tmforum

Telco-centric smart business networks for beyond connectivity

tmforum DIGITAL LEADERSHIP SUMMIT

2020-10-22

13:05 – 13:10

Driving a standardized approach to achieve the autonomous networks vision

W. George Glass, *CTO*, **TM Forum**

13:10 – 13:25

AN2.0 Empowering digital transformation for smart societies and industries

Aaron Boasman-Patel, *VP, AI and Customer Experience ,* **TM Forum**

Dong Sun, *Chief Business Strategist, Digital Transformation,* **Futurewei**

13:25 – 14:05

Rapid Fire: Industry in Action

Luca Pesando, *ISG F5G Chari*, **ETSI**

Raymond Forbes, *ISG ENI Chair,* **ETSI**

Klaus Martiny, *ISG ZSM Chair,* **ETSI**

Thomas Tovinger, *SA5 Chair,* **ETSI**

14:05 - 14:40

Panel Discussion: Addressing the key drivers for Autonomous Networks, zero touch operations and the need for a common framework

Aaron Boasman-Patel, *VP, AI and Customer Experience* , **TM Forum**

Ignacio Mas, *Senior Expert and Head of Technology Strategy OSS,* **Ericsson**

14:40 - 14:45

Closing Remarks

Aaron Boasman-Patel, *VP, AI and Customer Experience* , **TM Forum**

AN2.0 Empowering digital transformation for smart societies and industries

Aaron Boasman-Patel, *VP, AI and Customer Experience ,* **TM Forum**

Overview of Autonomous Networks Whitepaper Rel 2

- 23 companies, 41 members contributing on the whitepaper (Download link)

White Paper

Autonomous Networks: Empowering digital transformation for smart societies and industries

To further the vision of Autonomous Networks for smart societies and industries by addressing the business requirements, architecture, capabilities and use cases through simplified, automated, and intelligent connectivity and ICT infrastructure services and operations.

Release 2, October 2020

CONTRIBUTIONS BY

AsiaInfo, BearingPoint, blueplanet, 亿阳信通, BT, CAICT 中国信通院, 中国移动 China Mobile, China unicom 中国联通, ciena, Cognizant, ERICSSON, FUJITSU, FUTUREWEI, HUAWEI, Microsoft, NOKIA, NTT, orange, TIM, TEOCO, UBiqube, vodafone

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Addressing the need for autonomous networks

5 billion network devices connected to the internet 2025

1 billion network devices connected to the internet

Smart City

Smart industry

Smart government

Smart xxx...

Deliver new smart, connected services

Increase efficiency

Reduce OpEx

Increase CX

Rakuten Microsoft amazon Alibaba.com

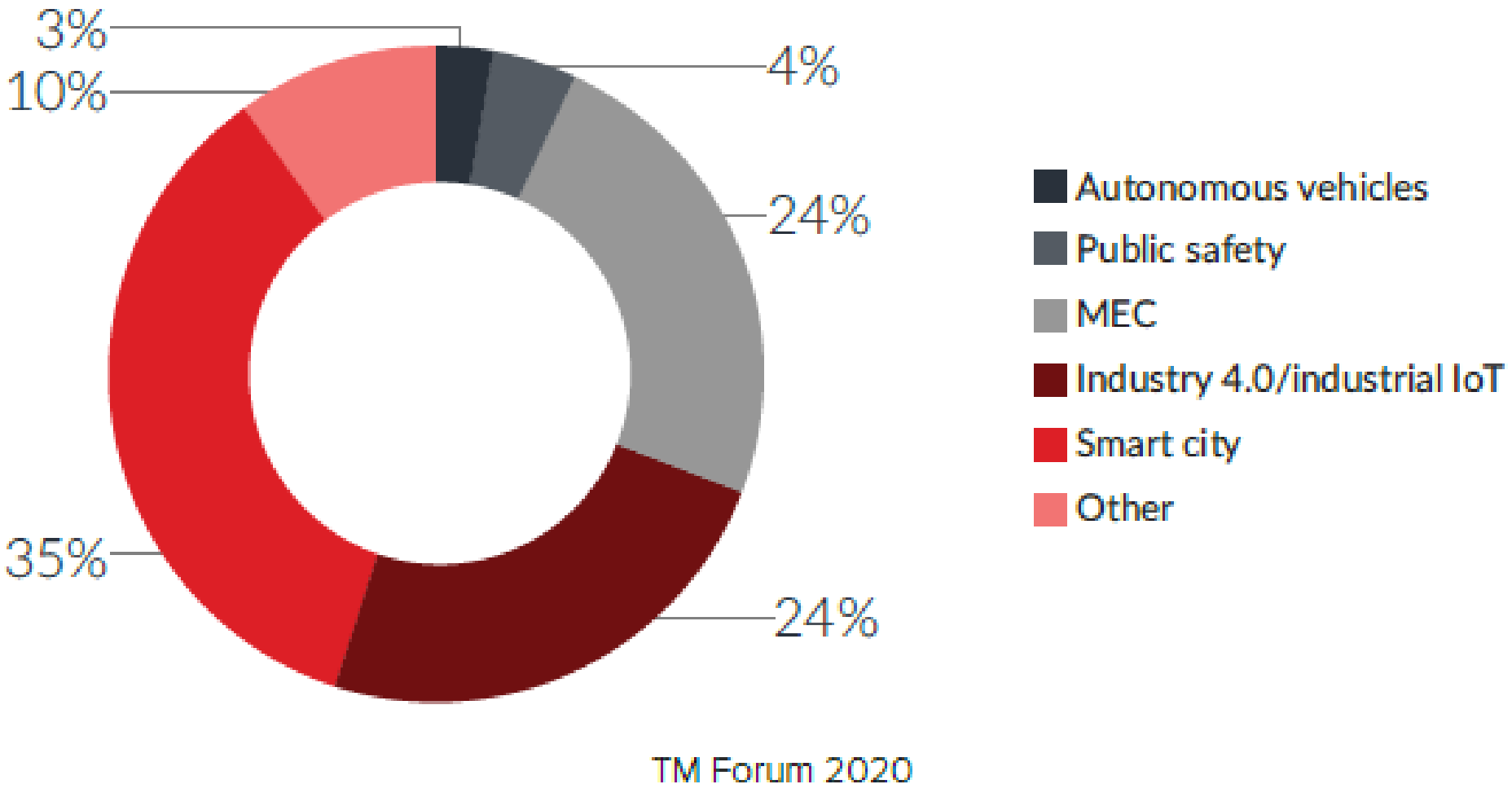
Google Baidu 百度 Tencent 腾讯

Compete with digital natives and hyperscalers

2.6 billion 5G subscribers will generate 65% of worlds 160 exabytes of mobile traffic data

Source: Ericsson Mobility Report

Best market opportunities for Autonomous Networks



Smart factories and manufacturing currently offers the best ROI for Autonomous networks

Smart industry

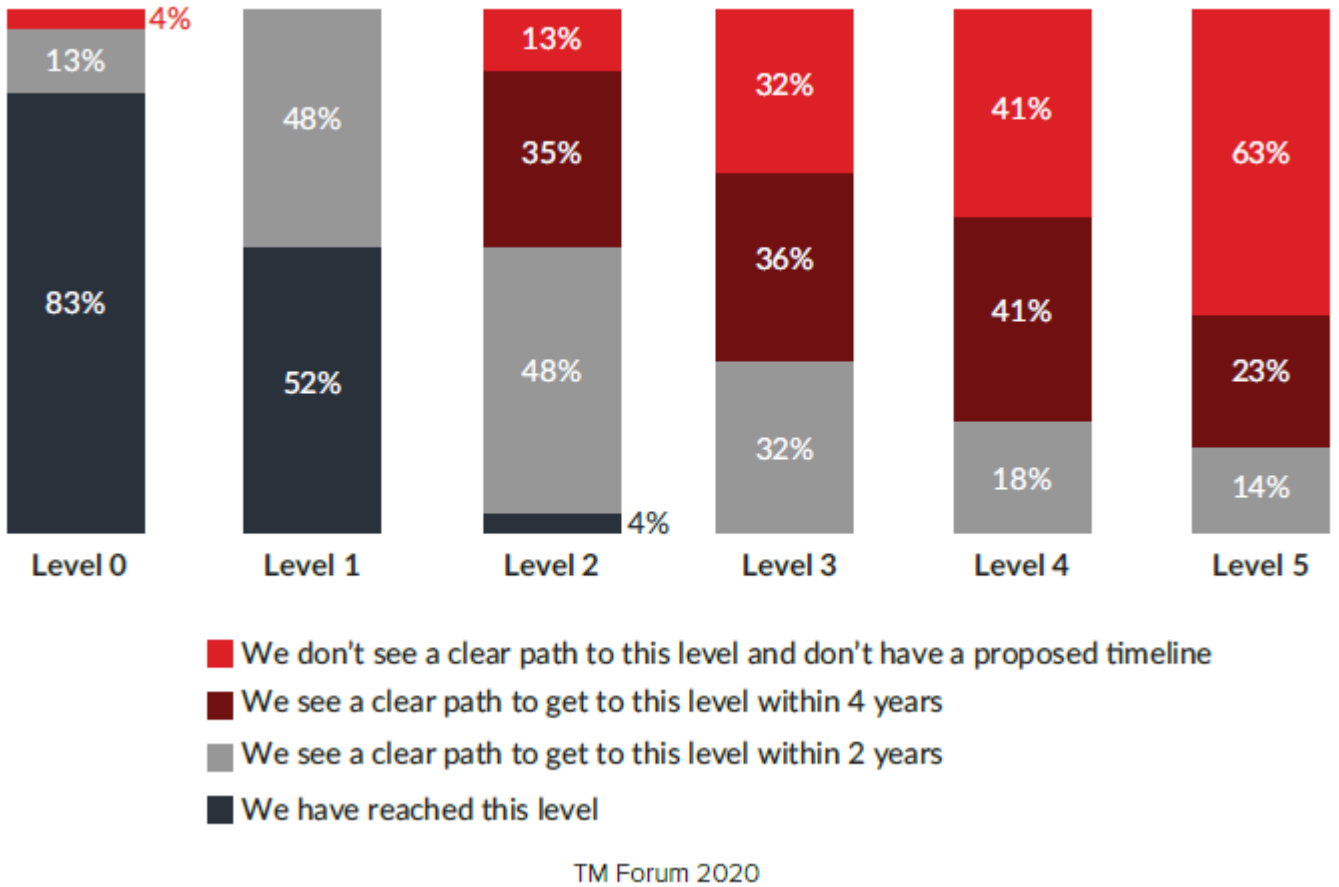
Ericsson predicts that 5G services for manufacturing will be $113 billion market in 2025 – potential revenue growth of 7% over current forecasts

Capgemini Digital Transformation Institute forecasts that smart factories could add $500 billion to $1.5 trillion in value to the global economy in five years.

Smart City

- Sanitation, trash and recycling
- Parks and recreation
- Water utilities
- Lighting and parking
- Public transportation and traffic systems
- Libraries and education
- Fire, police and ambulance emergency services
- Public health and safety

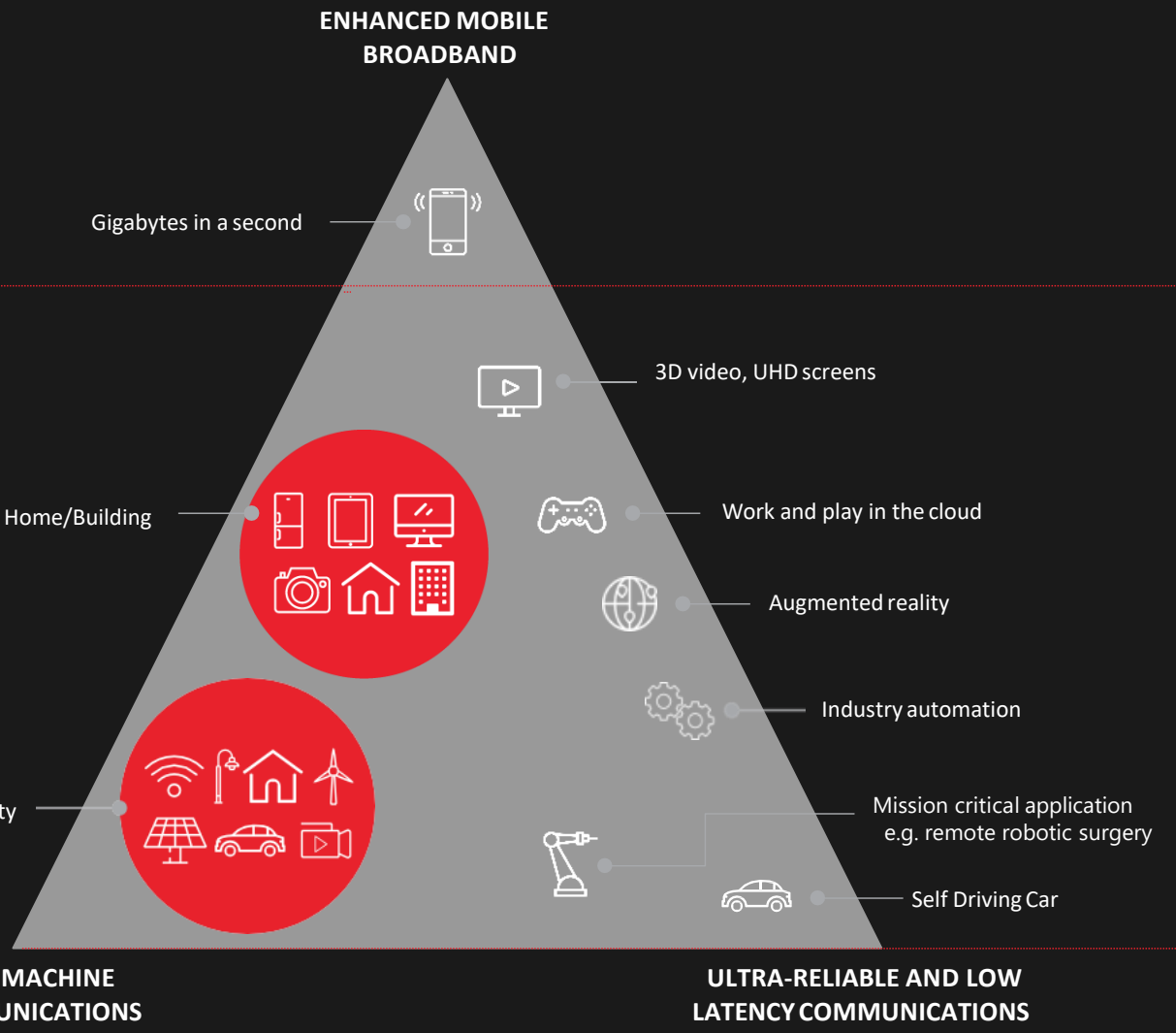
Yet despite the opportunities and benefits of AN, CSPs are still taking a haphazard approach to automation and are making slow progress



If CSPs want a slice of the $400 billion of growth that 5G unlocks, they need a co-ordinated approach to Autonomous Networks and need to move faster

TRADITIONAL TELCO

DIGITAL PARTNER
5G + Edge + AI



>70%
OF 5G-ERA GROWTH POTENTIAL REQUIRES **OPERATING MODEL TRANSFORMATION**

* Source: TM Forum 5G Monetization Research Report, August 2018
'5G Triangle' Diagram Source: ITU

Autonomous Networks Whitepaper 2.0: Empowering digital transformation for smart societies and industries – Part II

Dong Sun, *Chief Business Strategist, Digital Transformation,* **Futurewei**

Autonomous Networks: Use cases and services

Use cases

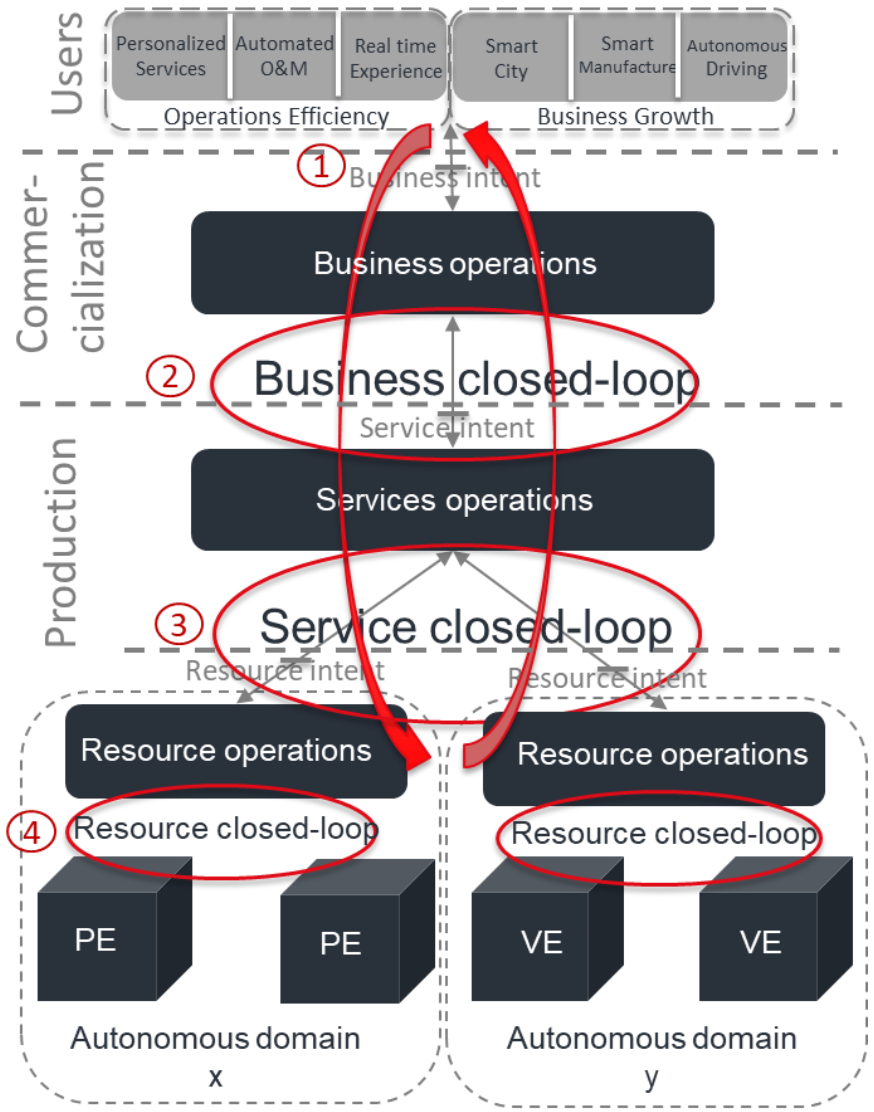
#	User stories	Example use cases
1	**Smart city**	Future IoT in the city; eHealth, remote surgery cameras; drones as a service; financial services, insurance ('just-in-time' insurance); traffic congestion/management; smart venue
2	**Smart manufacturing**	Smart factories – private network, production monitoring (for example, Schindler Elevator working with Telefonica IoT and BT IPConnect); remote troubleshooting & maintenance; smart electric power network
3	**Autonomous vehicles**	Connectivity (5G) + edge + cloud synergy; mobility as a service
4	**Media/entertainment (sports event, gaming, remote production)**	Gaming; "pop-up" network for music festivals and new housing estates; AR/VR, for example, digital tourism for historical buildings and within the City of Bath.
5	**Public safety (information casting, disaster recovery)**	Disaster management/emergency services (for example, Verizon first responders/5G riders, BT Emergency Team); balloon base station – portable tower
6	**Efficiency 1: Automated O&M**	End-to-end automation of network operations and maintenance (O&M), troubleshooting, alerting, prediction, recovery, for example home broadband, DC energy saving, one trouble ticket, one network fault
7	**Efficiency 2: Innovative services**	Connectivity as a service; guaranteed broadband at home using 5G; enterprise customer portal; service level agreements/objectives (SLA/SLOs) with business partners - SLAs for financial private line (VPN Service with SLA bandwidth, QoS for mission critical business of banks), SLAs for virtual/remote working and learning

AN Services

AN Services	Business growth (Vertical industries)	Operations efficiency (Telecom industry)
Services automation	**1. Network services automation** e.g. VPN, SD-WAN, 5G connectivity	**4. Network operations automation** e.g. predefined services and operations
Autonomous services	**2. Autonomous** ICT services e.g. network + cloud + edge **3. Autonomous digital enabling services** e.g. ICT services + platforms (operations, collaboration)	**5. Autonomous network operations** e.g. platform based, dynamic process, flexible production operations

TMF AN Framework: 3-layers + 4-closed-loops with autonomous levels

Layers and closed-loops of Autonomous Networks



3-layers: Are common capabilities that can be utilized to support all scenarios and business need

- **Network resource layer**
- **Network operations layer**
- **Business operations layer**

4-closed-loops: to fulfill the full lifecycle of the process

- **Resource closed loop**
- **Service closed loop**
- **Business closed loop**
- **User closed loop**

Key mechanisms: to enable closed loop

- **Autonomous domain**
- **Intent driven interaction and open APIs**
- **Metadata modelling and abstraction**

Unique thread of the autonomy

- **6 levels of autonomous networks**

Autonomous Levels	**L0:** Manual operation & maintenance	**L1:** Assisted operation & maintenance	**L2:** Partial Autonomous Networks	**L3:** Conditional Autonomous Networks	**L4:** High Autonomous Networks	**L5:** Full Autonomous Networks
AN services (Zero X)	N/A	Individual AN case	Individual AN case	Select AN cases	Select AN services	Any AN services
Execution	P	P/S	S	S	S	S
Awareness	P	P	P/S	S	S	S
Analysis/ Decision	P	P	P	P/S	S	S
Intent/ Experience	P	P	P	P	P/S	S

Personnel (manual) Systems (autonomous)

Key Technical Topics

Simplified infrastructure	Advanced architecture with less hops, less layers and more intelligence and easy-to-use for operations of infrastructure and services e.g. AN enabled 5G, IP/Optical integration, next generation fixed networks, Network-Edge-Cloud synergy
Closed-loop	intelligent automation of full lifecycle of user/business/service/ resource operations with Self-X capabilities (self-serving, self-fulfilling, self-assuring etc.)
Autonomous domain	AD operations of key instances (e.g. 5G, Edge, Cloud) for various AN services (Autonomous ICT service/Digital enabling service)
Intent driven interaction	Business/service/resource intent mechanisms and interfaces for various applications (enabling verticals/operational efficiency)

Key metrics and capabilities

Zero-X

	Zero wait	Zero touch	Zero trouble
Key user experience	- Launch - Delivery - Care	- Operations - Development - Maintenance	- Infrastructure - Business - Service

Self-X

Categories	Sub-categories
Self-serving	**Self-planning/capability delivery:** Provides the customization (DIY) capabilities of network/ICT service planning, design and deployment **Self-ordering:** Provides the online, digitalized and/or one-click ordering capabilities of network/ ICT services **Self-marketing:** Provides the automated marketing activities for general and/or personalized campaign/promotion **Self-configuring:** As new network elements are added, they are automatically recognized, provisioned and configured in the network
Self-fulfilling	**Self-organizing:** Provides the collaboration of business/service/resource intent delivery on demand **Self-managing:** Provides the orchestration of business/service/resource intent delivery on demand **Self-governing:** Provides the governance of business/service/resource intent delivery on demand
Self-assuring	**Self-monitoring/reporting:** Provides the automatic, continuous monitoring and alerting in real time **Self-healing:** Provides the recovery of SLAs e.g. performance, availability and security recovery in real time and so that the network may build predictive failure models, which are then combined with automated processes that are capable of altering network configurations to avoid failure condition **Self-optimizing:** Provides the real time optimization of SLA e.g. performance, availability and security **Self-defending:** Behavioral analytics models can be built to identify network element behavior that is abnormal and could indicate a compromised component. Automated process could then sandbox the suspect network element for further analysis and remediation or even roll back to the last known good configuration.

