

ETSI GS ENI 001 V3.2.1 (2023-05)



Experiential Networked Intelligence (ENI); ENI Use Cases

(standards.iteh.ai)

ETSI GS ENI 001 V3.2.1 (2023-05)

<https://standards.iteh.ai/catalog/standards/sist/fcc9838d-35d9-4d5d-95c4-414f08bb5d00/etsi-gs-eni-001-v3-2-1-2023-05>

Disclaimer

The present document has been produced and approved by the Experiential Networked Intelligence (ENI) ETSI Industry Specification Group (ISG) and represents the views of those members who participated in this ISG.
It does not necessarily represent the views of the entire ETSI membership.

Reference

RGS/ENI-001v321_Use_cases

Keywords

artificial intelligence, management, network,
use case

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° w061004871

Important notice

The present document can be downloaded from:

<https://www.etsi.org/standards-search>

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the prevailing version of an ETSI deliverable is the one made publicly available in PDF format at www.etsi.org/deliver.

Users of the present document should be aware that the document may be subject to revision or change of status.

Information on the current status of this and other ETSI documents is available at

<https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx>

If you find errors in the present document, please send your comment to one of the following services:

<https://standards-portal.etsi.org/People/CommitteeSupportStaff.aspx>

If you find a security vulnerability in the present document, please report it through our
Coordinated Vulnerability Disclosure Program:

<https://www.etsi.org/standards/coordinated-vulnerability-disclosure>

Notice of disclaimer & limitation of liability

The information provided in the present deliverable is directed solely to professionals who have the appropriate degree of experience to understand and interpret its content in accordance with generally accepted engineering or other professional standard and applicable regulations.

No recommendation as to products and services or vendors is made or should be implied.

No representation or warranty is made that this deliverable is technically accurate or sufficient or conforms to any law and/or governmental rule and/or regulation and further, no representation or warranty is made of merchantability or fitness for any particular purpose or against infringement of intellectual property rights.

In no event shall ETSI be held liable for loss of profits or any other incidental or consequential damages.

Any software contained in this deliverable is provided "AS IS" with no warranties, express or implied, including but not limited to, the warranties of merchantability, fitness for a particular purpose and non-infringement of intellectual property rights and ETSI shall not be held liable in any event for any damages whatsoever (including, without limitation, damages for loss of profits, business interruption, loss of information, or any other pecuniary loss) arising out of or related to the use of or inability to use the software.

Copyright Notification

No part may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm except as authorized by written permission of ETSI.

The content of the PDF version shall not be modified without the written authorization of ETSI.

The copyright and the foregoing restriction extend to reproduction in all media.

© ETSI 2023.
All rights reserved.

Contents

Intellectual Property Rights	9
Foreword.....	9
Modal verbs terminology.....	9
1 Scope	10
2 References	10
2.1 Normative references	10
2.2 Informative references.....	10
3 Definition of terms, symbols and abbreviations.....	11
3.1 Terms.....	11
3.2 Symbols.....	11
3.3 Abbreviations	11
4 Overview	14
4.1 Background	14
4.2 Overview of the ENI System.....	14
4.2.1 Brief Description	14
4.2.2 Expected Benefits	15
5 Use cases	16
5.1 Introduction	16
5.2 Infrastructure Management	17
5.2.1 Use Case #1-1: Policy-driven IDC Traffic Steering	17
5.2.1.1 Use case context.....	17
5.2.1.2 Description of the use case.....	17
5.2.1.2.1 Overview	17
5.2.1.2.2 Motivation	18
5.2.1.2.3 Actors and Roles.....	18
5.2.1.2.4 Initial context configuration	19
5.2.1.2.5 Triggering conditions	19
5.2.1.2.6 Operational Flow of the actions.....	19
5.2.1.2.7 Post-conditions	20
5.2.2 Use Case #1-2: Handling of Peak Planned Occurrences.....	20
5.2.2.1 Use case context.....	20
5.2.2.2 Description of the use case.....	20
5.2.2.2.1 Overview	20
5.2.2.2.2 Motivation	21
5.2.2.2.3 Actors and Roles.....	21
5.2.2.2.4 Initial context configuration	21
5.2.2.2.5 Triggering conditions	21
5.2.2.2.6 Operational flow of actions	21
5.2.2.2.7 Post-conditions	22
5.2.3 Use Case #1-3: Energy optimization using AI.....	22
5.2.3.1 Use case context.....	22
5.2.3.2 Description of the use case.....	23
5.2.3.2.1 Overview	23
5.2.3.2.2 Motivation	23
5.2.3.2.3 Actors and Roles.....	24
5.2.3.2.4 Initial context configuration	24
5.2.3.2.5 Triggering conditions	24
5.2.3.2.6 Operational flow of actions	24
5.2.3.2.7 Post-conditions	25
5.2.3.3 Mapping to ENI reference architecture	25
5.2.3.3.1 Functional blocks.....	25
5.2.3.3.2 Interfaces	26
5.2.3.3.3 Flow of information.....	26
5.2.4 Use Case #1-4: Intelligent Optimization for Transmission Network.....	27

