



LF NETWORKING

Developer & Testing Forum

Cooperation with SDOs,
research on general implementation
with Intent-based network

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<https://lfnetworking.org>



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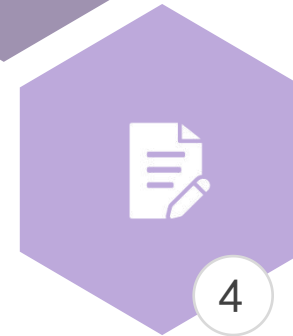
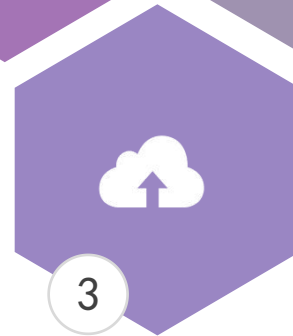
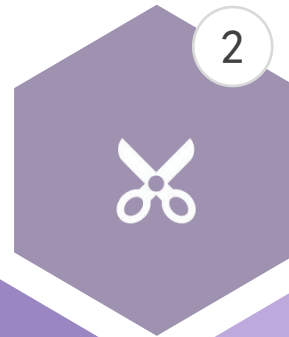
Relationship between intent and autonomous network

Intent is a must for autonomous Networks

Based on the user specified intent goal, combined with AI technology to achieve automatic closed-loop, and independent evolution, finally achieve autonomous operation.

Intent defines what an autonomous domain is expected to achieve

Leave details of how to design and operate network to the internal operation of the autonomous domain.



Evolution of autonomous domain interface

The interface between autonomous domains has evolved from rule based/policy based to intent based.

Key technologies of closed-loop management automation

Closed loop realizes and maintains explicitly intent goals through perception, analysis, decision-making and execution.

Research progress of our team in intent



R&D of IBN

01



Cooperate with SDOs

02



Hope to apply more standard research results to open source practice.

- Research the intent use case, intent model and intent management of **autonomous network**.
- Improve interoperability between components/systems via **standardized 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**: Reporter of ENI 013 and important contributor of ENI 015.
- **ETSI NFV**: Reporter of NFV-IFA 050.
- **3GPP**: Actively contribute to 3GPP R17 and R18.
- **TMF**: Actively contribute to autonomous network and intent project.
- **CCSA**: As the reporter, created five intent projects in the field of autonomous network and core network.

Important concepts

- **Intent:**

Intent is the formal specification of all expectations including requirements, goals, and constraints given to a technical system. (TMF IG1253)

- **Intent Object:**

Intent object is an object described in the format after the two parties of the requirement negotiate the intent.

- **Intent Instance:**

Intent instance is the carrier of formatted intent and intent fulfillment status.

- **Intent Owner:**

Intent owner is the creator of the intent object and is responsible for managing the life cycle of the intent object.

- **Intent Handler:**

Intent handler is the receiver of the intent object, responsible for the realization and satisfaction of the intent object, and managing the life cycle of the intent instance.

