



The Standards People

6 September 2021

ETSI ISG ENI**

Creating an intelligent service
optimization solution

ETSI ISG ENI short presentation

Chair:
Vice-Chair:
Presented by: Vice-Chair:
Technical Officer:

Dr. Raymond Forbes (Huawei Technologies)
Mrs. Haining Wang (Intel)
Mr. Antonio Gamelas (Portugal Telecom)
Mrs. Christine Mera (ETSI)

ENI Leadership Team

Role	Name (Organization)
Chair	Dr. Raymond Forbes (Huawei)
Vice Chair	Ms. Haining Wang (Intel)
Second Vice Chair	Mr. Antonio Gamelas (Portugal Telecom)
Support Officer	Mrs. Christine Mera (ETSI)
ENI ISG PoC Review Team	Raymond Forbes (Huawei) Christine Mera (ETSI Support Officer) Ultan Mulligan (ETSI CTI Director) Bill Wright (Redhat) Haining Wang (Intel) Luca Pesando (Telecom Italia) Yu Zeng (China Telecom) Antonio Gamelas (Portugal Telecom)

ENI Members and Participants

Officials

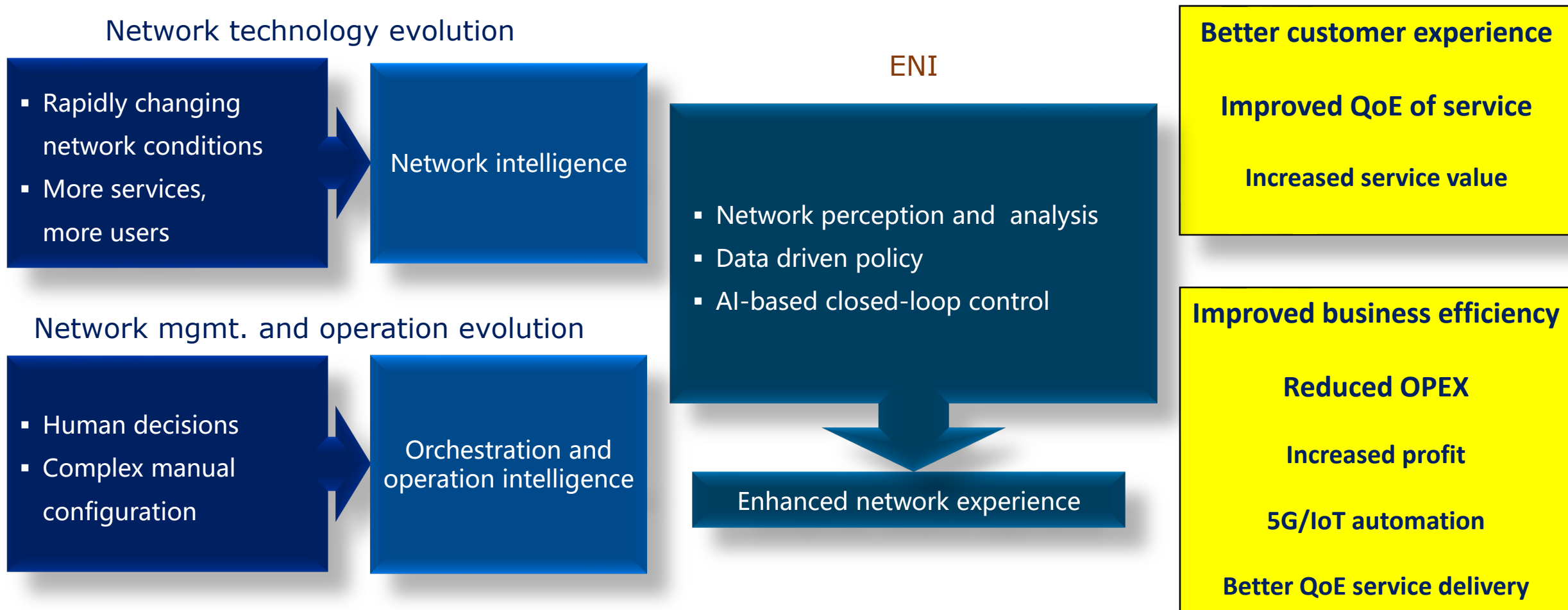
PoC Review Team

Participants



Source: <https://portal.etsi.org/TBSiteMap/ENI/ListOfENIMembers.aspx>
 Members signed the ENI Member agreement and are ETSI members
 Participants signed the ENI Participant agreement but are not ETSI members

ENI Vision



Source: ETSI ENI White Papers,
http://www.etsi.org/images/files/ETSIWhitePapers/etsi_wp22_ENI_FINAL.pdf
http://www.etsi.org/images/files/ETSIWhitePapers/etsi_wp44_ENI_FINAL.pdf

ENI Mission/Scope (1)

⇒ ETSI ISG ENI starting in Release 1 & 2 (2017–2019 + 2019–3Q2021):

- The ISG ENI has focused on improving the operator experience, adding closed-loop artificial intelligence mechanisms based on context-aware, metadata-driven policies. Enabling quick recognition and incorporation of new and changed knowledge, and hence, make actionable decisions.
- In particular, ENI has specified a set of use cases, and the functional architecture, for a network supervisory assistant system based on the ‘observe-orient-decide-act’ control loop model.
- This model can assist decision-making systems, such as network control and Interact with the domain orchestration systems, to adjust services and resources offered based on changes in user needs, environmental conditions and business goals.

ENI Mission/Scope (2)

⇒ **ETSI ISG ENI starting in Release 1 & 2 (2017–2019 + 2019–3Q2021) (cont.):**

- Definition of AI Categories into levels 0-5 regarding autonomicity.
- Evaluation criteria for Categorization and methods of measuring.
- Use of the API broker for non-capable signaling systems.
- Specification of external reference points, implementation, PoCs, data mechanisms
- Definition of closed control loops in the real-time network.

ENI Mission/Scope (or just Mission?) (3)

Future expected issues



⇒ ENI Release 3 starting 3Q2021:

- Revision of the Use cases & Requirements + Evaluation & Measurement of Categorization + Data Management
 - Priority Use Cases demonstrated in PoCs
 - Measurement Criteria
 - Data Handling related with format and flow between FBs
- Further deployment and specification of the system architecture
 - Interface definitions and information models
 - Data models and APIs
 - Handling of Policy Management Model
 - Handling of Intent-based concept

ENI Published Reports, Specifications & Work plan

Published ENI deliverables:

- [ETSI GS ENI 001 V3.1.1 \(2020-12\)](#) **Published** Use Cases
- [ETSI GS ENI 002 V3.1.1 \(2020-12\)](#) **Published** Requirements
- [ETSI GR ENI 003 V1.1.1 \(2018-05\)](#) **Published** Context-Aware Policy Man.
- [ETSI GR ENI 004 V2.1.1 \(2019-10\)](#) **Published** General Terminology
- [ETSI GS ENI 005 V1.1.1 \(2019-09\)](#) **Published** System Architecture
- [ETSI GS ENI 006 V2.1.1 \(2020-05\)](#) **Published** PoC Framework
- [ETSI GR ENI 007 V1.1.1 \(2019-11\)](#) **Published** Definition of Categories
- [ETSI GR ENI 008 V1.1.1 \(2021-03\)](#) **Published** Intent Aware Net. Autonomicity
- [ETSI GR ENI 009 V1.1.1 \(2021-06\)](#) **Published** Data Mechanisms
- [ETSI GR ENI 010 V1.1.1 \(2021-03\)](#) **Published** Evaluation of categories
- [ETSI GR ENI 016 V2.1.1 \(2021-07\)](#) **Newly Published** Functional Concepts
- [ETSI GR ENI 017 V2.1.1 \(2021-08\)](#) **Newly Published** Control Loop Archit.
- [ETSI GR ENI 018 V2.1.1 \(2021-08\)](#) **Newly Published** AI Mechanisms

Ongoing ENI Work Items and Rapporteurs:

- ENI 001 (WI RGS/ENI-0001v321) – **Target for approval Mar. 2023**
Use Cases (Release 3) – Da Wang (Asia Info)
- ENI 002 (WI RGS/ENI-0002v321) – **Target for approval Mar. 2023**
Requirements (Release 3) – Haining Wang (Intel)
- ENI 004 (WI RGR/ENI-0018) – **Approved in remote consensus Sept. 2021**
General Terminology (Release 2 version 3) – Yu Zeng (China Telecom)
- ENI 005 (WI RGS/ENI-0016) – **Approved in Ratification with an MEF CA**
System Architecture (Release 2) – John Strassner (FutureWei)
- ENI 009 (WI RGR/ENI-009v121) – **draft in progress**
Data processing mechanisms – Hongden Ren (China Telecom)
- ENI 010 (WI RGR/ENI-0010v121) – **draft in progress**
Measurement of Evaluation Categories for AI application to Networks – Yu Zeng (China Telecom)
- ENI 011 (WI DGS/ENI-0021) – **draft in progress**
Mapping between ENI architecture and operational systems – Ziting Zhang (China Telecom)
- ENI 012 (WI DGR/ENI-0022) – **draft in progress - Stable**
Reactive In-situ flow information Telemetry – Yali Wang (Huawei)
- ENI 013 (WI DGR/ENI-0023) – **draft in progress**
ENI Intent Policy Model – Jiachen Zheng (China Mobile)
- ENI 015 (WI DGR/ENI-025) – **draft in progress**
Processing and Management of Intent Policy – Ziting Zhang (China Telecom)
- ENI 019 (WI DGS/ENI-029) – **draft in progress**
Proposal for Representing, Inferring – John Strassner (Futurewei)
- ENI 030 (WI DGS/ENI-0030) – **WI Form in discussion**
AI Mechanisms – John Strassner (Futurewei)

Main concepts: Use Cases

Infrastructure Management

Policy-driven IDC traffic steering

Handling of peak planned occurrences

Energy optimization using AI

Network Assurance

Network fault identification and prediction

Assurance of Service Requirements

Network Fault Root-cause Analysis and Intelligent Recovery

Network Operations

Policy-driven IP managed networks

Radio coverage and capacity optimization

Intelligent software rollouts

Intelligent fronthaul management and orchestration

Elastic Resource Management and Orchestration

Application Characteristic based Network Operation

AI enabled network traffic classification

Automatic service and resource design framework for cloud service

Intelligent time synchronization of network

Intelligent Content-Aware Real-Time Gaming Network

Service Orchestration and Management

Context aware VoLTE service experience optimization

Intelligent network slicing management

Intelligent carrier-managed SD-WAN

Intelligent caching based on prediction of content popularity

Network Security

Policy-based network slicing for IoT security

Limiting profit in cyber-attacks

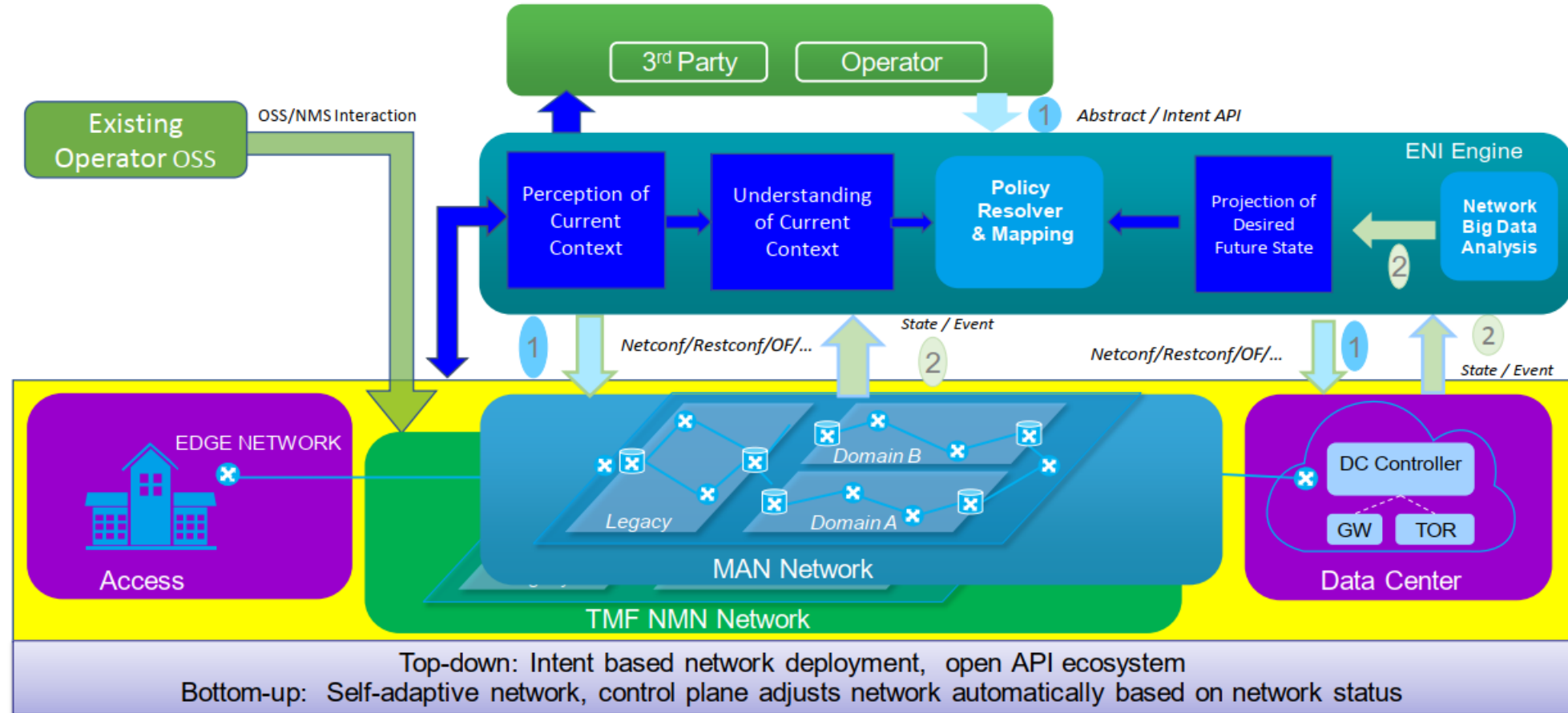
Main concepts: Requirements

Level 1	Level 2
Service and network requirements	General requirements
	Service orchestration and management
	Network planning and deployment
	Network optimization
	Resilience and reliability
	Security and privacy