5.2.4.1	Use case context.....	27
5.2.4.2	Description of the use case.....	28
5.2.4.2.1	Overview	28
5.2.4.2.2	Motivation	28
5.2.4.2.3	Actors and Roles.....	29
5.2.4.2.4	Initial context configuration	29
5.2.4.2.5	Trigger conditions	29
5.2.4.2.6	Operational Flow of the actions.....	30
5.2.4.2.7	Post-conditions	30
5.2.5	Use Case #1-5: Energy saving in radio network.....	30
5.2.5.1	Use case context.....	30
5.2.5.2	Description of the use case.....	30
5.2.5.2.1	Overview	30
5.2.5.2.2	Motivation	31
5.2.5.2.3	Actors and Roles.....	31
5.2.5.2.4	Initial context configuration	31
5.2.5.2.5	Triggering conditions	31
5.2.5.2.6	Operational flow of actions	32
5.2.5.2.7	Post-conditions	32
5.3	Network Operations	32
5.3.1	Use Case #2-1: Policy-driven IP managed networks.....	32
5.3.1.1	Use case context.....	32
5.3.1.2	Description of the use case.....	32
5.3.1.2.1	Overview	32
5.3.1.2.2	Motivation	32
5.3.1.2.3	Actors and Roles.....	33
5.3.1.2.4	Initial context configuration	33
5.3.1.2.5	Triggering conditions	33
5.3.1.2.6	Operational flow of actions	34
5.3.1.2.7	Post-conditions	34
5.3.2	Use Case #2-2: Radio Coverage and capacity optimization	34
5.3.2.1	Use case context.....	34
5.3.2.2	Description of the use case.....	35
5.3.2.2.1	Overview	35
5.3.2.2.2	Motivation	35
5.3.2.2.3	Actors and Roles.....	35
5.3.2.2.4	Initial context configuration	36
5.3.2.2.5	Triggering conditions	36
5.3.2.2.6	Operational flow of actions	36
5.3.2.2.7	Post-conditions	36
5.3.2.3	Mapping to ENI reference architecture	36
5.3.2.3.1	Functional blocks.....	36
5.3.2.3.2	Interfaces	37
5.3.2.3.3	Flow of information.....	38
5.3.3	Use Case #2-3: Intelligent Software Rollouts.....	39
5.3.3.1	Use Case context.....	39
5.3.3.2	Description of the use case.....	40
5.3.3.2.1	Overview	40
5.3.3.2.2	Motivation	40
5.3.3.2.3	Actors and Roles.....	40
5.3.3.2.4	Initial context configuration	41
5.3.3.2.5	Triggering conditions	41
5.3.3.2.6	Operational flow of actions	41
5.3.3.2.7	Post-conditions	41
5.3.4	Use Case #2-4: Intelligent Fronthaul Management and Orchestration	42
5.3.4.1	Use Case context.....	42
5.3.4.2	Description of the use case.....	42
5.3.4.2.1	Overview	42
5.3.4.2.2	Motivation	42
5.3.4.2.3	Actors and Roles.....	43
5.3.4.2.4	Initial context configuration	43
5.3.4.2.5	Triggering conditions	43