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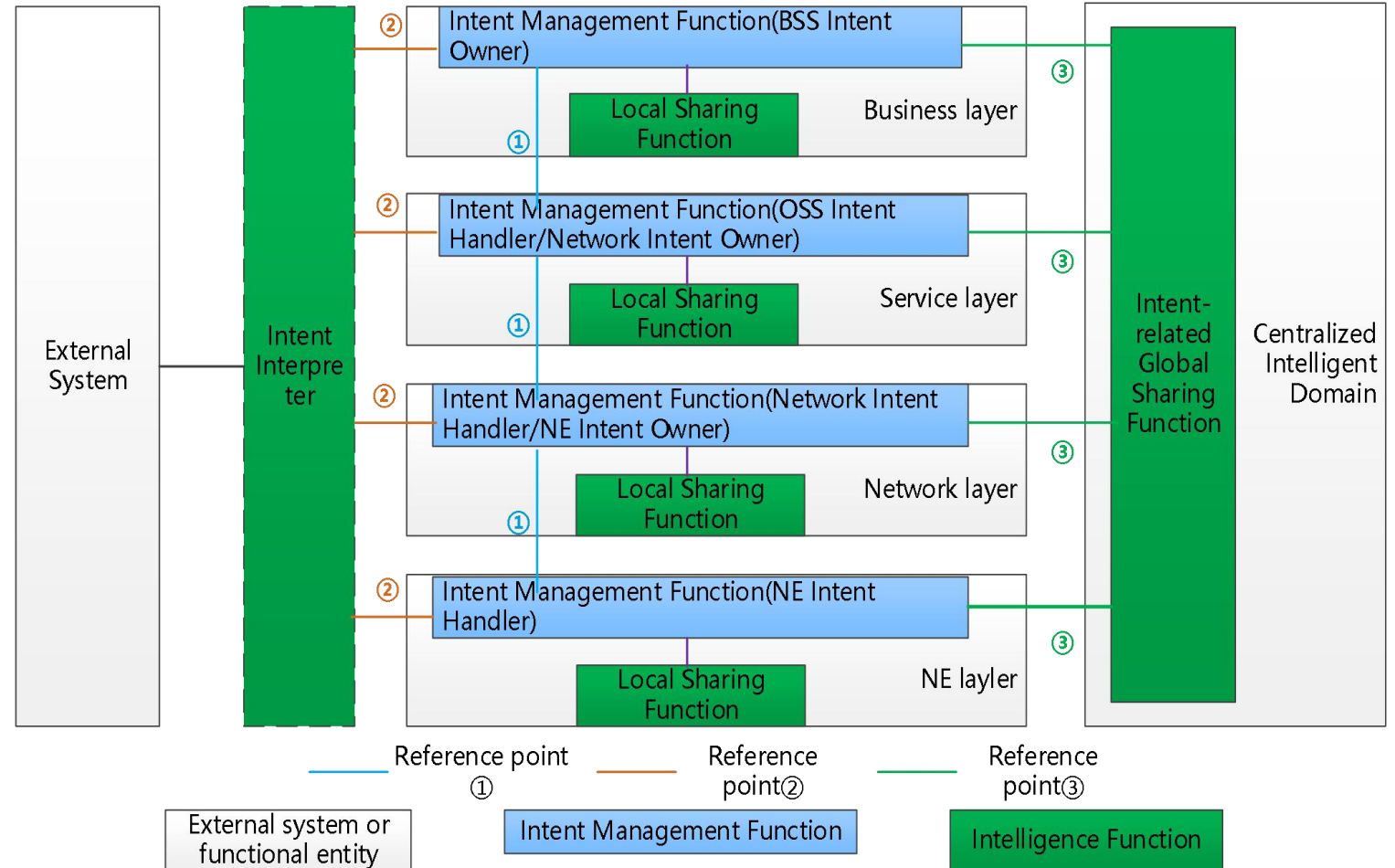
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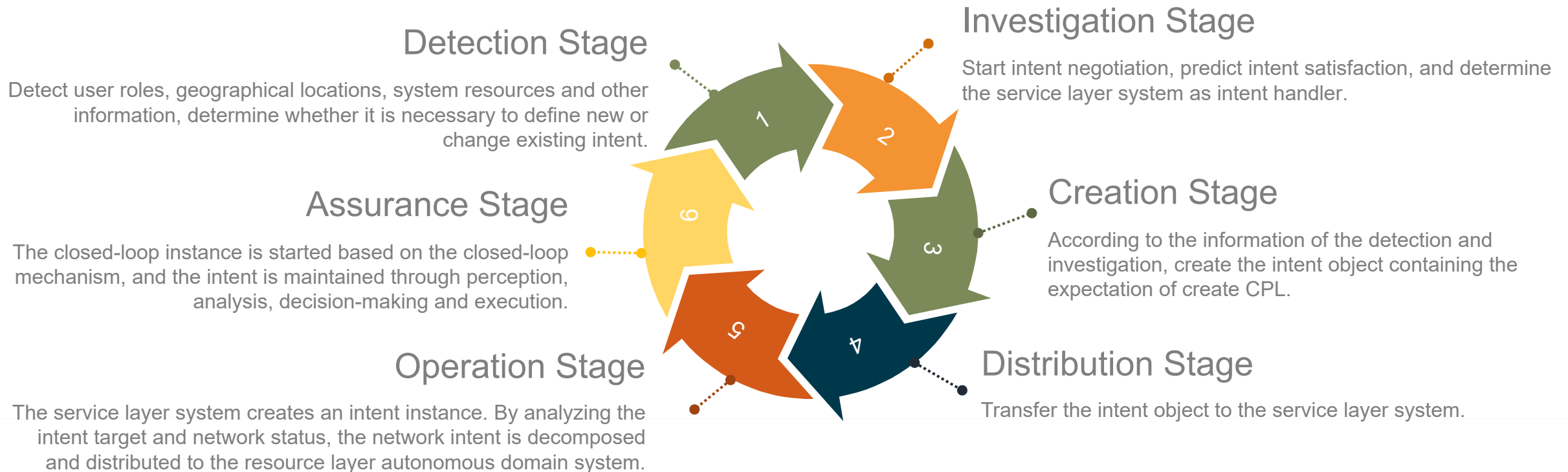
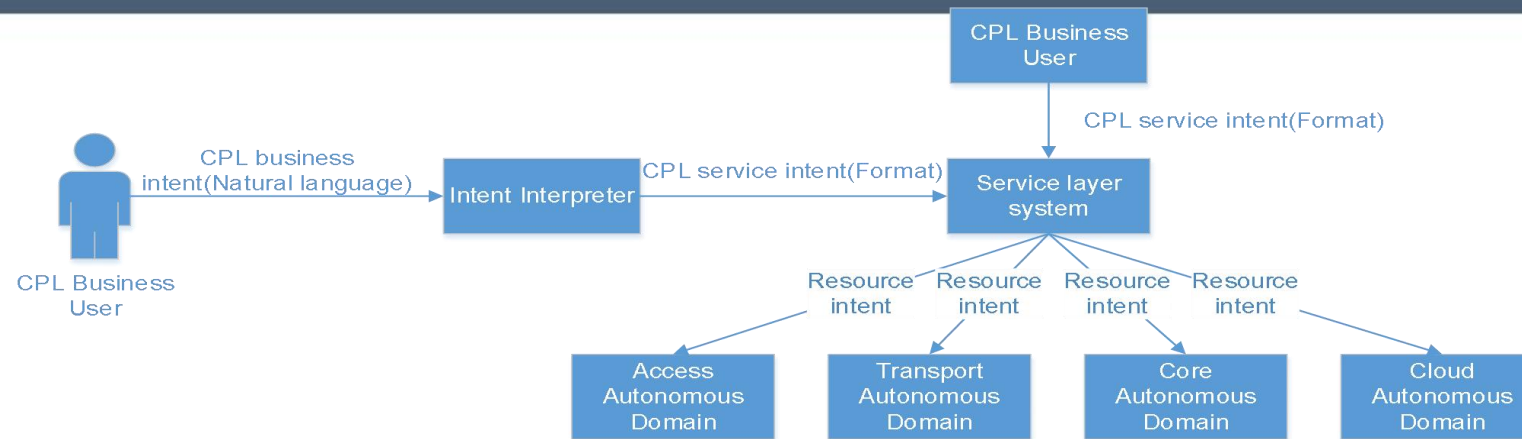
Autonomous network intent management framework

- The intent management function of the intent owner interacts with the intent management function of the intent handler.
- Format intent input interface provided by intent management function.
- Intent management functions interact with intent related global external functions.

- ONAP: Focus on the intent of Business layer and Service layer.
- Nephio: Focus on the intent of Network layer and NE layer.
- Need to unite with more open source organizations to achieve end-to-end intent.

