SA5 Rel-19 23Q3 moderated discussion – Digital Twin aspects of management - Version 0.0.4

SA5

https://nwm-trial.etsi.org/#/documents/8717

Feedback Form 1: Summary

1 – China Mobile Com. Corporation

Based on the discussion in NWM, following are the brief summary:

Comments received from Nokia, Ericsson, TELEFONICA S.A., Huawei. All comments are taken care of. It is recommended to agree on the submitted SID.

1 Proposal in SA5#150

Topic Name: Digital Twin aspects of management

Potential scope includes:

(1) Identify the potential scenarios, use cases and corresponding requirements for management and orchestration purposes based on digital twin of the 5G network. This also includes identifying the network domain, function or feature which needs to be managed using digital twin.

(2) Investigate the potential enhancements (e.g., new interfaces) and extensions (e.g., data collection type, frequency and methods) of the MnSs to support the management and orchestration based on digital twin of the identified 5G network.

Potential collaboration groups and related topics: ITU-T SG13, SA1, SA2, RAN3, ETSI ZSM

2 Justification

Digital Twins (DTs) are an increasingly examined technology relevant to system automation. A DT is a virtual replica of a real-world system - a “physical” system - on which operations can be performed. The observed outcomes and effects of such operations constitute information that can be used e.g. to inform operational decision-making, including within automation-supporting closed loops.

A Network Digital Twin (NDT) is a DT whose physical counterpart is a communications network, or some part of one. The communications network can include e.g. physical network elements and components, virtualized network functions (VNFs - i.e., network functional elements instantiated as software-based entities), the physical hosts for such VNFs, services and traffic, etc.

Some standardization organizations have also started the digital twin related research. For example, ETSI ZSM is studying Digital Twin as an enabling technology in the fields of autonomous scenarios and management services. ISO is studying the digital twin manufacturing framework. ITU-T is studying the requirements and architecture of digital twin network. IETF has also triggered the discussion of digital twin network which focus on the concepts and architecture.

The potential benefit to introduce the digital twin in 3GPP management system can include:

1. Help for efficiently verification of the network operation, the configuration and policy decided by the management and orchestration system can be verified before the deployment.

- Service assurance verification: modification of network slice SLA attribute(s)
- The 5GC management verification: creation/modification of 5GC NFs, etc
- The AI-related optimizations verification

2. Construct a full view of network topology and traffic, which can help for end-to-end or single-domain fault localization, traffic path optimization, prediction and avoidance of signaling storms, etc. By using this MnS, management and orchestration system can get the result of verification and optimize configuration and avoid to make the failures of actual network.

Therefore, it is necessary for SA5 to investigate the network digital twin derived by above scenarios. SA5 also will align the work from other SDOs and forums concerning digital twin.

Feedback Form 2: Comments for Justification

1 – China Mobile Com. Corporation

1 – Nokia: This statement is confusing: ”the twin used to construct a twin”!

1) China Mobile Com. Corporation:Reply to comment#1 from (Nokia):It states the twin technology can be used to construct a twin network. It will be revised a lot in next version.

Clarify definitions – Nokia: Since network management already has a good representation of the real network in digital form, it is critical that we define what the digital twin is in a way that it is differentiated from the existing NM artefacts.

1) China Mobile Com. Corporation:Reply to comment#Clarify definitions from (Nokia):It will be revised in next version. The definition will refer to ZSM□ that is A Network Digital Twin (NDT) is a DT whose physical counterpart is a communications network, or some part of one. The communications network can include e.g. physical network elements and components, virtualized network functions (VNFs - i.e., network functional elements instantiated as software-based entities), the physical hosts for such VNFs, services and traffic, etc.

2) TELEFONICA S.A.: We should clarify what Digital Twin differs from NRM, from SA5 viewpoint. Doesn’t NRM comply (at least partially) with the actual digital twin definition?