5.3.4.2.6	Operational flow of actions	43
5.3.4.2.7	Post-conditions	44
5.3.5	Use Case #2-5: Elastic Resource Management and Orchestration	44
5.3.5.1	Use case context	44
5.3.5.2	Description of the use case	44
5.3.5.2.1	Overview	44
5.3.5.2.2	Motivation	45
5.3.5.2.3	Actors and Roles	45
5.3.5.2.4	Initial context configuration	46
5.3.5.2.5	Triggering conditions	46
5.3.5.2.6	Operational flow of actions	46
5.3.5.2.7	Post-conditions	47
5.3.5.3	Mapping to ENI reference architecture	47
5.3.5.3.1	Functional blocks	47
5.3.5.3.2	Interfaces	48
5.3.5.3.3	Flow of information	49
5.3.6	Use Case #2-6: Application Characteristic based Network Operation	50
5.3.6.1	Use case context	50
5.3.6.2	Description of the use case	50
5.3.6.2.1	Overview	50
5.3.6.2.2	Motivation	51
5.3.6.2.3	Actors and Roles	51
5.3.6.2.4	Initial context configuration	51
5.3.6.2.5	Triggering conditions	51
5.3.6.2.6	Operational flow of actions	52
5.3.6.2.7	Post-conditions	52
5.3.6.3	Mapping to ENI reference architecture	53
5.3.6.3.1	Functional blocks	53
5.3.6.3.2	Reference Point	54
5.3.6.3.3	Flow of information	55
5.3.7	Use Case #2-7: AI enabled network traffic classification	56
5.3.7.1	Use case context	56
5.3.7.2	Description of the use case	57
5.3.7.2.1	Overview	57
5.3.7.2.2	Motivation	57
5.3.7.2.3	Actors and Roles	58
5.3.7.2.4	Initial context configuration	58
5.3.7.2.5	Triggering conditions	58
5.3.7.2.6	Operational flow of actions	58
5.3.7.2.7	Post-conditions	59
5.3.7.3	Mapping to ENI reference architecture	59
5.3.7.3.1	Functional blocks	59
5.3.7.3.2	Interfaces	61
5.3.7.3.3	Flow of information	63
5.3.8	Use Case #2-8: Automatic service and resource design framework for cloud service	66
5.3.8.1	Use case context	66
5.3.8.2	Description of the use case	67
5.3.8.2.1	Overview	67
5.3.8.2.2	Motivation	68
5.3.8.2.3	Actors and Roles	68
5.3.8.2.4	Initial context configuration	69
5.3.8.2.5	Triggering conditions	69
5.3.8.2.6	Operational flow of actions	69
5.3.8.2.7	Post-conditions	70
5.3.9	Use Case #2-9: Intelligent time synchronization of network	70
5.3.9.1	Use case context	70
5.3.9.2	Description of the use case	70
5.3.9.2.1	Overview	70
5.3.9.2.2	Motivation	70
5.3.9.2.3	Actors and Roles	71
5.3.9.2.4	Initial context configuration	71
5.3.9.2.5	Triggering conditions	72