Level 1	Level 2
Functional requirements	Data collection and analysis
	Policy management
	Data learning
	Interworking with other systems
	Mode of operations
	Model training and iterative optimization
	API requirements

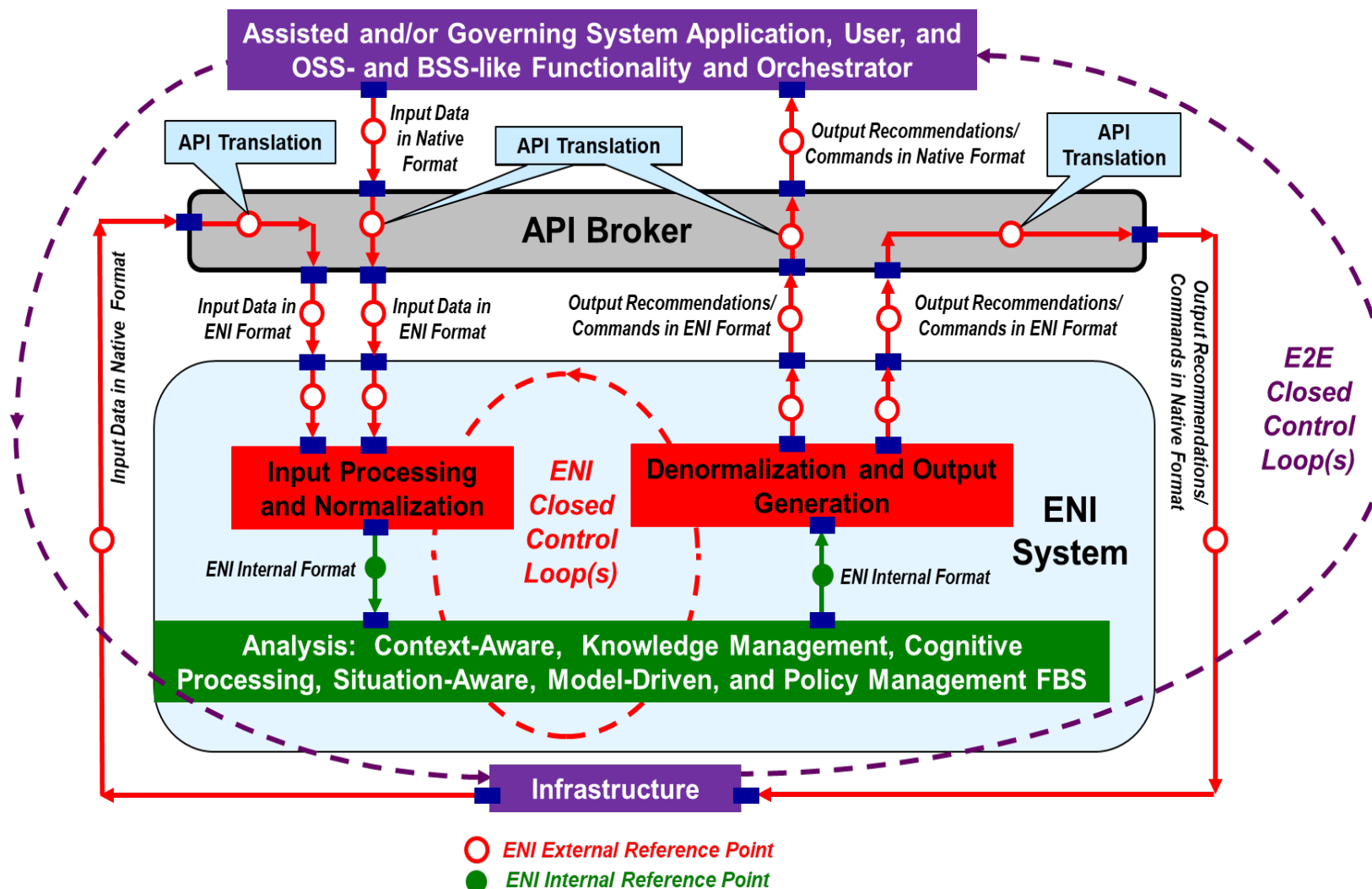
Level 1	Level 2
Non-functional requirements	Performance requirements
	Operational requirements
	Regulatory requirements

E2E view of ENI Conceptual Architecture



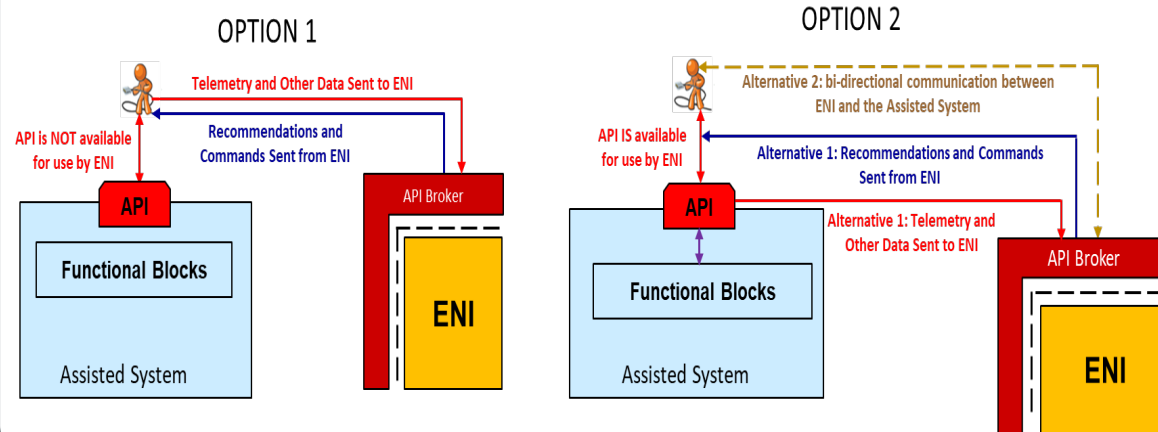
Source: ENI Whitepaper, 1st Edition-Oct. 2017

