to timely generate diverse intent reports.



## Insufficient Capability in Intent Processing

Unable to dynamically and flexibly respond to user intents and ensure continuous satisfaction of user intents.

## Service Layer Intent Transformation to Resource Layer Intent

The intent in ONAP is biased towards the business layer and service layer, while Nephio's intent is biased towards the resource layer. There is a need to consider how to facilitate the transformation between them.

# Generative AI Enhances User Experience

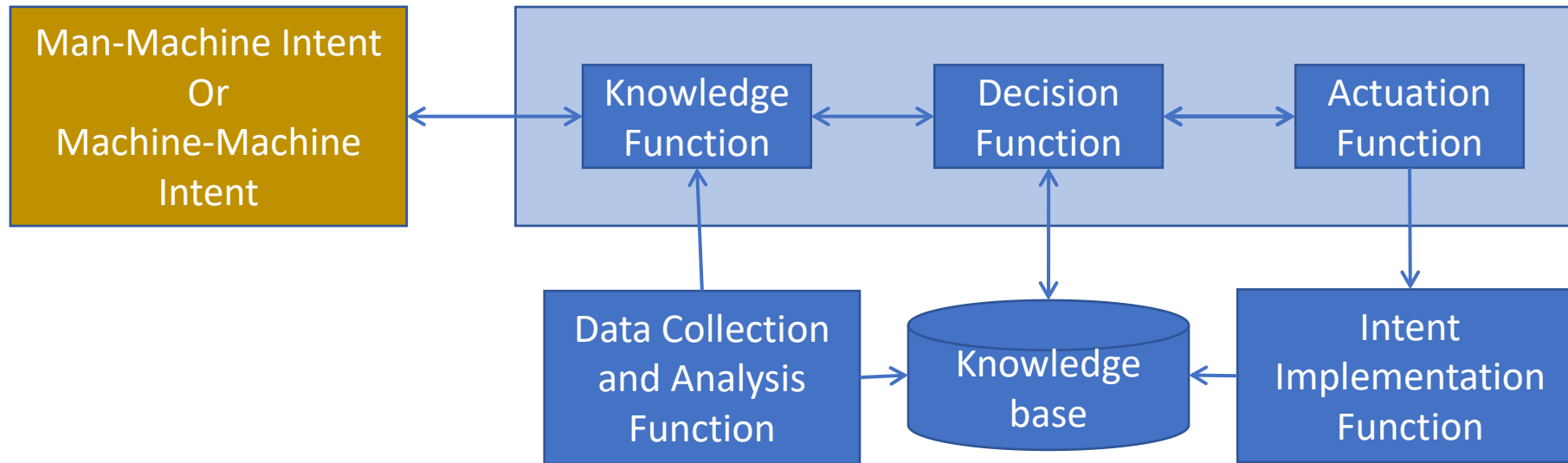
**Although the UUI-UI currently utilizes AI models, but the provided interactive functionality is relatively simple, further enhancement is needed:**

- **Natural Language Understanding and Generation:** Generative AI has the capability to comprehend and generate natural language, enabling customers to interact with machines in a more natural manner. It can identify the semantic meaning and intent of customers, responding to their questions and needs in a natural language format, thereby enhancing the fluency and authenticity of interactions.
- **Personalized Interaction Experience:** Generative AI can offer a personalized interaction experience based on customer preferences and behavior patterns. By analyzing customer historical data and interaction records, it customizes recommendations and suggestions for products or services, meets the individualized requirements of the customer.
- **Automatic Design Capability:** It can quickly provide feedback on whether user intents can be fulfilled. Additionally, leveraging generative AI, it can generate design templates or even code swiftly to offer solutions tailored to user intents.



COMPUTER

# Enhancing Intent Processing Capabilities with AI



In the subsequent intent processing within ONAP and Nephio, various data observed, user intent expectations, and solutions can be stored with a knowledge base. Utilizing AI-related technologies, this process forms a knowledge loop. The Decision Function of the intent management feature can leverage existing knowledge to determine the most suitable solution to fulfill the intent.