5.3.9.2.6	Operational flow of actions	72
5.3.9.2.7	Post-conditions	72
5.3.10	Use Case #2-10: Intelligent Content-Aware Real-Time Gaming Network.....	72
5.3.10.1	Use Case context.....	72
5.3.10.2	Description of the use case.....	73
5.3.10.2.1	Overview	73
5.3.10.2.2	Motivation	73
5.3.10.2.3	Actors and Roles.....	73
5.3.10.2.4	Initial context configuration	73
5.3.10.2.5	Triggering condition	73
5.3.10.2.6	Operational flow of actions	74
5.3.10.2.7	Post-condition.....	74
5.4	Service Orchestration and Management.....	74
5.4.1	Use Case #3-1: Context-aware VoLTE Service Experience Optimization.....	74
5.4.1.1	Use case context.....	74
5.4.1.2	Description of the use case.....	75
5.4.1.2.1	Overview	75
5.4.1.2.2	Motivation	75
5.4.1.2.3	Actors and Roles.....	75
5.4.1.2.4	Initial context configuration	76
5.4.1.2.5	Triggering conditions	76
5.4.1.2.6	Operational flow of actions	76
5.4.1.2.7	Post-conditions	76
5.4.1.3	Mapping to ENI reference architecture	77
5.4.1.3.1	Functional blocks.....	77
5.4.1.3.2	Reference Points.....	78
5.4.1.3.3	Flow of information.....	79
5.4.2	Use Case #3-2: Intelligent network slicing management.....	80
5.4.2.1	Use case context.....	80
5.4.2.2	Description of the use case.....	80
5.4.2.2.1	Overview	80
5.4.2.2.2	Motivation	81
5.4.2.2.3	Actors and Roles.....	81
5.4.2.2.4	Initial context configuration	82
5.4.2.2.5	Triggering conditions	82
5.4.2.2.6	Operational flow of actions	82
5.4.2.2.7	Post-conditions	82
5.4.3	Use Case #3-3: Intelligent carrier-managed SD-WAN.....	82
5.4.3.1	Use case context.....	82
5.4.3.2	Description of the use case.....	83
5.4.3.2.1	Overview	83
5.4.3.2.2	Motivation	83
5.4.3.2.3	Actors and Roles.....	84
5.4.3.2.4	Initial context configuration	84
5.4.3.2.5	Triggering conditions	84
5.4.3.2.6	Operational flow of actions	84
5.4.3.2.7	Post-conditions	85
5.4.4	Use Case #3-4: Intelligent caching based on prediction of content popularity.....	85
5.4.4.1	Use case context.....	85
5.4.4.2	Description of the use case.....	85
5.4.4.2.1	Overview	85
5.4.4.2.2	Motivation	86
5.4.4.2.3	Actors and Roles.....	87
5.4.4.2.4	Initial context configuration	87
5.4.4.2.5	Triggering conditions	88
5.4.4.2.6	Operational flow of actions	88
5.4.4.2.7	Post-conditions	88
5.4.5	Use Case #3-5: Service experience optimization of E2E slicing involving both OSS and BSS.....	88
5.4.5.1	Use case context.....	88
5.4.5.2	Description of the use case.....	89
5.4.5.2.1	Overview	89
5.4.5.2.2	Motivation	90

5.4.5.2.3	Actors and Roles.....	90
5.4.5.2.4	Initial context configuration	90
5.4.5.2.5	Triggering conditions	90
5.4.5.2.6	Operational flow of actions	91
5.4.5.2.7	Post-conditions	91
5.4.5.3	Mapping to ENI reference architecture	91
5.4.5.3.1	Functional blocks.....	91
5.4.5.3.2	Interfaces	93
5.4.5.3.3	Flow of information.....	94
5.4.6	Use Case #3-6: Intent-based Cloud Management for VDI service	95
5.4.6.1	Use case context.....	95
5.4.6.2	Description of the use case.....	96
5.4.6.2.1	Overview	96
5.4.6.2.2	Motivation	96
5.4.6.2.3	Actors and Roles.....	96
5.4.6.2.4	Initial context configuration	96
5.4.6.2.5	Triggering conditions	96
5.4.6.2.6	Operational flow of actions	96
5.4.6.2.7	Post-conditions	97
5.4.6.3	Mapping to ENI reference architecture	97
5.4.6.3.1	Functional blocks.....	97
5.4.6.3.2	Flow of information.....	98
5.4.7	Use Case #3-7: Intelligent vehicle diversified service fulfilment based on polymorphic network.....	99
5.4.7.1	Use case context.....	99
5.4.7.2	Description of the use case.....	100
5.4.7.2.1	Overview	100
5.4.7.2.2	Motivation	101
5.4.7.2.3	Actors and Roles.....	101
5.4.7.2.4	Initial context configuration	101
5.4.7.2.5	Triggering conditions	101
5.4.7.2.6	Operational flow of actions	101
5.4.7.2.7	Post-conditions	102
5.4.8	Use Case #3-8: AI based family broadband network user experience optimization.....	102
5.4.8.1	Use Case context.....	102
5.4.8.2	Description of the use case.....	102
5.4.8.2.1	Overview	102
5.4.8.2.2	Motivation	102
5.4.8.2.3	Actors and Roles.....	103
5.4.8.2.4	Initial context configuration	103
5.4.8.2.5	Triggering conditions	104
5.4.8.2.6	Operational flow of actions	104
5.4.8.2.7	Post-conditions	104
5.4.8.3	Mapping to ENI reference architecture	104
5.4.8.3.1	Mapping to ENI reference architecture	104
5.4.8.3.2	Flow of information.....	105
5.5	Assurance	106
5.5.1	Use Case #4-1: Network fault identification and prediction.....	106
5.5.1.1	Use case context.....	106
5.5.1.2	Description of the use case.....	107
5.5.1.2.1	Overview	107
5.5.1.2.2	Motivation	107
5.5.1.2.3	Actors and Roles.....	107
5.5.1.2.4	Initial context configuration	107
5.5.1.2.5	Triggering conditions	108
5.5.1.2.6	Operational flow of actions	108
5.5.1.2.7	Post-conditions	108
5.5.2	Use Case #4-2: Assurance of Service Requirements	108
5.5.2.1	Use Case context.....	108
5.5.2.2	Description of the use case.....	108
5.5.2.2.1	Overview	108
5.5.2.2.2	Motivation	109
5.5.2.2.3	Actors and Roles.....	109