ENI System Reference Architecture

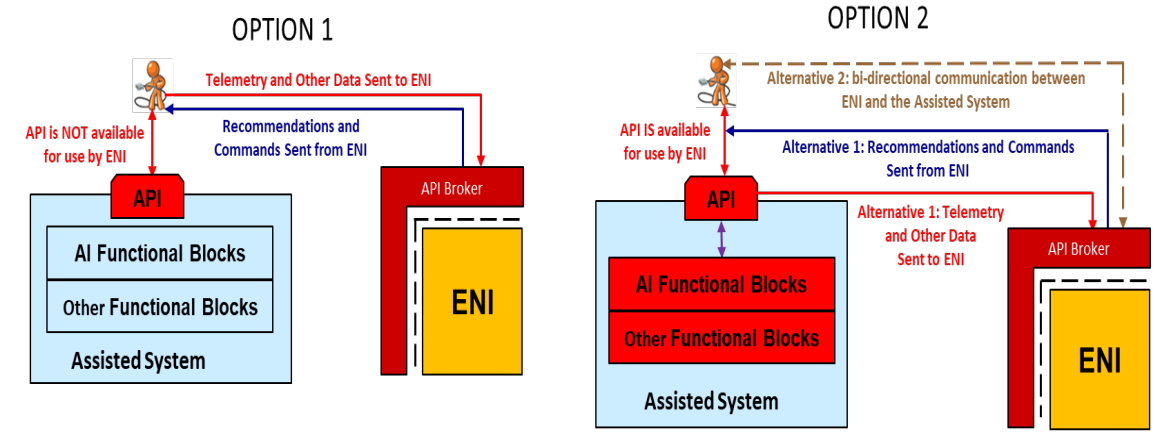


ENI System Architecture - Mode of Operation and Class

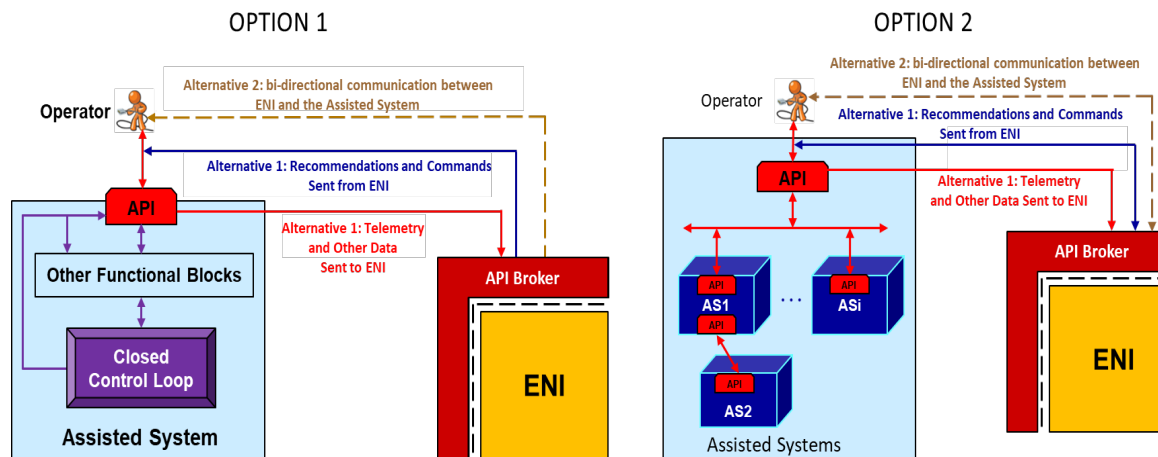
Class 1: An Assisted System that has No AI-based Capabilities