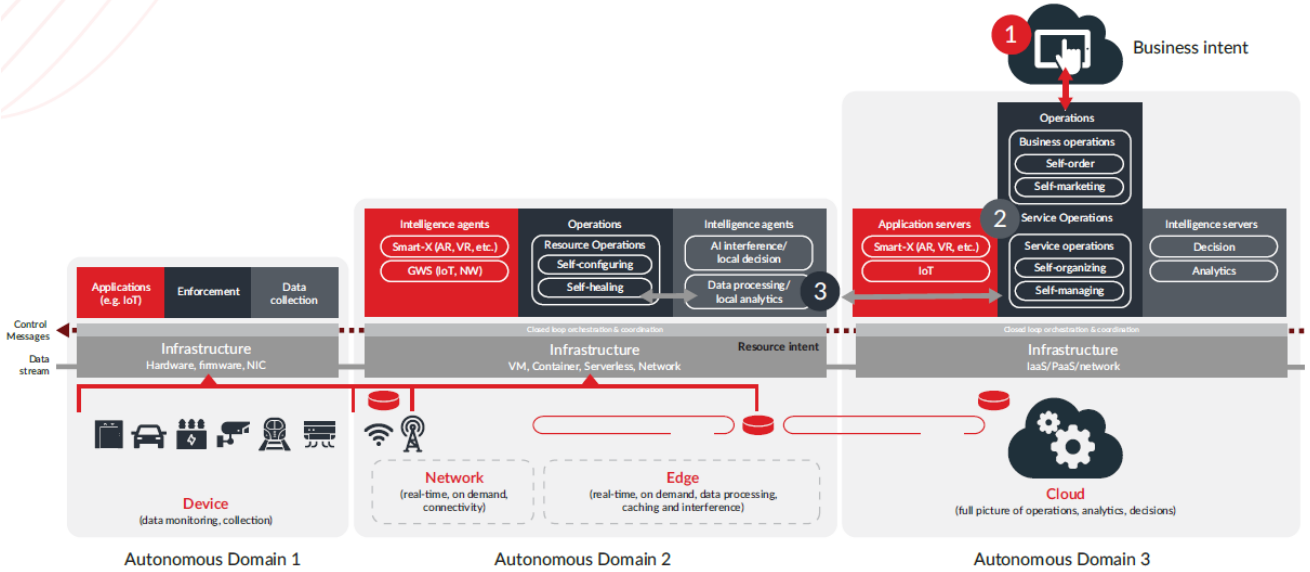
Use cases

- Business Growth – enabling verticals

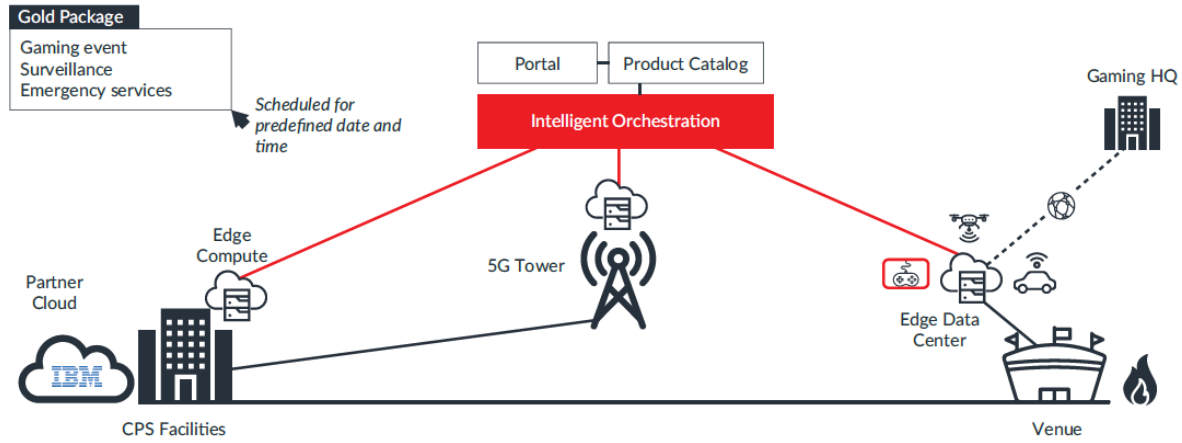
Smart manufacturing Large scale M2M & IoT deployment with increased automation & self-monitoring	**Smart healthcare** Robotic surgery demanding high levels of precision, flexibility, control, network latency & availability	**Smart cities** Self-sustainable urban ecosystem leveraging 5G/IoT ans smart ICT infrastructure	**Smart automotive** Self-driven vehicles communicating & learning from surroundings, be it V2V, V2I,V2P or V2X	**Smart entertainment** Autonomous media, & gaming systems dynamically scaling up to meet varying QoS need
Smart energy Automated grid failure management	**Smart tourism** Tourists visiting an art gallery experience an AR view of art on their mobile	**Smart education** Interactive, digital & AR enabled services for interest based remote learning	**Smart mobility** Automated guided car management & integrated billing	
Smart security Minimizing risk for police or fire rescue officers in uncertain or dangerous situations	**Smart waste management** 'Just in time' waste collection by tracking waste levels & providing route optimization	**Smart environment** Soil moisture level detection & automated sprinkler system based on type of plant	**Smart infrastructure** Monitoring and maintaining street lighting networks remotely	

Self-config/ZTP Auto scaling AI assistance Predictive maintenance/self-healing

Self-X Digital Services for Smart-X Verticals



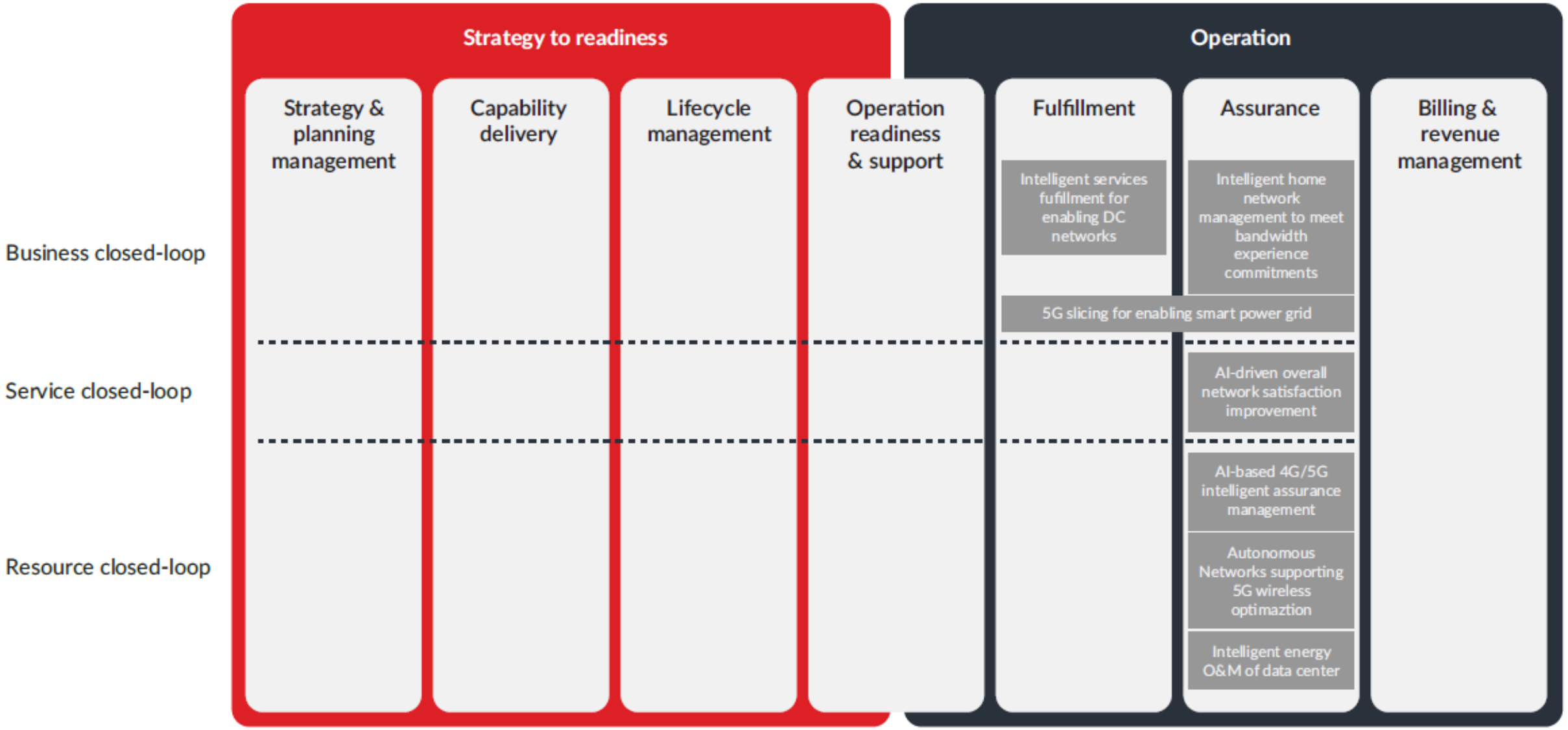
Autonomous Networks Hyperloops



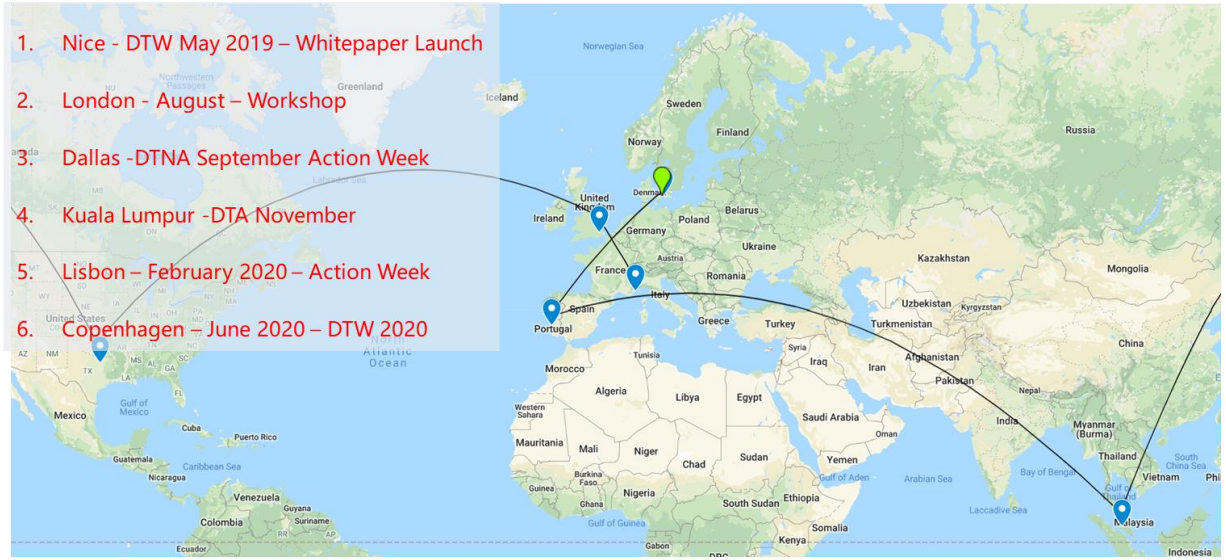
Automated, zero-touch ECaas (Edge Computing as a service)

Use cases

- Operational Efficiency – automating and optimizing networks



Overview of Autonomous Networks Project (ANP) in TMF



- **Completed**

✓ May 2019: Nice: 1st industry whitepaper & workshop

✓ July 2019: London: Kick off workshop

✓ August 2019: Establish the ANP (Autonomous Networks Project) officially

✓ February 2020~ now: start the catalyst (PoC) projects (10 projects, 60 companies)

✓ September 2019~ now: Multiple workshops/industry events

✓ Three publications:

- May 2019: AN Whitepaper 1.0
- October 2019: IG1193 Vision & Roadmap v1.0
- July 2020: IG1218 Business requirement & architecture v1.0

- **Ongoing**

✓ AN Whitepaper 2.0 (Oct 2020)

✓ Business requirements & architecture v1.1 (Oct 2020)

✓ Technical architecture (2020)

✓ Demo of Catalyst projects (Oct 2020)

✓ User stories/use cases (ongoing)

Autonomous Networks Project (ANP) Context

Vision:
- Cross Industry digital transformation (business growth and operation efficiency)
- Cross industry Collaboration (CSPs, IDOs/SDOs, verticals, suppliers etc.)

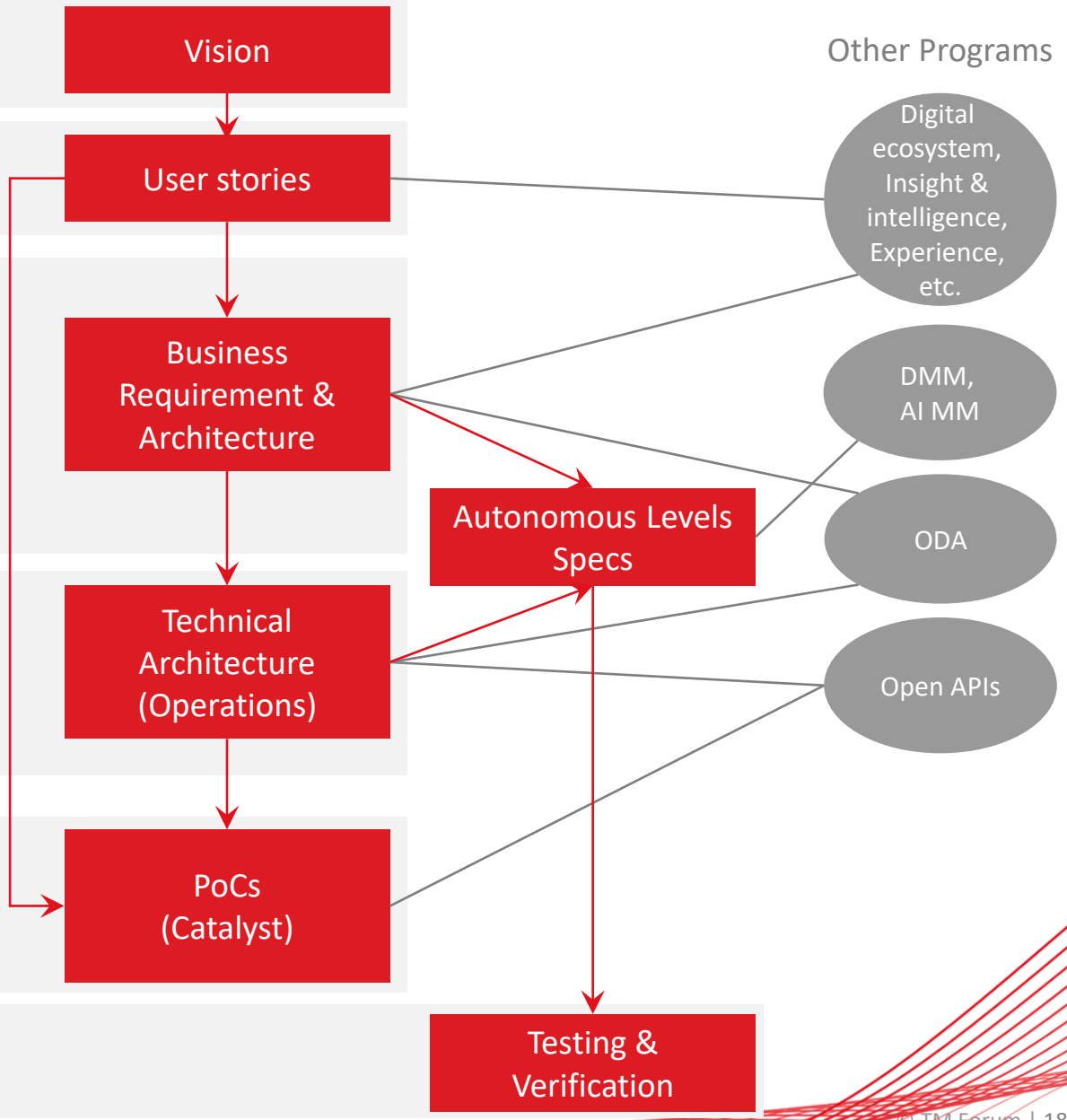
User stories:
- Enabling verticals, e.g. Smart city, smart manufacture, self driving …
- Improving Telecom, e.g. network operations, production & services, customer experience…

Business requirements & architectures:
1) requirements
   - AN Services: business growth, operations efficiency
   - Zero-X: customer experience
   - SLA: business metrics
2) Architecture
   - Framework (3 layer, 4 closed loop)
   - Key business capabilities & autonomous levels: Autonomous domain, closed loop, intent, simplified infrastructure, Self-X

Technical architectures:
1) High level architecture (per Business architecture)
   - Key technical capabilities (Operations) per Business capabilities
   - High level of Autonomous Levels of key technical capabilities
   - Interfaces & APIs
2) Solution scenarios (references/appendix)

PoCs/Catalyst projects:
   - Demo of AN solution & capabilities
   - One complete or partial AN services per user stories

Autonomous Level Testing and verification:（TBD）
- Autonomous Level specs
- Measurement and certification of autonomous levels



TM Forum catalyst projects focused on AN: 10 projects, 60+ companies

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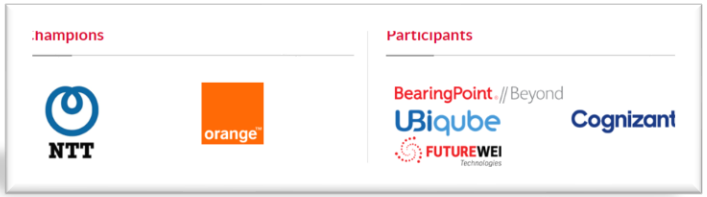
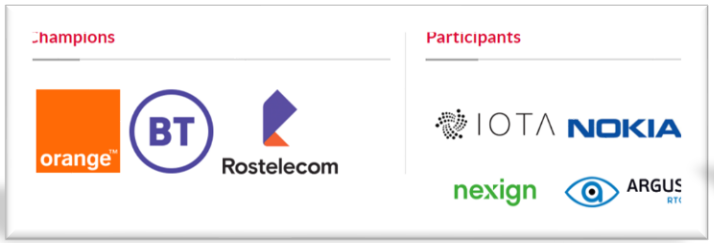
Autonomous Networks

ANHL for Smart-X verticals

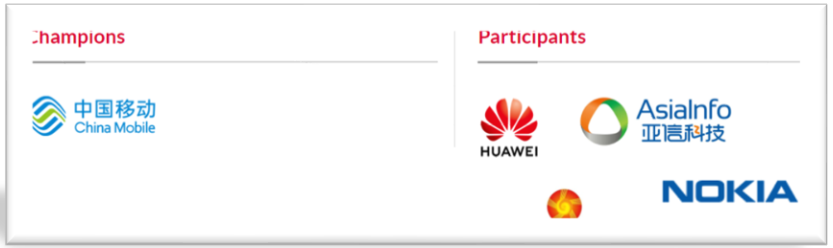


Ready Telco One: Gamified customer journeys enabled by a dynamic partner ecosystem and marketplace!

Vertical Industry Telcos: a Federated DLT-based Marketplace



AI empowered 5G intelligent operations



AI for AN: Accelerating digital transformation in 5G era

The "EDGE" in Automation

5G Ride On!

Smart networks for smart cities

AIOps autonomous service assurance

Boosting AIOps for full hybrid NaaS

Thank you!

