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Experiential Networked Intelligence (ENI);

Coordination Orchestration of Multiple Elements(CoordOME)

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**Group Specification**

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# Foreword

This Group Specification (GS) has been produced by ETSI Industry Specification Group Experiential Networked Intelligence (ENI).

# Modal verbs terminology

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# Executive summary

The present document discuss the framework of Coordination Orchestration of Multiple Elements, presents its impact on the ENI System Architecture, defines the functions, interfaces, and workflow of the framework of Multiple Elements Coordination orchestration. It also describes a collection of typical use cases of Coordination Orchestration of Multiple Elements.

# 1 Scope

The present documen will investigate the addition of multi-elements coordination orchestration capabilities in the ENI functional block. To support technologies such as digital twins and edge federated learning that require multiple types of resource consumption. The elements in this GS mainly refer to the resources that support business practices (network, computing, storage), OPEX (save energy, etc.), etc. This Specification will standardize element information, to study the impact of the newly added multi-elements coordination orchestration function block on the ENI architecture, multi-elements coordination orchestration framework, processes, potential application scenarios, etc.

# 2 References

## 2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non‑specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] ETSI GS ENI 005 (V3.1.1): "Experiential Networked Intelligence (ENI); System Architecture"

## 2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non‑specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ETSI GR ENI 008(V2.1.1): "Experiential Networked Intelligence (ENI); InTent Aware Network Autonomicity (ITANA) "

# 3 Definition of terms, symbols and abbreviations

## 3.1 Terms

## 3.2 Symbols

## 3.3 Abbreviations

# 4 Background and Overview

ENI005 specifies the functional architecture of ENI System, defining its functionality, behaviour and the decomposition of sytem into functional blocks. ENI008 describes using intent with the ENI system architecture, which includes accepting, translating and validating intent statements. The present document will discuss how to collaboratively and optimally schedule multiple resource elements for complex business needs based on current ENI system architecture.

With the development of technology, emerging applications such as Cloud Rendering, Metaverse, Internet of Vehicles, AI Large Language Model have strong demand for multiple resource elements, including network, computing power, dataset, storage, application and so on. Meanwhile, the business logic becomes more and more complex. Therefore, how to supply the optimal elements combination for applications to meet these complex business needs has become a difficult problem. Multiple elements coordination orchestration bases on network commucation capabilities, combimes multiple elements capabilities into a unified element view, dynamically and jointly orchestrates these element capabilities as business needs, finally provides an integrated multiple elements capability scheduling strategy.

# 5 Elements

Note: This clause will list all kinds of elements required by coordination orchestration and describe the characteristics, parameter metrics, functionalities of these elements.

## 5.1Overview

This clause discusses the capabilities and parameter metrics of each type of element. Based on these parameter metrics of elements, CoordOME could orchestrate services, processes, workflows, etc., and schedule multiple elements resources to meet business needs accurately, efficiently and reasonably.

## 5.2 Networks

Networks provide connectivity capabilities for business system. Networks include core networks, transport networks, access networks, cloud private networks, etc. The network performance can be measured by metrics such as bandwidth, delay, jitter, and so on.

## 5.3 Computing

Computing powers provide data processing capabilities for business. In ENI system, all the computing powers will be accessed to a unified resource management platform through network. Computing powers can be categorized into general-purpose computing power, intelligent computing power, super computing power, and edge computing power.

General-purpose computing power mainly used for running general-purpose workloads; intelligent computing power mainly used for accelerating AI workloads; supercomputing power is mainly based on supercomputer which process vast amounts of data in parallel by distributing workloads to thousands of processors; edge computing power mainly provides real-time computing power for users nearby, which is a combination of the first three types, and edge computing power focus on solving the problem of network latency.

Some important specifications and features of processors are Core Count, Clock Frequencies, L Cache, Hyper-Threading support, Generation and Micro-architecture, and so on. FLOPS (Floating-point Operations Per Second) is the most common key performance indicator to measure computational capability.

## 5.4 Storage

Storage provides the capability of holding information permanently. Typical storage devices or system include hard disk, Ssd, Nas, San, Nfs, Hdfs, Ceph and so on. The performance metrics of storage devices include storage capacity (units: MB or GB), IOPS (performance of random read/write, units: MB/s), Throughput (performance of sequential read/write, units: MB/s), Response Time/Latency (units: ms or µs), etc.

