Reconfigurable In-network Security Sensor Network with beyond 5G Emerging Technology (REINS network)

Satoru OKAMOTO[†a)], **Naoaki YAMANAKA**[†], ***Fellows***, **Masaki SUZUKI**[††], ***Nonmember***, **Atsushi TAGAMI**[††], ***Senior Member***, **Nobuhito MATSUYAMA**[†††], ***and*** **Takayuki MURANAKA**[†††], ***Nonmembers***

1. Introduction

In the Beyond 5G (B5G) era, a wide variety of devices are connected to the communication network. Therefore, to effectively utilize radio resources, it is necessary to eliminate unnecessary communication and highly secure the entire transport network. To realize a secure network by efficiently utilizing limited computational resources and human resources, digital twin network management with distributed network sensors is one of the key technologies of secure networks.

2. Proposed Secure Network Concept: "Reconfigurable In-network Security Sensor (REINS) Network"

Proposed concept is as follows, "Traffic data collected by network sensors distributed over the network are transferred to network operation and management center (NOC) via ultra-reliable and low latency probing (URLLP) paths, and the analyzed results are reflected in the transport layer via application program interface (API)". An overview of the proposed concept is shown in Fig. 1. The REINS network is constructed with three layers: the reconfigurable transport layer, the hyper probing layer, and the digital twin monitoring and control layer.

3. Required Technologies for realizing REINS Network

To realize the REINS network concept, we have proposed a digital twin-type deeply programmable resource pool architecture by optically interconnected sensor nodes and a centralized NOC [1]. The Reconfigurable Communication Processor (RCP) [2] which has capability of over 100 Gbps in-network sensor function is now developing. RCPs and reconfigurable optical networks will provide the reconfigurable transport layer for realizing B5G packet transport infrastructure network.

Traffic data collected by network sensors distributed over the network are transferred to NOC using ultra-reliable and low latency communication – deterministic networking (URLLC-DN) tunnels. To realize reconfigurable URLLC-DN tunnels, developing ultra-low delay jitter packet transport technologies are required. µs order delay jitter packet path is preferable to realize an end-to-end URLLC-DN service on B5G networks especially for xR applications. The URLLC-DN tunnel can be dynamically setup between the network sensor (probing point) and the NOC, therefore it can provide URLLP path. The hyper probing layer is defined by URLLP paths and control systems of URLLP paths.

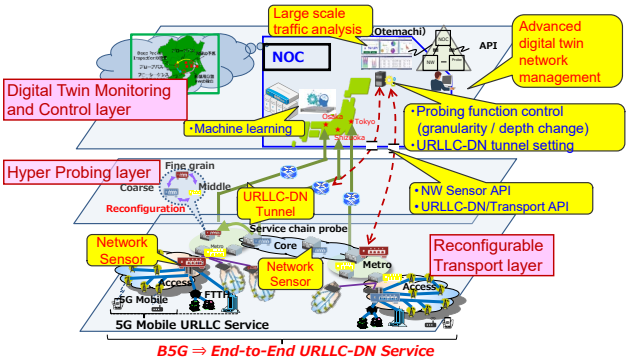

Fig. 1. Concept of the REINS network.

In the NOC, two functions will be implemented. One is building digital twin data from just-in-time collected data via URLLP paths. Another is autonomous network monitoring and control in cooperation with machine learning and automatic defense against wide-area cyber-attacks. This is the digital twin monitoring and control layer. The analyzed results in the NOC are reflected in the transport layer via APIs. The APIs should be defined.

Realizing a closed loop of these 3 layers technologies in the B5G transport is a target of the REINS network development.

4. Conclusions

The REINS network concept and required technologies are discussed.

Acknowledgments

This work is partly supported by the commissioned research (02501) of the National Institute of Information and Communications Technology (NICT), JAPAN.

References

[1] Y. Nasu, et al., "Deeply programmable resource pool architecture by optically interconnected highly secure and manageable packet switching network," ICETC 2020, L2-1, Dec. 2020.

[2] S. Okamoto, et al., "Reconfigurable Communication Processor for Future Smart and Connected Community Network," ISACIT 2019, No.15, Aug. 2019.

[†]The authors are with Keio University, Japan
[††]The authors are with KDDI Research Inc., Japan
[†††]The authors are with Alaxala Networks Corp., Japan
[a)] E-mail: okamoto@ieee.org