Rapid Fire: Industry in Action

ISG F5G
5th Generation Fixed Network: a playground for automation

Luca Pesando, *ISG F5G Chair*, **ETSI**

ETSI The Standards People

ISG F5G
5th Generation Fixed Network: a playground for automation

Presented by: **Luca Pesando (Chair of ISG F5G)**

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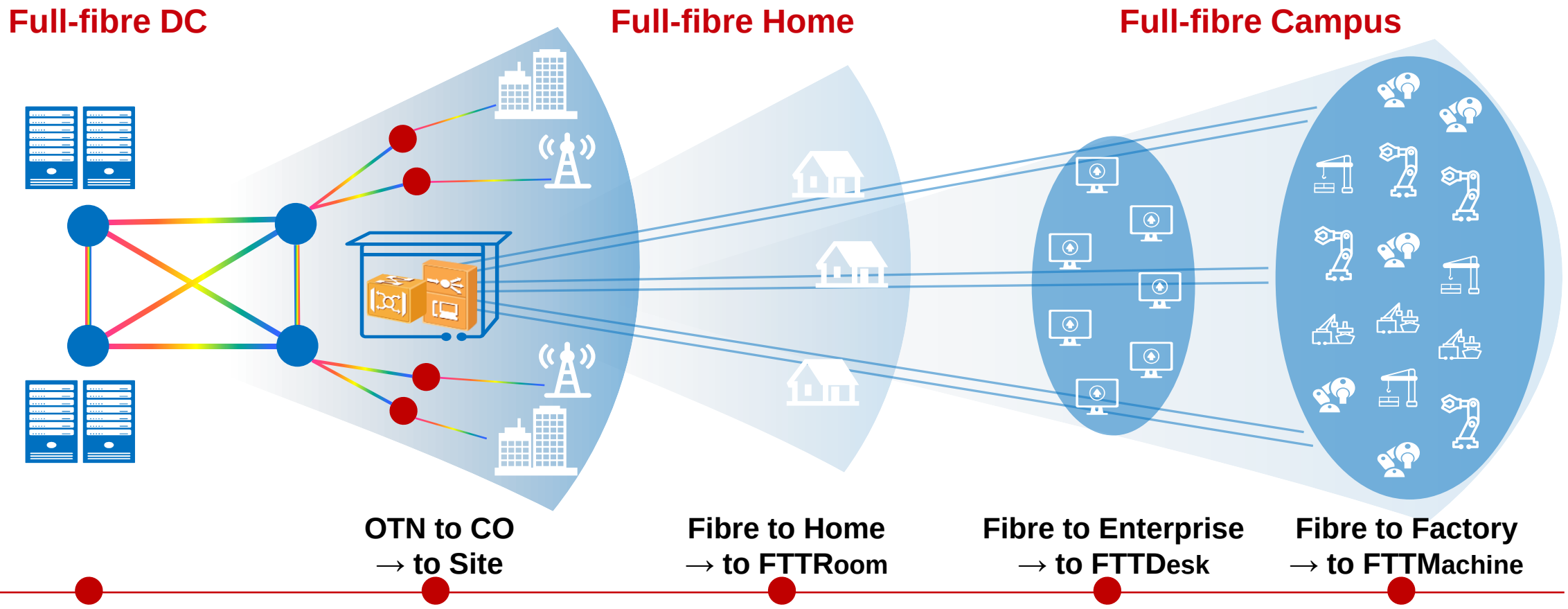
October 22, 2020

WHY 1- Fibre to Everywhere for a better connected future

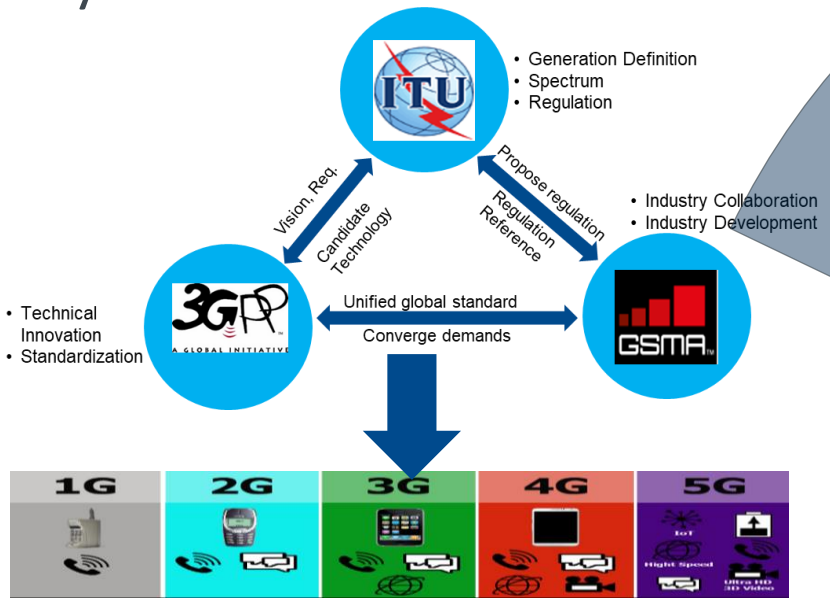


Fiber to Everywhere to make fixed access future proof

- Extending to more end-user : 2Home, 2Room, 2Business, 2Comsumer, 2Mobile, 2Device, 2Machine, etc.
- Reducing everywhere the fibre-to-end user distance: Km → 100m → 10m → 1m
- Number of connections expanding: X3 (Room), X10 (Desk), X30 (Machine), X100 (Smart city)

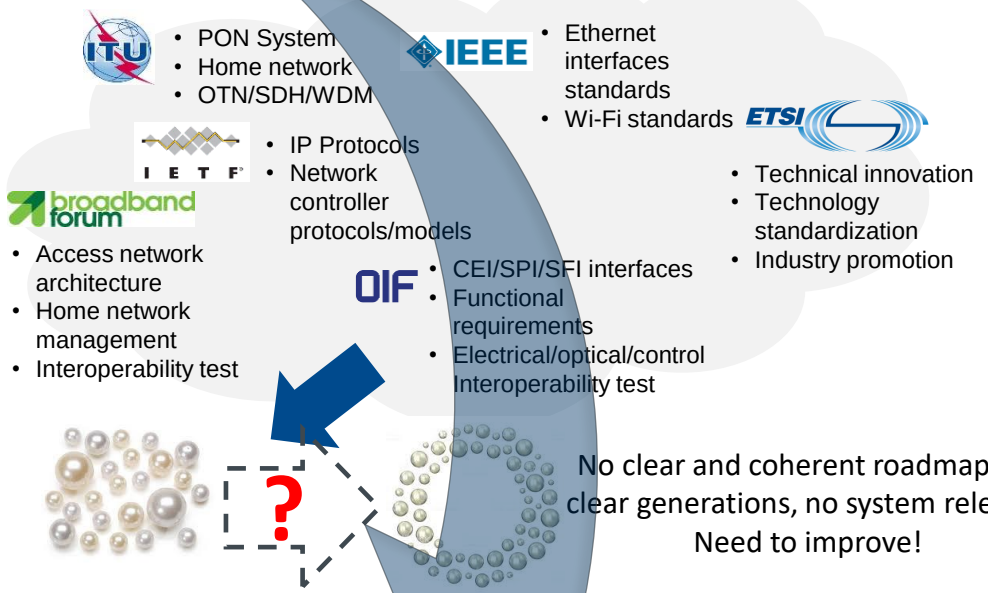
WHY 2- Learning from Mobile: improving the standard process in Fixed Networks

Mobile World: Sync'ed Work of few entities

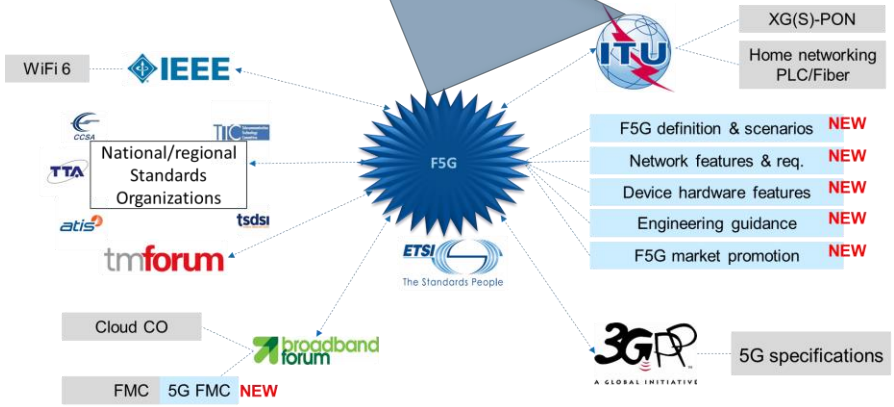


Clear roadmap, tech generations and system releases
very good synergy

Fixed World: Scattered Efforts and loose Coordination



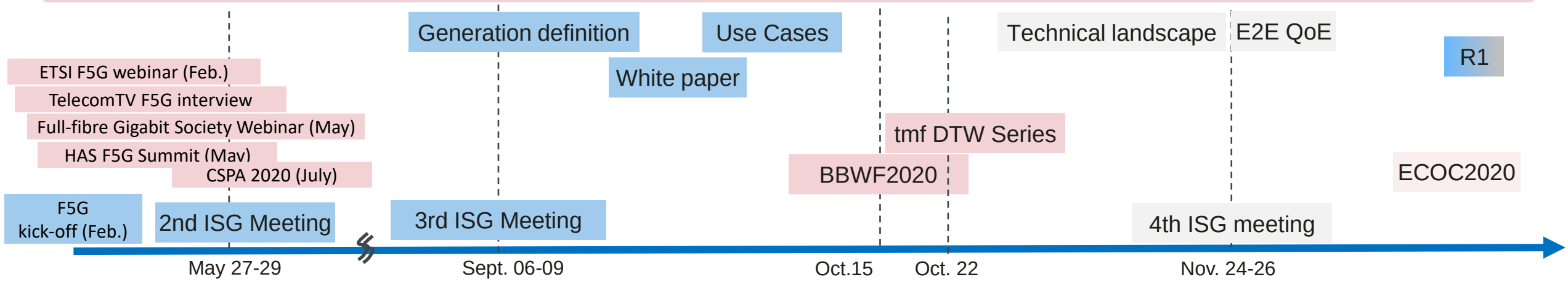
No clear and coherent roadmap, no clear generations, no system releases
Need to improve!



ISG F5G snapshot

Membership: increasing from 10 founding members in Feb to 50 in Oct 2020

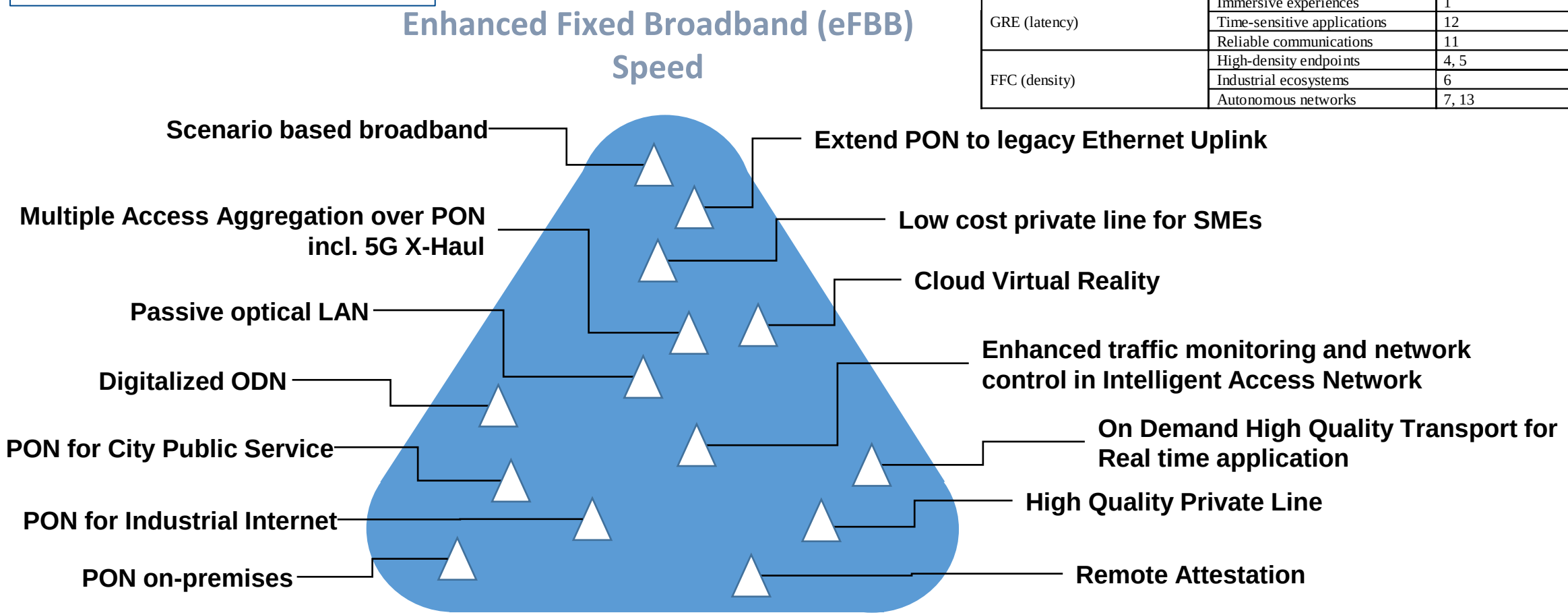
Work Plan: 3 documents finalized (WP and 2 deliverables) 2 more in progress for R1 (target 2020)



Use Cases

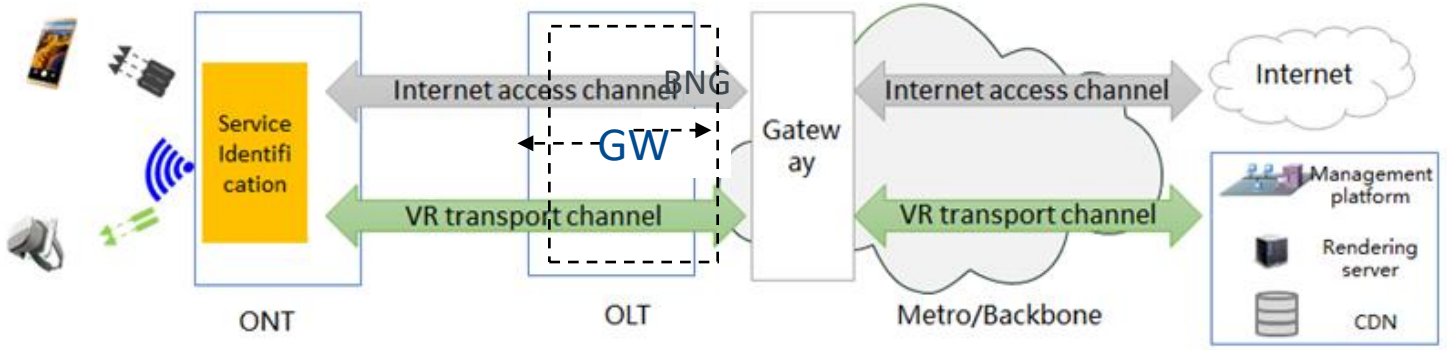
14 Accepted Use Cases for R1

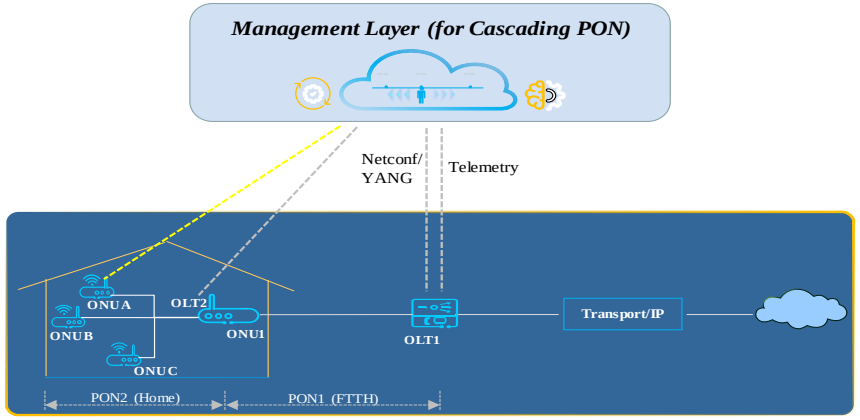
UC technical driver	UC application category	UC mapping
eFBB (speed)	Broadband networking	8, 9, 10
	Home networking	-
	Physical networking	2, 3, 14
GRE (latency)	Immersive experiences	1
	Time-sensitive applications	12
	Reliable communications	11
FFC (density)	High-density endpoints	4, 5
	Industrial ecosystems	6
	Autonomous networks	7, 13



Use Cases and AN role in F5G

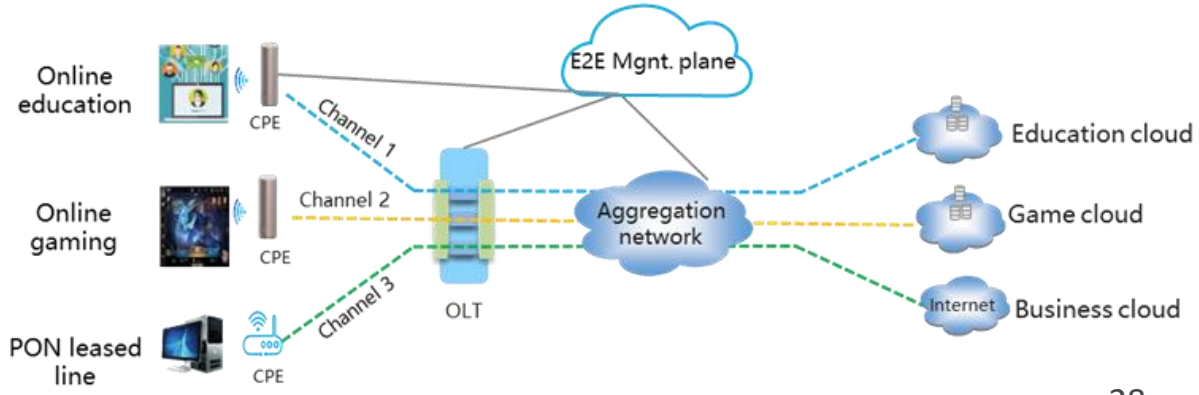
Cloud VR: need intelligence to identify the traffic flows for which to activate the needed resources in a dynamic way;
A VR gateway is needed between transport and access network





Enhanced traffic monitoring: network monitoring data are provided to the management layer that adapts the configuration not only of network resources but also of those in the end user optical network

Scenario based BB: similarly to what proposed for industrial applications, resources for services to residential users or small enterprises must be based on dynamical resource allocation



Conclusions

- ISG F5G does not focus on the management layer in particular
- Fibre deployment is anyway not enough for service delivery: Artificial Intelligence and Autonomous Network functionalities are needed
- ISG F5G Use Cases give evidence of the very different applications that Fibre has to deliver and that require AI and AN characteristics
- Evidence of the need of collaboration of different standard organizations to define the evolution of networks

Thank you!

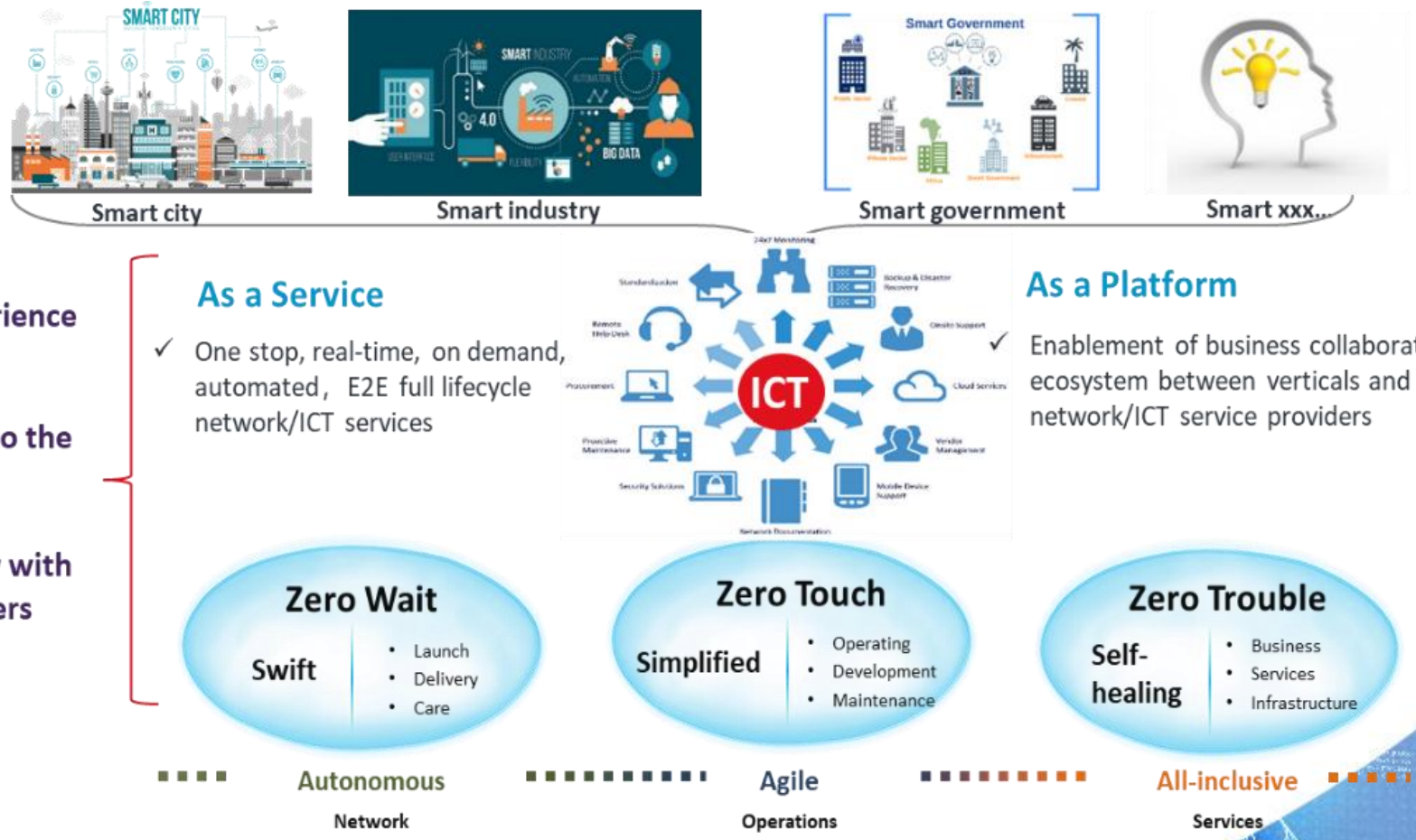
Together, we make it happen.

ETSI's Standards activities in the area of Autonomous Networks ISG ENI – Resource Optimization

Raymond Forbes, *ISG ENI Chair,* **ETSI**

Autonomous network descriptive figure,
Used in TMForum & ETSI

Vision of Autonomous Networks: Upgrading the ICT industry ecosystem



Dong Sun, Christian Maître: "Autonomous Networks – the network of the future being designed and built today!", TM Forum Digital Transformation Asia Conference, Kuala Lumper, November 2019.

High level definition of terms taken from the draft ETSI AN whitepaper

Categories	Sub-categories
Self-serving	Self-planning/capability delivery: provides the customization (DIY) capabilities of network/ICT service planning, design and deployment
	Self-ordering: provides the online, digitalized and/or one-click ordering capabilities of network/ICT services
	Self-marketing: provides the automated marketing activities for general and/or personalized campaign/promotion
Self-fulfiling	Self-organizing: provides the collaboration of business/service/resource intent delivery on demand
	Self-managing: provides the orchestration of business/service/resource intent delivery on demand
	Self-governing: provides the governance of business/service/resource intent delivery on demand
Self-assuring	Self-monitoring/reporting: provide the Automated, continuous monitoring and alerting in real time
	Self-healing: provides the recovery of SLA e.g. performance, availability and security in real time
	Self-optimizing: provides the optimization of SLA e.g. performance, availability and security in real time

ENI Published Reports, Specifications & Workplan

Published ENI deliverables:

- ETSI GS ENI 001 V2.1.1 (2019-09) Published
  Use Cases
- ETSI GS ENI 002 V2.1.1 (2019-09) Published
  Requirements
- ETSI GR ENI 003 V1.1.1 (2018-05) Published
  Context-Aware Policy Management Gap Analysis
- 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) Newly Published
  Proof of Concept (PoC) Framework
- ETSI GR ENI 007 V1.1.1 (2019-11) Published
  Definition of Categories for AI Application to Networks

Accessible via Work Item Monitoring - ENI

Ongoing ENI Work Items and Rapporteurs:

- ENI 001 (WI RGS/ENI-0014)
  Use Cases (Revision 3) – Yue Wang (Samsung)
- ENI 002 (WI RGS/ENI-0015)
  Requirements (Revision 3) – Haining Wang (Intel)
- ENI 004 (WI RGR/ENI-0018)
  General Terminology (Revision 3) – Yu Zeng (China Telecom)
- ENI 005 (WI DGS/ENI-0016)
  System Architecture (Revision 2) – John Strassner (FutureWei)
- ENI 008 (WI DGR/ENI-0013)
  Intent Aware Network Autonomicity – Yannan Bai (China Telecom)
- ENI 009 (WI DGR/ENI-0017)
  Definition of data processing mechanisms - Weiyuan Li (China Mobile)
- ENI 010 (WI DGR/ENI-0020)
  Evaluation of categories for AI application to Networks - Bingming Huang (China Unicom)
- ENI 011 (WI DGS/ENI-0021)
  Mapping between ENI architecture and operational systems– Yannan Bai (China Telecom)
- ENI 022 (WI DGR/ENI-0022)
  Reactive In-situ flow information Telemetry– Yali Wang (Huawei)

ENI Members and 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 Goals and Leadership Team

Core idea: Network perception analysis, data-driven policy, AI based closed-loop control

ETSI ISG ENI starting in 2017- present

- The ISG ENI focuses 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. Release 1 defined big data-analysis functionality.
- Definition of AI Categories: levels 0-5

Extended at 19Q1 (2019-2021)

- Version 2: API broker for non-capable signaling systems, specified external reference points, implementation, PoCs, data mechanisms and evaluation of categories.
- Version 2 defines closed loop control in the real-time network.
- Definition of Intent policy and policy management.
- Evaluation of the Categorization.