- During the execution of intents, providing updated solutions to accommodate changes in user intent. For example, if there is a new requirement for security reinforcement or an update in business processes following an initial intent to deploy network functionalities, AI can be utilized to incorporate relevant processing steps. This may include adding security reinforcement procedures or automatically modifying and implementing existing workflows in response to evolving user expectations.
- In response to instances of intent conflicts and unmet intents during the runtime, analyzing various data and generating new solutions to ensure the refulfillment of user intents.
- AI can predict when devices are likely to experience failures, enabling proactive maintenance before the occurrence of faults. For instance, AI can forecast when resource shortages may occur and allocate additional resources to those areas before issues arise.

# Generative AI Automatically Completes Intent Model Transformation

## ONAP Intent Model

Attribute	Content	Description
intentId	String	The identifier of this intent.
intentName	String	It describes the name of the intent.
	IntentExpectation	Multiple expectation lists contained in one intent.
intentContexts	Context	It describes the list of IntentContext(s) which represents the constraints and conditions that should apply for the entire intent.
intentFulfilmentInfo	FulfilmentInfo	It describes status of fulfilment of an intent and the related reasons for that status.

- With the assistance of AI technology, ONAP intents can be transformed into intents in different domains and formats.
- Intent reports from different systems can also be automatically transformed.

Nephio CRD

3GPP SA5 28.312

TM Forum TR290

Other Format

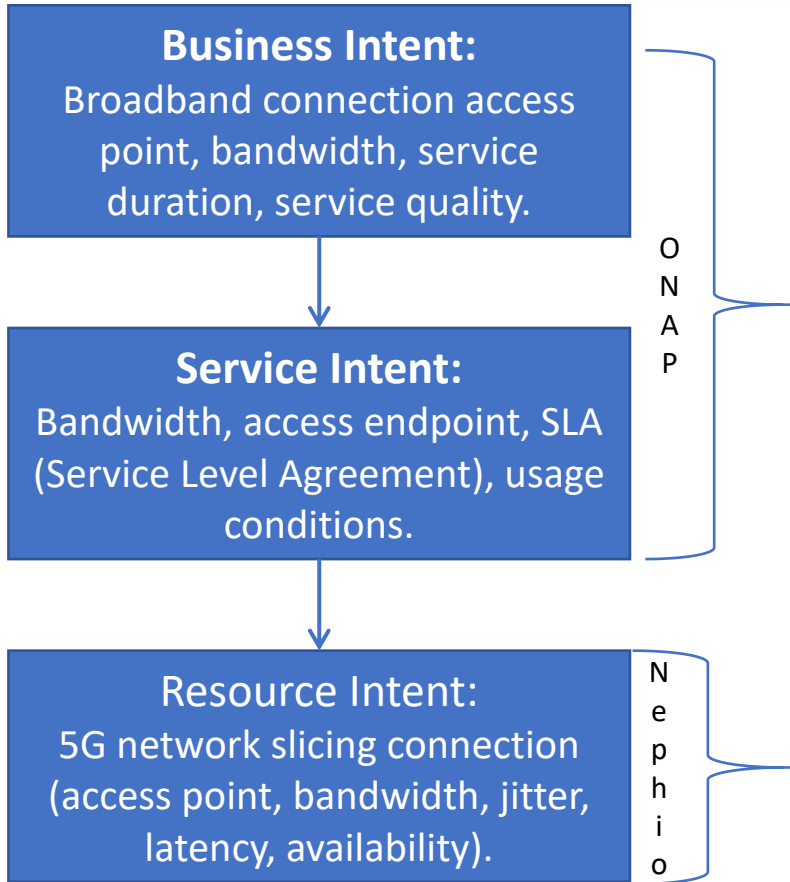
```
apiVersion: nf.nephio.org/v1alpha1
kind: FiveCoreTopology
metadata:
  name: fivecoretopology-sample
spec:
  upfs:
    - name: "agg-layer"
      selector:
        matchLabels:
          nephio.org/region: us-central1
          nephio.org/site-type: edge
      namespace: "upf"
      upf:
        upfClassName: "free5gc-upf"
        capacity:
          uplinkThroughput: "1G"
          downlinkThroughput: "10G"
        n3:
          - networkInstance: "sample-vpc"
            networkName: "sample-n3-net"
        n4:
          - networkInstance: "sample-vpc"
            networkName: "sample-n4-net"
        n6:
          - dnn: "internet"
            uePool:
              networkInstance: "sample-vpc"
              networkName: "ue-net"
              prefixSize: "16"
```

```
...#-----Definition of generic IOCS-----#...
...
...SubNetwork-Single:
  ....allOf:
  ....- $ref: '#/components/schemas/Top'
  ....- type: object
  ....- properties:
  ....- attributes:
  ....- $ref: '#/components/schemas/SubNetwork-Attr'
  ....- type: object
  ....- properties:
  ....- SubNetwork:
  ....- $ref: '#/components/schemas/SubNetwork-Multiple'
  ....- IntentHandlingFunction:
  ....- $ref: '#/components/schemas/IntentHandlingFunction-Multiple'
...
...Intent-Single:
  ....allOf:
  ....- $ref: '#/components/schemas/Top'
  ....- type: object
  ....- properties:
  ....- userLabel:
  ....- type: string
  ....- IntentExpectations:
  ....- type: array
  ....- items:
  ....- type: object
  ....- oneOf:
  ....- $ref: '#/components/schemas/IntentExpectation'
  ....- $ref: '#/components/schemas/IntentExpectations'
  ....- $ref: '#/components/schemas/IntentExpectations'
  ....- IntentContexts:
  ....- type: array
  ....- items:
  ....- $ref: '#/components/schemas/IntentContext'
  ....- IntentAdminState:
  ....- type: string
```