Class 2: An Assisted System with AI that is Not in the Control Loop

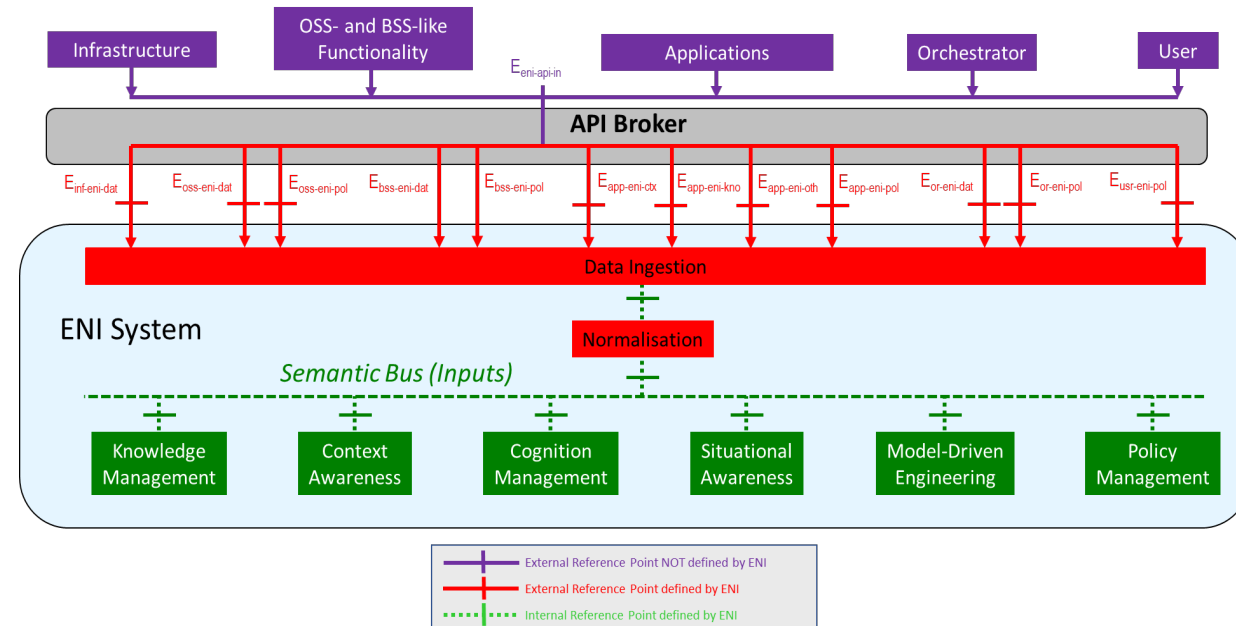


Class 3: An Assisted System with AI Capabilities in its Control Loop

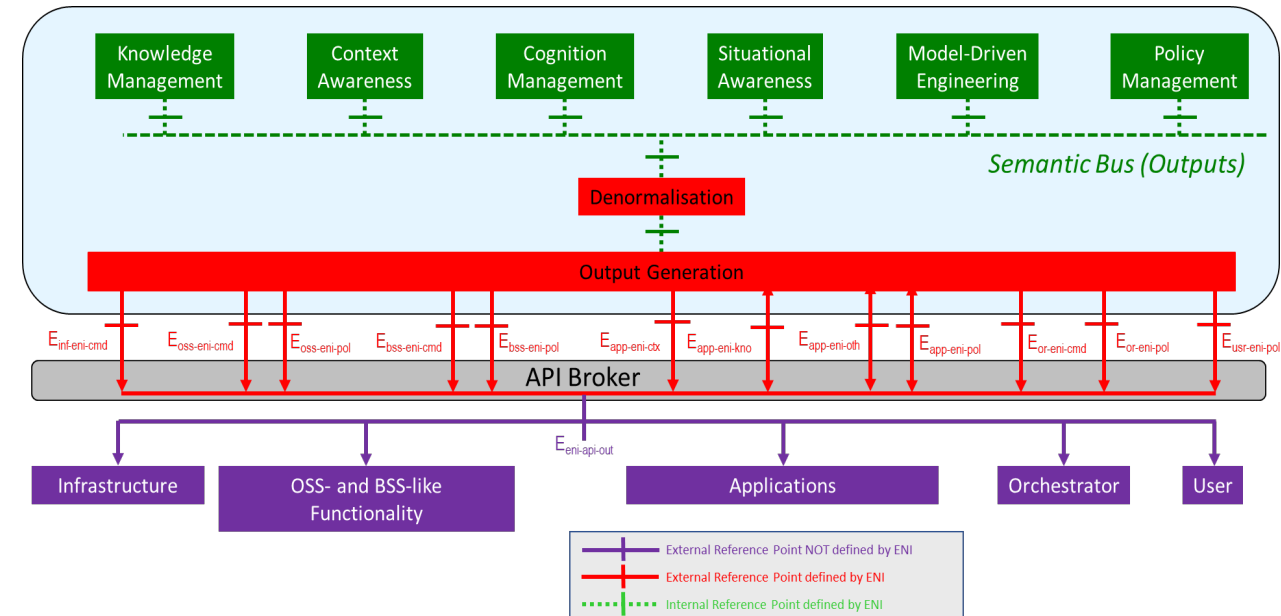


- In each case, ENI requires data from the Assisted System.
- Changes to the Assisted System are not required for any class of Assisted System, shown here
- This facilitates the use and rapid adoption of ENI.
- ENI shall use the API Broker to mediate between ENI and the Assisted System
- ENI provides actionable decisions back to the assisted system (autonomous or recommendatory)
- ENI monitors the effect

Architecture External Reference Points (Inputs & Outputs)



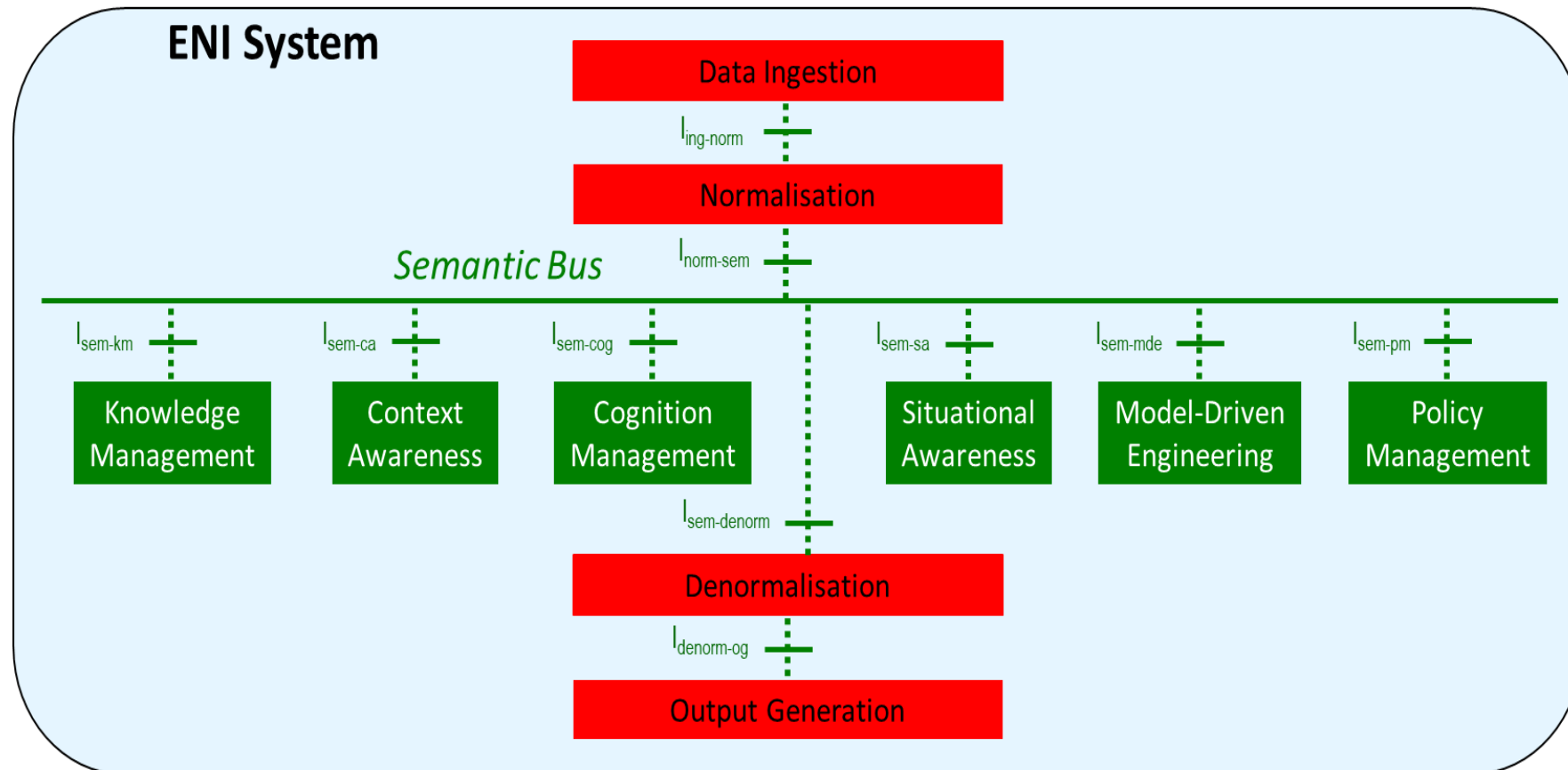
Functional Architecture with its Input Reference Points



Functional Architecture with its Output Reference Points

Imperative, Declarative, and Intent Policies are handled within the same architecture, with no additional RP or FB needed