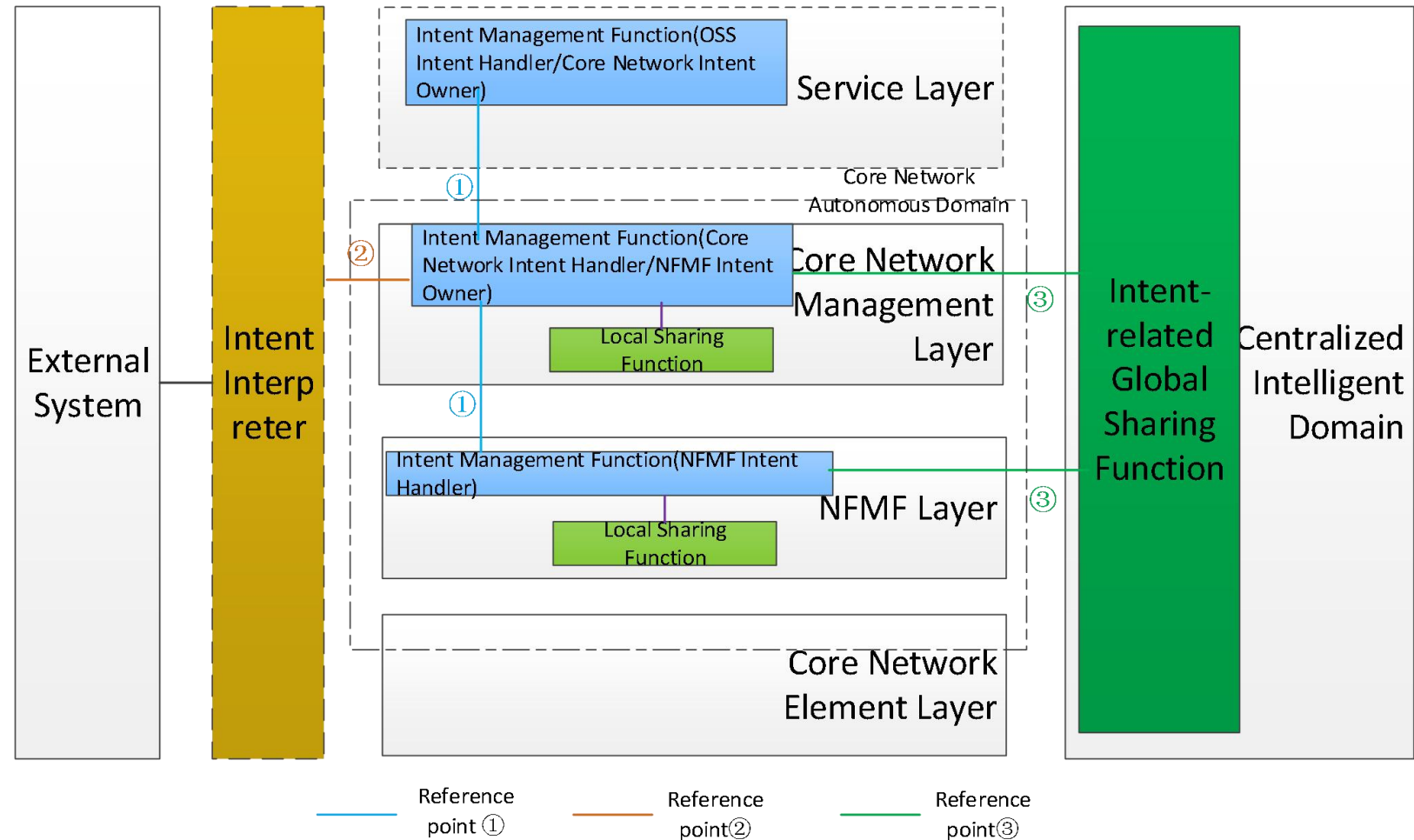


Autonomous network intent use case: intent-based cloud leased line service

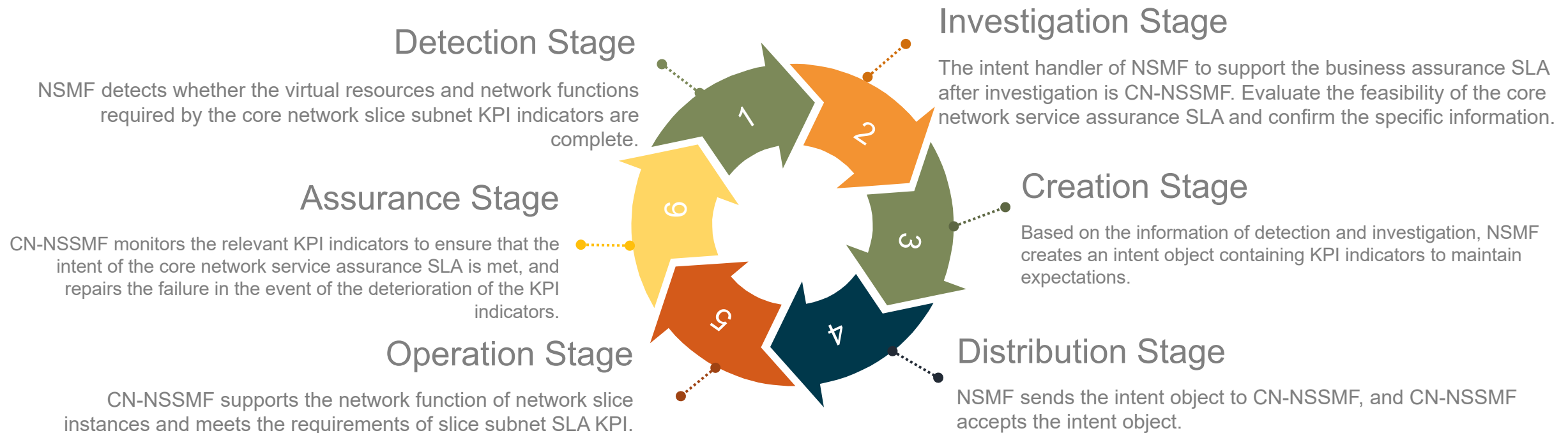


Core network intent management framework

- The intent management function of each layer can interact with the local sharing function, such as data collection or simulation.
- The intent-related global sharing function located in the centralized intelligent domain provides the storage and management of cross-layer intent instances, intent processing capabilities, intent model knowledge and other global shared information.



