NTT

(Press Release)

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NTT Corporation

NTT & Nokia Demonstrate Dynamic Rerouting in Mobile Fronthaul using IOWN All-Photonics Network (APN)

Achieved power reduction of operating base stations in wide areas using the IOWN APN towards flexible RAN network operation

Tokyo –Jan. 18, 2024 – NTT Corporation (NTT) and Nokia Corporation (Nokia) demonstrated that the IOWN All Photonics Network (APN)[1] which is considered as an architecture for IOWN Global Forum[2], can be applied to the mobile fronthaul between the antenna unit (Radio Unit/RU) and the control unit (Distributed Unit/DU) of a 5G RAN base station. In the demonstration, even when the distance between RU and DU is about 25 km, the low delay transmission using IOWN APN meets the standard regulation of mobile fronthaul, and it was confirmed that the RU and DU of 5G operate normally. This achievement will contribute to reducing the number of DUs and their power consumption by enabling long-distance transmission between RU and DU and wide-range base station operation.

1. Background of the study

5G and 6G use higher frequency bands than 4G, and require many base stations to cover the same area, which creates a problem of increase in the number of base stations and power consumption.

Until now, we have dealt with this problem by separating the antenna equipment and the control equipment of the base station and aggregating the DUs. The IOWN GF's report states that the distance between RU and DU is often less than 7 km, which means that a large number of RUs that exist over a wide are cannot be sufficiently aggregated into a DU.

Conventionally, a fixed single mode optical fiber connection (dark fiber) has been used for the mobile fronthaul between the RU and DU, but in this case, the RU is connected in single mode with a specific DU, and in the event of a failure, service in the area covered by the RU is affected.

The IOWN APN enables dynamic re-routing between RUs and DUs. If a failure occurs between an RU and a DU, the IOWN APN can bypass the failure, allowing the service to continue in the area covered by the RU. There is currently a strict industry standard[3] for mobile fronthaul with a delay time of 160 μs or less[4], and 5G RUs and DUs are designed to operate under this standard. In this demonstration, we verified that 5G RU and DU can operate normally even if the distance between RU and DU is extended by using IOWN APN.

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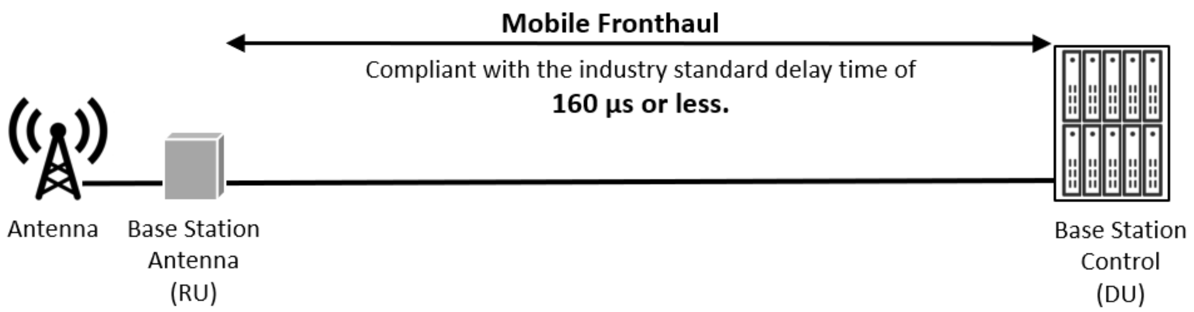

Figure 1 *Mobile Fronthaul and Delay Requirements*

2. Overview of demonstration experiments

The IOWN APN connects the 5G RUs and DUs to verify that the 5G RUs and DUs work properly for long-distance transmission, including data transfer. The verification was performed in accordance with the IOWN Global Forum's PoC Reference[5] for the IOWN for mobile network, including the IOWN APN device configuration and transmission method. We also tested different APN device sections (Between APN-T and APN-G, between APN-G and APN-I, etc.) for long-distance transmission, assuming various APN device deployment.

2.1. Results of demonstration experiment

As a result of the demonstration experiments, it was confirmed that RU and DU operate normally in an environment with a transmission distance of 25 km, that there is no impact on the communication quality such as data transfer speed and loss rate[6], and that the delay time is 133 µs.

We also confirmed in theory that, with the delay time of 133 µs, the maximum distance of long-distance transmission is approximately 30 km[7].

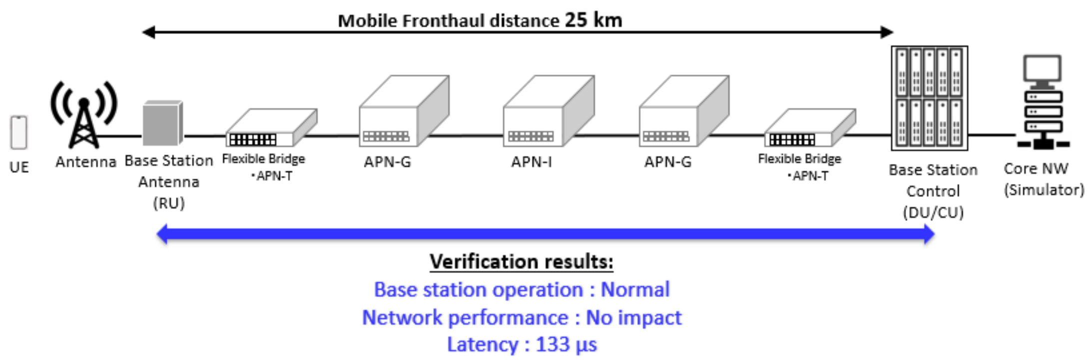

Figure 2 *Structure and Results of Demonstration Experiment*

2.2. Role of each company in the demonstration experiment

A mobile fronthaul demonstration experiment (Figure 2) using the IOWN APN was conducted as