Architecture Internal Reference Points

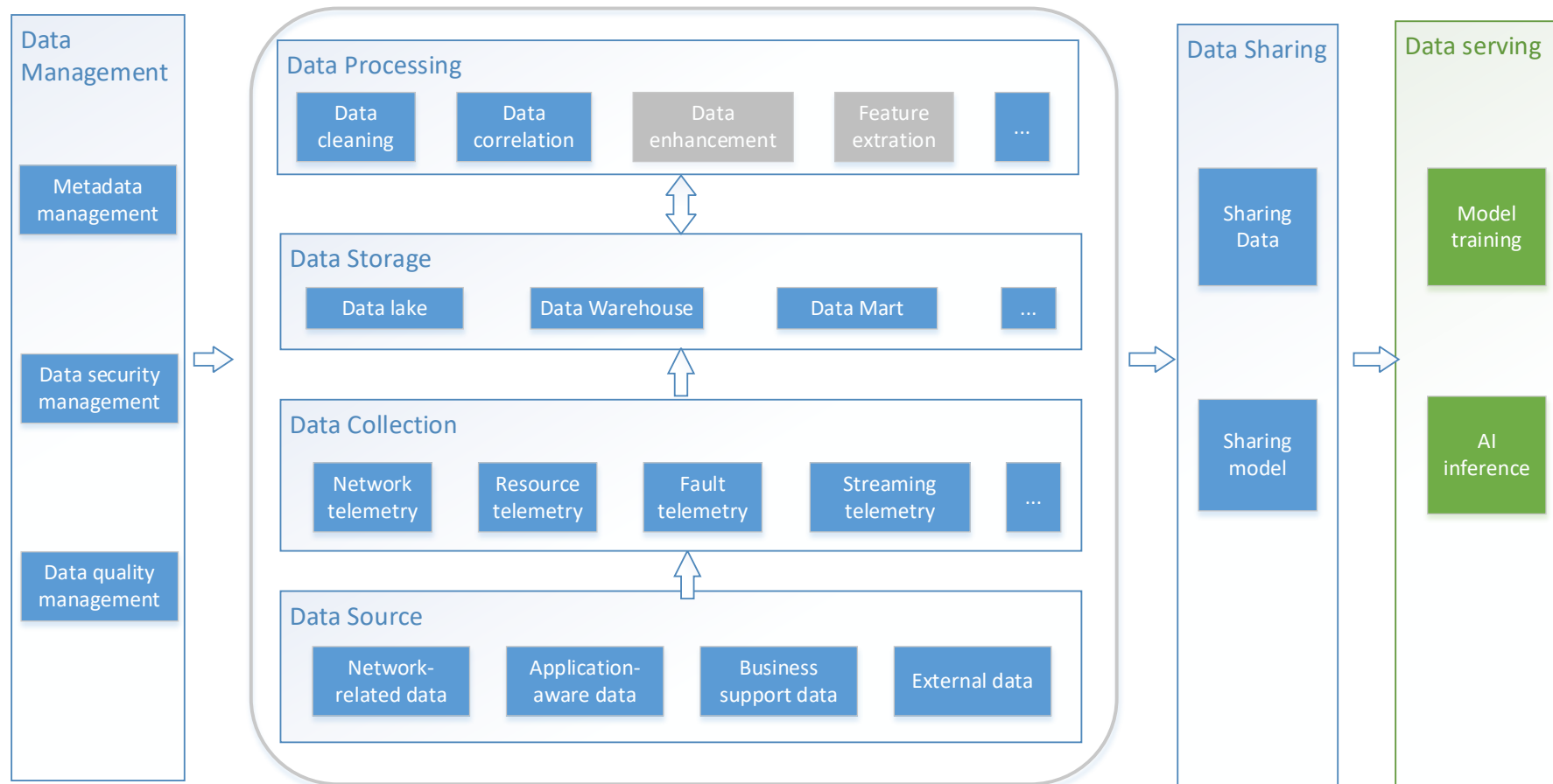


Definition of Categories for AI Application to Networks

Category	Name	Definition	Man-Machine Interface	Decision Making Participation	Data Collection and Analysis	Degree of Intelligence	Environment Adaptability	Supported Scenario
Category 0	Manual O&M	O&M operators manually control the network and obtain network alarms and logs	How (command)	All-manual	Single and shallow awareness (SNMP events and alarms)	Lack of AI based understanding (manual management and control)	Fixed	Single scenario
Category 1	Assisted O&M	Automated scripts are used in service provisioning, network deployment, and maintenance. Shallow perception of network status and machine suggestions for decision making	How (command)	Provide suggestions for machines or humans and help decision making	Local awareness (SNMP events, alarms, KPIs, and logs)	Limited analysis capability	Limited adaptability to changes	Selected scenarios
Category 2	Partial automation	Automation of most service provisioning, network deployment, and maintenance Comprehensive perception of network status and local machine decision making	How (declarative)	The machine provides multiple opinions, and the machine makes limited decisions	Comprehensive awareness (basic telemetry data)	Deep analysis capability	Limited adaptability to changes	Selected scenarios
Category 3	Conditional automation	In specific environmental and network conditions there is automatic network control and adaptation	How (declarative)	Most of the machines make decisions	Comprehensive and adaptive sensing (such as data compression and optimization technologies)	Comprehensive analysis and knowledge; Short-term forecast capability	Adaptability to significant changes	Multiple scenarios
Category 4	Partial autonomy	Deep awareness of network status; in most cases the network performs autonomic decision-making and operation adjustment	What (intent)	Optional decision-making response	Adaptive posture awareness	Comprehensive analysis and knowledge Long-term forecast capability	Adaptability to significant changes	Multiple scenarios
Category 5	Full autonomy	In all environmental and network conditions, the network can automatically adapt	What (intent)	Machine autonomous decision	Adaptive optimization as a consequence of quality of service deterioration	Autonomic evolution and knowledge reasoning	Adaptability to any change	Any scenario

Autonomy capability
Continuous improvement

Data Mechanism Framework



The Data Mechanism supports different data acquisition and processing mechanisms for data from different sources and for use by different network applications. This makes it possible to assemble a comprehensive data mechanism supporting AI enabled network OAM and service management.

Main Contents of the Data Processing Mechanisms

Data Collection Techniques

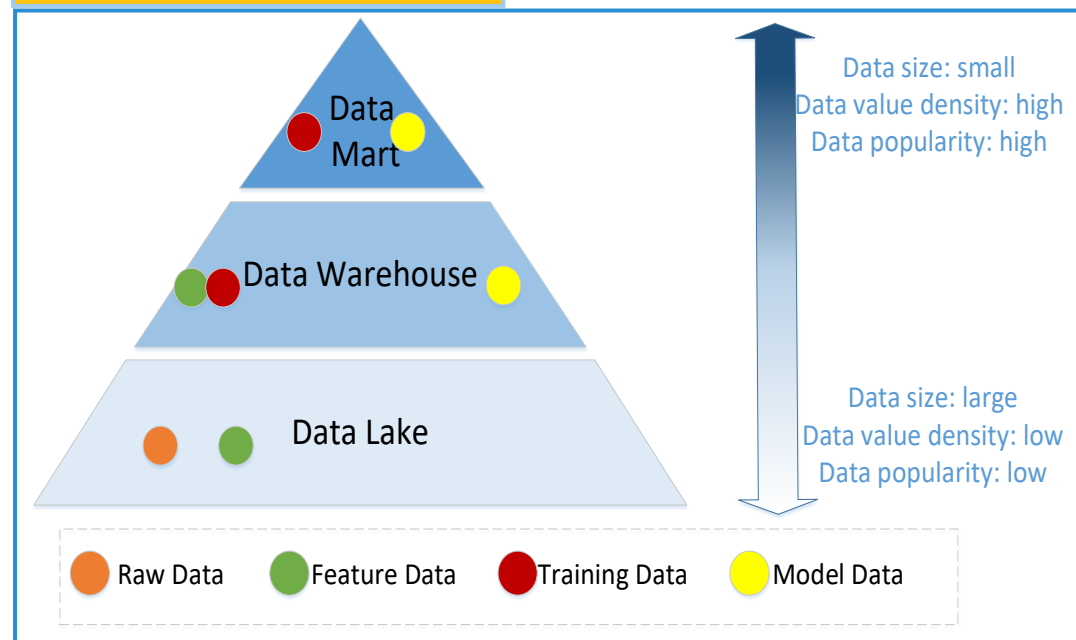
Data carried out in functional planes protocols

- ✓ Data carried out in the Forwarding/User Plane
- ✓ Data carried out in the Control Plane
- ✓ Data carried out in the Management Plane

Specific data used to deploy telemetry

- ✓ Network Telemetry
- ✓ Resource Telemetry
- ✓ Fault Telemetry
- ✓ Streaming Telemetry

Hierarchical Data Storage



Example Scenarios to Illustrate Data Mechanisms

Description of data processing in the selected use cases proposed in ENI 001, supporting analysis in ENI System, e.g., data cleansing.