The ISG ENI Leadership team

Role	Name (Organization)
Chairman	**Dr. Raymond Forbes** (Huawei)
Vice Chairman	**Mrs. Haining Wang** (Intel)
Second Vice Chairman	**Dr. Luca Pesando** (Telecom Italia)
Secretary	**Dr. Yue Wang** (Samsung)
Technical Officer	**Mrs. Christine Mera** (ETSI)
Technical Manager	**Dr. Shucheng Liu "Will"** (Huawei)
ENI ISG PoC Review Team	**Raymond Forbes** (Huawei) **Christine Mera** (ETSI Technical Officer) **Michele Carignani** (ETSI CTI) **Bill Wright** (Redhat) **Haining Wang** (Intel) **Luca Pesando** (Telecom Italia) **Mostafa Essa** (Vodafone) **Yu Zeng** (China Telecom) **Antonio Gamelas** (Portugal Telecom)

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

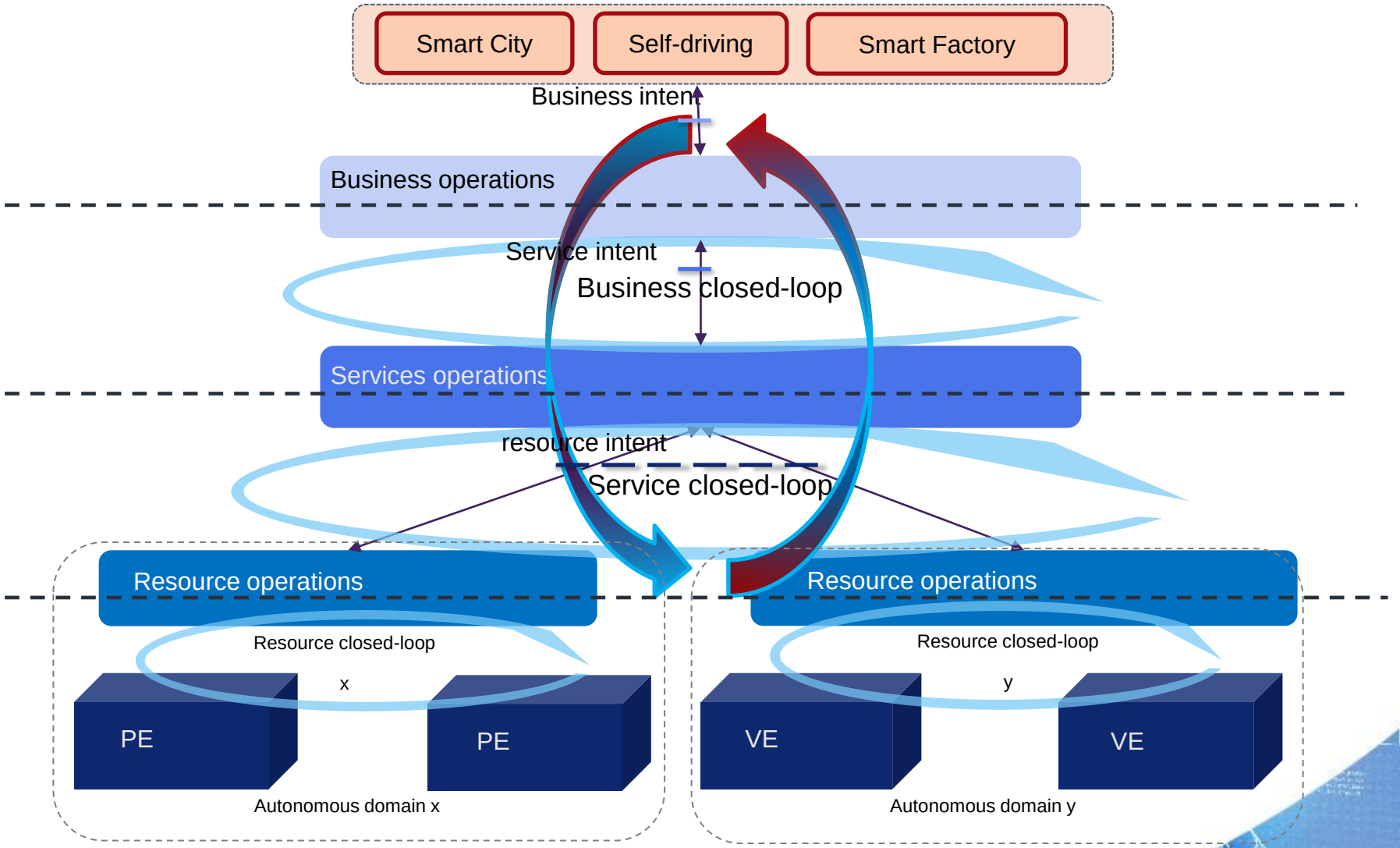
Service Orchestration and Management
Context aware VoLTE service experience optimization
Intelligent network slicing management
Intelligent carrier-managed SD-WAN
Intelligent caching based on prediction of content popularity

Network Security
Policy-based network slicing for IoT security
Limiting profit in cyber-attacks

Source: ETSI GS ENI 001 ; ENI Use Cases

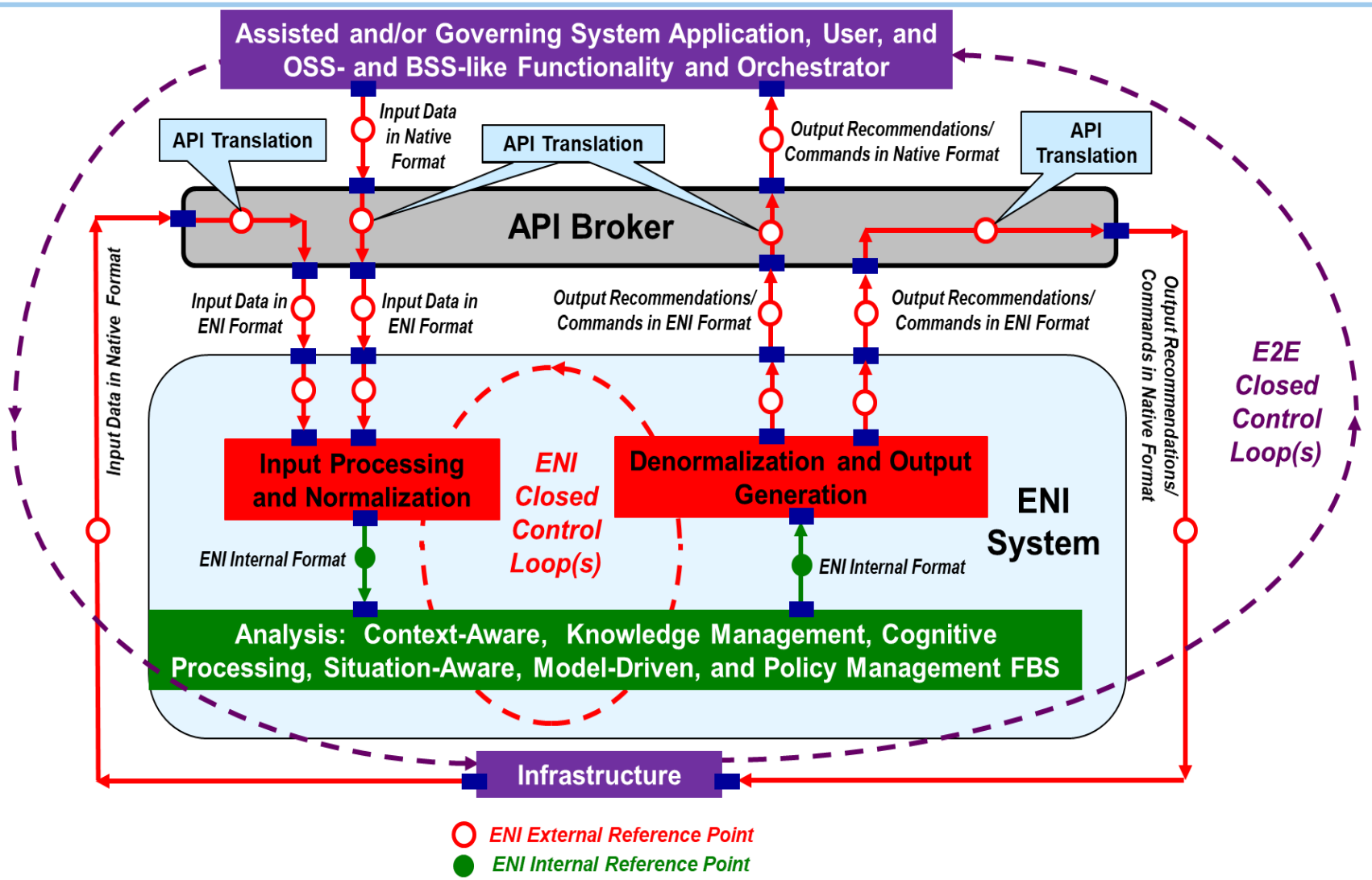
TMForum AN Whitepaper

- Overarching framework of Autonomous Networks



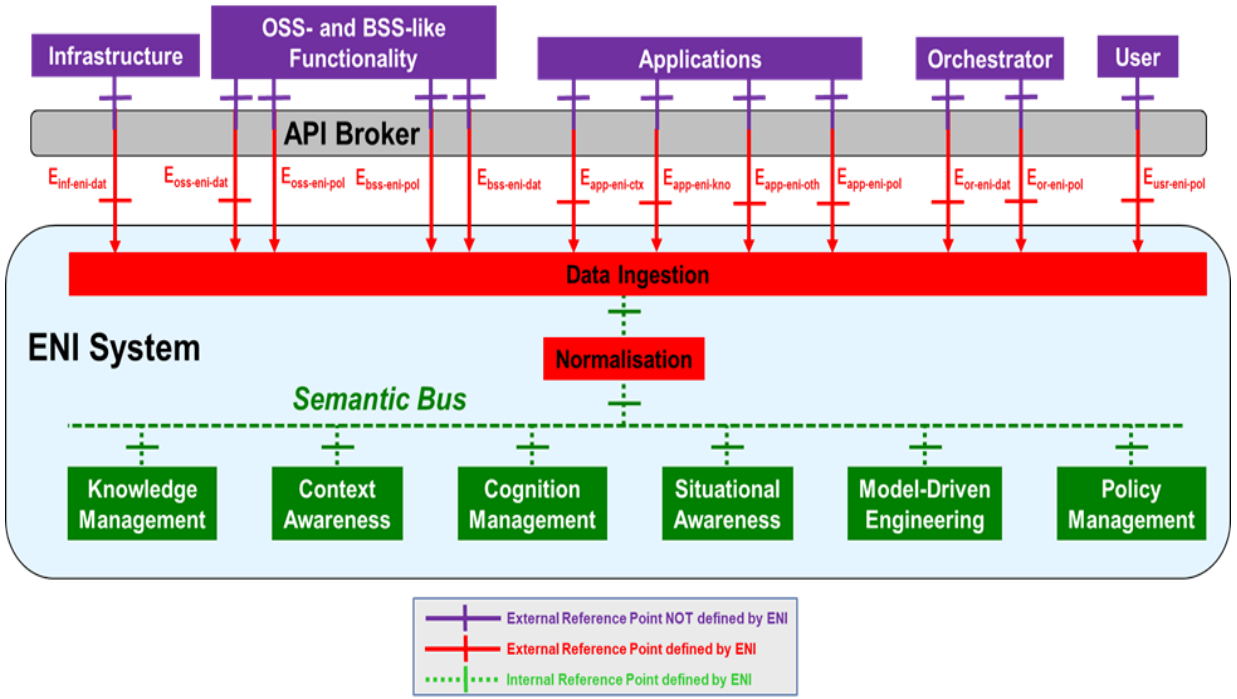
TM Forum Whitepaper: "Autonomous Networks: Empowering Digital Transformation For Telecoms Industry", Release 1.0, May 2019.

ENI High-Level Functional Architecture

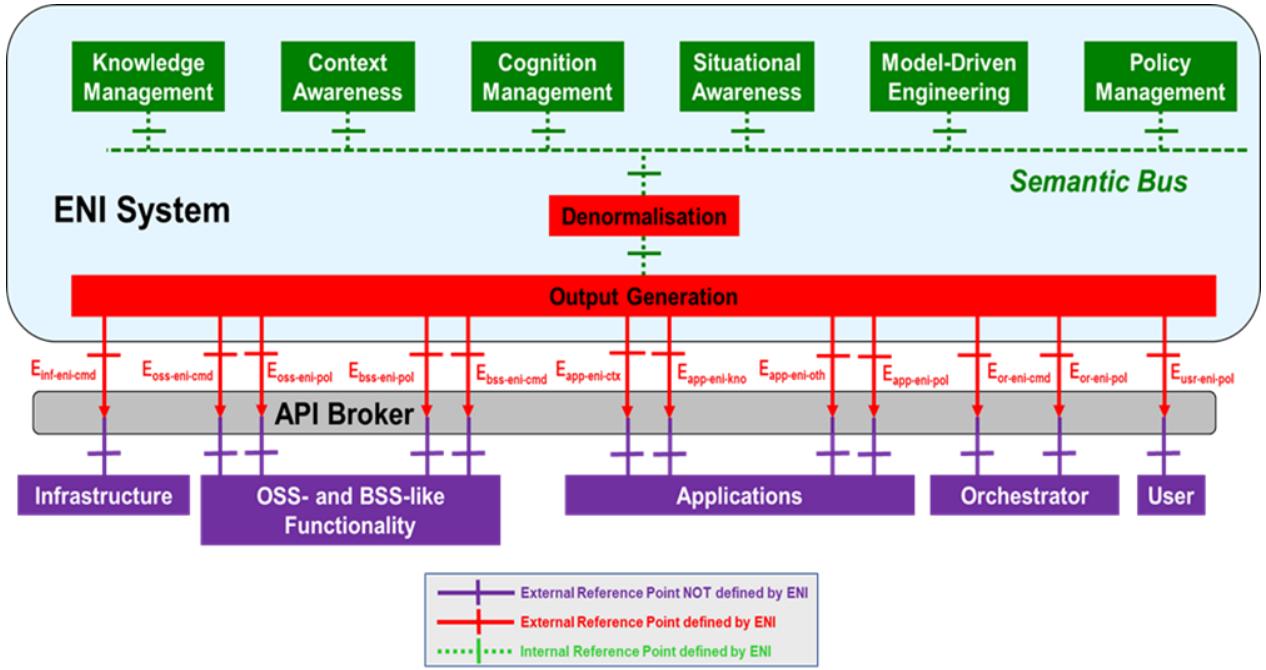


High-Level Functional Architecture Diagram in GS ENI 005 (GS ENI 005) published in 2019, revision 2 available https://docbox.etsi.org/ISG/ENI/Open/0016

Architecture External Reference Points (Inputs & Outputs)



Functional Architecture with its Input Reference Points

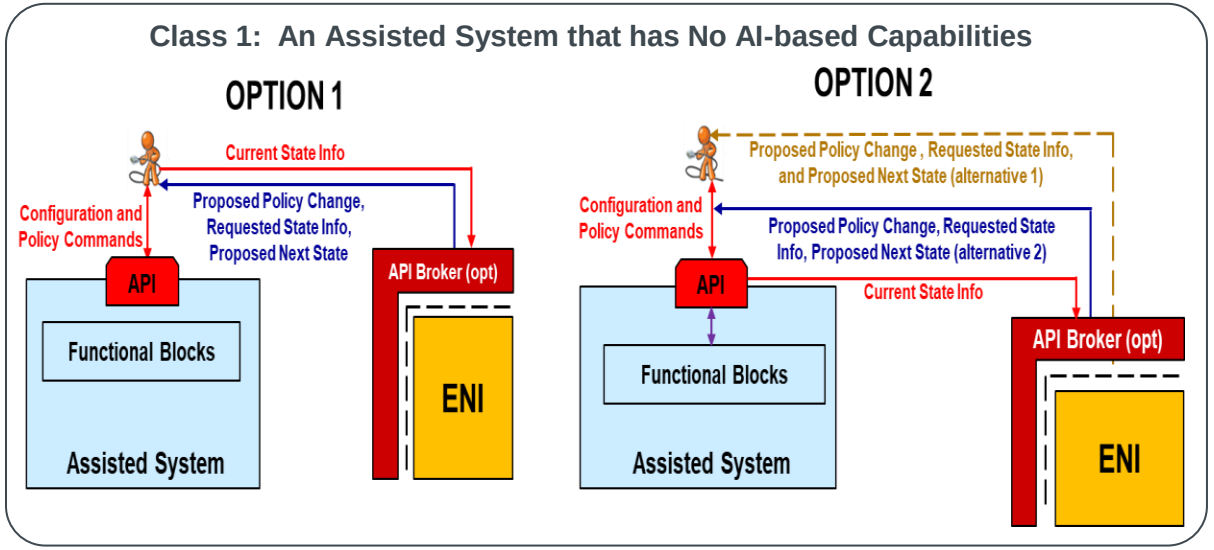


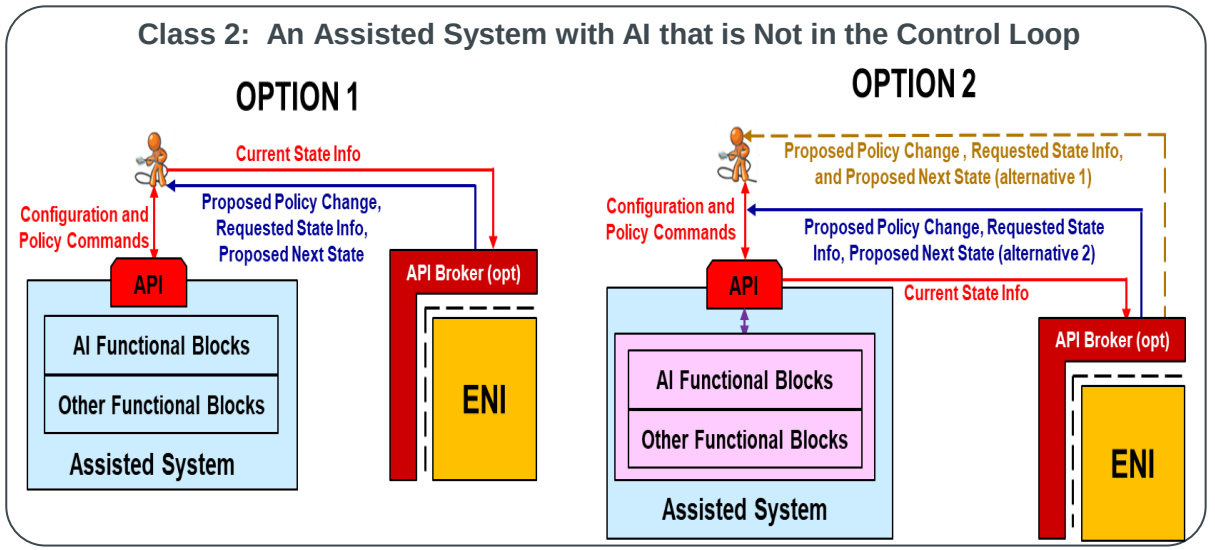
Functional Architecture with its Output Reference Points

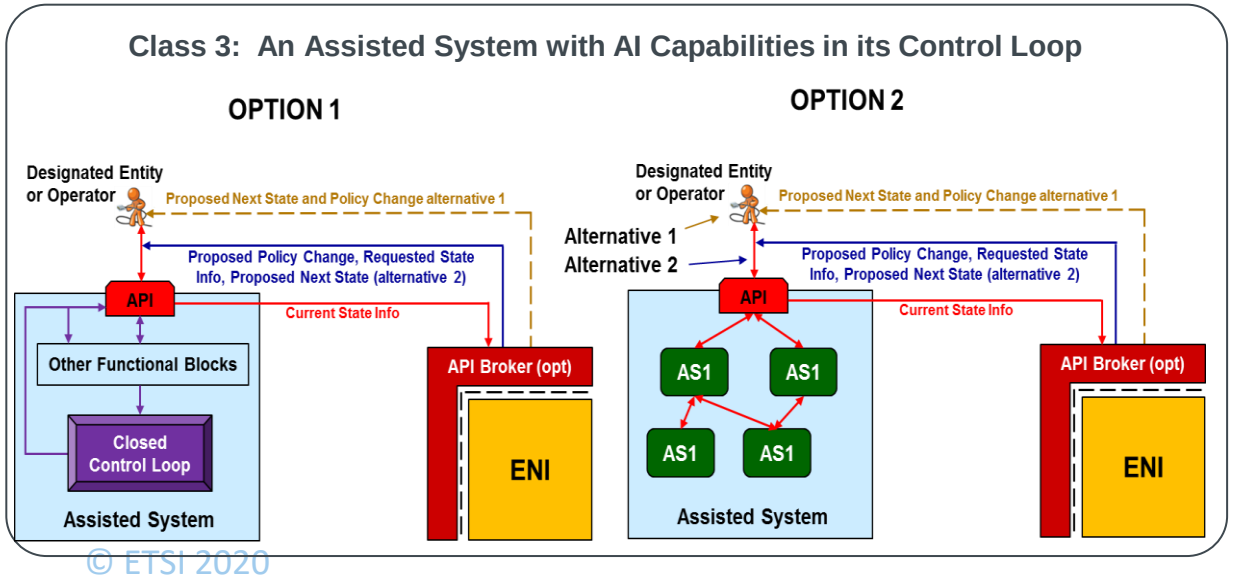
Imperative, Declarative, and Intent Policies *are handled within the same architecture, with no additional RP or FB needed*