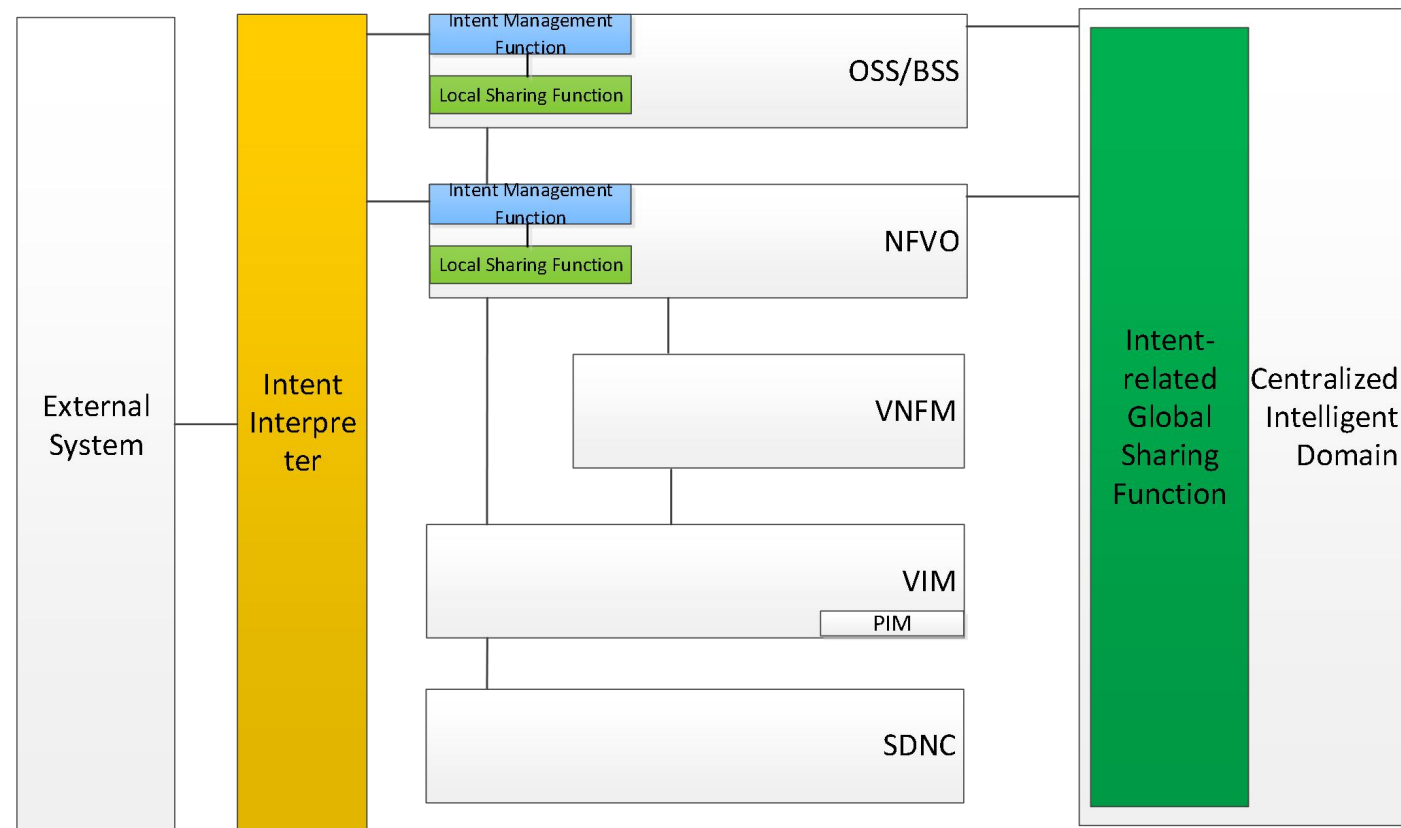
Core network intent use case: slice subnet KPI maintenance intent



NFV intent management framework

The intent management function can be called by each function block in the NFV-MANO domain as an overlay layer.

For example, the Intent Owner expresses its intent about delivering an NS which contains the NS expectation and constraints. For example, functional requirements (e.g. which VNFs are needed), performance requirements (e.g. the min incoming/outgoing data of a certain SAP), geographical location, isolation requirements (e.g. whether or not it is allowed to share any resources with other NSs), special security requirements (e.g., use of secure enclaves). The intent management function translates intent to corresponding NS operation (s) (e.g. instantiate a new NS or update an existing NS) to fulfil the intent requirements.



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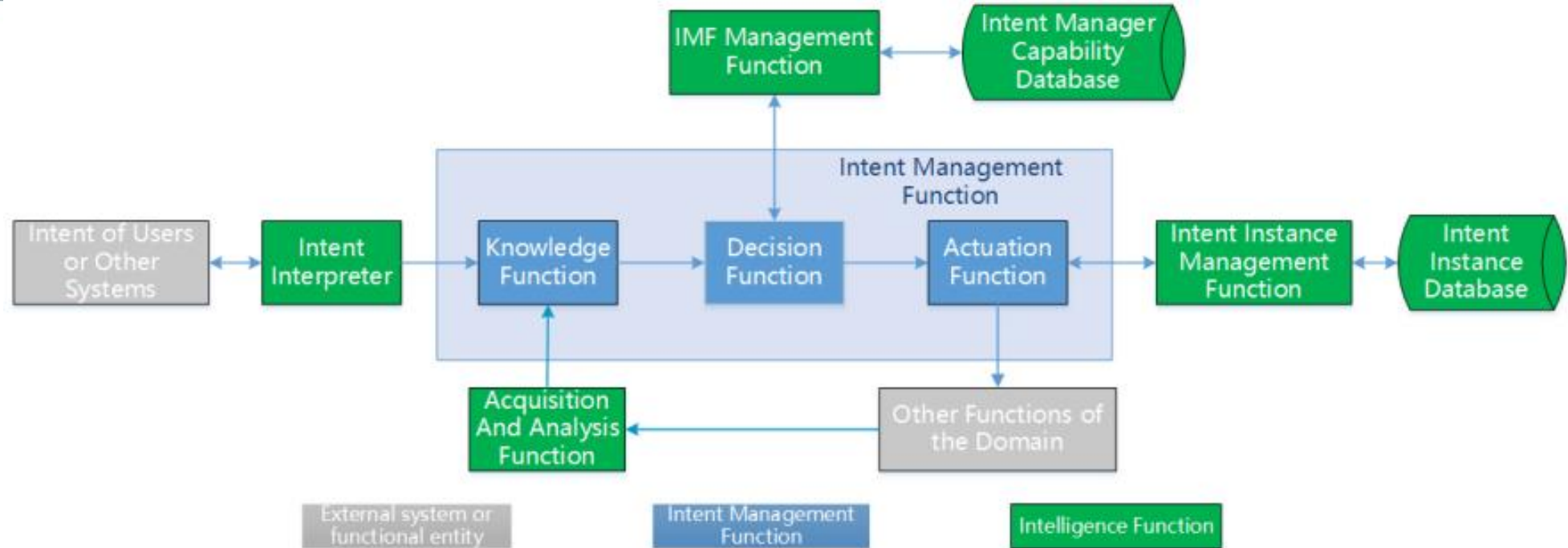
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Functional architecture related to intent management