- ✓ AI-enabled Traffic Classification
- ✓ Network Fault Root-Cause Analysis and Intelligent
- ✓ Intelligent Service Experience Evaluation

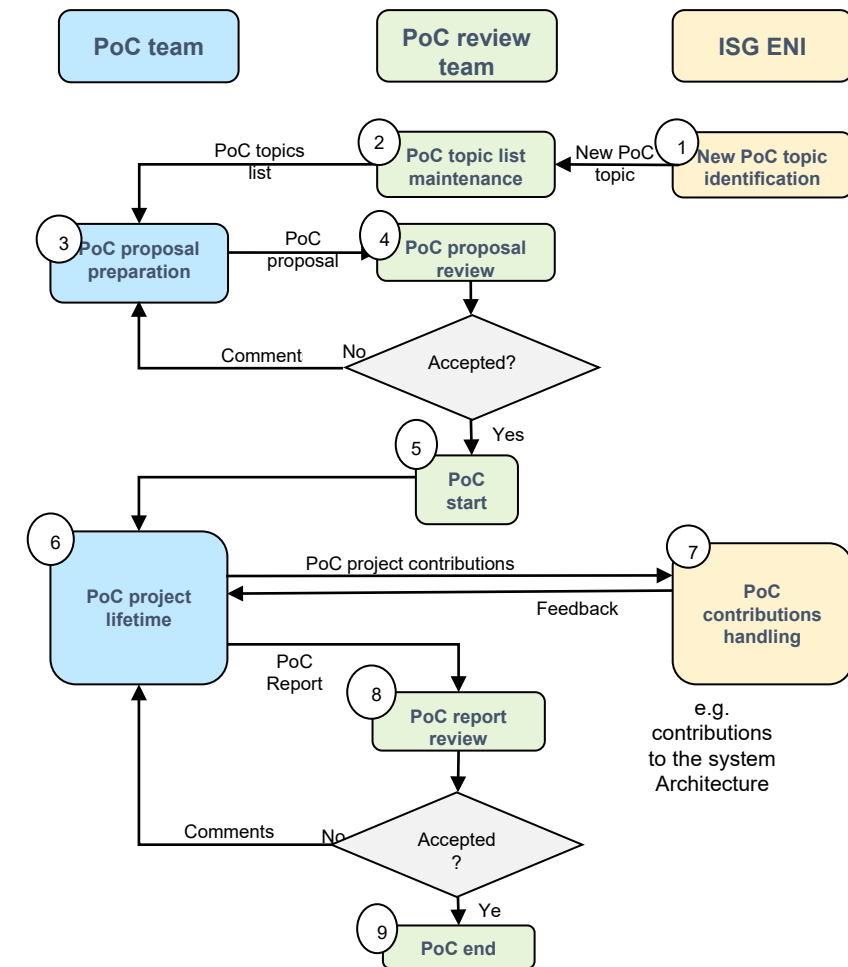
PoC Team and ENI Work-Flow proposal



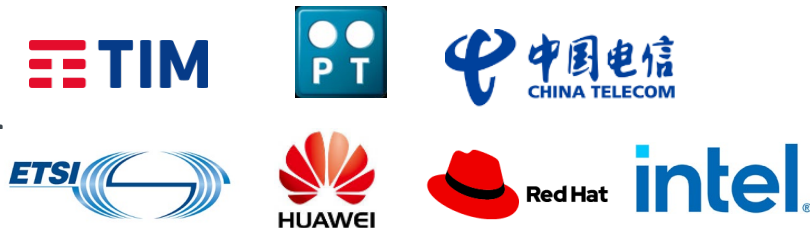
Using the process defined in ETSI

Procedures:

- ✔ ISG ENI approved & published a PoC framework (2nd version)
- ✔ PoC review group to receive and review PoC proposals with formal delegation from ISG
- ✔ Publish the PoC proposals (on ETSI Portal wiki) according to the PoC framework
- ✔ PoC teams (the proposers – which may include non-members) shall present an initial proposal and a final report, according to the templates given by ISG for review
- ✔ PoC Team(s) are independent of the ISG, must choose a POC Team Leader and draft the proposal according to the process and templates defined by the ISG



ENI PoC review team:



PoC project wiki: https://eniwiki.etsi.org/index.php?title=Ongoing_PoCs

ENI PoC List (1)

Title	PoC Team Members	Main Contact	Start Time	Current Status (Dec.-2020)
PoC#1: Intelligent Network Slice Lifecycle Management	China Telecom Huawei, Intel, CATT, DAHO Networks, China Electric Power Research Institute	Haining Wang	Jun-2018	Completed
PoC#2: Elastic Network Slice Management	Universidad Carlos III de Madrid Telecom Italia S.p.A., CEA-Leti, Samsung R&D Institute UK, Huawei	Marco Gramaglia	Nov-2018	Completed
PoC#3: SHIELD, security through NFV	Telefonica Space Hellas, ORION, Demokritos (NCSR)	Diego R. Lopez Antonio Pastor	Jan-2019	Completed
PoC#4: Predictive Fault management of E2E Network Slices	Portugal Telecom/Altice Labs SliceNet Consortium	António Gamelas Rui Calé	Mar-2019	Completed
PoC#5: AI Enabled Network Traffic Classification	China Mobile Huawei, Intel, Tsinghua University	Weiyuan Li	Jun- 2019	Completed
PoC#6: Intelligent caching based on prediction of content popularity	China Unicom Beijing University of Posts and Telecommunications, Samsung, Cambricon, Huawei	Bingming Huang	Sep-2019	Completed
PoC#7: Intelligent time synchronization of network	China Unicom Beijing University of Posts and Telecommunications, Samsung, Cambricon, Huawei	Bingming Huang	Sep-2019	Completed