Source: ETSI GS ENI 005 , ENI System Architecture

ENI System Architecture - Mode of Operation and Class



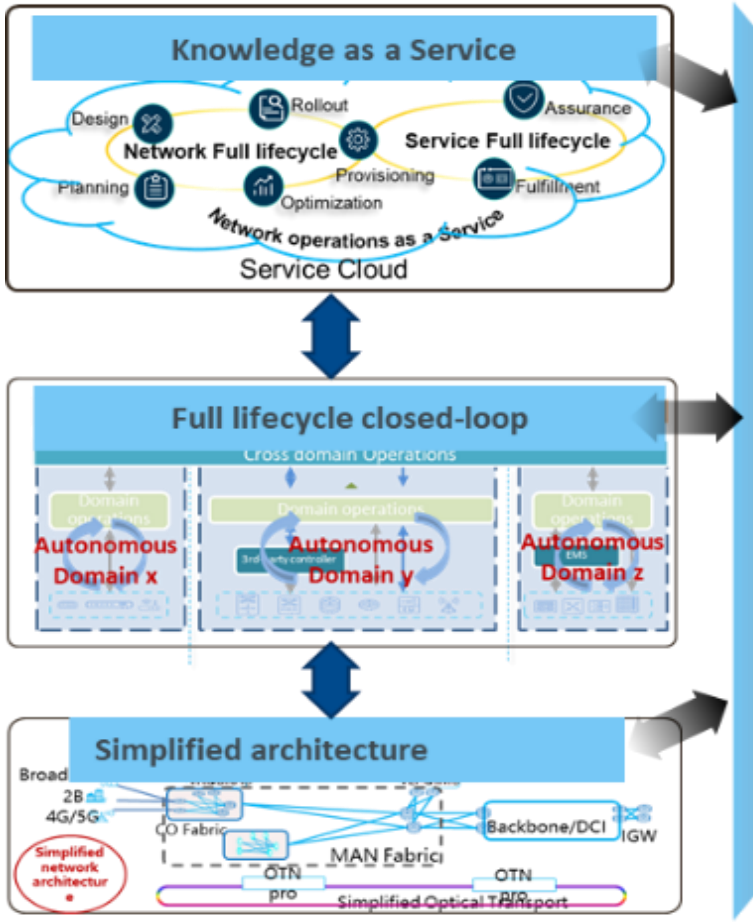


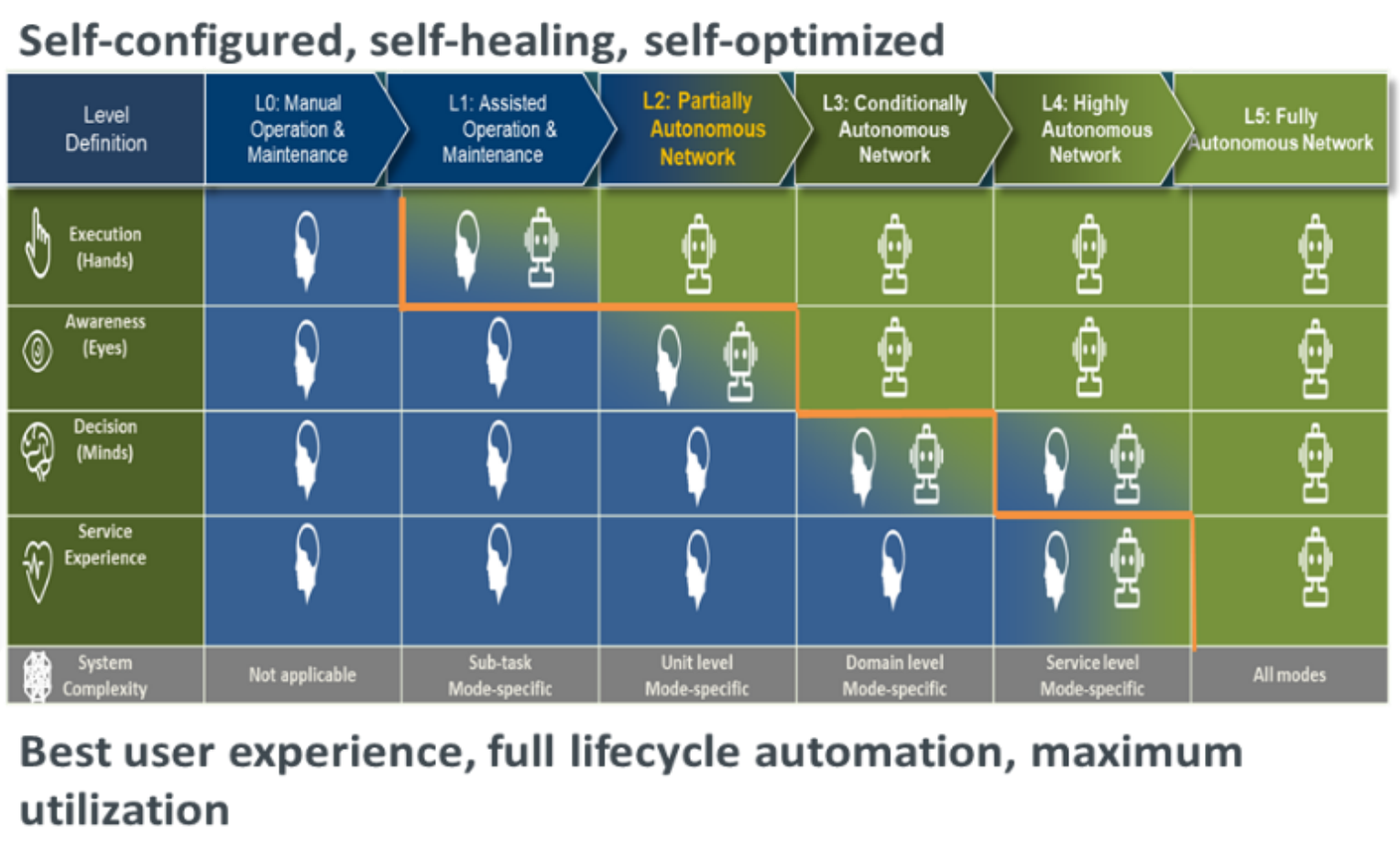


- In each case, ENI requires data from the Assisted System.
- Changes to the Assisted System are not required for any class of Assisted System in order to facilitate the use and rapid adoption of ENI.
- ENI shall use the API Broker to mediate between ENI and the Assisted System
- ENI provides actionable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

Categories of Autonomous network - TMForum Whitepaper

Autonomous networks levels





TMF Categorization of AN aligns with AI Categories in ENI 007 & ENI 010 – table extracted from ENI 007 v1.1.1

Autonomicity capability
Continuous improvement

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 autonomicity	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 autonomicity	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

Categories of network autonomicity from a technical point of view

Source: ETSI GR ENI 007 , ENI Definition of Categories for AI Application to Networks

ENI Proof of Concept List - Completed

Title	PoC Team Members	Main Contact	Start Time	Current Status (Sept.-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

More info can be found https://eniwiki.etsi.org/index.php?title=Ongoing_PoCs

ENI PoC List

Title	PoC Team Members	Main Contact	Start Time	Current Status (Sept.-2020)
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	Ongoing
PoC#9: Autonomous Network Slice Management for 5G Vertical Services	**Nextworks** TIM, Nextworks, Samsung, WINGS, UC3M	Gino Carrozzo / Marco Gramaglia	Jan-2020	Ongoing
PoC#10: Intelligent Telecom Network Energy Optimization	**China Mobile** China Mobile Research Institute, Intel, Quanta Cloud Technology, Hong Kong ASTRI	Liexiang Yue	Jan-2020	Ongoing
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	In Review
PoC#13: Intelligent Coverage Optimization of 5G Massive MIMO BS	**China Telecom** China Telecom, Intel, Inspur	Xueqi Yuan	October-2020	In Review

More info can be found https://eniwiki.etsi.org/index.php?title=Ongoing_PoCs

ETSI Zero touch network and Service Management (ZSM)

Klaus Martiny, *ISG ZSM Chair,* **ETSI**

Zero-touch network and service management
Trends and market drivers

- Rapid business digitization and automation of all major industries, supporting a similar level of business agility and flexibility
- Increase in overall complexity created by the transformation of the networks into programmable, software-driven and service-based architecture
- New business models and value creation opportunities enabled by technology breakthroughs such as Network Slicing, imposing unprecedented operational agility and higher cooperation across network domains

ETSI Zero touch network and Service Management

The 1 Million dollar question. How can that be achieved ?

Network Automation (Autonomous)

Automation enables

- flexibility,
- new functions,
- services and
- the capability to manage complexity.

Gain new outstanding customer experience by driven Network Automation

ISG ZSM members overview

73 members; 20 operators

Work status

The ISG ZSM work has started with the approval of the following Work Items (WIs):

- ZSM 001: Requirements based on documented scenarios (specification) → **published**
- ZSM 002: Reference Architecture (specification) → **published**
- ZSM 003: End to end management and orchestration of network slicing (specification) → **In progress**
- ZSM 004: ZSM Landscape (report) → **publication**
- ZSM 005: Means for Automation (report) → **published**
- ZSM 006: Proof of Concept Framework (specification) → **published**
- ZSM 007: Terminology (specification) → **published**
- ZSM 008: Cross-domain E2E service lifecycle management (specification) → **In progress**
- ZSM 009 :
  - ZSM-009-1 Closed-loop autom enablers → **in progress**
  - ZSM-009-2 Closed-loop autom solutions → **in progress**
  - ZSM-009-3 Closed-loop autom adv topics → **in progress**
- ZSM 010: Security Study → **in progress**

The ETSI ZSM framework reference architecture

ZSM service aka management service: A set of offered management capabilities.

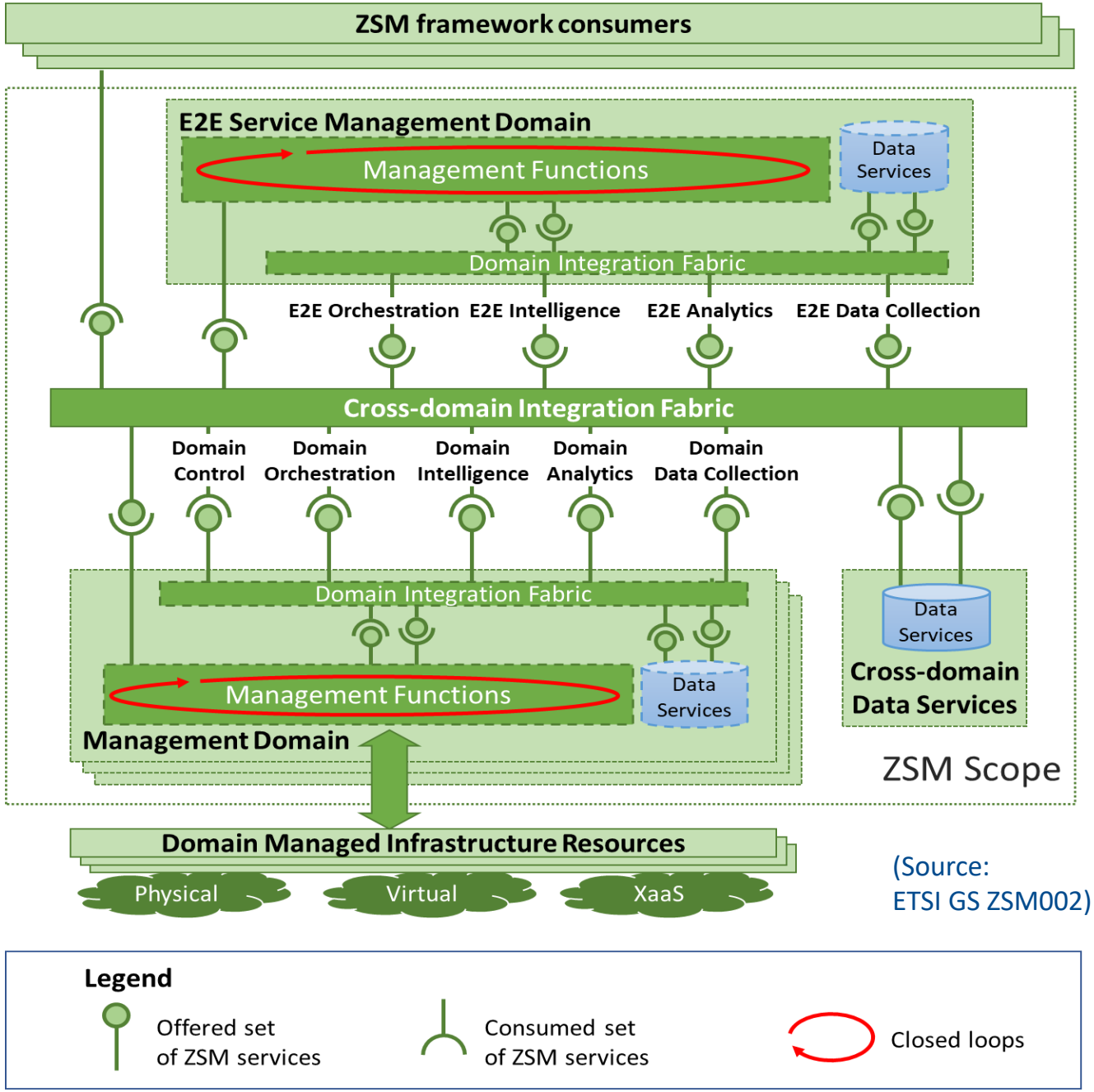
Management function: Logical entity playing the roles of service consumer and/or service producer.

Integration fabric: A management function, playing the roles of both service consumer and service producer, that enables interoperation and communication between management functions within and across management domains.

Cross-domain data services: Services that allow to persist data and share them with authorized consumers across domains.

Management domain: A scope of management delineated by a technological, business, administrative or other boundary.

E2E service management domain: A manage-ment domain specialized to manage E2E services.



(Source: ETSI GS ZSM002)

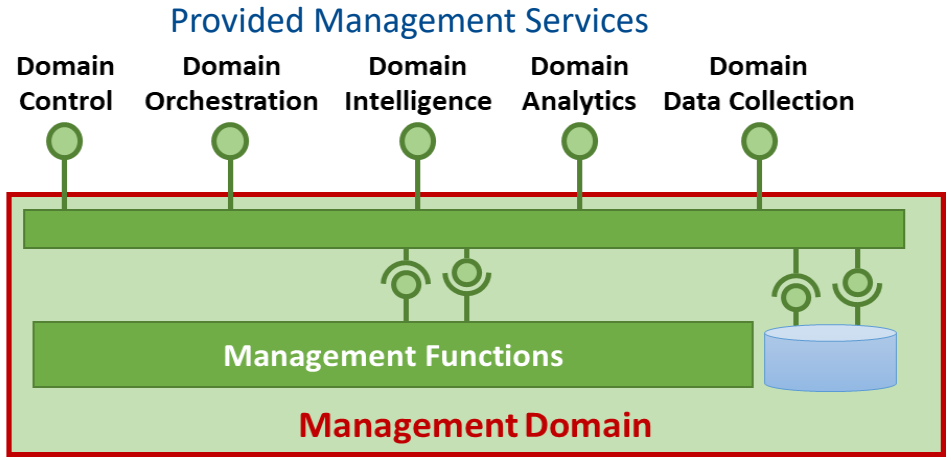
ZSM architecture feature: Separation of concerns in management

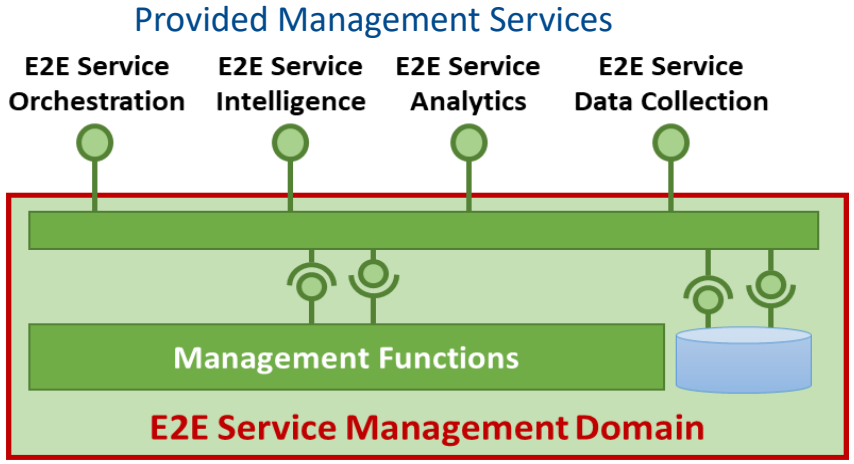
Management Domain (aka Network Management Domain)

- Scope of management delineated by a, e.g., technological or organizational boundary
- Manages resources and services based on these
- Provides management services and decouples the inner domain details from the outside world
- Can consume management services from other management domains

E2E Service Management Domain

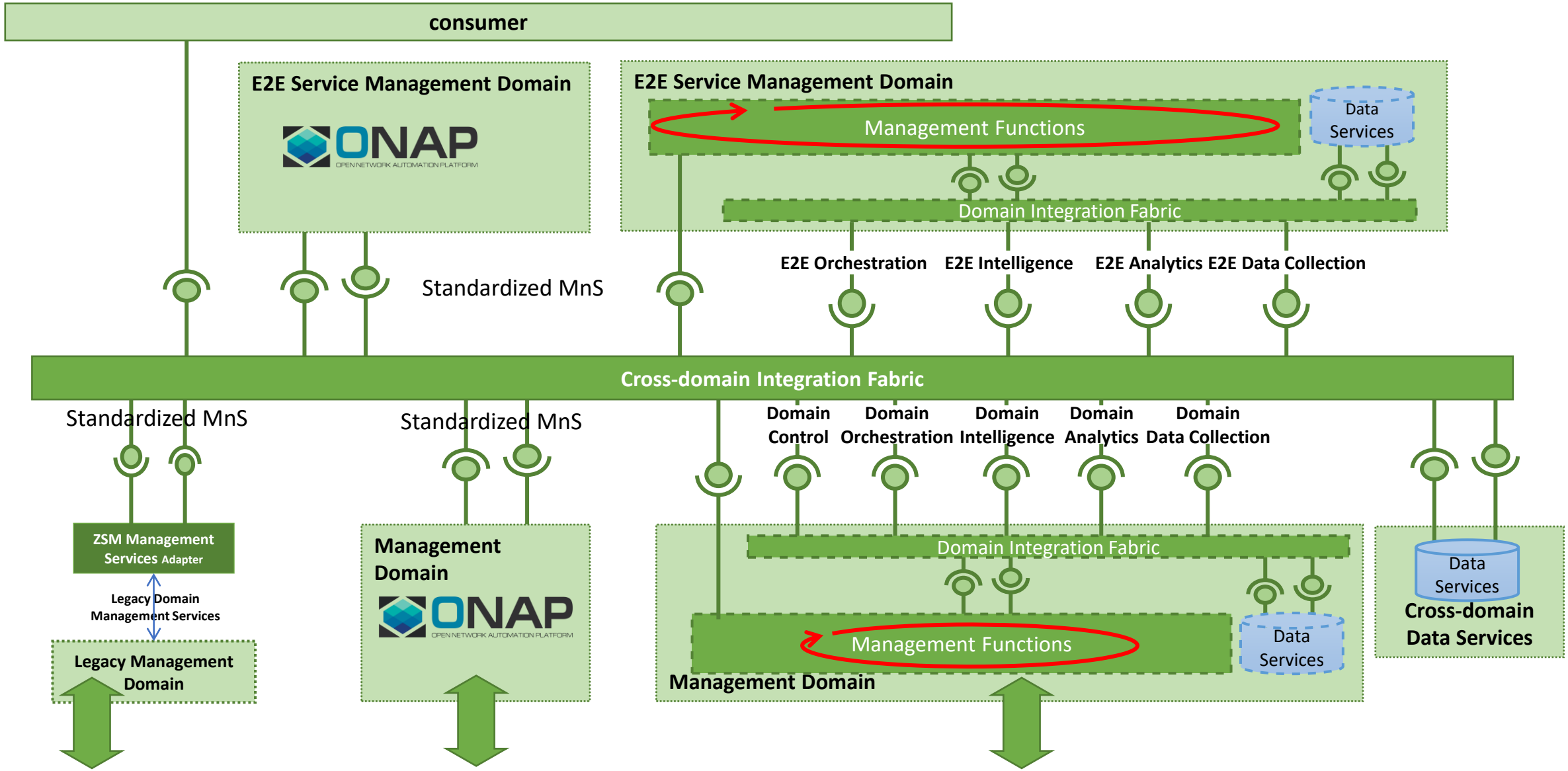
- Manages E2E services that span multiple management domains
- Provides and consumes management services
- Coordinates between management domains





(Source: ETSI GS ZSM002)

Implementation Options (for ONAP as a whole)



Harmonization and collaboration across the industry

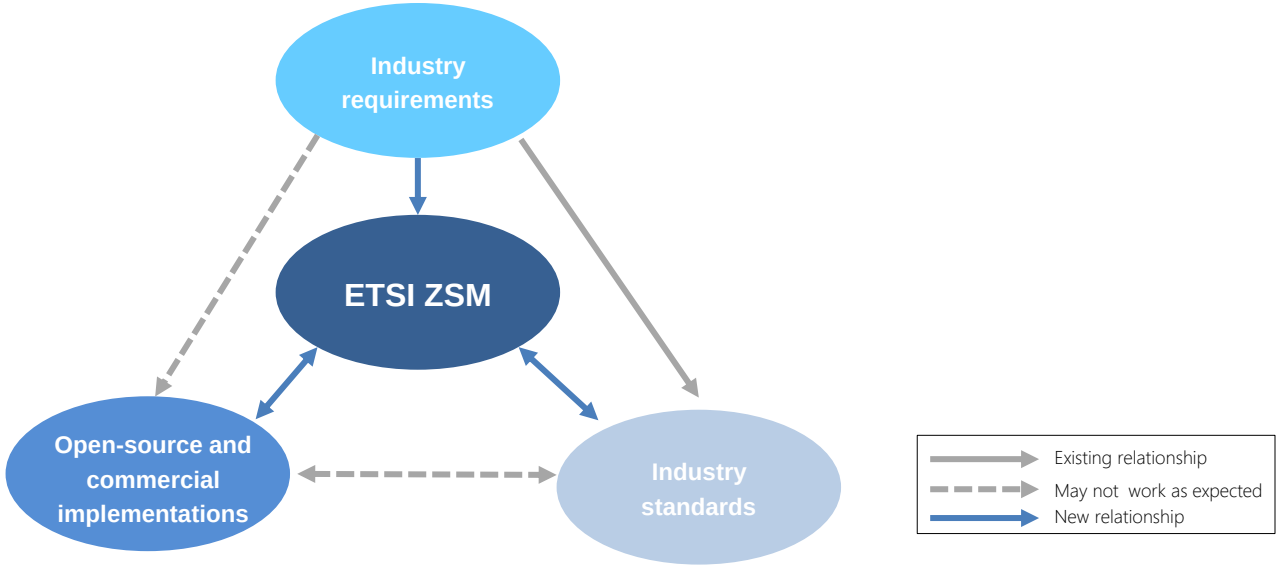
- Cooperation, cooperation and alignment with other SDOs (including ETSI groups), forums and Open Source projects is essential to:
  - promote adoption of and alignment with the ZSM architecture and solutions;
  - achieve automated end-to-end network and service management

Collaboration with others is key.

No organization can do it alone

ZSM is in discussion with:

- SA5, TMF, GSMA, O-RAN, ….