5.5.2.2.4	Initial context configuration	110
5.5.2.2.5	Triggering conditions	110
5.5.2.2.6	Operational flow of actions	110
5.5.2.2.7	Post-conditions	110
5.5.2.3	Mapping to ENI reference architecture	111
5.5.2.3.1	Functional blocks.....	111
5.5.2.3.2	Interfaces	112
5.5.2.3.3	Flow of information.....	113
5.5.3	Use Case #4-3: Network fault root-cause analysis and intelligent recovery.....	116
5.5.3.1	Use case context.....	116
5.5.3.2	Description of the use case.....	117
5.5.3.2.1	Overview	117
5.5.3.2.2	Motivation	117
5.5.3.2.3	Actors and Roles.....	118
5.5.3.2.4	Initial context configuration	118
5.5.3.2.5	Triggering conditions	118
5.5.3.2.6	Operational flow of actions	119
5.5.3.2.7	Post-conditions	119
5.6	Network Security.....	119
5.6.1	Use Case #5-1: Policy-based network slicing for IoT security	119
5.6.1.1	Use Case context.....	119
5.6.1.2	Description of the use case.....	120
5.6.1.2.1	Motivation	120
5.6.1.2.2	Actors and Roles.....	121
5.6.1.2.3	Initial context configuration	121
5.6.1.2.4	Triggering conditions	121
5.6.1.2.5	Operational flow of actions	121
5.6.1.2.6	Post-conditions	121
5.6.2	Use Case #5-2: Limiting profit in cyber-attacks	122
5.6.2.1	Use Case context.....	122
5.6.2.2	Description of the use case.....	122
5.6.2.2.1	Motivation	122
5.6.2.2.2	Actors and Roles.....	123
5.6.2.2.3	Initial context configuration	123
5.6.2.2.4	Triggering conditions	123
5.6.2.2.5	Operational flow of actions	123
5.6.2.2.6	Post-conditions	124
5.6.2.3	Mapping to ENI reference architecture	124
5.6.2.3.1	Functional blocks.....	124
5.6.2.3.2	Interfaces	124
5.6.2.3.3	Flow of information.....	125
5.7	Void.....	125
5.8	Void.....	125
6	Recommendations to other ENI Work Items	126
Annex A (informative):	Bibliography.....	127
History		128

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The declarations pertaining to these essential IPRs, if any, are publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (<https://ipr.etsi.org/>).

Pursuant to the ETSI Directives including the ETSI IPR Policy, no investigation regarding the essentiality of IPRs, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

DECT™, **PLUGTESTS™**, **UMTS™** and the ETSI logo are trademarks of ETSI registered for the benefit of its Members. **3GPP™** and **LTE™** are trademarks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners. **oneM2M™** logo is a trademark of ETSI registered for the benefit of its Members and of the oneM2M Partners. **GSM®** and the GSM logo are trademarks registered and owned by the GSM Association.

Foreword

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

Modal verbs terminology

In the present document **"shall"**, **"shall not"**, **"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).

"must" and **"must not"** are **NOT** allowed in ETSI deliverables except when used in direct citation.

1 Scope

The present document specifies a collection of use cases from a variety of stakeholders, where the use of an Experiential Networked Intelligence (ENI) system can be applied to the fixed network, the mobile network, and cloud-based network, to enhance the operator experience through the use of network intelligence. The present document is a revision of ETSI GS ENI 001 [i.1]. It identifies and describes additional use cases and scenarios and gives the baseline on how the studies in ENI can be applied as solutions of some identified use cases in accordance with the ENI Reference Architecture and will substantially benefit the operators and other stakeholders.

In Release 3 the present document will add additional use cases, including cloud based use cases.