IMF:

Intent Management Function



- **Intent Format Function:** Receive intent from external users or other systems, and format it into a general intent model definition form.
- **Acquisition And Analysis Function:** Collect and analyze the corresponding information of the system, and monitor the operation status.
- **Intent Function Management Function:** Provide intent management function registration mechanism, and support the query function .
- **Intent Instance Management Function:** Perform lifecycle management on intent instances.

Intent Life Cycle Overview

Figure1: The procedures of an intent
(the perspective of intent owner)

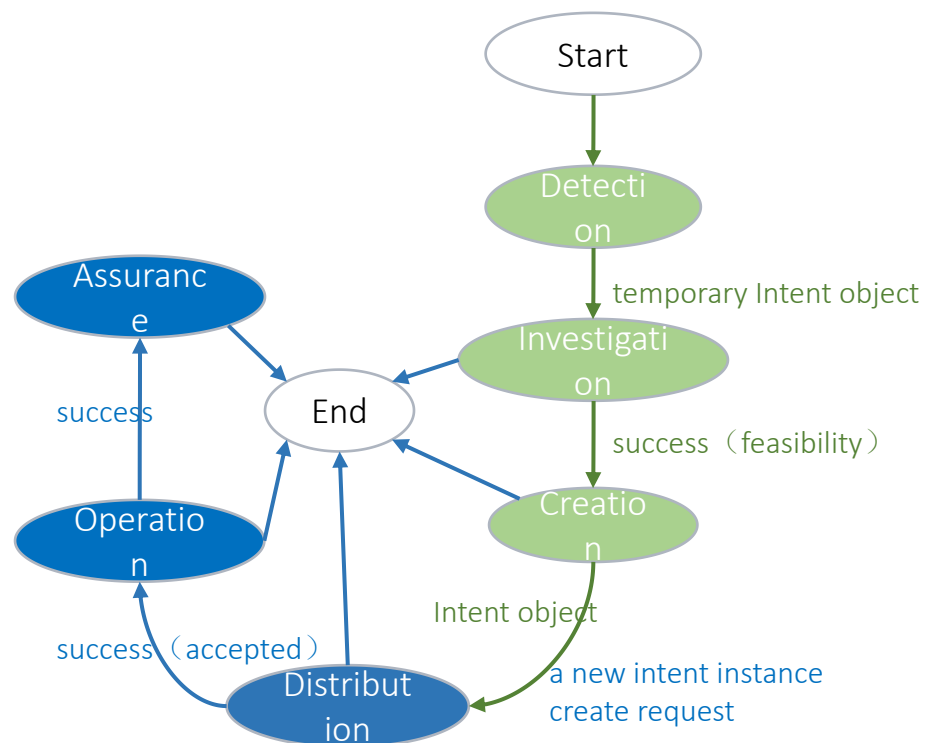
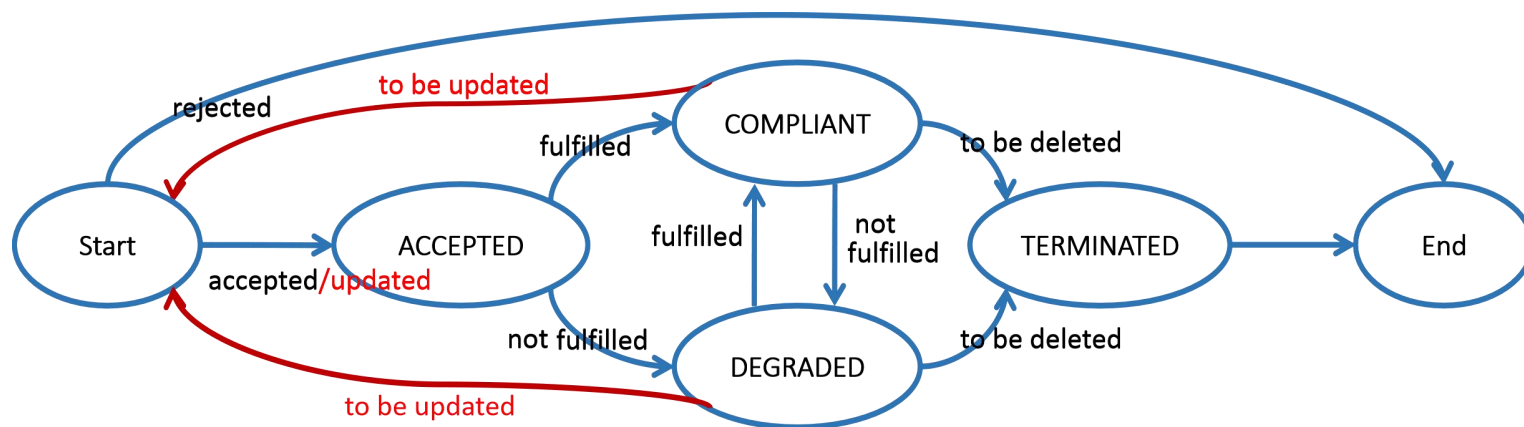
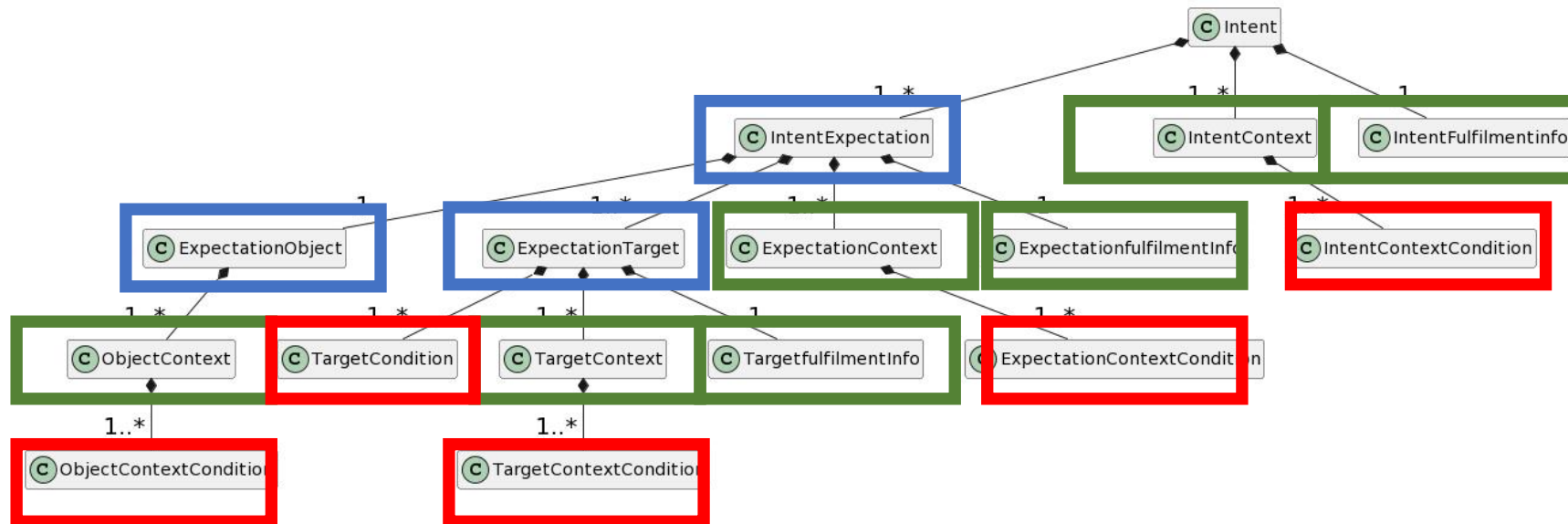