ZSM second term 2020 /2021

Building on the first term foundations:

- Finalize and maintain the first term work
- Continue the technical work on the next level of details
- Maintain overall ownership in ZSM (beyond ETSI)
- Strengthen the collaboration with other organizations; work constructively with open source communities
- Coordinate experimentation and showcasing of ZSM solutions (e.g. PoC Zone); produce PoC case studies and report of PoCs' results.

- Focus on interface specification
- Discussion about which API's the ISG should focus on
- Endorse the collaboration with others (e.g. GSMA, ETSI NFV, 3GPP SA5, ONAP/ ORAN…)

The AN Road to 5G

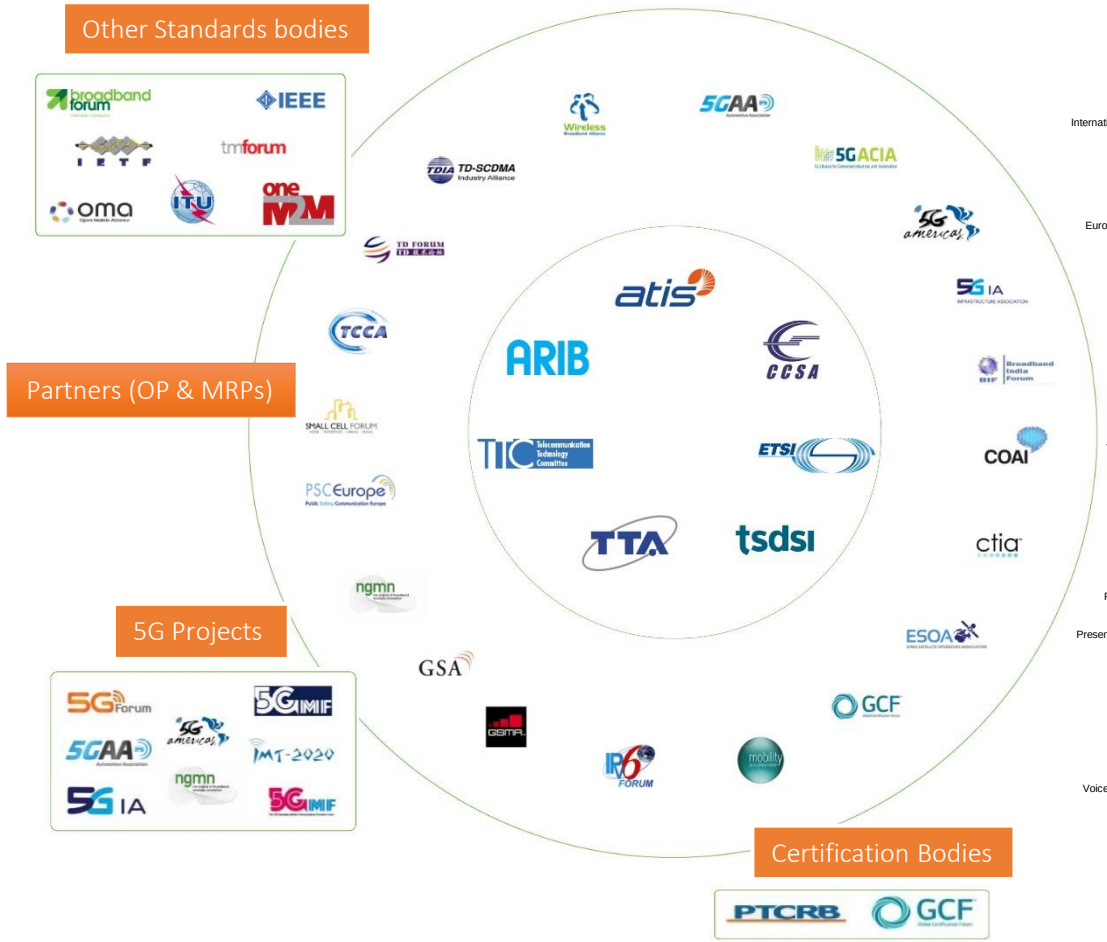
Thomas Tovinger, *SA5 Chair,* **3GPP**

Contents

- Brief 3GPP introduction
- 3GPP SA5 ToR
- Rel-16 5G management specifications
- 5G Service based Management architecture(SBMA)
- Autonomous network relevant topics for pre-5G
- Autonomous network relevant topics for 5G
- Conclusions

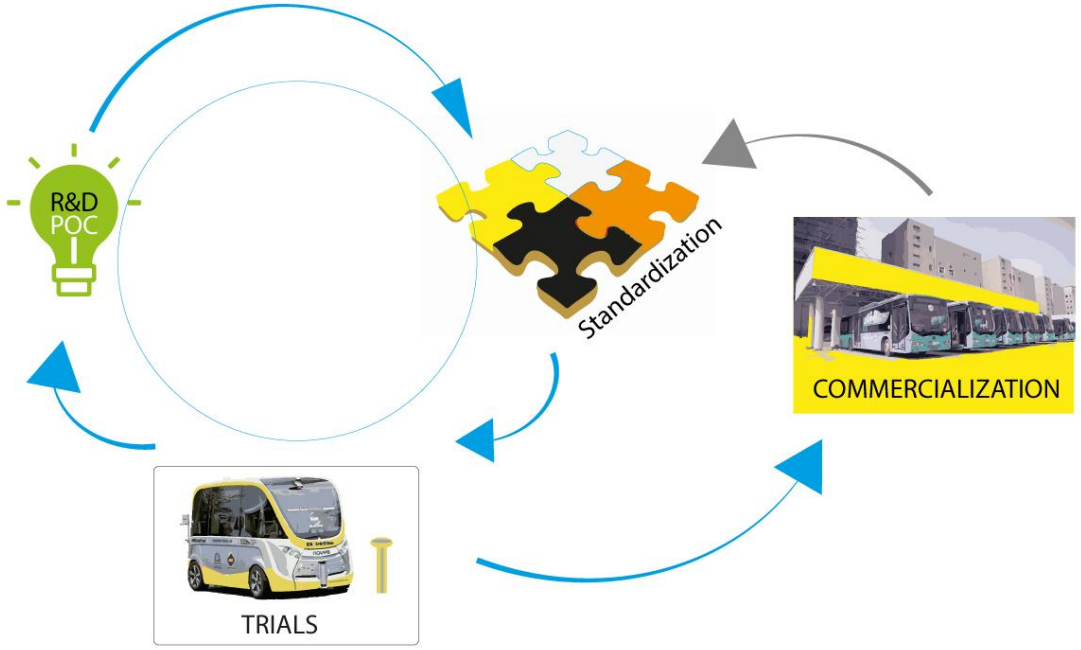
3GPP standards eco-system

- Participation in 3GPP is made possible by companies and organizations becoming members of one of the 3GPP Organizational Partners, the seven Standards Developing Organizations (SDOs) - from China, Europe, India, Japan, Korea and the United States.
- Specific inputs, in the form of market requirements may also come in to the Project via any of the twenty Market Representation Partners in 3GPP. These organizations have all signed up to the 3GPP Project scope and objectives.
- There is also a lot of external cooperation with other standards bodies and a broad variety of other groups, by way of formal Liaisons.

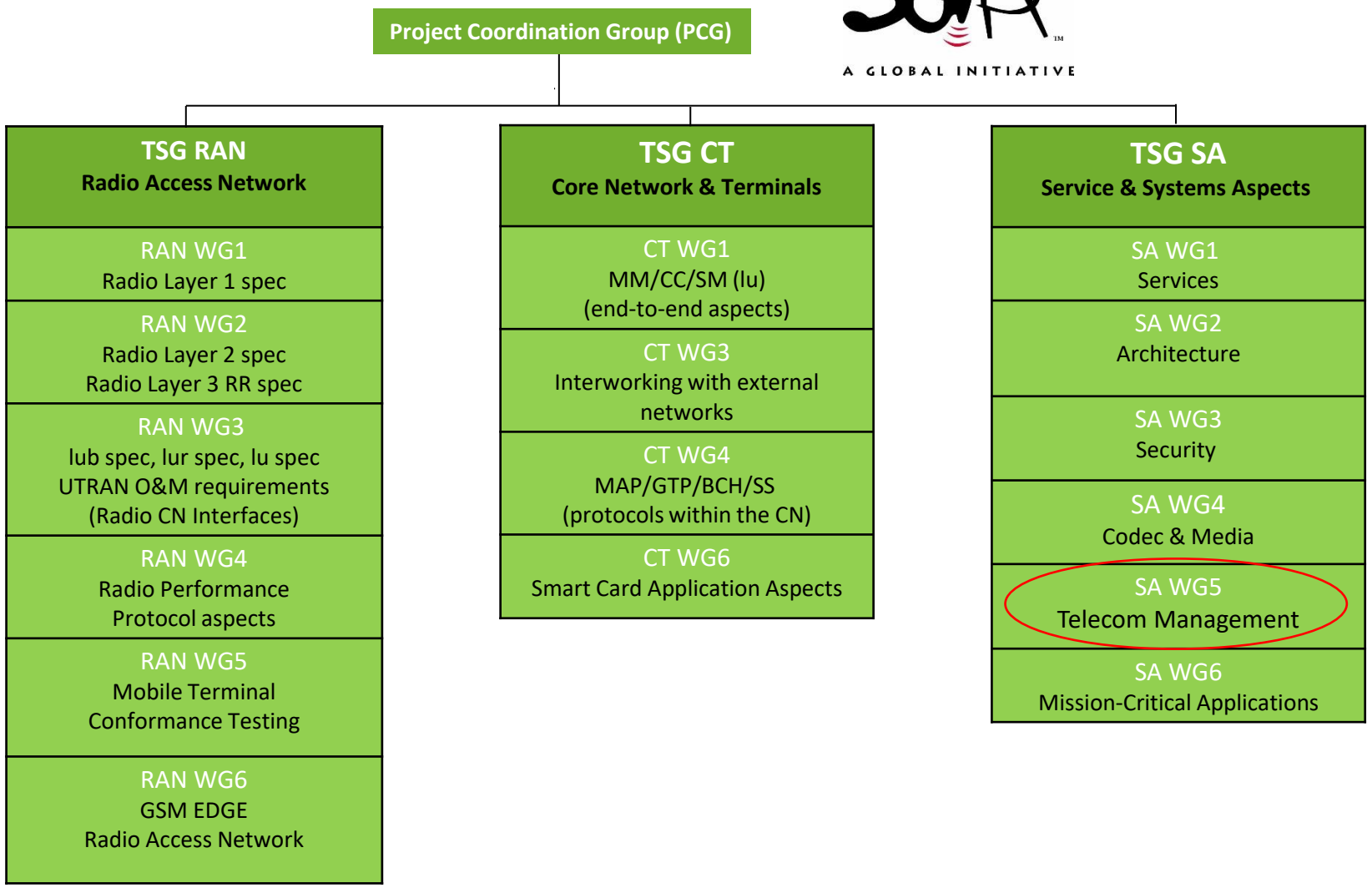


The role of 3GPP

- 3GPP is part of the invention, proof of concept, standardization, trials, commercialization …cycle
- Its role is to specify and maintain a complete system description for mobile telecommunications
- The system description is characterized by a number of standardized interfaces, not a description of standardized deployment
- This standardization approach enables an interoperable, multi-vendor approach to deployment and generates mass market economies of scale, without stifling innovation

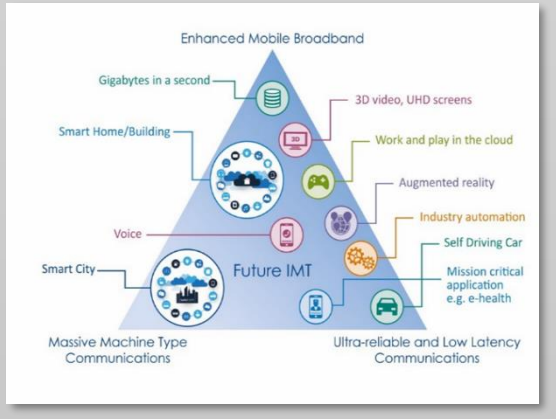


3GPP organization



- 3GPP SA5 is responsible for management, orchestration and charging standards for 3GPP networks
- Coordinates with all 3GPP working groups
- Communicates with other SDOs and industry fora

Bring the work in to the group

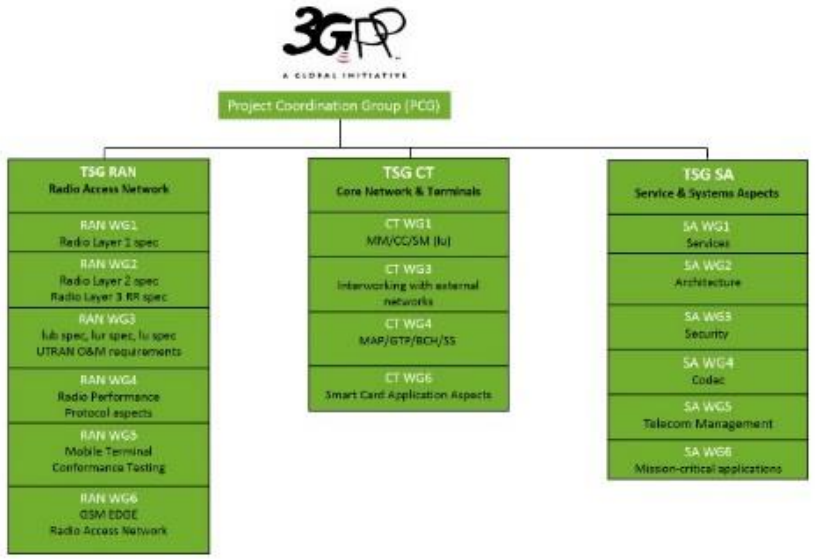


Use Cases

- Higher Data Rates
- Higher User Mobility
- Highly variable data rates
- Diverse Deployments
- Improved Coverage

Overall Goals

- **Enable new business**
- **Greater Efficiency (lower cost per bit for capital investment, operations & energy)**
- **Flexibility (not one-size fits all system)**



3GPP Specifications and Reports:	
Requirements	21 series
Service aspects ("stage 1")	22 series
Technical realization ("stage 2")	23 series
Signalling protocols ("stage 3") - user equipment to network	24 series
Radio aspects	25 series
CODECs	26 series
Data	27 series
Signalling protocols ("stage 3") -(RSS-CN) and OAM&P and Charging (overflow from 32.- range)	28 series
Signalling protocols ("stage 3") - intra-fixed-network	29 series
Programme management	30 series
Subscriber Identity Module (SIM / USIM), IC Cards. Test specs.	31 series
OAM&P and Charging	32 series
Security aspects	33 series
UE and (U)SIM test specifications	34 series
Security algorithms	35 series
LTE (Evolved UTRA), LTE-Advanced, LTE-Advanced Pro radio technology	36 series
Multiple radio access technology aspects	37 series
Radio technology beyond LTE	38 series

3GPP SA5 ToR introduction - 1

Overview

- TSG SA WG5 is responsible for Telecom Management of the 3GPP network. This includes aspects such as operation, orchestration, assurance, fulfillment, automation and charging. Both functional and service perspectives are covered.
- TSG SA WG5 specifies requirements, stage 2 and stage 3 solutions. The solutions include architecture, service definitions and data definitions. Management services includes services towards vertical industries. Charging service is used for billing or other analytics as well as customer care.
- TSG SA WG5 also specifies design principles, guidelines and methodology for management, orchestration and assurance.

Scope of Responsibilities

- TSG SA WG5 is responsible for all specification work pertinent to Telecom Management. Important areas where TSG SA WG5 is actively involved and developing specifications with full support of automation are:
  - Telecom management architecture framework.
  - Service Management, Network Management, Element Management (which includes management of Network Elements and Network Functions) and Charging Management.

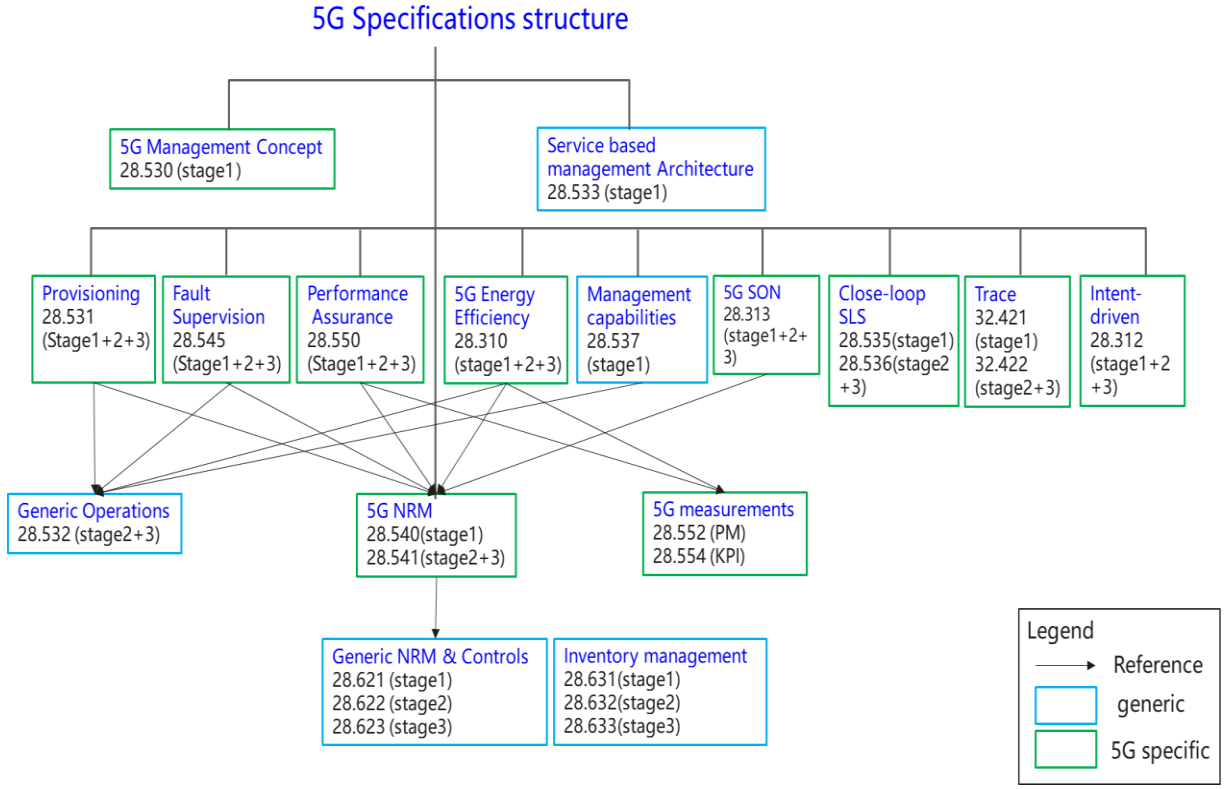
3GPP SA5 ToR introduction-2

- Management aspects of energy efficiency.
- Exposure of management services to entities external to the network operator, e.g. verticals.
- Data collection for Telecom Management. Examples of data being collected: alarms, performance measurements, KPIs, QoE, trace, MDT data and charging data.
- Services and functions which support orchestration, assurance and analytics. Examples are (but not limited to):
  - Life Cycle Management (LCM), Fault Management, Configuration Management, Accounting Management, Performance Management and Security Management (FCAPS).
  - Management of autonomous networks, Self-Organizing Networks (SON), Intent driven management, Closed and open loop assurance and Data analytics.
  - Network Resource Models (NRMs), operations and notifications.
- 3GPP Management support for edge components deployed at MNO premises.
- TSG SA WG5 is committed to engage in charging and management aspects of supporting new services for public and non-public networks.
- TSG SA WG5 coordinates with other 3GPP WGs and all relevant Standards Developing Organizations (SDOs), industry fora and Market Representation Partners (MRPs) in the specification work pertinent to Telecom Management.