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.

Referenced documents which are not found to be publicly available in the expected location might be found at <https://docbox.etsi.org/Reference>.

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.

Not applicable.

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 (V3.1.1): "Experiential Networked Intelligence (ENI); ENI use cases".
- [i.2] [NGMN Alliance](#): "Description of Network Slicing Concept", Version 1.0, January 13, 2016.
- [i.3] 3GPP TR 23.799 (V14.0.0): "Study on Architecture for Next Generation System (Release 14)", December 2016.
- [i.4] ETSI TS 132 101 (V11.4.0): "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; Telecommunication management; Principles and high level requirements (3GPP TS 32.101 version 11.4.0 Release 11)".
- [i.5] ETSI TS 128 530 (V15.1.0): "5G; Management and orchestration; Concepts, use cases and requirements (3GPP TS 28.530 version 15.1.0 Release 15)".
- [i.6] ETSI GR NFV-EVE 012 (V3.1.1): "Network Functions Virtualisation (NFV) Release 3; Evolution and Ecosystem; Report on Network Slicing Support with ETSI NFV Architecture Framework".
- [i.7] ETSI GS ENI 002 (V3.2.1): "Experiential Networked Intelligence (ENI); ENI requirements".

- [i.8] ETSI GS ENI 005 (V3.1.1): "Experiential Networked Intelligence (ENI); System Architecture".
- [i.9] ETSI GR ENI 004 (V3.1.1): "Experiential Networked Intelligence (ENI); Terminology".
- [i.10] IETF RFC 6645: "IP Flow Information Accounting and Export Benchmarking Methodology".
- [i.11] Y. Hu, D. Li, P. Sun, P. Yi and J. Wu, "Polymorphic Smart Network: An Open, Flexible and Universal Architecture for Future Heterogeneous Networks," in IEEE Transactions on Network Science and Engineering, vol. 7, no. 4, pp. 2515-2525, 1 Oct.-Dec. 2020, doi: 10.1109/TNSE.2020.3006249.

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in ETSI GR ENI 004 [i.9] apply.

3.2 Symbols

Void.

3.3 Abbreviations

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

2G	Second Generation GSM
3G	Third Generation
3GPP	Third Generation Partnership Group
4G	Forth Generation
5G	Fifth Generation
ACNO	Algorithmic Centre for Network Operation
AI	Artificial Intelligence
AI/ML	Artificial Intelligence/Machine Learning
AI-MC	AI-based Mobile Caching
AIML	AI Mark-up Language
AI-NTC	AI enabled Network Traffic Classifier
AN	Access Network
AP	Access Point
API	Application Programming Interface
APIB	API Broker
APP	Application
AT	Antenna
BBU	Baseband Unit
BRAS	Broadband Remote Access Server
BSS	Business Support System
CA	Context Awareness
CA-KM	Context Awareness-Knowledge Management
C-AM	Context-Aware Management (functional block)
CAPEX	Capital Expenditure
CCO	Capacity and Coverage Optimization
CFD	Computational Fluid Dynamics
CGN	Carrier Grade Network address translation
CMS	Cloud Management System
CN	Core Network
CogM	Cognitive Management
COVID	Coronavirus
CP	Cloud Provider
CPRI	Common Public Radio Interface