Figure2: The state machine of an intent instance (the perspective of intent handler)



General Intent Model



TM Forum

3GPP

ONAP

It is recommended to consider the following interface

•Mandatory Operations

- **CREATE:** Used by the intent owner to request a new intent instance from the intent handler.
- **UPDATE:** Used by the intent owner to request an update intent instance from the intent handler.
- **QUERY:** Used by intent owner and intent handler to query existing intent instance information.
- **DELETE:** Used by the intent owner to request deletion of the intent instance from the intent handler.
- **REPORT:** Used by intent handler to report intent processing satisfaction, execution status, and reasons.

Optional Operations

- **PROBE:** Used by intent owner to explore whether an intent handler can implement a specific intent and verify the effect and potential impact of the intent in advance.
- **NEGOTIATE:** Used by intent handler to negotiate with intent owner the necessary modifications to the content of the intent object to enable the realization and fulfillment of the intent.

Note: **negotiate** is proposed as an independent operation, which could be used in combination with either **create** or **probe** operations.

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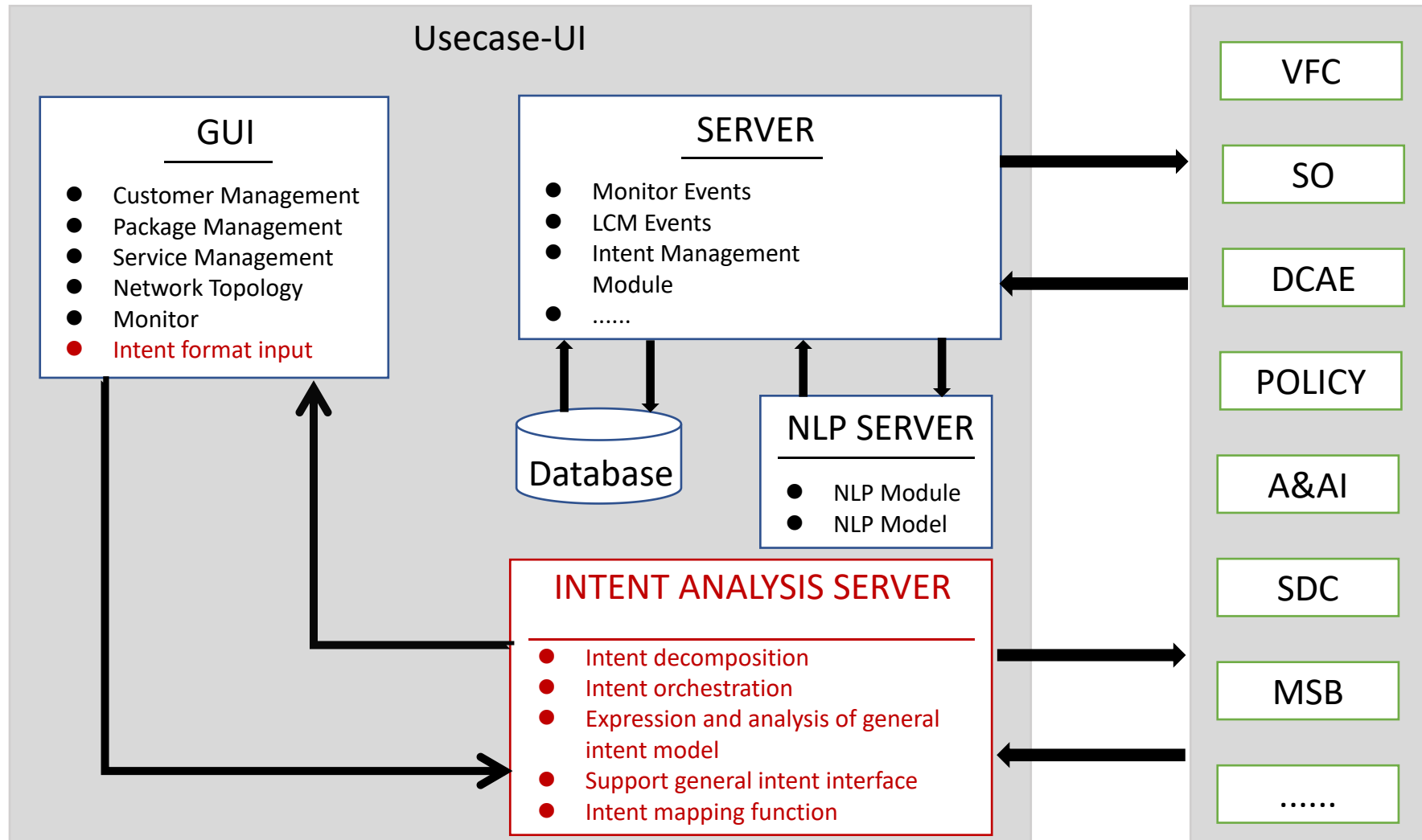
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Kohn Release: REQ-1267 General Intent Model And General Intent Interface