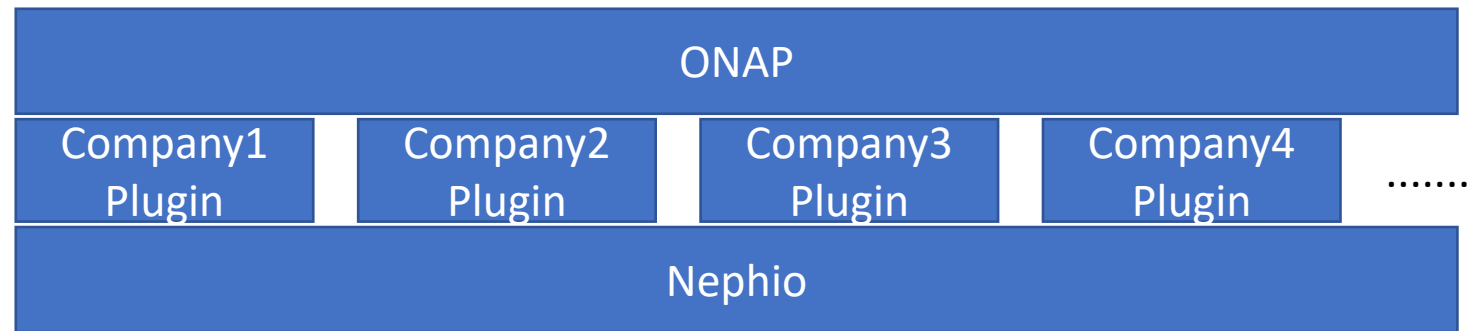
```
ex: Intent1
  a icm:Intent
  .
ex: T1
  a icm:Target
  .
ex: T2
  a icm:Target ;
  rdfs:member ex:Intent1, ex:T1, ex:E1, ex:E3, ex:C1
  .
ex: E1
  a icm:PropertyExpectation ;
  icm:target ex:T1
  .
ex: E2
  a icm:PropertyExpectation ;
  icm:target ex:T1
  .
ex: C1
  a icm:Condition
  .
ex: C2
  a icm:Condition
  .
ex: E3
  a icm:ReportingExpectation ;
  icm:target ex:T2
  .
```

Yang.....

