**3GPP TSG-SA5 Meeting #140-e *S5-21xxxx***

**e-meeting, 15 - 24 November 2021**

**Source: China Mobile**

**Title: Discussion on digital twin for network management**

**Document for: Discussion**

**Agenda Item: 6.2**

# 1 Decision/action requested

***In this box give a very clear / short /concise statement of what is wanted.***

# 2 References

# 3 Rationale

There have been some discussions on Digital Twin technology for network management system, but there are still some issues that has not reached consensuses. We would like to share China Mobile’s views on this topic.

3.1 Motivation

Digital twin a new technology which can make full use of physical model, sensor update, operation history and other data to complete the mapping in the virtual space, thereby reflecting the full lifecycle of the corresponding physical network process.

By applying digital twin technology to the mobile network, virtual images of different physical network facilities can be created, the digital twin network is consistent with the physical network elements, topology, and data, and can provide environments for verifying the correctness of network configuration and the effect of new technologies, etc. It can greatly reduce the risk of the existing network management and eliminates the possibility of faults in the existing network caused by incorrect configuration. In addition, the digital twin network can also play an important role in scenarios such as perspective of network traffic and full life cycle management of network elements. Through the real-time interaction between the physical network and the twin network, Digital Twin Network (DTN) is likely to become a new direction for future network planning, operation, management, and help network operators and vendors to improve network management efficiency.

3.2 Roles in Mobile Network Management

**Holographic perspective of network topology and traffic:**

Description:

Digital twin network can greatly improve the level of holographic presentation of the network. Not only can the various network elements and topology information in the network be dynamically visualized, but also the dynamic change process, real-time status, evolution direction and other information of the network's full lifecycle can also be presented to the customer through the digital twin network. Network virtual-real interaction mapping will help customers to more clearly perceive the network status. The physical network has changed from a "black box" to a "white box".

Requirements for network management:

* Input to digital twin network: network performance, topology, management data (e.g. configuration information), etc. Assuming digital twin network is controlled by network operators.
* Real time communication between digital twin network and real network

**Verification of network operations:**

Description:

Efficiently simulation of the network operation and deploy it to the physical network after full verification, which can greatly reduce the trial and error risk and cost of existing network deployment, and improve the efficiency of network planning, thereby greatly reducing the risk of network crash when verifying in the real network. Compared with traditional simulators, digital twin network presents the real network more accurately based on the network data obtained by real-time communication, the verification results can reflect the results of the final network operation more accurately.

Requirements for network management:

* Network service reconstruction in digital twin network with the same conditions and environments with the real network.
* Procedure of verification between real network and digital twin network, the network operations will either be generated inside the network management system, or digital twin network system will integrate some decision making nodes (this part may need a new digital twin network platform/architecture which is out of 3GPP scope).

**Full lifecycle management of both equipment and network service:**

Description:

The lifecycle of network equipment is mainly managed by vendors and the lifecycle of the network is managed by the network operators. The main body of responsibility for the network and equipment is different, and the two different lifecycle management is not well cooperated, which is not conducive to network failure retrospective, failure prediction, and network optimization design, etc. Construction of digital twin network includes not only the network service model, but also the network element model. Through the network element model, the operating state of the equipment in the network can be simulated, controlled, diagnosed and predicted. When a network service failure occurs during network operation, based on different kind of models, it can not only go back to the “past” network, but also go back to the “past” of network equipment through the network element model, thus realizing the lifecycle correlation analysis of the network serive and equipment.

Requirements for network management:

* Distinguish vendor-specific and standardization part in modelling. For network service model, it will not touch detail information of the network constitutes e.g. internal logic of network function, network elements configuration. This part can be standardized. For network element model, vendor specific solution will not be managed by operator and this will not be presented in the model. But for the standardized part, for example network resource model, this should be reflected in the network element model, the operator will have a global view of the whole digital twin network system like traditional physical network management.
* Perform digital twin network management and orchestration
* Network element and network service information reporting to support modelling

Note: Network modelling in digital twin is out of 3GPP scope, here SA5 only need specify what kind of existed standardized information inside network management system need to be reporting to support modelling.

**Optimisation of real time close loop management:**

Description:

Digital twin network can be used as an additional node in the closed loop of the network management. Through network configuration adjustment and optimization in the digital twin network, real-time control, feedback and optimization of the physical network can be realized, and finally real-time closed-loop control of network self-learning, self-verification, and self-evolution can be achieved.

Requirements for network management:

* Specify the relationship with existed topic in SA5 (e.g. eMDAS, eCOSLA). Digital twin network for close loop is an optional and possible additional feature, we can first focus on discuss how to assist digital twin network management and orchestration by using the existed features.

# 4 Detailed proposal

We propose to trigger a new study item on digital twin for network management, the objective of this study will focus the following aspects:

- Identify the potential scenarios, corresponding requirements and possible solutions by introducing digital twin to network management system.

- Investigate the potential improvements and extensions for network management and orchestration based on digital twin e.g. prediction, validation.

- Investigate how to assist digital twin network management and orchestration by using AI/ML.

- Identify how to specify network management services related to digital twin network.