General

ID[1]		
Use case name	Autonomous network and automation level definition	
Application domain	ICT	
Deployment model	Cyber-physical systems	
Status	PoC	
Scope[2]		
Objective(s)	To define autonomous network concept and automation level for the common understanding and consensus	
Narrative	Short description (not more than 150 words)	With the goal of providing common understanding and consensus for autonomous self-driving network, this use case delivers a harmonized classification system and supporting definitions that: • Define the concept of autonomous network • Identify six levels of network automation from “no automation” to “full automation”. • Base definitions and levels on functional aspects of technology. • Describe categorical distinctions for a step-wise progression through the levels. • Educate a wider community by clarifying for each level what role (if any) operators have in performing the dynamic network operations task while a network automation system is engaged.
	Complete description	The telecom CSPs have a dual challenge – to increase agility while reducing network operating cost. 1) The exponential growth of network complexity e.g. 5G will make the traditional network O&M model unsustainable; 2) Digital transformation accelerates service innovation but requires automation capabilities. As CSPs start to evaluate their digital transformation strategies, automation is a central concern. Some operators are already introducing automation to some of their network processes, most commonly O&M, planning and optimization. According to Analysys Mason, in 2018, 56% of CSPs globally have little or no automation in their networks. But by 2025, according to their own predictions, almost 80% expect to have automated 40% or more of their network operations, and one-third will have automated over 80%. The introduction of AI/ML (artificial intelligence/machine learning) will be an important part of that process for many CSPs, helping to make the network more intelligent, agile and predictive. The autonomous self-driving network has two essential elements in common with the autonomous self-driving car: ● There are different levels of automation, relating to different timescales and scenarios ● Intensive use of artificial intelligence (AI) is essential

With the goal of providing common understanding and consensus for autonomous self driving network, this use case delivers a harmonized classification system and supporting definitions that set out six levels of automation for the network.

Level	Name	Definition	Execution (Hands)	Awareness (Eyes)	Decision (Minds)	Experienc (Hearts)
0	**Manual Operation & Maintenance**	Even with auxiliary tools, O&M personnel perform all dynamic tasks.	P	P	P	P
1	**Assisted Operation & Maintenance**	Under the applicable design scope, the system can execute a sub-task repeatedly based on rules.	P/S	P	P	P
2	**Partial Autonomous Network**	Under the applicable design scope, the system continuously completes the control task of a unit based on the model.	**S**	P	P	P
3	**Conditional Autonomous Network**	Under the applicable design scope, the system can implement complete closed-loop automation of single-domain scenarios. Users can	S	**S**	P	P

		respond to the requests in a timely manner when the system fails.				
4	**Highly Autonomous Network**	Under the applicable design scope, the system can automatically analyze and execute cross-domain and service close-loop automation.	S	S	**P**	P
5	**Full Autonomous Network**	The system can perform complete dynamic tasks and exception handling in all network environments. O&M personnel do not need to intervene.	S	S	S	**P/S**

P=Personnel (Manual), S=System (Automated)

-Level 0 - manual O&M: The system delivers assisted monitoring capabilities, which means all dynamic tasks have to be executed manually.

-Level 1 - assisted O&M: The system executes a certain sub-task based on existing rules to increase execution efficiency.

-Level 2 - partial autonomous network: The system enables closed-loop O&M for certain units under certain external environments, lowering the bar for personnel experience and skills.

-Level 3 - conditional autonomous network: Building on L2 capabilities, the system can sense real-time environmental changes, and in certain domains, optimize

		and adjust itself to the external environment to enable intent-based closed-loop management. **-Level 4 - highly autonomous network:** Building on L3 capabilities, the system enables, in a more complicated cross-domain environment, predictive or active closed-loop management of service and customer experience-driven networks. This allows operators to resolve network faults prior to customer complaints, reduce service outages and customer complaints, and ultimately, improve customer satisfaction. **-Level 5 - full autonomous network:** This level is the ultimate goal for telecom network evolution. The system possesses closed-loop automation capabilities across multiple services, multiple domains, and the entire lifecycle, achieving autonomous driving networks. The lower levels can be applied now and deliver immediate cost and agility benefits in certain scenarios. An operator can then evolve to the higher levels, gaining additional benefits and addressing a wider range of scenarios. Network automation is a long run objective with step-to-step process, from providing an alternative to repetitive execution actions, to performing perception and monitoring of network environment and network device status, making decisions based on multiple factors and policies, and providing effective perception of end user experience. The system capability also starts from some service scenarios and covers all service scenarios.
Stakeholders[3]		
Stakeholders' assets, values[4]		
System's threats and vulnerabilities[5]		

Key performance indicators (KPIs)	ID	Name	Description	Reference to mentioned use case objectives

AI features		
	Task(s)	Other (please specify): All
	Method(s)[6]	
	Hardware[7]	
	Topology[8]	
	Terms and concepts used[9]	Autonomous network, self-driving network

Standardization opportunities/ requirements		
Challenges and issues		
Societal concerns	Description	

	SDGs[10]	Industry, Innovation, and Infrastructure

Data (optional)

