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Experiential Networked Intelligence (ENI); Intent Policy Model Gap Analysis

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Foreword

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

Modal verbs terminology

In the present document "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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1 Scope

The present document contains:

1) work on a gap analysis report on intent information model based on existing SDO work, including the policy management model as specified by ETSI ISG ENI in the system architecture deliverables; and

2) a list of recommendations on general guidelines addressing the high-level policy model of a number of each SDO's intent policy model (i.e. 3GPP SA5, NFV, TM Forum, IRTF, and ZSM), and how these guidelines compare with those stated in the ETSI ENI system architecture.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

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.

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

[i.1] ETSI GS ENI 001 (V3.1.13): "Experiential Networked Intelligence (ENI); ENI use cases".

[i.2] ETSI GS ENI 005 (V2.1.1): "Experiential Networked Intelligence (ENI); System Architecture".

[i.3] ETSI GS ENI 019 (V3.1.1): "Experiential Networked Intelligence (ENI); Representing, Inferring, and Proving Knowledge in ENI".

[i.4] ETSI TS 128 312 (V17.1.1): "LTE; 5G; Management and orchestration; Intent driven management services for mobile networks (3GPP TS 28.312 version 17.1.1 Release 17)".

[i.5] ETSI GR NFV-IFA 041 (V4.1.1): "Network Functions Virtualisation (NFV); Release 4 Management and Orchestration; Report on Enabling Autonomous Management in NFV-MANO".

[i.6] ETSI GS NFV-IFA 005 (V4.3.1):"Network Functions Virtualisation (NFV) Release 4; Management and Orchestration; Or-Vi reference point - Interface and Information Model Specification".

[i.7] 3GPP TR 28.812: "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Telecommunication management; Study on scenarios for Intent driven management services for mobile networks (Release 17)".

[i.8] ETSI GR ZSM 011 (V1.1.1): "Zero-Touch Network and Service Management (ZSM); Intent-driven autonomous networks; Generic aspects".

[i.9] TM Forum IG1253 (V1.3.0): "Intent in Autonomous Networks".

[i.10] TM Forum IG1253A (V1.1.0): "Intent Common Model".

[i.11] TM Forum IG1253C (V1.1.0): "Intent Life Cycle Management and Interface".

[i.12] IRTF draft-irtf-nmrg-ibn-concepts-definitions-09: "Intent-Based Networking - Concepts and Definitions", March 2022.

[i.13] IRTF draft-irtf-nmrg-ibn-intent-classification-08: "Intent Classification", May 18, 2022.

[i.14] ETSI GS NFV-IFA 050: "Network Functions Virtualisation (NFV) Release 4; Management and Orchestration; Intent Management Service Interface and Intent Information Model Specification".

3 Definition of terms, symbols and abbreviations

3.1 Terms

Void.

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

3GPP	3rd Generation Partnership Project
API	Application Programming Interface
ATTR	Attribute
CRUD	Create Read Update and Delete
CSC	Communication Service Customer
CSP	Communication Service Provider
DB	Database
DC	Data Center
DDOS	Distributed Denial of Service Attack
DHCP	Dynamic Host Configuration Protocol
DSL	Domain Specific Language
ENI	Experiential Networked Intelligence
GEN	General
GPU	Graphics Processing Unit
HD	High Definition
IBS	Intent-Based Systems
IDA	Intent Driven Action
IDO	Intent Driven Object
IFA	Interface and Architecture
IM	Intent Management
INF	Information
IPv4	Internet Protocol version 4
IRI	Internationalized Resource Identifiers
IRTF	Internet Research Task Force
KPI	Key Performance Indicator
MEF	MEF (a Standards body)
MnS	Management Service
MOD	Model
MPM	MEF Policy Model
NFV	Network Functions Virtualisation
NFV-MANO	Network Functions Virtualisation Management and Orchestration
NFVO	Network Functions Virtualisation Orchestrator
NMRG	Network Management
NOP	Network Operator
NS	Network Service

NSD	Network Service Descriptor
OCL	Object Constraint Language
OPEX	Operating Expense
OSS/BSS	Operation Support Systems/Business Support System
QoE	Quality of Experience
RAN	Radio Access Network
RAT	Radio Access Type
RDF	Resource Description Framework
REC	Recommendation
REQ	Requirement
SA5	Service and System Aspects Working Group 5
SDO	Standard Development Organization
SD-WAN	Software Defined Wide Area Network
UE	User Equipment
UML	Unified Modeling Language
URI	Uniform Resource Identifier
VDI	Virtual Desktop Interface
VM	Virtual Machine
VNF	Virtual Network Function
VPN	Virtual Private Network
ZSM	Zero touch network & Service Management

4 Background and Overview

With the development of intelligent networks, the requirements for network management are stricter. To improve the performance of connectivity, bandwidth, latency and reliability, and reduce operational expenditure, the concept of intent is introduced as a key enabling technology.