3) China Mobile Com. Corporation:Reply to comment#Clarify definitions from (TELEFONICA S.A.):The digital twin network is a virtual representation of the physical network, which means to construct the E2E 5G network formed by various physical devices (such as hosts, routers, switches, etc.) and media (fiber optic cables, cables, twisted pairs, etc.) connected together, including the RAN domain, TN domain, CN domain and data network. Digital twin network can build some twin models based on NRM. Build other twin models by extending MRN or collecting other data, such as topologies, links. These twin models are connected together to form a digital twin network.

Isn't this SON? – Nokia:A lot of this sounds like SON, we need to clarify what digital twin is and what the extra value is that it brings beyond SON, MDA, etc.

1) China Mobile Com. Corporation:Reply to comment#Isn't this SON? from (Nokia): The Digital twin network is a virtual replica of the communications network. It is not SON. It is mentioned that the digital twin network can be used to determine the expected behavioural impacts of changes to network, traffic, service, environmental or other conditions, or of prospective operational actions, and additionally can make operational decisions based on such assessments and drive those decisions forward into actuation on the physical network, in the ZSM specification. It will be revised in the next version.

3 – Nokia:Is the title 1) meant to reflect the content or is it 2) the default that was used in the discussion paper. If 1) - does it there are other aspects that do not relate to management? Where then shall they be discussed? if 2), please propose an appropriate title for the work that matches the objectives

2) Ericsson LM:As said many times before in Rel-18 discussions about Digital Twin:This is an technology looking for a problem and not the other way around. It is also written in the end of Justification: "...evaluate whether this technology can bring some value to 3GPP network management and orchestration"It ought to start from a issue that can be solved using Digital Twin technology. It is not clear whether the Digital Twin is part of the 3GPP management system or if it is an outside system. Depending on that there are very different needs.

3) China Mobile Com. Corporation:Reply to comment: The title will be changed to New SID on Management aspect of Network Digital Twin. As the network becomes more complex, some network configurations applied directly to the network may cause errors, such as the opening of a new network or the deletion of some data. These errors can have a negative impact on the network. Therefore, a digital twin network is required to validate these network configurations.Only verified network configurations can be configured to the network. In addition, digital twin networks are needed to validate the AI's training and inference to ensure reliability when ML entities are deployed on a physical network. Digital Twin is a kind of MnS. It is part of the 3GPP management system.

5 – Nokia:What is "management and orchestration based on digital twin"? Are to focus on the management of digital twins (i.e. digital twins become managed objects in the network) or the use of digital twins towards fulfilling management requirements?

1) TELEFONICA S.A.: Agree with Nokia. I suspect it is the second assumption, but I will let the topic owner to clarify on this.

2) China Mobile Com. Corporation:Reply to comment: Yes, the purpose is using of digital twins towards fulfilling management requirements, like the MDAS does, which can be a service.

4 – Nokia:This means the digital twin will do the management! is that the intention? if it is why is that important to be studied if in that case, the digital twin is only 1 consumer of management services.

1) China Mobile Com. Corporation:Reply to comment: There was a clerical error. Please ignore the previous message. It means that digital twin network can be an auxiliary way to manage network domains, like the MDAS does, which can a service. From my point of view, digital twin is a kind of management service provider.

6 – Nokia: Here it requirements based on Digital twin but on the next line the digital twin is doing the management! That seems contradicting

1) China Mobile Com. Corporation:Reply to comment: It's really based on digital twins. The next sentence will be updated in the latest version.

7 – Nokia: This sentence is hard to understand! Plus you seem to focus on describing how the digital twin is constructed or how it works and now what it is.

1) China Mobile Com. Corporation:Reply to comment: Here are some concepts defined in ETSI ZSM, which may be referred to in SA5 for revised justification. Digital Twins (DTs) are an increasingly examined technology relevant to system automation. A DT is a virtual replica of a real-world system - a "physical" system - on which operations can be performed. The observed outcomes and effects of such operations constitute information that can be used e.g. to inform operational decision-making, including within automation-supporting closed loops. A Network Digital Twin (NDT) is a DT whose physical counterpart is a communications network, or some part of one. The communications network can include e.g. physical network elements and components, virtualized network functions (VNFs - i.e., network functional elements instantiated as software-based entities), the physical hosts for such VNFs, services and traffic, etc.