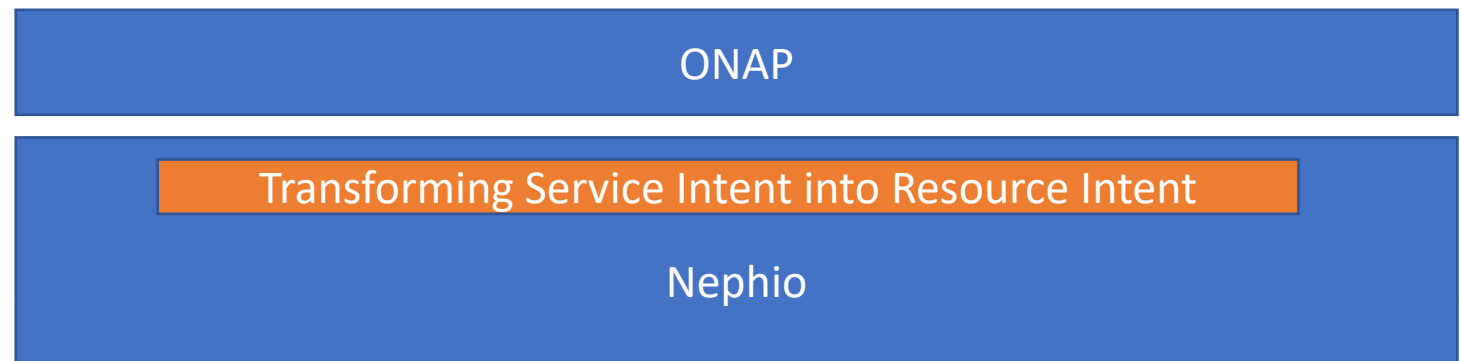
# Transformation of Service Layer Intent to Resource Layer Intent



**Solution 1:** On the ONAP side, different providers provide plugins to transform service layer intent into resource layer intent that aligns with their respective capabilities using AI.

