Accompanying the popularization of broadband services has been a growing expectation for a large-capacity optical transport network based on WDM technologies. Moreover, to provide future high-speed-transmission services, achieving ultra-high-speed transmission of 100 Gbit/s per wavelength is becoming a key challenge. In NTT Network Innovation Laboratories, by wavelength-multiplexing of 100-Gbit/s-class signals and by widening the available bandwidth and increasing transmission rate, we have successfully achieved large-capacity transmission of over 20 Tbit/s.

As a modulation format suitable for high-speed, large-capacity transmission, multi-level phase modulation called CSRZ-DQPSK was applied. This modulation format enabled transmission rate double the operation speed of electrical circuits and improved the spectral efficiency. On realization of this method, in cooperation with NTT Photonics Laboratories, prototypes of a high-speed optical modulator, a digital IC, and a prototype of a balanced receiver were constructed, and an ultra-high-speed (i.e., 111 Gbit/s) receiver was implemented. Moreover, a P-EDFA and an extended-L-band amplification technique using a distributed Raman amplifier were developed, and the number of wavelengths was doubled in comparison to the conventional systems. As a result of applying these technologies, we are the first in the world to successfully accomplish transmission of a 14-Tbit/s signal along a single optical fiber (with a length of 160 km). This is the first time in five years that we have taken the record for transmission capacity. Furthermore, by upgrading the optical-amplification technology, we are successfully performing transmission experiments of 20-Tbit/s over 240-km-long optical fiber.

At NTT Laboratories, from now onwards, we will continue to advance research and development on WDM transmission technology aimed at realizing the large-capacity optical networks that will support future broadband services.

*1 WDM: Wavelength Division Multiplexing
*2 Tbit: 10^12 bits
*3 CSRZ-DQPSK: Carrier-Suppressed Return-to-Zero Differential Quadrature Phase Shift Keying
*4 P-EDFA: Phosphorous co-doped Erbium-Doped Fiber Amplifier

20-Tbit/s transmission experiment

*1 Tx: Transmitter  *2 Rx: Receiver  *3 InP MUX: Indium Phosphide Multiplexer  
*4 LD: Laser Diode  *5 PLC MZDI: Planar Lightwave Circuit Mach-Zehnder Delay Interferometer