## 5.5 Data

Data is the carrier of information, and is fundamental to the analysis of services and businesses. Different services and businesses have different data formats (structured, semi-structured, unstructured) and data volumes. While allocating processing resources, it is necessary to consider the data magnitude, the processing difficulty caused by the data format, the delay constraint on uploading and delivering data, and the controllability and security requirement during data transmission. Rather, some services such as privacy computing, federated learning need cross-industry and cross-specialty data collaboration. It is important to keep the privacy of data by means such as encryption, anonymization, pseudonymization, secure computation and data partitioning throughout the data processing procedure, which will consume certain amount of compute power resources and should be taken into consideration in service orchestration and scheduling.

## 5.6 Application

Applications always have close relationship with or even heavily depend on back-end services. In communication business or operation support systems, applications generally could be categorized into four types of cloud, cloud-edge, cloud-edge-end and multi-cloud, and each type of application has its own computing, networking and storage needs. Moreover, the data traffic of different application types is also one important parameter for the consideration of services deployment and resources orchestration.

For cloud-edge-end collaboration applications, it needs to dynamically orchestrate and schedule resources based on factors such as devices computing power, data traffic characteristics, transmission delay, bandwidth resources, etc. Generally, end devices are responsible for executing computing tasks closely interacting with users, and also data acquisition and upload. Edge computing power is mainly used to support end-side perception, control, data aggregation and fusion. Large-scale computing power on cloud side supports intelligent decision-making. For multi-cloud collaboration applications, not only resource orchestration within a single cloud platform but also resource orchestration across multiple cloud platforms both needs to take into account.

# 6 Impact of Coordination orchestration of multiple elements on the System Architecture

Note: This clause will discuss the framework details of Coordination orchestration of multiple elements, including new sub functional blocks to be integrated to run strategy scheduling, the functional enhancement on existing functional blocks to support CoordOME, and some new internal and external reference points.

## 6.1 Adding a CoordOME Functional Block

A new Functional Block named CoordOME is recommended to be added within Policy Management Functional Block to support coordination orchestration of Multiple Elements, which includes Requirements Mapping, Element Screening, Integrated Orchestration, Process Management, and Service Assurance.