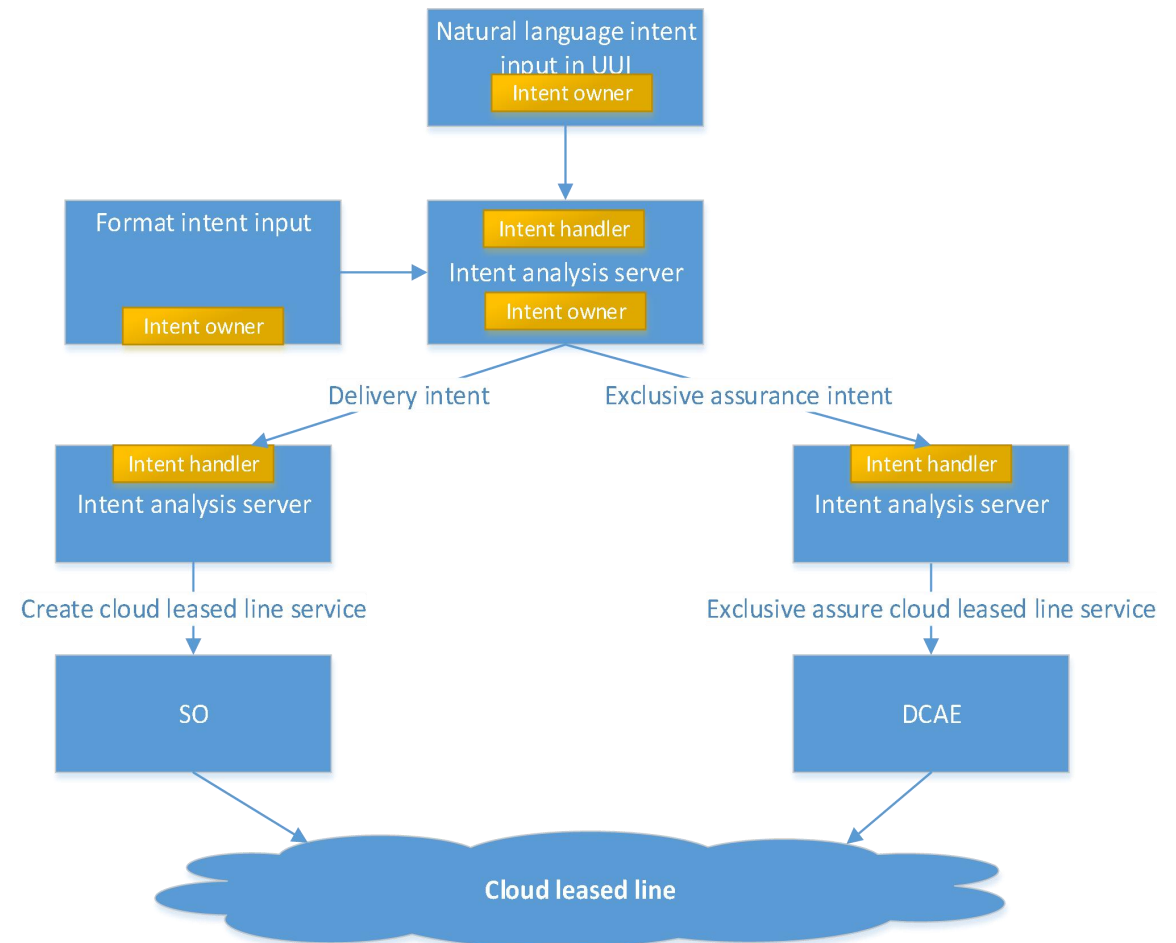


Kohn Release: REQ-1267 General Intent Model And General Intent Interface

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.



London Release: REQ-1408 Enhance general intent implementation solutions

In London release, we continue plan to do deep research about general intent implementation. Mainly includes those work as below:

Optimize the interaction between intent owner and intent hanler.

A

Introduce AI-related technologies, focusing on the introduction of AI technology in the processes of intent formatting, intent translation, and intent decomposition.