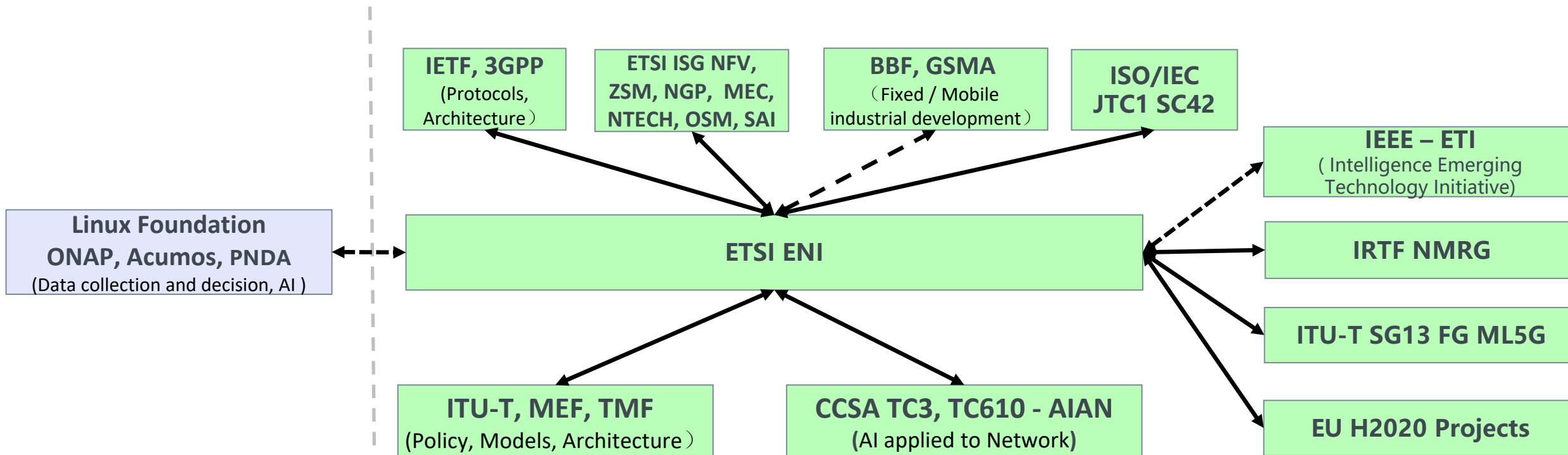
ENI PoC List (2)

Title	PoC Team Members	Main Contact	Start Time	Current Status (Sep.-2021)
PoC#8: Intent-based user experience optimization	China Telecom/Huawei Technologies China Telecom, Huawei Technologies, AsiaInfo, Beijing University of Posts and Telecommunications	Dong Li	Jan-2020	Completed
PoC#9: Autonomous Network Slice Management for 5G Vertical Services	Nextworks TIM, Nextworks, Samsung, WINGS, UC3M	Gino Carrozzo / Marco Gramaglia	Jan-2020	Completed
PoC#10: Intelligent Telecom Network Energy Optimization	China Mobile China Mobile Research Institute, Intel, Quanta Cloud Technology, Hong Kong ASTRI	Liexiang Yue	Jan-2020	Completed
PoC#11: Intelligent Energy Management of DC	China Telecom: China Telecom, Intel, AsiaInfo, Samsung, Huawei	Yu Zeng	April-2020	Ongoing
PoC #12: Intelligent Transmission Network Optimization	China Mobile China Mobile Research Institute, China Mobile Group Zhejiang Co., Ltd., Huawei, Intel	Chen Shaofan	Sept.-2020	Completed
PoC#13: Intelligent Coverage Optimization of 5G Massive MIMO BS	China Telecom China Telecom, Intel, Inspur	Xueqi Yuan	October-2020	Ongoing
PoC #14: Intent-based Cloud Management	NTT Labs NTT labs, Intracom Telecom, NTT-AT, Intel	Chao Wu	June-2021	Ongoing

External Cooperation: Ecosystem

Open Source

Standard & Industry & Research



- Cooperate with mainstream operators, vendors and research institutes in Europe, USA and Asia
- Collaborate with other SDOs and industry ad-hocs
 - Liaisons exchanged with IETF, BBF, MEF, ITU-T, ISO/IEC
 - Liaisons with other ETSI groups: NFV, NGP, MEC, NTECH, OSM, ZSM, SAI
- Position ETSI ENI as the home of network intelligence standards
- Guide the industry with consensus on evolution of network intelligence
- Boarder between different categories are becoming vague.

Network Intelligence Activities between 2016 and 2021

Activities:

- Forum on Network Intelligence, Dec'16, Shenzhen, China
- ENI & SDNIA Joint Forum, Sep'17, Beijing, China
- ENI & H2020-SliceNet Workshop, Dec'17, London, UK
- ENI & 5GPPP MoNArch Workshop, Jun'18, Turin Italy
- ENI presentation to ITU workshop, Aug'18, San Jose, CA, USA
- ENI & CCSA TC610 AIAN Joint Forum, Sep'18, Beijing, China
- ENI & 5Tonic Joint Workshop, Dec'18, Madrid, Spain
- ENI & Samsung joint Workshop, Apr'19, Warsaw, Poland
- ENI & Altice Lab / Portugal Telecom joint Workshop, Jul'19, Aveiro, Portugal
- ENI & China Telecom Research labs, workshop with CCSA TC 610 SNIA, September 2019
- ENI in the pandemic 4 plenaries online remote, Release 2 progressed to near completion
- In 2020 – 6 deliverables approved
- ENI in 2021 Release 3 start: initially 4 Work-items started
- ENI June 2021 finalize Release 2; more Release 3 Work-items



Forum on Network Intelligence, Dec'16



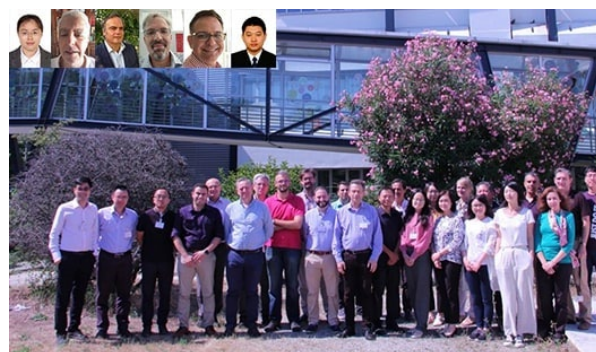
ENI & SDNIA Joint Forum on Network Intelligence, Sep'17



ENI & SliceNet workshop, Dec'17



ENI & Samsung Workshop, Apr'19



ENI & Altice Lab / Portugal Telecom Workshop, Jul'19



ENI & China telecom Labs, Sept'19

Please Contribute

Contact Details:

Chair: Dr. Raymond Forbes Raymond.Forbes@huawei.com

+44 771 851 1361

Useful links:

[ENI Terms of Reference](#)
[ENI Member Agreement](#)
[ENI Participant Agreement](#)
[ENI Activity Report](#)

[ENI membership list](#)
[ENI Published Deliverables](#)
[ENI Presentation](#)
[ENI Wiki and PoC info](#)

[ENI High Level Notice](#)
[ENI White Paper](#)
[ENI Blog](#)
[ENI Webpage](#)

Acknowledge the assistance of: Dr. Yu Zeng zengyu@chinatelecom.cn

Thank you!