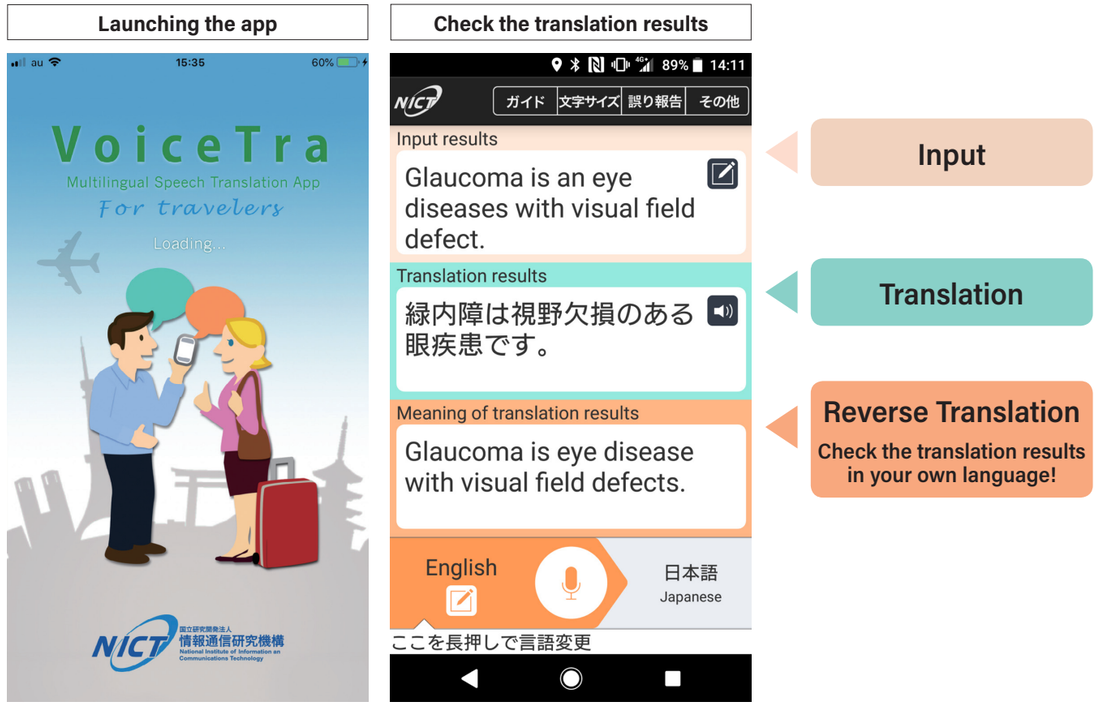


Fig. : "VoiceTra" translates your spoken words into different languages.

CONNECT

Multimode/multicore fiber system for practical optical communication infrastructure

World-record, 1.2Pb/s transmission through <0.2mm three-mode/four-core fiber was demonstrated

In order to cope with ever-increasing communication traffic, research on large-scale optical transmission using new types of optical fibers that allow exceeding the limit of conventional optical fibers and their application are actively conducted all over the world. The main new types of optical fibers studied are multicore fibers, in which multiple passages (cores) are arranged in an optical fiber, and multimode fibers that support multiple propagation modes in a single core with a larger core diameter. Ultimate throughputs of several Peta-b/s have been achieved by using hybrid of multimode/multicore fibers. However, such fibers were required to have much larger cladding diameter than standard single-mode fiber. To achieve practical implementation, the fiber cladding diameter must be reduced to less than 0.2mm to ensure the necessary reliability standards, mainly regarding mechanical strength.

NICT Network System Research Institute (NSRI), Fujikura Ltd. (Fujikura, President: Masahiko Ito) , Hokkaido Univ. (President: Toyoharu Nawa), and Macquarie Univ. MQ Photonics Research Centre (MQ)developed a three-mode four-core optical fiber, capable of wide-band wavelength multiplexing transmission with 0.16 mm cladding diameter (coating diameter: 0.25 mm) that can be easily cabled with existing equipment. They have successfully demonstrated a transmission experiment with a data-rate of 1.2 Peta-b/s. This is the world record throughput with an optical fiber with a cladding diameter below 0.2mm.

Thinner fibers have several advantages such as volume productivity from same size of preform, less failure probability and loss in fusion splicing, in addition to mechanical strength. Also, the core number of four has an affinity to data center communications.

In order to achieve the transmission capacity of 1.2 Peta-b/s, mode and core multiplexing in a single optical coupler was used in combination with 256-QAM (quadrature-amplitude modulation), which is a high-end practical high-density multilevel modulation optical signal, for a total of 368 wavelengths. Digital MIMO (multiple-input and multiple-output) enabled unscrambling the mixed modal signals for each individual core. This showed that multimode/multicore fiber which have compatible diameter with SMF can provide Peta-b/s transmission capability.

"This is promising for commercialization inter/intra-data center applications"

Yoshinari Awaji and Hideaki Furukawa, both Research manager of the NSRI Photonic Network System Laboratory have stated: "We succeeded in Peta-b/s transmission with much thinner fiber than before. When laying of standard outer diameter optical fibers takes place, the existing equipment for cabling can be used and the practical use at an early stage is promising. Such kind of transmission system can be applied to inter-/intra- data center applications earlier, then the transmission distance will be extended toward metro-area applications in the future if combined with brand-new fiber fabrication technology, which is researched by NICT through Industry-University-Government Cooperation."

The demonstration shows that SMF-compatible-diameter multimode/multicore fibers can increase the capacity potential for eight times within same cable accommodation space. They say, "We will continue to research and develop future optical communication infrastructure technologies which can smoothly accommodate traffic such as big data and 5G services and beyond."

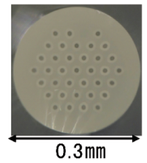
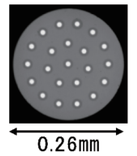
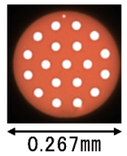
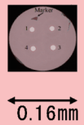
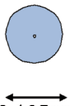
	Previous hybrid fibers			This report	SSMF
	2015, Mar.	2015, Sep.	2017, Sep.	2018, Sep.	
Throughput (bps)		2.15P	10.16P	1.2P	0.15P
Core/mode	36core/3mode	22core/1mode	19core/3mode	4core/3mode	1core/1mode
Cladding diameter	 0.3mm	 0.26mm	 0.267mm	 0.16mm	 0.125mm
Coating diameter				0.25mm	0.235~ 0.265mm

Fig. : Comparison of 3-mode/4-core fiber with previous fibers

Reference

Ruben S. Luís, Georg Rademacher, Benjamin J. Puttnam, Tobias A. Eriksson, Hideaki Furukawa, Andrew Ross-Adams, Simon Gross, Michael Withford, Nicolas Riesen, Yusuke Sasaki, Kunimasa Saitoh, Kazuhiko Aikawa, Yoshinari Awaji, and Naoya Wada, "1.2 Pb/s Transmission Over a 160 µm Cladding, 4-Core, 3-Mode Fiber, Using 368 C+L band PDM-256-QAM Channels," in Proc. 44th European Conference on Optical Communication (ECOC), September 2018, paper Th3B.3.