CPU	Computing Processing Unit
CS	Control System
CSMF	Communication Service Management Function
CSP	Cloud Service Provider
CT	Client/Tenant
DaaS	Desktop as a Service
DC	Data Centre
DDoS	Distributed Denial of Service
DevOps	Development and Operations
DHCP	Dynamic Host Configuration Protocol
DIN	Data Ingestion and Normalization
DL	Downlink
DNS	Domain Name System
DOG	Denormalization and Output Generation
DPI	Deep Packet Inspection
D-RAN	Distributed RAN
E2E	End-to-End
eCPRI	electronic Common Public Radio Interface
eMBB	electronic Mobile Broad Band
EMS	Element Management System
ENI	Experiential Networked Intelligence
ETL	Extract-Transform-Load
FB	Functional Block
FCAPS	Fault, Configuration, Accounting, Performance and Security
FPS	Frames Per Second
FTP	File Transfer Protocol
GUI	Graphic User Interface
HTTP	Hypertext Transfer Protocol
I/O	Input and Output
IANA	Internet Assign Number Authority
IBCM	Intent-Based Cloud Management
ID	Identity
IDC	Internet Data Centre
IDS	Intrusion Detection Systems
INFP	Intelligent Network Failure Prevention
IoT	Internet of Things
IP	Internet Protocol
ISP	Internet Service Provider
IT	Information Technology
KM	Knowledge Management (functional block)
KPI	Key Performance Indicator
KVM	Kernel-based Virtual Machine
LTE	Long Term Architecture
MAN	Metro Area Network
MANO	Management and Orchestration
MC	Mobile Caching
MCP	Multi-vendor Command Platform
MDE	Model Driven Engineering (functional block)
MEC	Multi-access Edge Computing
MIMO	Multiple Input Multiple Output
ML	Machine Learning
MOP	Mode Of Operations
MOS	Mean Opinion Score
MPLS	Multi-Protocol Label Switching
MS	Monitoring System
N/A	Non Applicable
NF	Network Function
NFV	Network Functions Virtualisation
NFVI	NFV Infrastructure
NFVO	NFV Orchestrator
NGFI	Next Generation Fronthaul Interface
NGMN	Next Generation Mobile Networks

NPO	Network Planning and Optimization
NRM	Network Resource Management
NSI	Network Slice Instances
NSMF	Network Service Management Function
NSSMF	Network Sub-Slicing Management Function
O&M	Operation and Maintenance
OMC	Operation and Maintenance Centre
OPEX	Operational EXpenditure
OPN	Operations/Parameters in the Network
OS	Operating Systems
OSS	Operations Support System
OTN	Optical Transport Network
P2P	Point to Point
PHY	PHYsical layer
PINet	PolymorphIc Network
PM	Policy Management (functional block)
PoC	Proof of Concept
PoP	Point of Presance
PTN	Packet Transport Network
PTP	Precision Time Protocol
PUE	Power Usage Effectiveness
QCI	Quality of service Class Identifiers
QoE	Quality of Experience
QoS	Quality of Service
RAM	Random Access Memory
C-RAN	Centralized RAN
RAN	Radio Access Network
RAU	Remote Aggregation Unit
RCA	Root Cause Analysis
RCC	Radio Cloud Centre
RF	Radio Frequency
RP	Reference Point
RRU	Remote Radio Units
RSRP	Reference Signal Received Power
SA	Service Assurance
SDN	Software Defined Networking
SD-WAN	Software Defined - Wide Area Network
SIA	Service Impact Analysis
SINR	Signal to Interference plus Noise Ratio
SIP	Session Initiation Protocol
SLA	Service-Level Agreement
SM	Session Management
SON	Self-Organizing Network
SP	Service Provider
TCP	Transmission Control Protocol
TLS	Transport Layer Security
TN	Transport Network
TT	Trouble Ticket
UC	Use Case
UE	User Equipment
UL	UpLink
UPF	User Plane Function in 5G
V2I	Vehicle to Infrastructure
V2N	Vehicle to Network
V2P	Vehicle to People
V2V	Vehicle to Vehicle
vBRAS	virtual Broadband Remote Access Server
vCPU	virtual CPU
VDI	Virtual Desktop Interface
VM	Virtual Machines
VNF	Virtualised Network Functions
VoIP	Voice over IP (Internet Protocol)

VoLTE	Voice over LTE in 4G
WAN	Wireless Access Network
WLAN	Wireless Local Area Network
XDR	eXternal Data Representation
XML	eXtensible Markup Language
YAML	YAML Ain't Markup Language

4 Overview

4.1 Background

Operators see human-machine interaction as slow, error-prone, expensive, and cumbersome. For example, operators are worried about the increasing complexity of integration of different standardization platforms in their network and operational environment; this is due to the vast differences inherent in programming different devices as well as the difficulty in building agile, personalized services that can be easily created and torn down. These human-machine interaction challenges are considered by operators as barriers to reducing the time to market of innovative and advanced services. Moreover, there is no efficient and extensible standards-based mechanism to provide contextually-aware services (e.g. services that adapt to changes in user needs, business goals, or environmental conditions).