follows:
■NTT: Conduct a demonstration experiment to provide a test environment that can confirm the health and measure the quality of 5G mobile communications such as terminals, RU, and CU/DU.
■Nokia: Provide IOWN APN devices such as Flexible Bridge, APN-T, APN-G and APN-I for the demonstration experiment.

3. Outlook

This demonstration showed that 5G RU and DU work correctly even if the distance between RU and DU is extended by using IOWN APN.

In the future, we will simulate the failure between RU and DU, and work on a demonstration experiment to see if stable mobile communication services can continue under those environments by dynamically re-routing of the IOWN APN, with the aim of realizing a resilient network. In addition, we will work on a demonstration experiment of a power-efficient mobile network by dynamically re-routing between RUs and DUs using IOWN APN according to fluctuations in the number of users and traffic volume during the day and at night.

“I believe this is a significant achievement proving the effectiveness of the IOWN Global Forum All Photonics Network for the mobile fronthaul. The result clearly illustrates technical feasibilities for a robust and flexible commercial mobile network with low power consumption. NTT will continue to collaborate with Nokia and other IOWN Global Forum members to develop the next generation of ICT infrastructures.” said **Katsuhiko Kawazoe, Representative Member of the Board, Senior Executive Vice President (CTO/ CIO/ CDO), NTT.**

“Nokia is proud to contribute to the IOWN GF and we are looking forward to our continued journey with NTT and other IOWN GF members. As an innovative and trusted global optical leader, Nokia is deeply aware of the growing need for high-speed and low-latency connections because of the virtualization of key mobile core components. This test showcases that our high-performance optical solutions are designed to effectively address this need.” said **James Watt, Vice President and General Manager for the Optical Networks Division at Nokia.**

[1] *IOWN Global Forum (IOWN GF):*
A new industry forum that promotes the realization of a new communication platform consisting of the All-Photonics Network, which includes silicon photonics, edge computing, and wireless distributed computing, through the development of new technologies, frameworks, technical specifications, and designs.
https://iowngf.org/
https://group.ntt/en/newsrelease/2019/10/31/191031a.html
[2] *IOWN APN (All Photonics Network):*

The IOWN consists of three main components: the All-Photonics Network (APN), which introduces photonics-based technology to everything from networks to terminals; the Digital Twin Computing, which enables advanced and real-time interaction between objects and humans in cyberspace; and the Cognitive Foundation, which efficiently deploys various ICT resources including them.
By introducing new optical technologies from the network to terminals and chips, APN achieves ultra-low power consumption and ultra-high-speed processing, which has been difficult to achieve. By assigning wavelengths to each function on a single optical fiber, we can provide multiple functions that support our social infrastructure, such as information and communication functions, and internet and sensing functions, without interfering with each other.
https://www.rd.ntt/e/iown/

[3] *3GPP (The 3rd Generation Partnership Project [3GPP TR 38.801], [3GPP TR 38.806], [3GPP TR 38.816] RAN For feature split option 7.*

[4] *Fiber delay: 0~150 μs and packet delay variation (PDV): 0~ 10 μs for a total of 160 μs.*

[5] *PoC Reference of IOWN for mobile network: As a result of the technical study in the mobile network area in the IOWN Global Forum, the technical conditions for the demonstration experiment are defined and published.*
https://iowngf.org/wp-content/uploads/formidable/21/IOWN-GF-RD-MFH_over_APN_PoC_Reference_1.0.pdf

[6] *We compared the APN configuration data with the conventional configuration data in which a single mode connection was made between the RU and DU using optical dark fiber, and confirmed that the values were the same.*

[7] *With a delay time of 133 μs at the time of verification, it was possible to extend the 27 μs spectroscopic fiber in contrast to the specified delay time of 160 μs. When the delay time of the optical fiber was 5 μs/km, it was proven in theory that the optical fiber could be connected for a total of about 5 km up to about 30 km.*

About NTT

NTT contributes to a sustainable society through the power of innovation. We are a leading global technology company providing services to consumers and business as a mobile operator, infrastructure, networks, applications, and consulting provider. Our offerings include digital business consulting, managed application services, workplace and cloud solutions, data center and edge computing, all supported by our deep global industry expertise. We are over $97B in revenue and 330,000 employees, with $3.6B in annual R&D investments. Our operations span across 80+ countries and regions, allowing us to serve clients in over 190 of them. We serve over 75% of Fortune Global 100 companies, thousands of other enterprise and government clients and millions of consumers.

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