3GPP SA5 ToR URI: https://www.3gpp.org/specifications-groups/sa-plenary/sa5-telecom-management

3GPP SA5 5G specifications (TS 32.103)

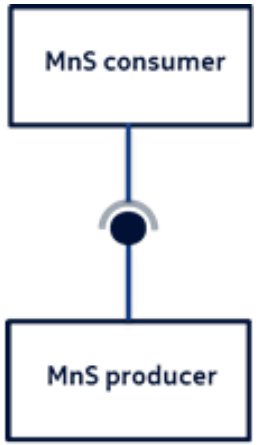
1	Network and service management concept specification	TS 28.530[42]
2	Network management service based management architecture specifications	TS 28.533[43]
3	Network and Network slicing management related specifications	
3.1	Network and Network slicing provisioning	TS 28.531[44],TS 28.532[45],TS 28.540[46],TS 28.541[47]
3.2	Network and Network slicing fault supervision	TS 28.545[48],TS 28.532[45]
3.3	Network and Network slicing performance assurance	TS 28.550[49],TS 28.532[45],TS 28.540[46],TS 28.541[47],TS 28.552[50], TS 28.554[51]
3.4	NRM	TS 28.540[46],TS 28.541[47]
4	Energy efficiency related specifications	TS 28.310[52],TS 28.532[45],TS 28.552[50],TS 28.554[51]
5	ONAP-3GPP integration	TS 28.532[45]
6	Trace and MDT management	TS 32.421[37],TS 32.422[54]
7	5G SON management	TS 28.313[53],TS 28.541[47]
8	SLA management	TS 28.540[46],TS 28.541[47]
9	5G management capabilities (Heart beat)	TS 28.537[54],TS 28.532[45]
10	Close-loop SLS	TS 28.535[55], TS 28.536[56]
11	Management service discovery	TS 28.530[42],TS 28.533[43]
12	Management of tenant information	TS 28.530[42], TS 28.531[44],TS 28.533[43],TS 28.550[49],TS 28.552[50],TS 28.541[47]



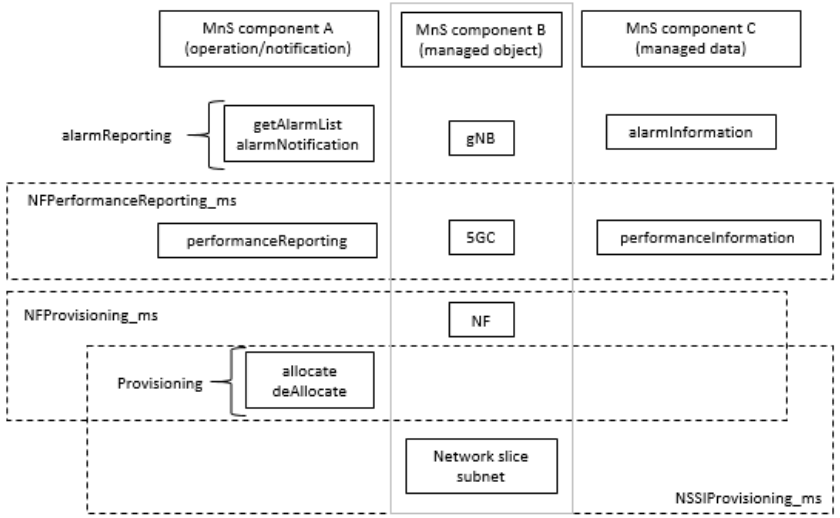
Service Based Management architecture(TS 28.533)

- The fundamental building block of the Service Based Management Architecture (SBMA) is the Management Service (MnS). A MnS is a set of offered capabilities for management and orchestration of networks and services. An MnS producer offers its services via a standardized service interface composed of individually specified MnS components (i.e. MnS component type A, B,C).
- A Management Function (MnF) is a logical entity playing the roles of MnS consumer and/or MnS producer

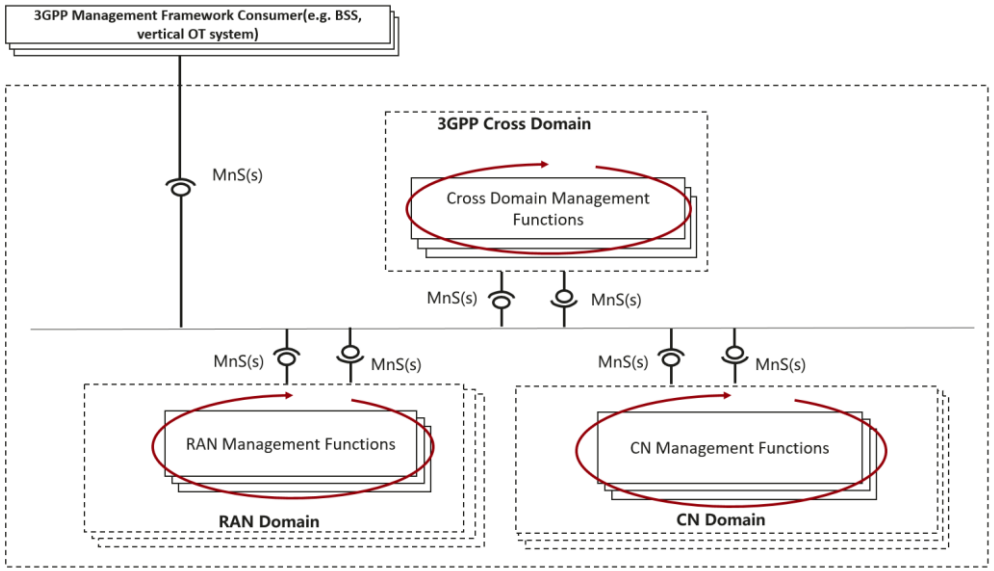
MnS producer and MnS consumer



Example of Management Service and component type A, B and C



Example of Management Service deployment framework



Autonomous network related topics in LTE and 5G

LTE

- 3GPP SA5 has been engaged in autonomous network relevant topics for LTE network. Self-Organizing Network (SON) for E-UTRAN including SON concepts and requirements, Self-configuration, Automatic neighbour relation (ANR), self-optimization and self-healing were standardized since 3GPP Rel-8 (in 2008).
  - Centralised SON: SON solution where SON algorithms are executed in the OAM system. Centralised SON has two variants:
    - NM-Centralised SON: SON solution where SON algorithms are executed at the Network Management level.
    - EM-Centralised SON: SON solution where SON algorithms are executed at the Element Management level.
  - Distributed SON: SON solution where SON algorithms are executed at the Network Element level.
  - Hybrid SON: SON solution where SON algorithms are executed at two or more of the following levels: NE or EM or NM.

5G

- Autonomous Network Level
- Closed loop communication service assurance
- Intent driven management service for mobile networks
- Management Data Analytics Service
- Self-Organizing Networks (SON) for 5G networks
- Network Slicing

Autonomous Network Level Study - Introduction

- In 3GPP Release 16, 3GPP SA5 has studied on concept, use case, requirements and solutions for levels of autonomous network (Corresponding contents have been captured in TR 28.810).
  - 3GPP TR 28.810: “Study on concept, requirements and solutions for levels of autonomous network”

- In 3GPP Release 17, 3GPP SA5 has started a new work item on normative work for levels of autonomous network (Corresponding contents will be captured in TS 28.100).
  - 3GPP TS 28.100: “Management and orchestration; Levels of autonomous network”

Autonomous Network Level Study (TR 28.810) - Concepts

Concept of network autonomy

Network autonomy describes the telecom system (including management system and network) capability which is able to be governed by itself with minimal to no human intervention. Some features discussed in 3GPP are related to network autonomy. Following are some examples:

- Self-Organizing Network (SON)
- Management data analytics
- Intent driven management
- Close loop SLS assurance

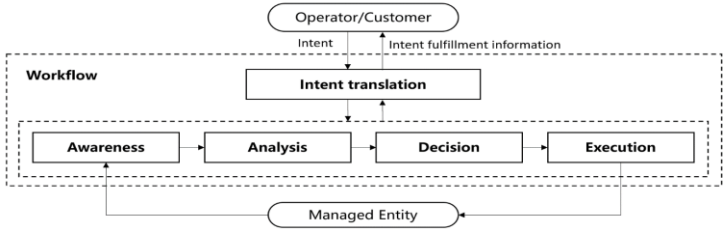
Concept of network autonomy level

Network autonomy level describes the level of application of autonomy capabilities in the network management workflow. The participation of the human and telecom system in the network management workflow are important factors to evaluate the network autonomy level. For each network autonomy level, which tasks can be performed by telecom system, which tasks can be performed by human, and which tasks can be performed by cooperation of human and telecom system needs to be clarified. For example, in the highest autonomy level, all tasks are performed by telecom system.

Potential dimensions for classification of network autonomy

Workflow

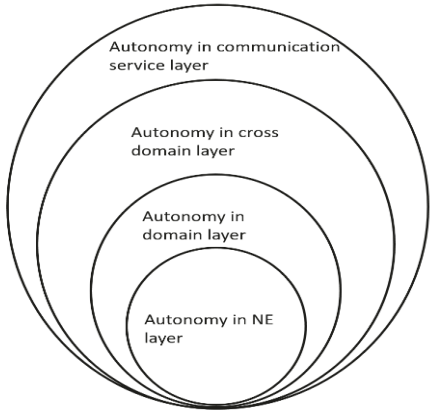
- **Intent translation:** The group of tasks which translate network or service intent from operator or customer into detailed management operations which may affect one or more of the following groups of tasks (i.e. awareness, analysis, decision, execution) and translate the detailed network and service information to intent fulfilment information (e.g. the intent is satisfied or not)..
- **Awareness:** The group of tasks which monitor network information (including network performance, network anomaly, network event, etc).
- **Analysis:** The group of tasks which analyse the collected information (e.g. information about network status, network issues and so on) or based on the historical data to further predict the future change trend of the above network status, and make recommendation for decision.
- **Decision:** The group of tasks which decide the necessary management operation for execution, e.g. network configuration or adjustment.
- **Execution:** The group of tasks which execute the management operations.



Management scope

Potential scopes of network autonomy:

- Autonomy in NE layer, which means the autonomy mechanism is executed in the NE.
- Autonomy in domain layer, which means the autonomy mechanism is executed in the MnF(s) in domain.
- Autonomy in cross domain layer, which means the autonomy mechanism is executed in the MnF(s) in cross domain.
- Autonomy in communication service layer, how to execute the autonomy mechanism in communication service layer is FFS.



Scenarios

The network autonomy can be implemented for different scenarios, the complexity of network autonomy depends on the detailed scenarios it applied. Also it will be more challenge for the telecom system to achieve the network autonomy for full scenarios than for certain scenarios. For example, autonomy applicability of network deployment will be more challenge for outdoor combine indoor scenario than only outdoor scenario.

Autonomous Network Level Study (TR 28.810) - Classification

Framework approach for classification of autonomous network level

Level 0 manual operating network: No categorization of the tasks is accomplished by telecom system itself.

Level 1 assisted operating network: A part of the execution and awareness tasks are accomplished automatically by telecom system itself based on human defined rules. At this level, telecom system can assist human to improve the execution and awareness efficiency.

Level 2 preliminary autonomous network: All the execution tasks are accomplished automatically by telecom system itself. A part of the awareness and analysis tasks are accomplished automatically by telecom system itself based on human defined policies. At this level, telecom system can assist human to achieve the close loop based on human defined policies.

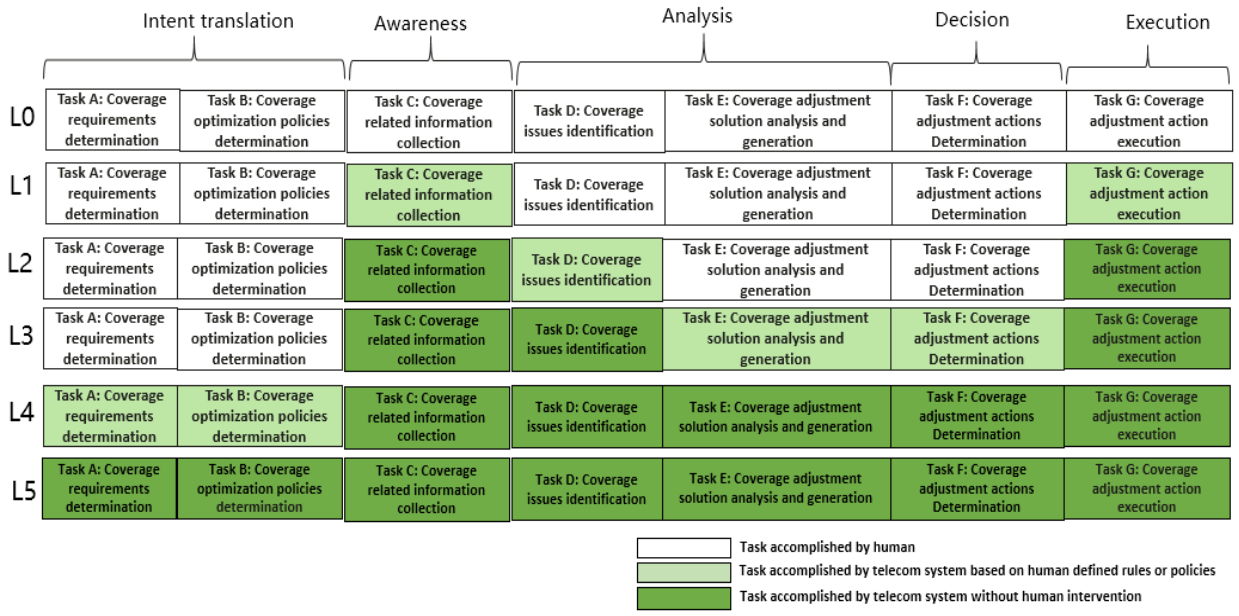
Network autonomy level		Task categories				
		Execution	Awareness	Analysis	Decision	Intent translation
L0	Manual operating network	Human	Human	Human	Human	Human
L1	Assisted operating network	Human & Telecom system	Human & Telecom system	Human	Human	Human
L2	Preliminary autonomous network	Telecom system	Human & Telecom system	Human & Telecom system	Human	Human
L3	Intermediate autonomous network	Telecom system	Telecom system	Human & Telecom system	Human & Telecom system	Human
L4	Advanced autonomous network	Telecom system	Telecom system	Telecom system	Telecom system	Human & Telecom system
L5	Full autonomous network	Telecom system	Telecom system	Telecom system	Telecom system	Telecom system

Note 1: Human reviewed decision have the highest authority in each level if there is any confliction between human reviewed decision and telecom system generated decision.
Note 2: The present of above five task categories does not reflect the workflow sequence.

Level 3 intermediate autonomous network: All the execution and awareness tasks are accomplished automatically by telecom system itself. A part of the analysis and decision tasks are accomplished automatically by telecom system itself based on human defined policies. At this level, the telecom system can achieve the close loop automation based on the human defined close loop automation policies.

Level 4 advanced autonomous network: All the execution, awareness, analysis and decision tasks are accomplished automatically by telecom system itself. And intent translation tasks can be partly accomplished automatically by telecom system itself based on human defined intent translation policies. At this level, telecom system can achieve the intent driven close loop automation based on human defined intent translation policies, which means the telecom system can translate the intent to the detailed close loop automation and translate the detailed network and service information to intent fulfilment information (e.g. the intent is satisfied or not) based on human defined intent translation policies.

Level 5 fully autonomous network: The entire network autonomy workflow is accomplished automatically by telecom system without human intervention. At this level, telecom system can achieve the whole network autonomy.



Autonomous Network Level Workitem (TS 28.100)

The following definition has been captured:

- **Autonomous Network**: telecommunication system (including management system and network) with autonomy capabilities which is able to be governed by itself with minimal to no human intervention.
- **Autonomous Network Level**: describes the level of autonomy capabilities in the autonomous network.

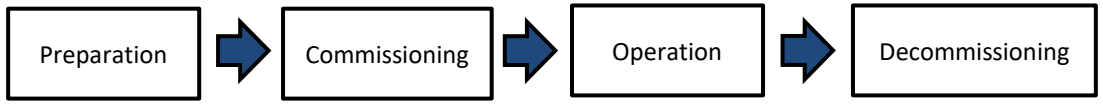
Note: The content of this slide is under discussion in the draft TS 28.100.

Closed loop communication service assurance- Introduction

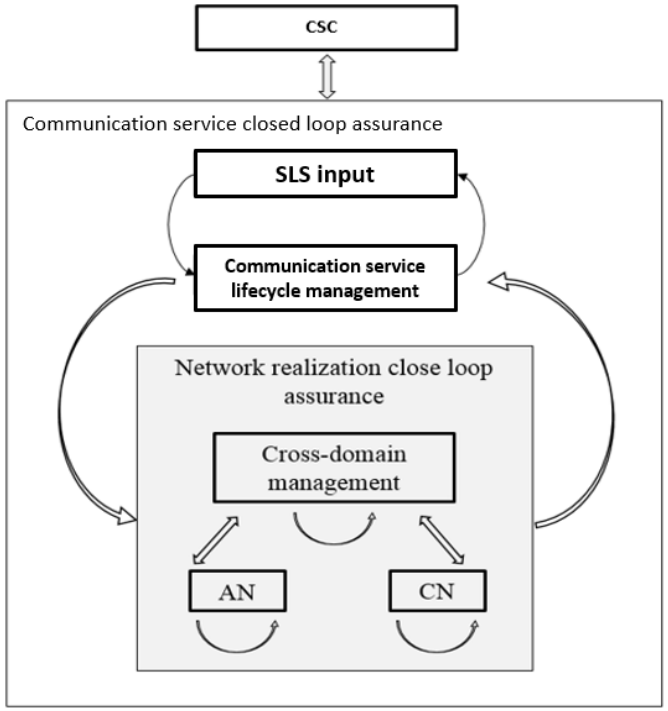
- In 3GPP Release 16, 3GPP SA5 has specified the concept for open control loops and closed control loops, as well as use cases, requirements and a model for closed loop communication service assurance (Corresponding contents have been captured in TS 28.535 and TS 28.536).
- In 3GPP Release 17, 3GPP SA5 has started a new work item on enhanced closed loop SLS assurance.
  - TS 28.535: “Management and orchestration; Management services for communication service assurance; Requirements”
  - TS 28.536: “Management and orchestration; Management services for communication service assurance; Stage 2 and stage 3”

Closed loop communication service assurance (TS 28.535)

- Communication service assurance applies to different phases in the life of communication services these lifecycle phases are; preparation, commissioning, operation and decommissioning.

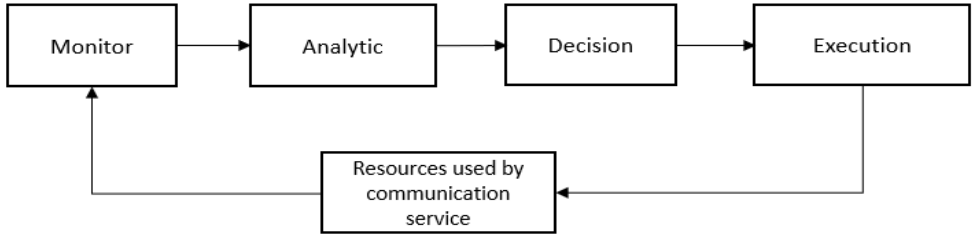


- For communication service assurance one can identify two interactions of management control loops:
  - Between the CSC and the CSP: In this case, the CSC provides the requirements for an assured communication service to the CSP, the CSP provides the corresponding communication service, the CSP also provides feedback to the CSC. The CSP adjusts the resources used by a communication service or the CSC adjusts the SLS continuously to achieve the assured requirements.
  - Between the CSP and the NSP: the communication service provided by CSP requires the network capabilities. For example, the CSP requires a certain network latency. The NSP management system adjusts the network or CSP adjusts the latency requirement continuously to satisfy the latency requirement.

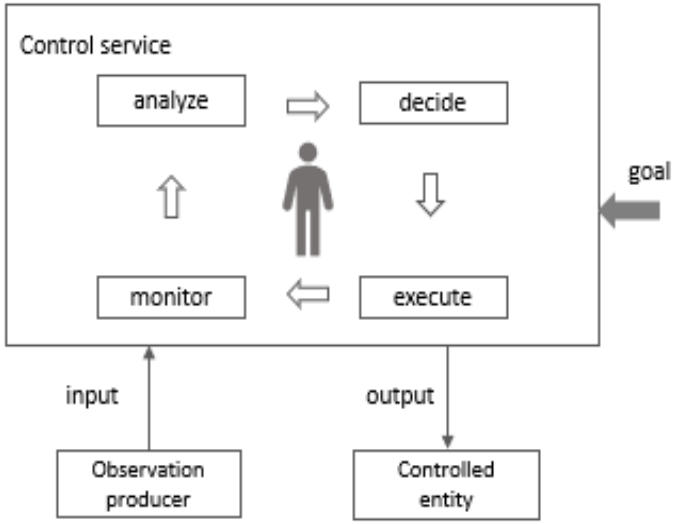


Closed loop communication service assurance (TS 28.535)

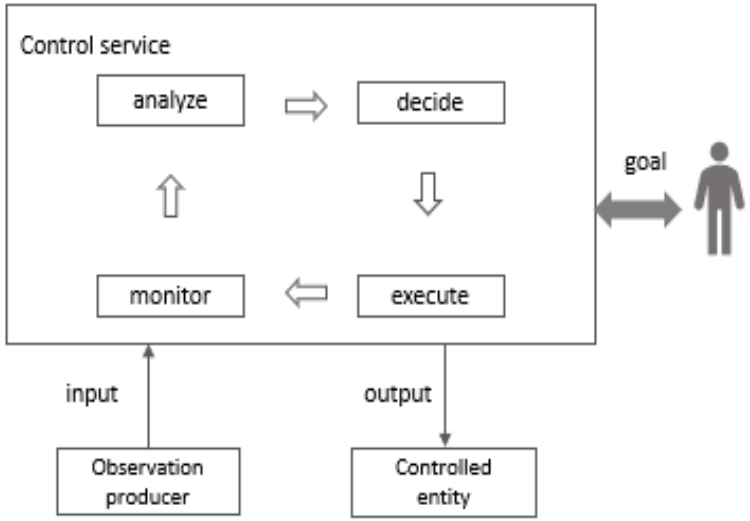
- Overall process of communication service assurance using a management control loop



- A control loop can be an open control loop in which case a human operator or other management entity intervenes inside the loop A control loop can be closed and operates without human operator or other management entity involvement inside the loop other than possibly the initial configuration of the measurement producer and configuration of control loop.



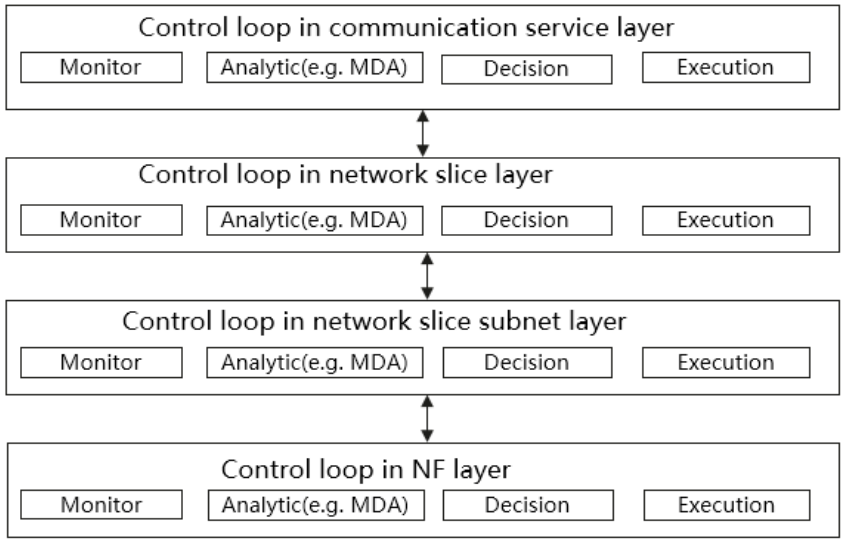
Open control loops



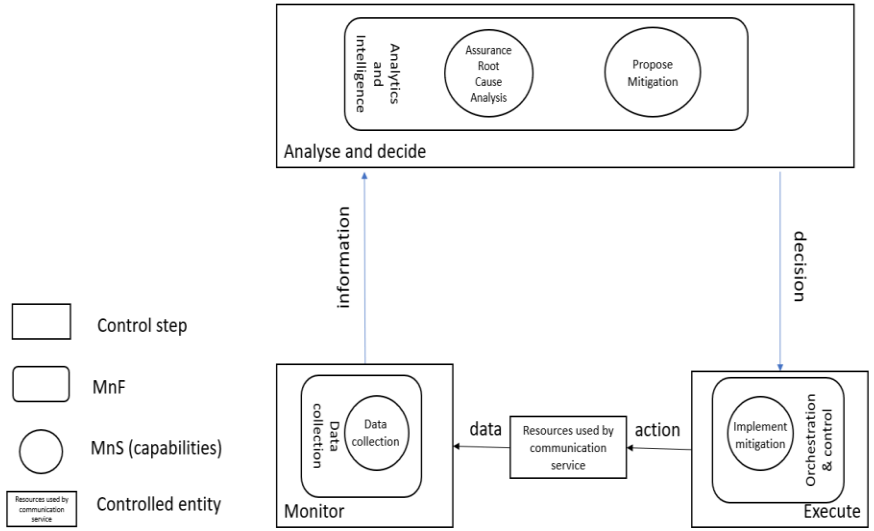
Closed control loops

Closed loop communication service assurance (TS 28.536)

- Control loop deployed in different layers



- Communication service assurance relies on a set of management services that together provide the CSP with the capability to assure the communication service as per agreement with a CSC (e.g. enterprise).