Data characteristics	
Description	
Source[11]	
Type[12]	
Volume (size)	
Velocity (e.g. real time)[13]	
Variety (multiple datasets)[14]	
Variability (rate of change)[15]	
Quality[16]	

Process scenario (optional)

Scenario conditions					
No.	Scenario name	Scenario description	Triggering event	Pre-condition[17]	Post-condition[18]

Training (optional)

Scenario name	Training				
Step No.	Event[19]	Name of process/Activity[20]	Primary actor	Description of process/activity	Requirement

Specification of training data[21]	

Evaluation (optional)

Scenario name	Evaluation				
Step No.	Event[22]	Name of process/Activity[23]	Primary actor	Description of process/activity	Requirement

Input of evaluation[24]	
Output of evaluation[25]	

Execution (optional)

Scenario name	Execution				
Step No.	Event[26]	Name of process/Activity[27]	Primary actor	Description of process/activity	Requirement

Input of Execution[28]	
Output of Execution[29]	

Retraining (optional)

Scenario name	Retraining				
Step No.	Event[30]	Name of process/Activity[31]	Primary actor	Description of process/activity	Requirement

Specification of retraining data[32]	

References

References						
No.	Type	Reference	Status	Impact on use case	Originator/organization	Link

(Examples of other citation that cannot be described in the table format)

[1] Lominandze, DG. *Cyclotron waves in plasma*. Translated by AN. Dellis; edited by SM. Hamberger. 1st ed. Oxford : Pergamon Press, 1981. 206 p. International series in natural philosophy. Translation of: Ciklotronnye volny v plazme. ISBN 0-08-021680-3.

[2]Parker, TJ. and Haswell, WD. *A Text-book of zoology*. 5th ed., vol 1. revised by WD. Lang. London : Macmillan 1930. Section 12, Phyllum Mollusca, pp. 663-782.

[3]Wringley, EA. Parish registers and the historian. In Steel, DJ. *National index of parish registers*. London : Society of Genealogists, 1968, vol. 1, pp. 155-167.

[4]Communication equipment manufacturers. Manufacturing a Primary Industries Division, Statistics Canada. Preliminary Edition, 1970- . Ottawa : Statistics Canada, 1971- . Annual census of manufacturers. (in English), (in French). ISSN 0700-0758.

[5] Weaver, William. The Collectors: command performances. Photography by Robert Emmet Bright. Architectural Digest, December 1985, vol. 42, no. 12, pp. 126-133.

Footnote

[1] Leave this cell blank.

[2] The scope defines the limits of the use case.

[3] Stakeholder involved in the scenario - examples are: type of organization; customers, 3rd parties; end users; humans; environment; negative stakeholders (attackers, criminals, etc).

[4] Assets and values that are valuable to the stakeholders and at the risk of being compromised by the AI system deployment – examples can include competitiveness; reputation or trust; fairness; safety; privacy; stability; etc.

[5] Threats and vulnerabilities can compromise the assets and values above. Examples are: different sources of bias; incorrect AI system use; new security threats; challenges to accountability; new privacy threats (hidden patterns).

[6] AI method(s)/framework(s) used.

[7] Hardware system used.

[8] Topology is the study of geometric forms differentiated by intersection and bifurcation. The term is used for the graphic aspects network architectures.

[9] Terms and concepts listed here can be used to extend the work of WG 1 (AWI 22989 and AWI 23053) as necessary.

[10] The Sustainable Development Goals (SDGs), otherwise known as the Global Goals, are a collection of 17 global goals set by the United Nations General Assembly. SDGs are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity.
See URL for more details: http://www.undp.org/content/undp/en/home/sustainable-development-goals.html

[11] Origin of data, which could be from instruments, IoT, web, surveys, commercial activity, or from simulations.

[12] Structured/unstructured Images, voices, text, gene sequences, and numerical. Composite: time-series, graph-structured

[13] The rate of flow at which the data is created, stored, analysed, or visualized.

[14] Data from a number of domains and a number of data types. The wider range of data formats, logical models, timescales, and semantics complicates the integration of the variety of data.

[15] Changes in data rate, format/structure, semantics, and/or quality.

[16] Completeness and accuracy of the data with respect to semantic content as well as syntactical of the data (such as presence of missing fields or incorrect values)

[17] Describe which condition(s) should have been met before this scenario happens.

[18] Describe which condition(s) should prevail after this scenario happens. The post-condition may also define "success" or "failure" conditions.

[19] The event that triggers the step. This might be completion of the previous event.

[20] Action verbs should be used when naming activity.

[21] Training data can be further specified.

[22] The event that triggers the step. This might be completion of the previous event.

[23] Action verbs should be used when naming activity.

[24] Specify input of evaluation.

[25] Specify output of evaluation.

[26] The event that triggers the step. This might be completion of the previous event.

[27] Action verbs should be used when naming activity.

[28] Specify input of evaluation.

[29] Specify output of evaluation.

[30] The event that triggers the step. This might be completion of the previous event.

[31] Action verbs should be used when naming activity.

[32] Retraining data can be further specified.