2) TELEFONICA S.A.: As I see it, the digital twin is the "Digital counterpart of the physical twin that captures its attributes, behaviour and interactions". In the context of SA5, the physical twin is a communications network, or some part of one.

3) China Mobile Com. Corporation:Reply to comment: Yes, Agreed. Rewording is needed.

8 – Nokia: So, what is a "digital twin network" and how does it differ from a "network digital twin"? To me: "a virtual representation of the physical network" sounds like a network digital twin.

1) China Mobile Com. Corporation:Yes, network digital twin may be better for understand in the sco pe of 3GPP, it will be revised in next version.

2) TELEFONICA S.A.: Digital twin is the "Digital counterpart of the physical twin that captures its attributes, behaviour and interactions", wherein physical twin is circumscribed to managed network resources/constructions.

3) China Mobile Com. Corporation:I agree your point. We consider to use it in the SID proposal.

9 – Nokia: Here you talk about "a simulation platform", but later you only mention the running status and health state of the network and don't talk much about emulation, prediction and other aspects. If it was only for monitoring purposes, is it justified to duplicate the network into this digital platform?

1) China Mobile Com. Corporation:At first, build a simulation platform, besides monitoring purposes, as mentioned later, the digital twin technology can help for efficiently simulation of the network operation, the configuration and policy decided by the management and orchestration system can be verified before the deployment. digital twin technology or the simulation platform constructed by digital twin can be provided as a service. It will be revised a lot in next version.

10 – Nokia: This seems to imply that there isn't any sort of verification done currently. Is this true?

1) TELEFONICA S.A.:I think this sentence described a 'what-if' analysis that allows you to test config/-control actions before getting them injected in production environments.

2) China Mobile Com. Corporation:It allows you to test the operational status of configurations in a real network environment before getting them injected in production environments . If the verification results do not meet the expected effect, timely adjustments can be made to the configuration to avoid affecting the real network. This is the significance of verification.

3) China Mobile Com. Corporation:T hat's exactly what Jose meant.

11 – Nokia: Not all the bullets are scenarios: at best they are all use cases

1) China Mobile Com. Corporation:We will update this in the next version.

12 – Nokia: Why this specific list of functions and data types? what is the motivation to select these?

1) TELEFONICA S.A.: suggest to write ”interact with MnS producers and/or Management Functions (e.g. NSMF, NSSMF, NFVO, NFMF.)”

2) China Mobile Com. Corporation:I agree your point. It will be revised in next version.

13– Nokia: Are we sure that invokation of PA, FS, MDA by digital twins is different from that by other Mns consumers?

1) China Mobile Com. Corporation:From my personal perspective, digital twins as MnS consumers are similar to other consumers.

14– Nokia: Do we have a notion of an AI model library in SA5? why does a digital twin need to select an AI model?

1) China Mobile Com. Corporation:We consider updating it to a digital twin interacting with AIML management services provider. ML entities can be deployed in digital twins to perform some intelligent analysis. After the intelligent analysis result is verified in the digital twin, it is configured to the physical network domain.

TELEFONICA S.A.: What do you mean with holographic?

1) China Mobile Com. Corporation:”Holographic perspective of network topology and traffic” refers to the use of holographic technology to visualize the network topology and data traffic in a three-dimensional manner. This perspective provides a more immersive and interactive way to understand and analyze the network structure and traffic patterns, which can help network administrators better manage and optimize the network. In other words, it is a method of representing the network topology and traffic in a holographic form that allows for a more detailed and comprehensive view of the network’s performance and status. For mobile network, digital twin can be used construct a digital twin network as a virtual representation of the physical network, which means to construct the E2E 5G network formed by various physical devices (such as hosts, routers, switches, etc.) and media (fiber optic cables, cables, twisted pairs, etc.) connected together, including the RAN domain, TN domain, CN domain and data network. So, we use the term of Holographic.