Some SDOs have worked on intent, but the concept of intent is still defined differently. However, there are still some gaps in intent information model, intent management and other aspects are specified requirements to deploy intent in real world situations is other documents.

In ETSI ISG ENI, intent policy is regarded as a key deliverable to help improve the operator experience. Considering the gaps in the different definitions and modelling by SDOs, a gap analysis is necessary for the ENI system. The gaps include but not limited to the following items:

- The definition of intent.
- The targeted use cases.
- The intent information models designed in other SDOs.
- The management of intent, including management roles, life cycles and operations.

The present document is targeted to recognize the gaps on intent information model and provide guidelines for ETSI ISG ENI.

5 Survey on Existing Areas of Work

5.1 ETSI ENI

5.1.1 Targeted Use Cases and Intent Definitions

5.1.1.1 Use Cases from ENI Specifications

The following ENI use cases are described in ETSI GS ENI 001 [i.1]. There are several use cases that use intent, and are summarized as follows.

Use Case #3-3: "Intelligent carrier-managed SD-WAN". It is possible for ENI to expose an intent-based interface that allows enterprises to customize their SD-WAN service using natural language with a terminology that is familiar to them.

Use Case #3-6, "Intent-based Cloud Management for VDI Service". The Intent-Based Cloud Manager is able to determine the optimal resource configuration for various user QoE requirements, and present them as intent.

Use Case #5-2: "Limiting profit in cyber-attacks". This use case has a goal of defining an ENI entity that uses machine learning to detect ransomware and cryptojacking attacks. Once detected, another ENI entity, which uses an intent based policy language, will propose a set of new security policies to the OSS to mitigate the attack.

5.1.1.2 Use Case types from ETSI GS ENI 005

The ENI System Architecture [i.2] describes two specific use cases for Policies processed by an ENI System. The first use case type is when an External Entity (e.g. an Operator) sends a Policy (of any type) to the ENI System that *affects the behaviour of the Assisted System (or its Designated Entity)*. This means that the ENI System will translate the Policy if needed, process it, and send recommendations and/or commands back to the Assisted System (or its Designated Entity). Note that an Intent Policy will always require translation as specified in ETSI GS ENI 005 [i.2].

The second use case type is when an External Entity sends a Policy (of any type) to the ENI System that *affects the behaviour of the ENI System*. This means that the ENI System will translate the Policy if needed, process it, and act on it to affect its own behaviour (e.g. add or remove knowledge from the Knowledge Management Functional Block, or define new goals that it should try and achieve). Note that an Intent Policy will always require translation.

5.1.1.3 Use Cases from ETSI GS ENI 001

Clause 5.1.1.2 describes two types of use cases in ENI. In Table 5.1.1.3-1, the use cases from ETSI GS ENI 001 [i.1] are listed. In addition, ETSI GS ENI 001 [i.1] uses cases are mapped into ETSI GS ENI 005 [i.2] use case types as follows:

1) Affect the behaviour of the system being managed.

2) Affect the behaviour of the ENI System.

Table 5.1.1.3-1: The related information of targeted use cases

Creator of intent	Targeted use cases	Corresponding clause in ETSI GS ENI 001 [i.1]	Corresponding management layer (Business/Service/Resource)
CSP	Intelligent carrier-managed SD-WAN	5.4.3 of [i.1]; affects system being managed	Service
CSP	Intent-based Cloud Management for VDI service	5.4.6 of [i.1]; affects system being managed	Service
CSP	Limiting profit in cyber-attacks	5.6.2 of [i.1]; affects system being managed	Service

5.1.1.4 Intent Definition from ETSI GS ENI 005

ETSI GS ENI 005 [i.2] provides the following definitions that involve intent.

policy: set of rules that is used to manage and control the changing and/or maintaining of the state of one or more managed objects:

- **ENI Policy Rules:** set of imperative, declarative, and/or intent policy rules.
- **intent policy:** type of policy that uses statements from a restricted natural language (e.g. an external DSL) to express the goals of the policy, but does not specify how to accomplish those goals. In particular, Intent Policy will refer to policies that do not execute as theories of a formal logic.

Hence, an intent policy is one type of policy. This enables other types of policies to interwork with an intent policy. This is realized using the ENI Extended Policy Model [i.3].

