

FY2013

JSPS Core-to-Core Program
-Strategic Research Networks-
Research Report

Project No.	21001
Research Theme	Collaborative Research Center on Ultrahigh-speed Optical Communication
Duration of Project	April 1, 2011 – March 31, 2014
Core Institution in Japan	Research Institute of Electrical Communication, Tohoku University

Implementing Organizations

Country	Japan
Core Institution	Research Institute of Electrical Communication, Tohoku University
Co-Chair (name and title)	Masataka NAKAZAWA, Professor
Number of Cooperating Institutions	3
Cooperating Institutions	Graduate School of Engineering, Tohoku University National Institute of Information and Communication Technology National Institute of Advanced Industrial Science and Technology

Country	Germany
Core Institution	Heinrich-Hertz Institute
Co-Chair (name and title)	Colja SCHUBERT, Group Leader
Number of Cooperating Institutions	0
Cooperating Institutions	
Matching Fund	①FhG-MPG cooperation projects ②Semiconductor Nanophotonics: Materials, Models, Devices ③ 7th Framework Programme, Information and Communication Technologies

Country	U.K.
Core Institution	University of Southampton
Co-Chair (name and title)	David RICHARDSON, Professor
Number of Cooperating Institutions	0
Cooperating Institutions	
Matching Fund	①EPSRC ②EPSRC ③Framework 7 ④Framework 7

Country	Denmark
Core Institution	Technical University of Denmark
Co-Chair (name and title)	Palle JEPPESEN, Professor
Number of Cooperating Institutions	0
Cooperating Institutions	
Matching Fund	①Villum Fonden (private Danish Foundation) ②European Research Council (ERC) ③Research Council for Technology and Production Sciences

Result of Program Implementation

As regards the research activities, a rapid progress has been made in our proposed ultrahigh-speed Nyquist pulse transmission technologies. We demonstrated 1.92 Tbit/s/ch, 64 QAM coherent Nyquist pulse transmission for the first time, and succeeded in increasing the spectral efficiency to 7.5 bit/s/Hz. DTU and AIST also contributed to the increase in symbol rate up to 1.28 Tsymbol/s and application to highly-efficient add-drop operation in network nodes.

We also held ISUPT 2013 at University of Rochester on Oct. 21–22, which was hosted by Prof. Wayne Knox. This played an important role to expand the collaboration to worldwide including US and Australia. We also organized Post ECOC Workshop on Sept. 27 at University of Southampton, where Prof. David Richardson served as an organizer. Through the discussions in these opportunities, space division multiplexing has become identified as a new direction toward a future optical communications research in order to overcome expected capacity crunch in today's optical infrastructure.

Achievements in FY2013 (Self Review)

Through the research activities, the advantage of optical Nyquist pulses for ultrahigh-speed and highly spectrally-efficient transmission has become clarified. In particular, the demonstration of 1.92 Tbit/s, 64 QAM coherent transmission with a spectral efficiency of as high as 7.5 bit/s/Hz by Tohoku University received a considerable attention. Motivated by our demonstrations, DTU has particularly been making intensive efforts for their application to signal processing, and novel OFDM demultiplexing scheme by combining time-domain optical Fourier transformation and Nyquist pulses have been proposed.

Regarding the international collaboration, ISUPT 2013 and Post ECOC Workshop contributed to stimulate discussion and clarify future directions in the field of ultrafast photonics, ranging over different areas from materials and fundamental devices to biophotonics, nano technology, and terahertz photonics. In particular, by recognizing the potential capacity limitation in current optical fibers, new directions in optical communications have been explored, including ultramulti-level coherent transmission, multi-core fibers, and multi-mode control for mode division multiplexing.

Future Plan (Measures toward Achieving Research Objectives)

In Japan, a collaborative study group called EXAT (EXtremely Advanced Transmission) has been organized to promote the 3M technologies described above. In EU, the ModeGap project has been launched with the aim to develop the disruptive technology and concepts needed to enhance our communications infrastructure by 100 fold. These two projects have jointly organized workshops in major conferences such as OFC and ECOC, which were very successful with many attendees. In future, intensive efforts will be made to realize integrated devices and systems through collaboration with industry toward the Exabit optical communication infrastructure in the coming 20 to 30 years.