TELEFONICA S.A.: Digital Twin consumption of SA5 capabilities.Is this Digital Twin capability/system presumed to be part of 3GPP mgmt system, or a capability/system acting as external MnS consumer? I

1) China Mobile Com. Corporation:Digital Twin capability/system more like a service can be provided by 3GPP mgmt system. The management system can therefore benefit from network digital twin services for improving networks performance and efficiency to accommodate and support the diversity of services and requirements. The network digital twin utilize the network management data collected from the network (including e.g. service, slicing and/or network functions related data) and make the corresponding feedback(e.g., configuration results) based on the collected information.

3 Objective

(1) Identify the potential scenarios, use cases and corresponding requirements for management and orchestration purposes based on digital twin of the 5G network. This also includes identifying the network

domain, function or feature which needs to be managed using digital twin.

Feedback Form 3: Comments for Obj-1

1 – Nokia First objective should be to clearly define digital twins and its features as well as its differences from existing 3GPP capabilities.
2 – Nokia First objective should be to clearly define digital twins and its features as well as its differences from existing 3GPP capabilities.
3 – Ericsson LM As it is not clear what issue is going to be solved, it is difficult to understand if the objective is correct or not.
4 – Huawei Tech.(UK) Co.. Ltd - Should SA5 give definition of digital twin or in where SA5 can have a ref to that? This should be the first step. - What is the relation between the two issues and objectives? are the issues the potential UC/scenarios mentioned in Objective 1? For objective 1, suggest making it clear on what are the the potential scenarios/use cases.
5 – TELEFONICA S.A. ”identifying the network domain, function or feature which needs to be managed using digital twin” -> *needs to* means requirement/mandate - I’d expect Digital Twin at least as an optional add-on.
6 – China Mobile Com. Corporation Thanks for the comments. Obj-1 is revised to ”- Identify the potential use cases and corresponding requirements for management and orchestration purposes based on digital twin of the 5G network. (The potential use cases may include: a full perspective of network topology and traffic, verification of network operations, etc.)”

(2) Investigate the potential enhancements (e.g., new interfaces) and extensions (e.g., data collection type, frequency and methods) of the MnS to support the management and orchestration based on digital twin of the identified 5G network.

Feedback Form 4: Comments for Obj-2

1 – Ericsson LM

As it is not clear what issue is going to be solved, it is difficult to understand if the objective is correct or not.

2 – Huawei Tech.(UK) Co.. Ltd

- What does it mean for the 'identified 5G network' of 'based on digital twin of the identified 5G network.'?
- Wording suggestion for obj 2: According to the identified UC and potentail new requirements, make gap analysis with exsiting MnS and investigate the potential enhancements of MnS.

3 – China Mobile Com. Corporation

Thanks for the comments. Obj-2 is revised to "- According to the identified UC and potential new requirements, make gap analysis with existing MnS and investigate the potential enhancements of MnS."

(3) ...

Feedback Form 5: Suggestions for

1 – Ericsson LM

The justification of what issue is to be solved has to be clarified first. Then what kind of objectives are to be taken has to follow the Justificaiton.

2 – Huawei Tech.(UK) Co.. Ltd

- For 'Potential collaboration groups and related topics: ITU-T SG13, SA1, SA2, RAN3, ETSI ZSM' - are there any info on these in the description? Need to be clarified.
- For issue 1, It's better to give further explanation/or a concrete problem description for each scenario. For instance, what is the existing problem in optimization of close loop management and how does NDT solve the problem.
- For issue 2, before figuring out 'how', we need to understand 'why' for the problems need to be resolved. What is a unified AI model library?
- Suggest to add one new objective: Define the concepts and terms related to DT and study the DT framework.

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3 – China Mobile Com. Corporation Thanks for the comments. Obj-3 is revised to ”- Define the concepts and terms related to DT and the DT framework in 3GPP management system.”
4 – China Mobile Com. Corporation Obj-4 is added for - Recommendations for the normative work.