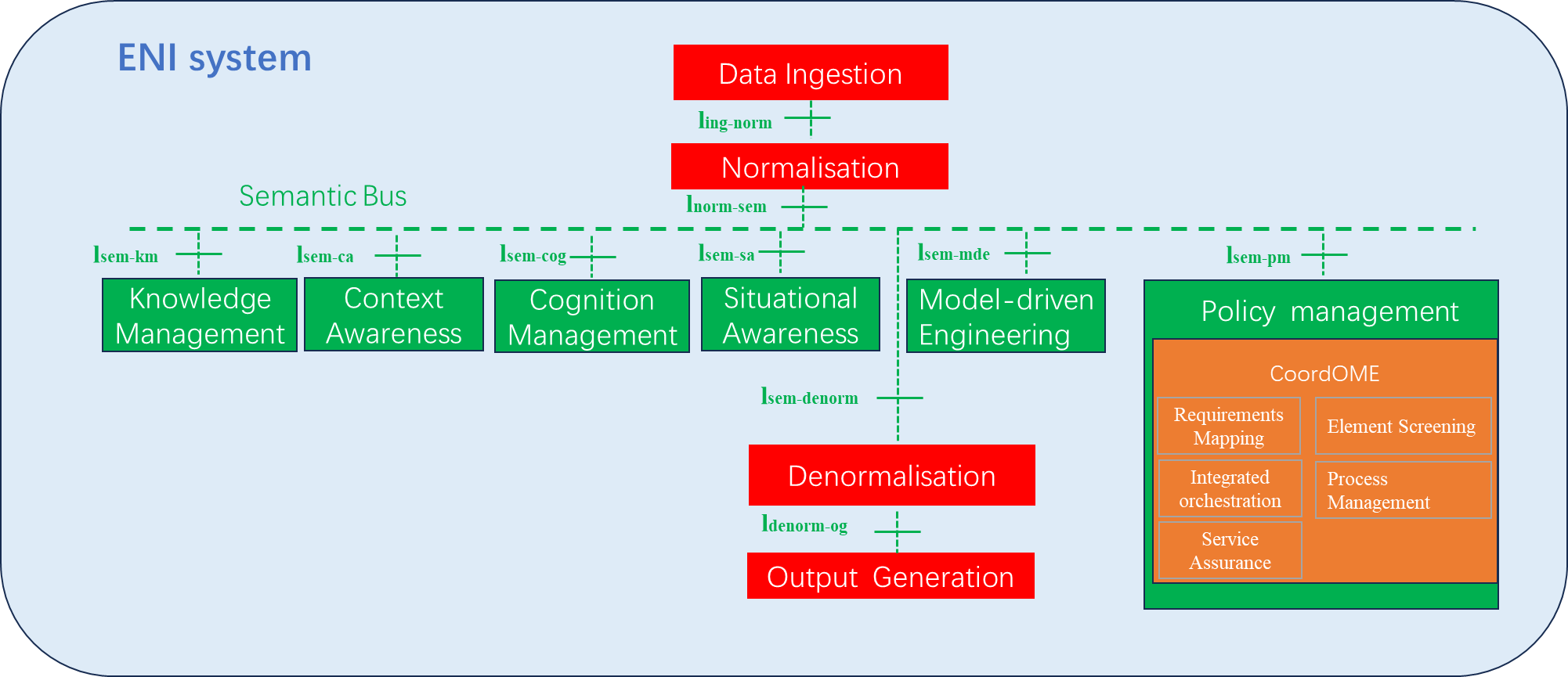


Figure 6-1 CoordOME Functional Block

* Requirements Mapping

This Sub-Functional Block is responsible for mapping input intent policy to resources elements. The input intent policy will first be ingested and normalized, and then be sent over the ENI Semantic Bus to the Policy Management Functional Block. After semantic analysis and translation of the text of intent policy, this block maps external intent requirement to associated internal resources element according to requirement-elements mapping template or by Gen-AI intelligence parser.

* Element Screening

This Sub-Functional Block is responsible for screening available, economic, and reliable elements from mapped candidate elements to meet intent requirement. It first determines the target performance metrics of resources orchestration, and then analyses the characteristics of elements such as performance, availability, reliability, flexibility, and extensibility, identifies its impact on Assisted System in terms of computing power, network, data storage, data traffic, and application, finally screens out the most suitable element items to the Integrated Orchestration Functional Block.

* Integrated Orchestration

This Sub-Functional Block is used to dynamically and jointly orchestrate screened elements according to intent requirement, and output an integrated multiple elements orchestration and scheduling policy. It depends on the algorithm model in Algorithm Model Repository to execute the operation of coordination orchestration and scheduling. The Algorithm Model Repository is one key component and should be added into Model-Driven Engineering Functional Block. The Algorithm Model may be developed by the Assisted System, and be translated into ENI System compatible format and stored in Algorithm Model Repository in advance. Additionally, the algorithm model could also be generated by the ENI System through self-learning mechanism which could be done by the interfering functionality of Knowledge Management Functional Block.

* Process Management

This Sub-Functional Block is used to manage process related raw information and meta-data. It performs operations such as creation, insertion, deletion, and update on requirements-element mapping templates, multiple elements coordination orchestration scheme, and orchestration procedure, orchestration tasks history, etc.

* Service Assurance

This Sub-Functional Block is used to monitor and maintain the availability of service, and to guarantee quality of service level. When service abnormality or failure information was sent to ENI system via ENI API Broker, this Sub-Functional Block first correlates the failure with existing orchestration scheme, and then generate back-up resources element orchestration scheme on the basis of exiting scheme with consideration of minimal Assisted System impact, so as to ensure quick and stable service recovery. Another possible service assurance mechanism is jointly utilizing the interfering functionality of Knowledge Management Functional Block and the learning and reasoning functionality of Situational Awareness Functional Block in ENI system. Knowledge Management Functional Block could observe multiple occurrences of a set of faults that cause performance degradation that eventually lead to a Service Level Agreement (SLA) violation, and use AI technology such as reinforcement learning to more quickly converge to a conclusion. Situational Awareness Functional Block have the ability to identify changes in both the current situation as well as possible future situations are critical for understanding how the environment is changing, and how those changes affect the goals that ENI is trying to achieve or maintain. These two methods are both choices for CoordOME Functional Block, and could be applied to Service Assurance according to the actual condition.

## 6.2 Functions

## 6.3 Interface

## 6.4 ……

# 7 Work flow

This clause will illustrate the interaction sequences of ENI system between internal functional blocks and assisted systems to perform the functionalites of multiple elements coordination orchestration.

## 7.1 ……

# 8 Use Cases of Coordination orchestration of multiple elements

This clause demonstrate the flexibility and compatibility of CoordOME, presents the use cases that how to use CoordOME when improving the operator experience.

## 8.1 ……

# History