5.1.2 Extracted Requirements from ETSI GS ENI 005

According to the definition and other modelling related content, Table 5.1.2-1 provides the general requirements for ENI intent policy model.

Table 5.1.2-1: General requirements for ENI intent policy model

Req Number	ENI Requirement Description	Comments
ENI. INTENT. MODEL. GEN. 001	ENI intent policy model is recommended to express the goals of the policy.	Intent policy can be used to express the goals of the policy, but does not specify how to accomplish those goals. Based on the content of clause 6.3.9.3.4 of [i.2].
ENI. INTENT. MODEL GEN.002	ENI intent policy model enables intent policies to interoperate with imperative and declarative policies, as well as the combination of these.	Based on the content of clause 6.3.9.3.4 of [i.2].
ENI. INTENT. MODEL GEN.003	ENI intent policy model is able to be used to specify the behaviour of a Domain and entities within a Domain.	Based on clause 5.2 of [i.2].
ENI. INTENT. MODEL GEN.004	ENI intent policy model is able to represent ENI recommendations and/or commands.	Based on clause 5.8.3 of [i.2].
ENI. INTENT. MODEL GEN.005	ENI intent policy model provides model elements to define all or part of a grammar of one or more Domain Specific Languages.	Based on clause 5.8.3 of [i.2].
ENI. INTENT. MODEL GEN.006	ENI intent policy model is able to equate goals to recommendations or commands (depending on operational mode) that result in desired behavioural changes to the Assisted System.	Based on clause 5.8.3 of [i.2].
ENI. INTENT. MODEL GEN.007	ENI intent policy model is able to represent context information and incorporate any contextual changes at runtime.	Based on clause 5.8.3 of [i.2].
ENI. INTENT. MODEL GEN.008	ENI intent policy model is able to incorporate situationally aware information and how those information relate to goals to be achieved as a function of changing situational information at runtime.	Based on clause 5.8.3 of [i.2].
ENI. INTENT. MODEL GEN.009	ENI intent policy model is able to provide model elements to represent the negotiation of how intent policies are defined and executed. The actual negotiation is done by other mechanisms using the intent policy model.	Based on clause 5.8.3 of [i.2].
ENI. INTENT. MODEL GEN.010	It is recommended that the ENI intent policy model have descriptive and/or prescriptive metadata (in the form of classes or attributes).	Based on clause 5.8.3 of [i.2].
ENI. INTENT. MODEL GEN.011	ENI intent policy model is recommended to use the Policy Continuum to differentiate between the needs of different constituencies in defining and expressing an Intent Policy.	Based on clause 6.3.9.6.2 of [i.2].
ENI. INTENT. MODEL GEN.012	It is recommended that the ENI intent policy model contains model elements that represent the administrative and operational status of ENI Policies. (ENI Policies are continuously monitored and updated throughout the life cycle of the ENI System).	Based on clause 6.3.9.6.6 of [i.2].

Table 5.1.2-2 provides the general requirements for ENI intent policy model information elements.

Table 5.1.2-2: General requirements for ENI intent policy model information elements