These and other factors contribute to a very high OPERational EXpenditure (OPEX) for network management. Operators need the ability to automate their network configuration and monitoring processes to reduce OPEX. More importantly, operators need to improve the use and maintenance of their networks. In particular, this requires the ability to visualize services and their underlying operations so that the proper changes can be applied to protect offered services and resources (e.g. ensure that their Quality of Service (QoS) and Quality of Experience (QoE) requirements are not violated). If such visualization could be provided, then operators would be better able to maintain their networks.

The associated challenges may be stated as:

- a) automating complex human-dependent decision-making processes;
- b) determining which services should be offered, and which services are in danger of not meeting their Service-Level Agreement (SLA), as a function of changing context;
- c) defining how best to visualize how network services are provided and managed to improve network maintenance and operation; and
- d) providing an experiential architecture (i.e. an architecture that uses various mechanisms to observe and learn from the experience an operator has in managing the network) to improve its understanding of the operator experience, over time.

The aforementioned challenges will require advances in network telemetry, big data mechanisms to gather appropriate data at speed and scale, machine learning for intelligent analysis and decision making, and applying innovative, policy-based, model-driven functionality to simplify and scale complex device configuration and monitoring.

4.2 Overview of the ENI System

4.2.1 Brief Description

The purpose of the ISG ENI is to define a Cognitive Network Management architecture that improves on the operator experience. The operator experience is improved by adding closed-loop mechanisms (including AI functions) based on context-aware, metadata-driven policies to recognize and incorporate new and changed knowledge, and hence, make actionable decisions more quickly.

The ENI System is an innovative, policy-based, model-driven functional architecture that improves operator experience. In addition to network automation, the ENI System assists decision-making of humans as well as machines, to enable a more maintainable and reliable system that provides context-aware services that more efficiently meet the needs of the business. For example, the ENI System enables the network to change its behaviour (e.g. the set of services offered) in accordance with changes in context, including business goals, environmental conditions, and the varying needs of end-users.

Examples of the possible functionalities of an ENI system are given in Figure 4-1.

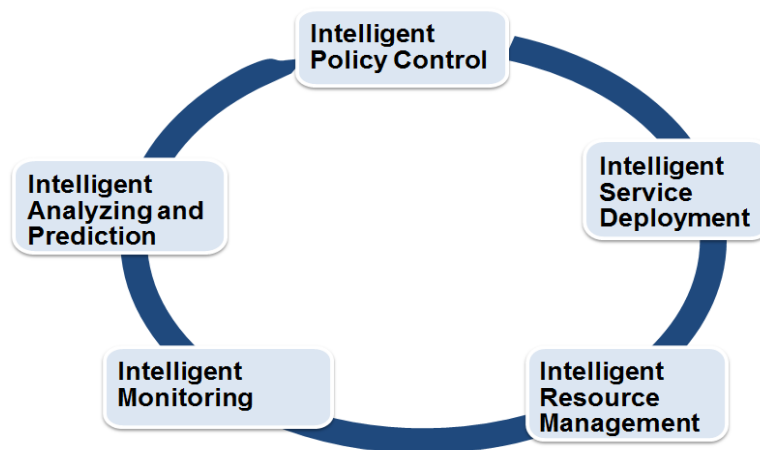


Figure 4-1: Example of functionalities of ENI system

4.2.2 Expected Benefits

The ENI System provides the following important benefits:

- 1) to measure and quantify the operation and performance of the resources and services of an operator;
- 2) to enable personalized services to be provided to customers;
- 3) to learn from the operation of the network, and decisions made by the operator;
- 4) to automate the operator's complex human-dependent decision-making processes by translating changing user needs, business goals, and environmental conditions into closed-loop configuration and monitoring;
- 5) to enable the optimization and adjustment of resources and services managed by the operator, as well as associated tools and applications needed by the operator to conduct business.

ENI system delivers enhanced customer experience by allowing operators to understand the operating status of their network and networked applications in near-real-time, and reconfigure their network. The ENI system automatically collects network status and associated metrics, faults, and errors, and then uses artificial intelligence to ensure network performance and quality of service are met at the highest possible efficiency (e.g. with the minimum required resources). An ENI system can also be used to find bottlenecks of service and/or failure of network. Both of these benefits are done on-demand, in response to changing contextual information.

The ENI system helps to increase the value of services provided by an operator to its customers by rapidly on-boarding new services, enabling the creation of a new ecosystem of cloud consumer and enterprise services, reducing Capital and Operational Expenditures, and providing efficient operations.