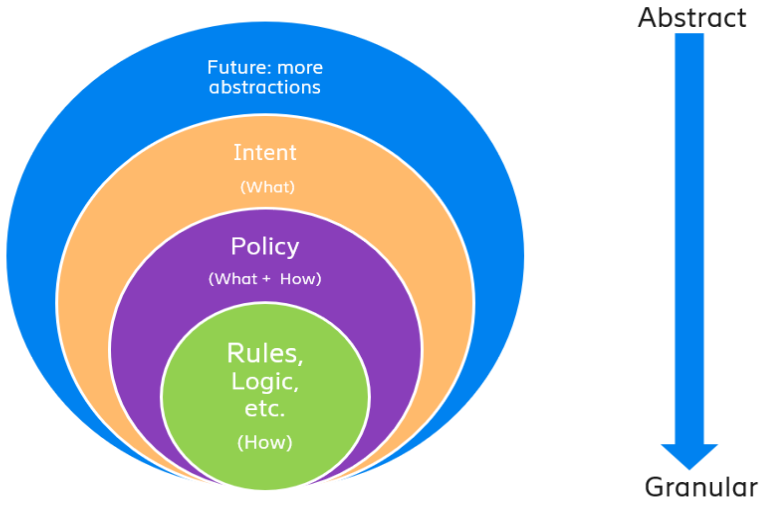


Intent driven management for mobile networks - Introduction

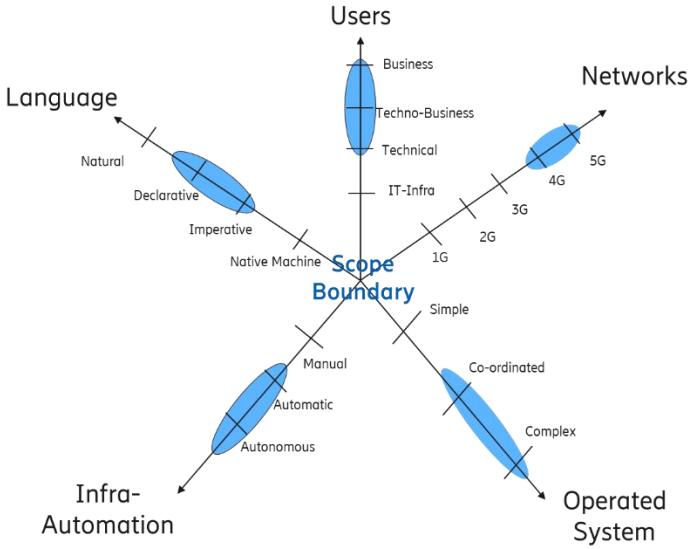
- In 3GPP Release 17, 3GPP SA5 has studied on concept, scenarios and solutions for intent driven management, which enable to simplify the management interfaces (Corresponding contents have been captured in TR 28.812). And the normative work for intent driven management has been started in 3GPP SA5 (Corresponding contents will be captured in TS 28.312).
  - 3GPP TR 28.812: “Telecommunication management; Study on scenarios for Intent driven management services for mobile networks”
  - 3GPP TS 28.312: ” Management and orchestration; Intent driven management services for mobile networks”

Intent driven management for mobile networks Study (TR 28.812) - Concepts

- Intent driven management vs policy driven management
  - A policy is a function that governs the choices in behaviour of a system. It specifies the action(s) to be taken when specified condition(s) occur. More focus on “How” and less on “What” covering domain specific issues/aspects.
  - An intent defines to what position (in what state) we want as specific entity to be. More focus on “What”.

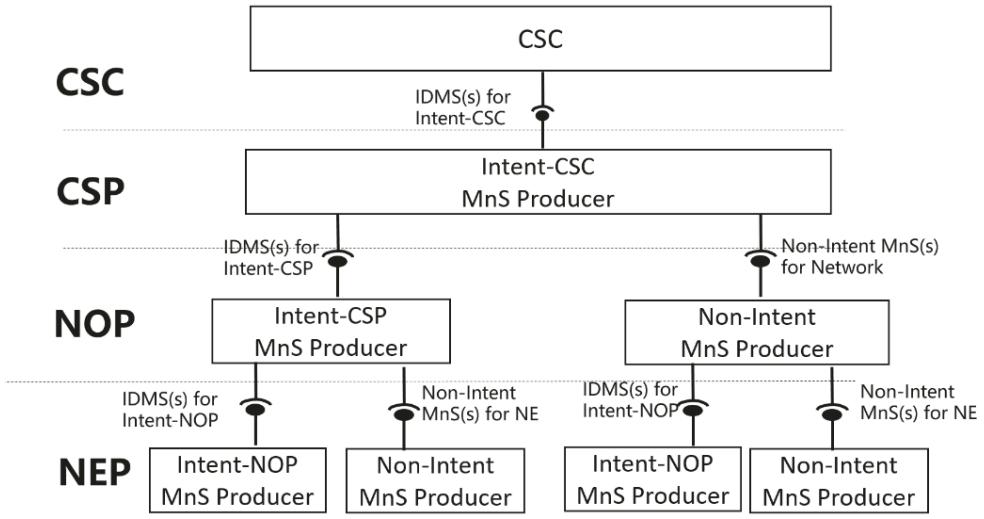


- Dimensions of intent driven framework
  - Users
  - Network
  - Operated system
  - Language
  - Infra-Automation



Intent driven management for mobile networks Study (TR 28.812) - Scenarios

- Potential way to satisfy intent-CSC



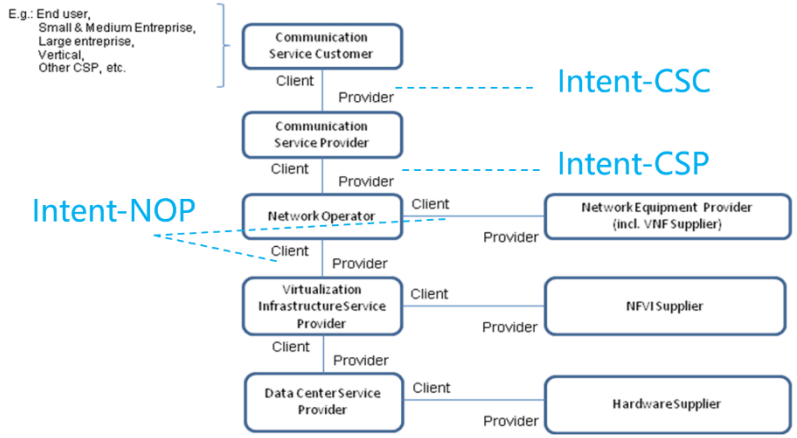
- Intent driven management scenarios

- 5 Scenarios for Intent driven management services for mobile network
  - 5.1 Scenarios related to Intent-CSC
    - 5.1.1 Service deployment
    - 5.1.2 Intent driven service creation
    - 5.1.3 Intent driven Communication Service deployment at the edge
  - 5.2 Scenarios related to Intent-CSP
    - 5.2.1 Network provisioning
    - 5.2.2 NSI resource utilization optimization
    - 5.2.3 Intent driven NSI resource capacity planning scenario
    - 5.2.4 Intent driven NSI performance assurance scenario
  - 5.3 Scenarios related to Intent-NOP
    - 5.3.1 Cell Re-home
    - 5.3.2 Area load balance
    - 5.3.3 Instant Cell Updating
    - 5.3.4 Instant Cell Deletion
    - 5.3.5 Intent driven network optimization scenario
    - 5.3.6 Capacity Management
    - 5.3.7 Intent driven NF deployment
    - 5.3.8 Intent driven NF capacity changing
    - 5.3.9 Intent driven management for area based deployment scenario
    - 5.3.10 Intent driven coverage optimization scenario

Intent driven management for mobile networks (TS 28.312)

- **Intent Definition:** A desire to reach a certain state for a specific service or network management workflow.

- **Intent categorizes based on user types**
  - Intent from Communication Service Customer (Intent-CSC)
  - Intent from Communication Service Provider (Intent-CSP)
  - Intent from Network Operator(Intent-NOP)



- **Intent categorizes based on management scenario types**
  - Intent for network and service design/planning
  - Intent for network and service deployment
  - Intent for network and service maintenance
  - Intent for network and service optimization/assurance

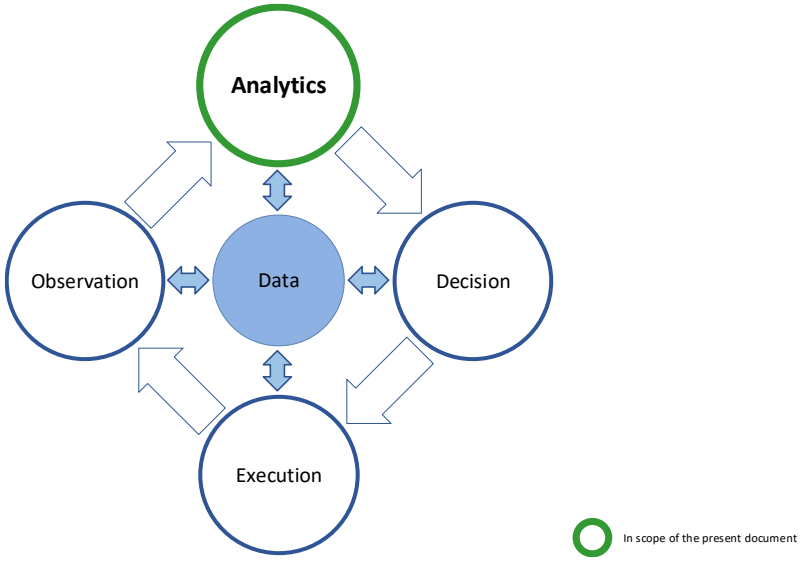
Note: The content of this slide is under discussion in the draft TS 28.312.

Management Data Analytics Service - Introduction

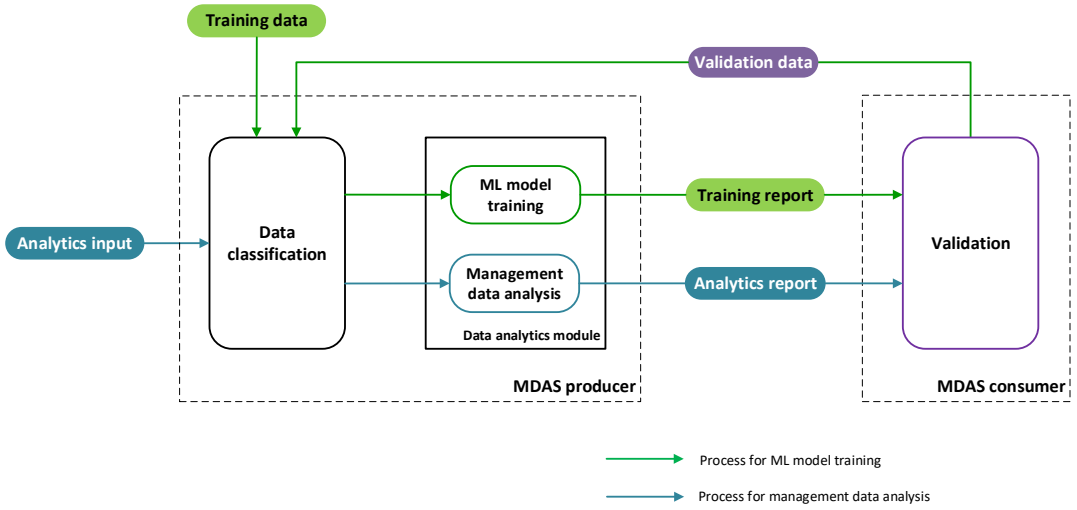
- In 3GPP Release 17, 3GPP SA5 has started the study on concept, use case, requirements and solutions for Management Data Analytics Service, which is in conjunction with AI and ML techniques, brings intelligence and automation to the network service management and orchestration (Corresponding contents will be captured in TR 28.809) .
  - 3GPP TR 28.809: “Study on enhancement of management data analytics”

Management Data Analytics Service Study (TR 28.809)

- MDA role in management loop
  - The MDA forms a part of the management loop (which can be open loop or closed loop, see TS 32.500 [10]), and it brings intelligence and generates value by processing and analysis of management and network data, where the AI and ML techniques may be utilized.



- MDA process
  - There are two kinds of processes for MDA, the process for ML model training and the process for management data analysis.



Note: The content of this slide is under discussion in the draft TR 28.809.

Management Data Analytics Service Study (TR 28.809)

MDA Use case

- 6.1 Coverage related issues
  - 6.1.1 Coverage issue analysis
- 6.2 Resource related issues
  - 6.2.1 RAN user plane congestion analysis
  - 6.2.2 Resource utilization analysis
  - 6.2.3 Cross-slice resource optimization
  - 6.2.4 NAS level congestion control optimization
- 6.3 SLS assurance related issues
  - 6.3.1 E2E latency analysis
  - 6.3.2 Network slice load analysis
  - 6.3.3 Service experience related analysis
  - 6.3.4 Network slice throughput analysis
  - 6.3.5 Uplink/downlink throughput per UE in network slice analysis
  - 6.3.6 KPI anomaly analysis
  - 6.3.7 Jitter analysis
- 6.4 Fault management related issues
  - 6.4.1 Alarm incident analysis
- 6.5 Mobility management related issues
  - 6.5.1 Handover optimization
  - 6.5.2 Inter-gNB Beam Selection Optimization
- 6.6 Energy efficiency related issues
  - 6.6.1 MDA assisted energy saving
- 6.7 Paging performance related issues
  - 6.7.1 Paging optimization
- 6.8 Software management related issues
  - 6.8.1 RAN Node Software Upgrade
- 6.9 MDA assisted SON coordination
  - 6.9.1 SON conflict prevention and resolution
- 6.99 MDA management aspects
  - 6.99.1 ML model training for MDA

Note: The content of this slide is under discussion in the draft TR 28.809.

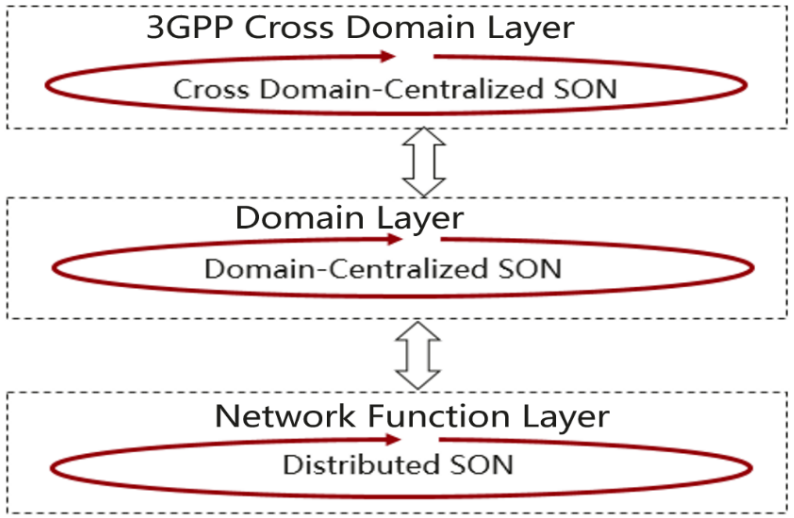
SON for 5G networks - Introduction

- In 3GPP Release 16, 3GPP SA5 has specified the concepts, use cases, requirements and solutions for 5G SON, including ANR management, PCI configuration, RACH optimization, MRO and Energy Saving (Corresponding contents have been captured in TS 28.313 and TS 28.541). In 3GPP Release 17, 3GPP SA5 has started new work item(s) to continue specify the use cases, requirements and solutions for the 5G SON, including, Self-establishment of 3GPP NF, Centralized Capacity and Coverage Optimization, Load Balancing Optimization, NSI resource allocation optimization, MRO enhancement and Handover Optimization enhancement.
  - 3GPP TS 28.313: “Self-Organizing Networks (SON) for 5G networks”
  - 3GPP TS 28.541: ” Management and orchestration; 5G Network Resource Model (NRM); Stage 2 and stage 3”

Figure 4.1.1-1 Overview of SON Framework

SON for 5G networks(TS 28.313)

Overview of SON Framework



SON Use case

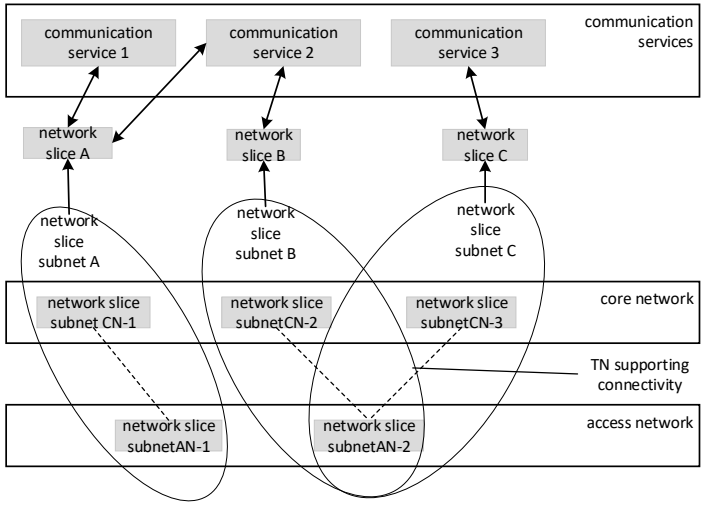
- 6.4 Use cases
  - 6.4.1 Distributed SON management
    - 6.4.1.1 RACH Optimization (Random Access Optimisation)
    - 6.4.1.2 MRO (Mobility Robustness Optimisation)
    - 6.4.1.3 ANR management
    - 6.4.1.4 PCI configuration
  - 6.4.2 Centralized SON
    - 6.4.2.1 PCI configuration
      - 6.4.2.1.1 Initial PCI configuration
      - 6.4.2.1.2 PCI re-configuration
    - 6.4.2.2 Use case for establishment of a new RAN NE in network
      - 6.4.2.2.1 Use case for RAN NE plug and connect to management system
      - 6.4.2.2.2 Use case for self-configuration of a new RAN NE

Network Slicing - Introduction

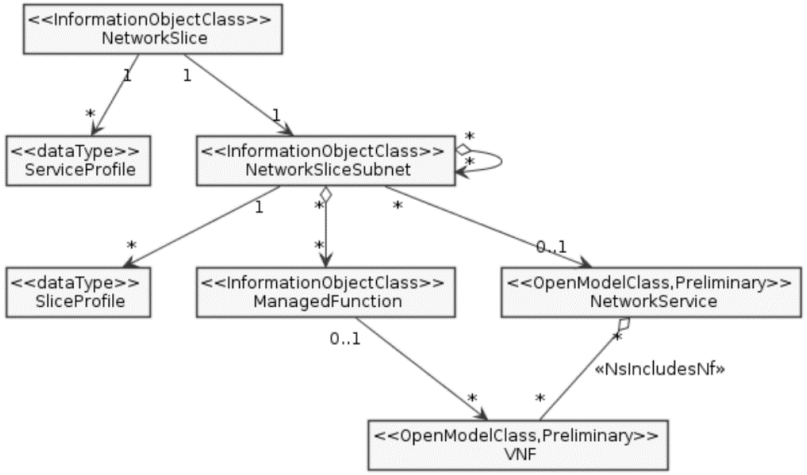
- 3GPP SA5 has worked on the network slicing topics from Release 15. In Release 16, the SLA parameters related to network slicing have been documented as Service Profile in TS 28.541. SA5 just started a Rel-17 network slice management enhancement study and 5G SLA enhancement work item.
  - TS 28.530: “Management and orchestration; Concepts, use cases and requirements”
  - TS 28.531: “Management and orchestration; Provisioning”
  - TS 28.541: “Management and orchestration; 5G Network Resource Model (NRM); Stage 2 and stage 3”
  - TS 28.545: ” Management and orchestration; Fault Supervision (FS)”
  - TS 28.550: “Management and orchestration; Performance assurance”

Network Slicing (TS 28.530 & 28.541)

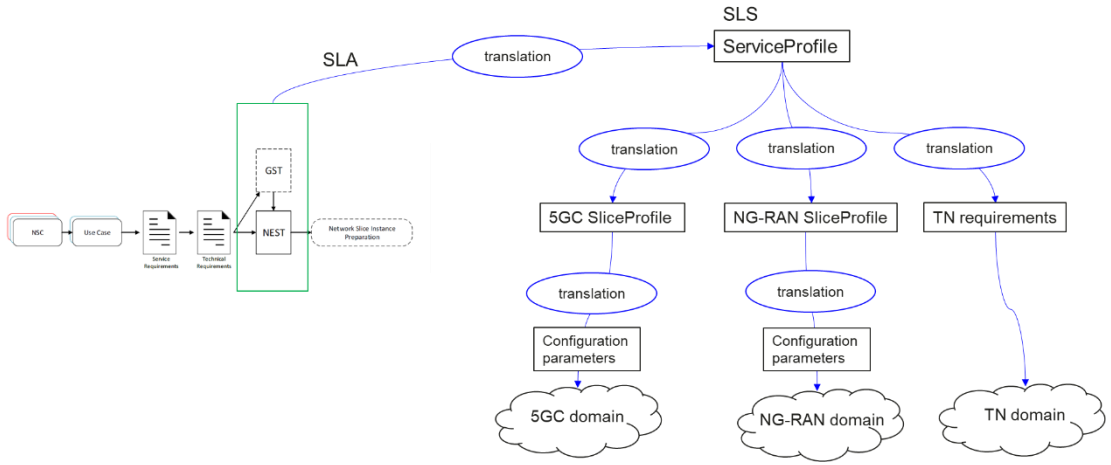
- Communication services using network slices



- Network Slicing NRM



- Relation between GSMA GST, ServiceProfile and SliceProfile



Conclusion

- 3GPP is an industry driven standardization activity with truly global reach.
- Standardization of interfaces enables an interoperable, multi-vendor approach to deployment and generates mass market economies of scale.
- 3GPP SA5 has built up experience related to autonomous networks since 2008.
- 3GPP SA5 has already made some progress on autonomous networks and continues to deliver more features to support autonomous networks.
- 3GPP SA5 is actively involved and developing specifications with full support of automation.
- 3GPP SA5 is happy to cooperate with other SDOs on autonomous networks.

Thank you!

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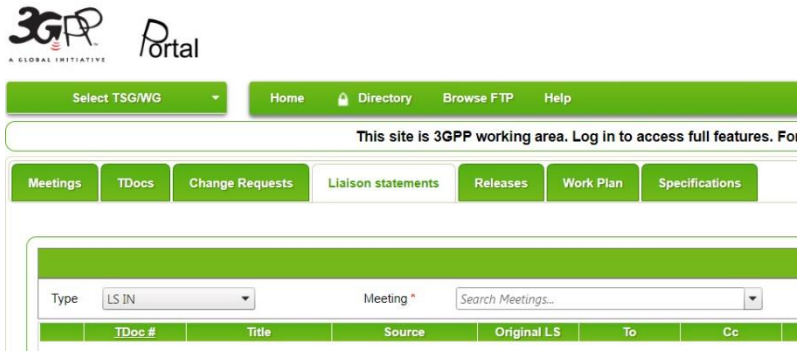

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Panel Discussion: Addressing the key drivers for Autonomous Networks, zero touch operations and the need for a common framework

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Ignacio Mas, *Senior Expert and Head of Technology Strategy OSS,* **Ericsson**
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Thank you for attending