World's Fastest 600-Gbit/s per Lambda (λ) Optical Transmission with 587-Gbit/s Data Transfer—Prospect for Realizing 600-Gbit/s/λ Optical Network and Data Transfer Protocol

1. Introduction

The National Institute of Informatics (NII), NTT EAST, and NTT announced that they had experimentally demonstrated communications with a data transfer rate of 587 Gbit/s between general-purpose servers on a 600-Gbit/s/λ (λ: lambda, indicating wavelength) optical transmission system spanning Tokyo and Chiba.

For this experiment, we constructed the world's longest transmission link with total distances of 102 km over commercial field fiber in a 600-Gbit/s/λ transmission system. In addition, we recorded the fastest data transfer rate of 587 Gbit/s between one set of servers by applying the Massively Multi-Connection File Transfer Protocol (MMCFTP) developed by NII for data transfer. Moreover, in order to achieve a highly reliable optical network, we developed and successfully demonstrated flexible route switching with an adaptive change in the transmission rate from 600 Gbit/s to 400 Gbit/s and with optical wavelength conversion, based on the transmission distance of the optical signal.

2. Overview of achievements

For the experimental demonstration conducted in November 2018, we constructed an optical transmission system (**Fig. 1**) capable of transmitting signals at a rate of 600 Gbit/s at a single wavelength, between the NII office (Hitotsubashi, Chiyoda-ku, Tokyo) and the NTT EAST office (Kashiwa City, Chiba). We successfully demonstrated three experiments.

2.1 Experiment 1

For the 600-Gbit/s transmission system, NTT introduced an adaptive-rate transponder supporting a variety of transmission rates ranging from 100 Gbit/s to 600 Gbit/s, by implementing the world's most advanced digital signal processing technology and OTUCn* technology which enables the multiplexing of up to six 100-Gbit/s Ethernet client signals on one chip. NTT EAST constructed a network that transferred data at 600 Gbit/s and at 400 Gbit/s in experiments. We verified the full throughput on a 600-Gbit/s/λ signal using data generated by test equipment. We demonstrated for the first time in the world 600-Gbit/s transmission over commercial field fiber with total distances of 102 km.

2.2 Experiment 2

In this communication environment, MMCFTP was used to transfer data from one server to two servers and data from two servers to one server. We successfully confirmed that large capacity data of 40 terabytes were transferred at data transfer rates of 587 Gbit/s and 590 Gbit/s. For example, 40 terabytes is equivalent to 1600 ordinary 25-gigabyte Blu-ray

* OTUCn: Technology that accommodates services of over 100 Gbit/s (such as ultrahigh-speed Ethernet signaling) and reliably transmits data over optical networks.

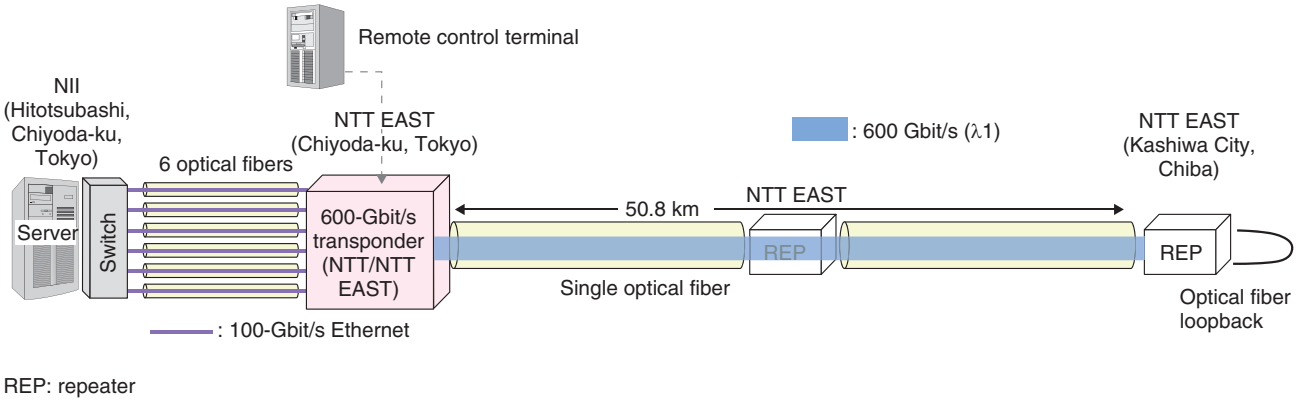

Fig. 1. Schematic of field trial network.

discs, which means that this large volume of data can be transferred in about 9 minutes, or the volume of one Blu-ray disc can be transferred in about 0.4 s. This result indicates a prospect of 587-Gbit/s data transfer between one set of servers.

2.3 Experiment 3

We successfully demonstrated a data transfer function linked with the route switching function. At that time, we confirmed that a communication link was reestablished by an adaptive change of transmission rate from 600 Gbit/s to 400 Gbit/s with the optical wavelength conversion according to the switching of the transmission route.

The transmission rate of the optical signal before transmission route switching was 600 Gbit/s, and the measured data transfer rate was 580 Gbit/s. After switching to the long distance route, the transmission rate of the optical signal was switched, and the measured data transfer rate was 393 Gbit/s.

Part of this work utilizes digital coherent optical transmission technology, which is the result obtained in the research project involving terabit optical network technologies towards the big data era supported by the Ministry of Internal Affairs and Communications.

3. Future work

In the state-of-the-art academic research, the amount of data to be handled—generated by computer simulation science, high-performance experimental apparatuses, and sensors used for Internet of Things services—has been increasing explosively. In order to transfer huge amounts of data efficiently, NII will further improve the MMCFTP software and provide it for advanced science research projects to stabilize and enhance data transfer rates.

NTT EAST and NTT will continue to promote the development of large capacity transmission technologies in order to continue meeting the demand for increases in traffic.

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http://www.ntt.co.jp/news2018/1812e/181211a.html