B

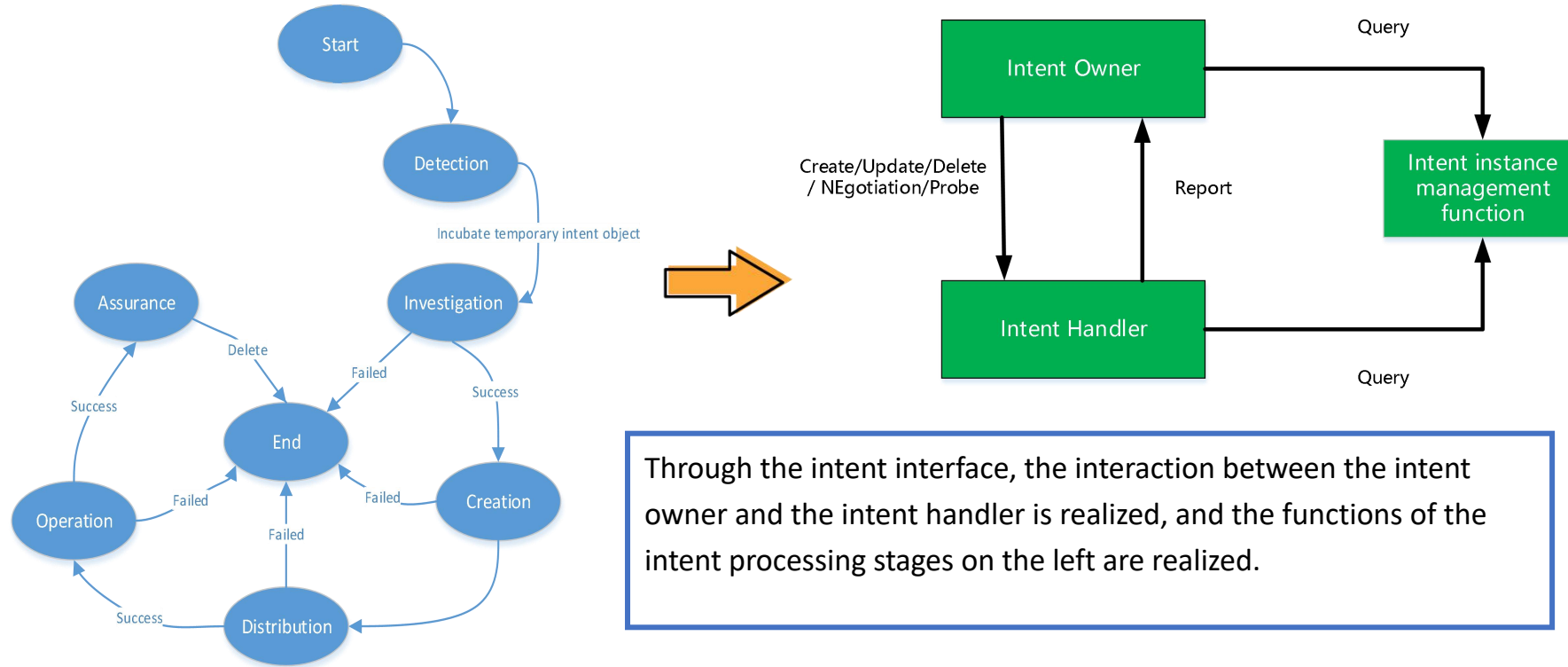
Implement more intent interfaces, such as intent negotiation, intent report, etc.

C

Cooperate with third party projects and open source projects such as nephio to realize end-to-end intent.

D

Optimize intent processing flow



Enhance the general intent model

- **Intent FulfilmentInfo**

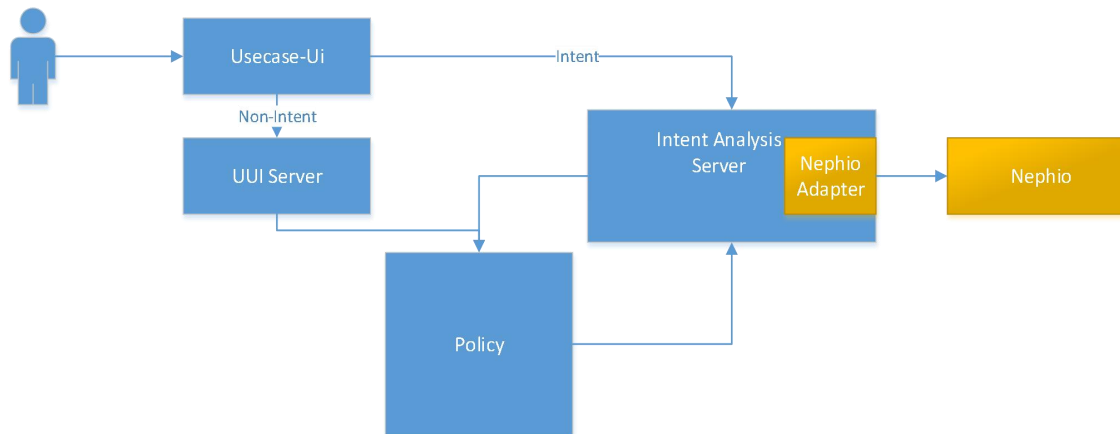
Attribute	Qualifier	Cardinality	Content	Description
fulfilmentStatus	M	1	ENUM	It describes Value: <ul style="list-style-type: none">● FULFILLED● NOT FULFILLED
notFulfilledState	CM	1	ENUM	It describes the current progress of or the reason for not achieving fulfilment for the intent, intentExpectation or expectationTarget.Value: <ul style="list-style-type: none">● ACKNOWLEDGED● COMPLIANT● DEGRADED● SUSPENDED● TERMINATED● FULFILMENTFAILED
notFulfilledReasons	CO	1	String	It describes the reasons/observations related to the specific noted notFulfilledState.

- **Intent Report**

- Attribute definitions of intent report model need to be provided.
- How to transfer the intent report model between the intent owner and the intent handler.

Integration with Nephio

- Intent analysis server is a general intent processing module under the ONAP Usecase UI module. The integration with Nephio can be realized by adding Nephio adapter to intent analysis server.
- Other modules of ONAP, such as policy, can interact with Nephio through Nephio adapter of Intent Analysis Server.



Nephio Adapter can provide the following functions:

- Interact with Nephio based on general intent interface.
- Conversion of ONAP and Nephio intent Model.
- Registrare and analysis of Nephio environment information.
- Life cycle management for the intent to interact with Nephio.
-

Collaboration in model

ONAP General 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.



Nephio CRD

```
apiVersion: nf.nephio.org/v1alpha1
kind: FiveGCoreTopology
metadata:
  name: fivegcoretopology-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"
```

- Convert ONAP general intent model of ONAP to the format of Nephio CRDs.
- Operation information of Nephio intent is parsed and added to the general intent model of ONAP.

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Future Plans

Improve the R&D of IBN

Improve AI driven capabilities

Introduce more AI related technologies in intent analysis, translation, decomposition and other processes.

Implement more intent interfaces

The interface of intent negotiation stage shall be formulated and relevant processing flow shall be realized.

Provide intent verification function

Verify the effect and possible impact of the intent in advance.



Cooperate with open source projects

Upstream to standards organizations

Analyze new technologies related to intent in SDO(TM/3GPP/ETSI/CCSA) for improvements in the next release.

Cooperate with nephio

Try to cooperate with open source projects such as nephio to realize end-to-end intent.

Provide more use cases

Provide more usage scenarios and use case implementations to support our solutions.



Thanks!

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