Req Number	ENI Requirement Description	Comments
ENI. INTENT. MODEL. INFO. 001	The design of information elements of the ENI intent policy model are recommended to express the goals of the policy.	Based on ENI. INTENT. MODEL. GEN. 001 in Table 5.1.2-1.
ENI. INTENT. MODEL. INFO. 002	The design of information elements of the ENI intent policy model are recommended to interact with imperative and declarative policies as well as their combination.	Based on ENI. INTENT. MODEL. GEN. 002 in Table 5.1.2-1.
ENI. INTENT. MODEL. INFO. 003	The design of information elements of the ENI intent policy model is recommended to include model elements that define the characteristics and behaviour of a Domain and entities within a Domain.	Based on ENI. INTENT. MODEL. GEN. 003 in Table 5.1.2-1.
ENI. INTENT. MODEL. INFO. 004	The design of information elements of the ENI intent policy model is recommended to include model elements that represent ENI recommendations and/or commands (as different classes).	Based on ENI. INTENT. MODEL. GEN. 004 in Table 5.1.2-1.
ENI. INTENT. MODEL. INFO. 005	The design of information elements of the ENI intent policy model is recommended to include model elements that are able to define all or part of a grammar of one or more Domain Specific Languages.	Based on ENI. INTENT. MODEL. GEN. 005 in Table 5.1.2-1.
ENI. INTENT. MODEL. INFO. 006	The design of information elements of the ENI intent policy model is recommended to include model elements that are able to equate goals to recommendations or commands (depending on operational mode) that result in desired behavioural changes to the Assisted System.	Based on ENI. INTENT. MODEL. GEN. 006 in Table 5.1.2-1.
ENI. INTENT. MODEL. INFO. 007	The design of information elements of the ENI intent policy model is recommended to include model elements that are able to represent context information and incorporate any contextual changes at runtime.	Based on ENI. INTENT. MODEL. GEN. 007 in Table 5.1.2-1.
ENI. INTENT. MODEL. INFO. 008	The design of information elements of the ENI intent policy model is recommended to include model elements that are able to incorporate situationally aware information and how those information relate to goals to be achieved as a function of changing situational information at runtime.	Based on ENI. INTENT. MODEL. GEN. 008 in Table 5.1.2-1.
ENI. INTENT. MODEL. INFO. 009	The design of information elements of the ENI intent policy model is recommended to include model elements that are able to represent the negotiation of how intent policies are defined and executed. The actual negotiation is done by other mechanisms using the intent policy model.	Based on ENI. INTENT. MODEL. GEN. 009 in Table 5.1.2-1.
ENI. INTENT. MODEL. INFO. 010	The design of information elements of the ENI intent policy model is recommended to include model elements that are able to provide descriptive and/or prescriptive metadata (in the form of classes or attributes).	Based on ENI. INTENT. MODEL. GEN. 010 in Table 5.1.2-1.
ENI. INTENT. MODEL. INFO. 011	The design of information elements of the ENI intent policy model is recommended to use the Policy Continuum to differentiate between the needs of different constituencies in defining and expressing an Intent Policy.	Based on ENI. INTENT. MODEL. GEN. 011 in Table 5.1.2-1.
ENI. INTENT. MODEL. INFO. 012	The design of information elements of the ENI intent policy model is recommended to represent the administrative and operational status of ENI Policies.	Based on ENI. INTENT. MODEL. GEN. 012 in Table 5.1.2-1.

Table 5.1.2-3 provides the general requirements for ENI intent policy model attributes.

Table 5.1.2-3: General requirements for ENI intent policy model attributes

Req Number	ENI Requirement Description	Comments
ENI. INTENT. MODEL. ATTR. 001	The design of attributes of ENI intent policy model is recommended to support the log data about VDI resource, workload and performance data.	Based on clause 5.4.6.3.2 of [i.1].
ENI. INTENT. MODEL. ATTR. 002	The design of attributes of ENI intent policy model is recommended to support the VDI QoE requirements.	Based on clause 5.4.6.3.2 of [i.1].

5.1.3 Intent Information Model

The ENI Policy Model is subclassed from the MEF Core Model. Both of these models are being extended by ETSI GS ENI 019 [i.3]. This enables any set of managed entities defined in the MEF Core Model to be used as the target of an ENI Policy (i.e. the set of managed entities whose behaviour will be affected by the ENI Policy). It also enables ENI Policies to make use of other model elements defined in the MEF Core Model, such as Role objects and MetaData.

The ENI Policy Model defines a unified policy model. A unified policy model provides three benefits:

1) It enables different types of policies to be used to accomplish tasks independent of the type or structure of policy.

2) It enables one type of policy to call any other types of policy.

3) It serves as a common language that enables concepts used by different policy authors to be mapped to equivalent concepts in other levels.

The ENI Policy Model defines three types of policies from the same information model (i.e. its unified Policy Model). These three types of policies (i.e. imperative, declarative, and intent) are examples of deriving different types of policies from a unified policy information model. Clause 6.3.9.6.3.5 of ETSI GS ENI 005 [i.2] describes how to use a unified model to represent different types of policies.

The unified policy information model is made up of two parts. One of the parts is used to represent the type of policy, and the other part is used to represent the contents of policy. The type of policy determines the allowed set of policy components that it can contain.

The MPM uses five important abstractions that collectively enable it to model multiple types of policies:

1) The first is the concept of a policy container. This means that any type of policy will be structured as an object that is made up of policy components.

2) The second defines two fundamental types of objects, a policy (called MPMPolicyStructure) and a policy component (called MPMPolicyComponentStructure). Hence, any policy consists of one instance of MPMPolicyStructure and one or more instances of MPMPolicyComponentStructure.

3) Third, the content of any policy will be made up of one or more statements (called MPMPolicyStatement).

4) Fourth, any MPMPolicyStatement may be made up of one or more clauses (called MPMPolicyClause).

5) Fifth, the type of policy will determine the set of statements that it can contain. This is enforced by a novel software pattern.