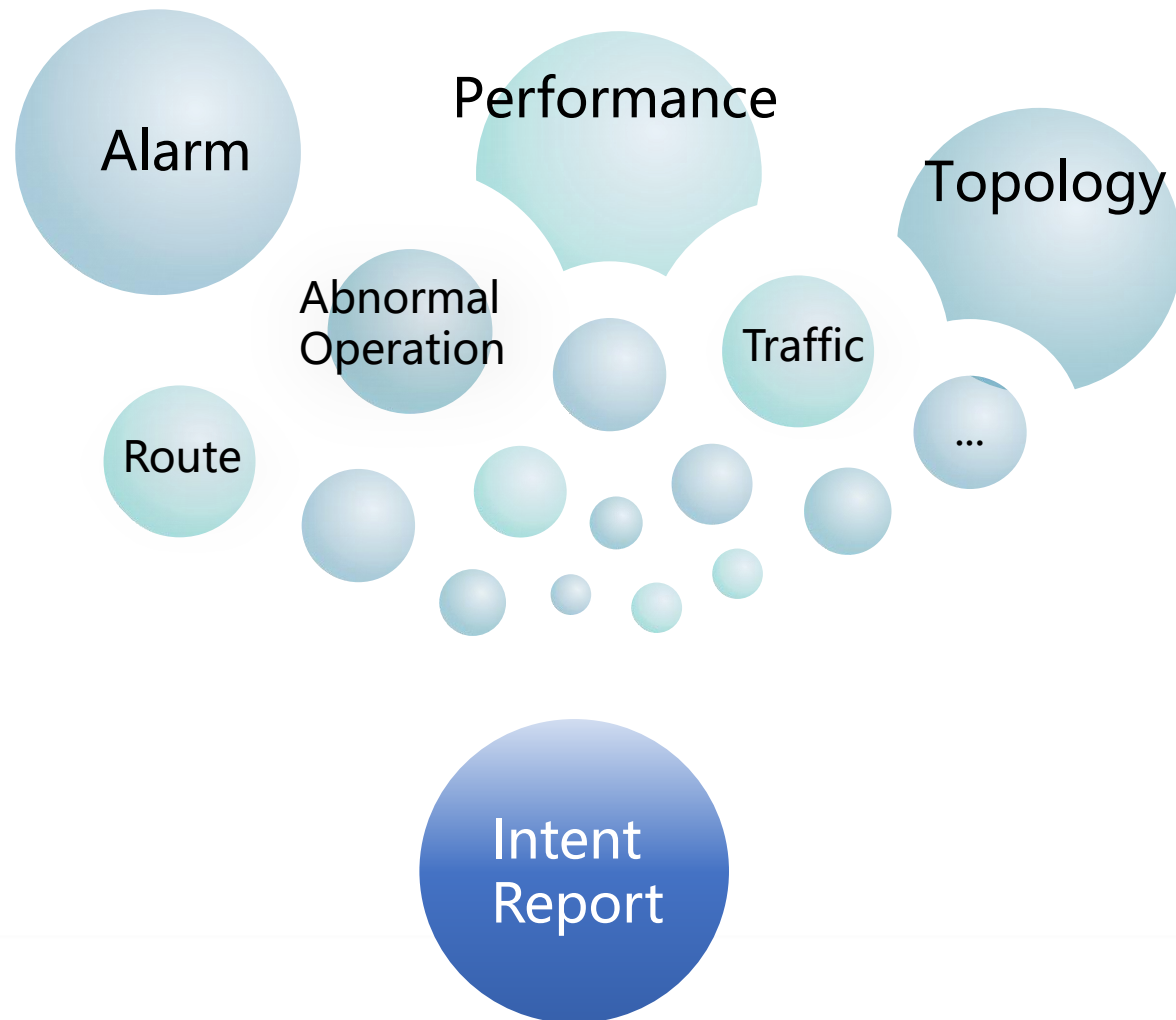


**Solution 2:** On the Nephio side, provide processing capabilities to transform a unified service layer intent into resource layer intents supported by different providers. This may also involve leveraging technologies such as AI.



In the process of transforming service layer intent into resource layer intent, differences in capabilities among different providers result in variations in the description of resource layer intent requirements, such as metrics and resource specifications

# Intelligent Generation of Intent Reports



Generative AI will assist in automatically generating intent reports based on the following content:

- Root cause analysis
  - Incident location
  - risk assessment
- Incident diagnosis
  - troubleshooting suggestions
  - Incident transmission path display
- Incident resolution
  - automatic solution
  - manual solution
- Integrate all information to create intent reports that cater to diverse requirements.

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**Conclusion and Discussion**

# Conclusion

- Collaboration between ONAP and Nephio can achieve an end-to-end intent-driven network.
- In the current ONAP and Nephio intent-based integration, there are still many challenges, such as model conversion and the transformation of business intent to resource intent.
- AI can be employed to address these issues, enhancing the intelligence of the solutions.
- This is a challenging goal that requires the collective efforts of more companies to participate together.



# 1st Workshop on iNtent drivEn autonomouS neTwORks (NESTOR)

Upcoming Important Events: The workshop aims to bring together researchers from both academia and industry to investigate challenging aspects in intent-driven management for the 5G and the future 6G systems, as well as to identify future research directions.

**Website link:** <https://www.icin-conference.org/nestor/>

## Important Dates

- Paper submission deadline: December 21, 2023
- Acceptance notification: January 15, 2024
- Camera-ready paper submission: January 22, 2024
- Workshop: March 11, 2024, Paris, France

## Topic:

- Standardization of intent-based management for the telco cloud
- Orchestration frameworks and intent-based management methodologies
- Intent-driven management for the virtualised RAN
- Intent-based management approaches in 5G and towards 6G communications
- Application of intent-based management architectures and frameworks in telecom networks
- Human-to-system intent interpretation through Natural Language Processing (NLP)
- Machine-to-machine intent expression
- Automated intent translation and policy generation
- Automated intent/policy conflict detection and resolution
- Automated intent monitoring and assurance
- Knowledge-driven intent/policy management
- AI-driven intent/policy management
- Intent test and verification before activation
- AI asset management for intent-driven autonomous networks
- Emerging standards, technologies and advances on intent-driven management
- Intent-driven management for real-time and deterministic communications



# Thanks!

