Open Innovation
Resilient ICT Research Center

Director General Yoichi Suzuki

The Resilient ICT Research Center is working in two main purposes: the research of basic technology, infrastructure and applications for disaster-resilient ICT, and the promotion of social implementations aimed at maximizing the benefits of research and development. In addition to performing research, the laboratories of the Center are also involved in developing social implementations of the results of this research, and the Planning and Collaboration Promotion Office is actively planning and executing demonstration tests using the results of laboratory research, and is actively involved in external cooperation and local coordination efforts. With the aim of maximizing the benefits of research, we will work on social implementations of the results of research related to disaster resilient ICT.

The activities of the Resilient ICT Research Center are as follows. First, we have been steadily promoting research and development for disaster resilient ICT, and have played a role as a research center. And the other one, we are promoting industry-academia-government collaboration activities relating to disaster resilient ICT; the collaboration with external research organizations including universities and research institutes; forming a network to link industry, government, and academia (including local public organizations); collecting, accumulating, and exchanging knowledge; transfer of technology to companies; ascertaining the needs of users; and the council activity. Furthermore, we are promoting the social implementation of R&D results related to disaster resilient ICT by performing demonstration trials using the results, and disaster training performed by regional public bodies.

Our research is taking place in two laboratories, which are working on the following three projects:

Disaster-Resilient Optical Network Technology

(a) Resilient optical switching infrastructure technology

To enable the instantaneous dynamic optical network control, we are conducting the fundamental research and development of optical network subsystems including both optical signal monitoring subsystems and control subsystems. In particular, we employ burst mode optical amplifiers to mitigate the power fluctuations of the optical signals owing to the dynamic behavior of optical paths along the time axis and wavelength axis especially in the event of a link failure. Specifically, we have made it possible to reconfigure the optical network much faster by reducing the time taken to switch the wavelength paths, for instance, reconfigure four wavelength lightpaths from 36 seconds (needed by the conventional technique) to 0.2 seconds (Fig.1). This is the first time that the ultra-fast switching of optical paths is experimentally validated.

(b) Basic emergency recovery technology for optical networks

We have been investigating and developing the emergency recovery resources and technologies to achieve the quick and low-cost recovery of optical networks. For example, an emergency disaster-recovery first-aid unit and the corresponding recovery schemes are proposed for the recovery of Control & Management-plane, and optical Data-plane, as shown in Fig.2. To enable the collaboration between carriers, we have also been investing an approach: "emergency exchange points of carrier collaboration (EPOC)" which avoids the leakage of the carriers' confidential topology information. EPOC-based emergency

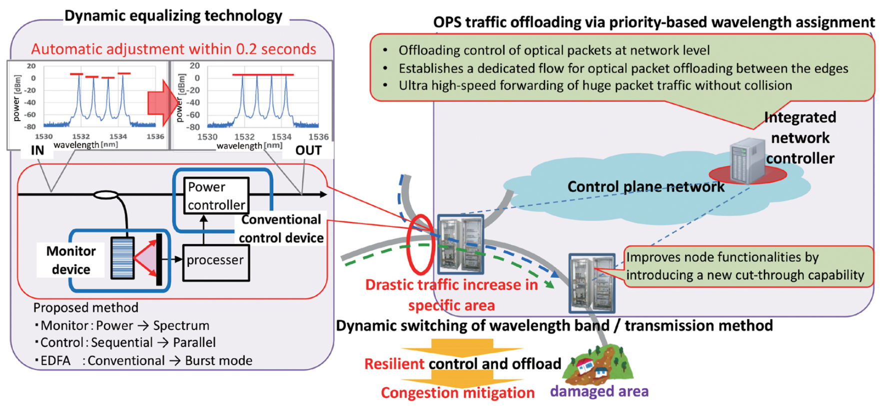

Fig.1 : Principle achievements in flexibly optical switching platform technology. Left: High-speed wavelength switching, Right: Optical packet offloading

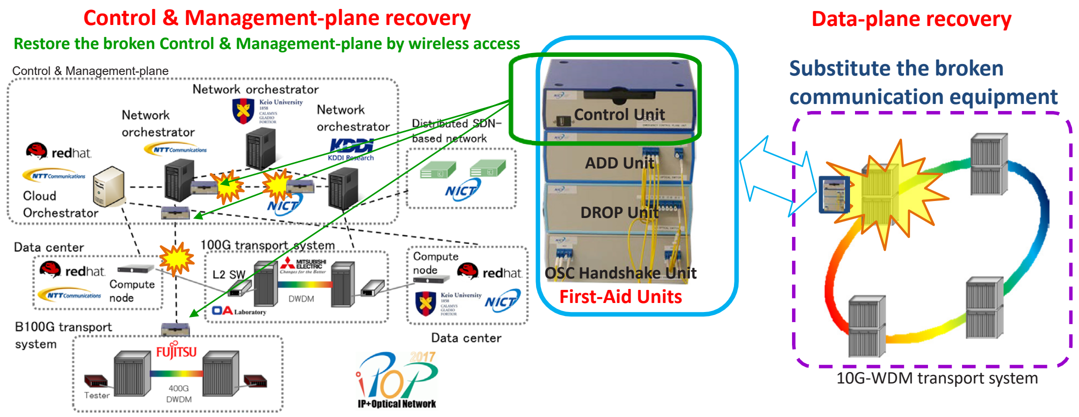

Fig.2 : Demonstrations of optical network quick recovery with the first-aid units.

packet transport capability can be quickly created via the cooperation between carriers and a third-party organization which efficiently and smoothly interconnects both the surviving optical network resources and various types of packet network resources. We first time demonstrated the principles and successfully validated the feasibility of these technologies for disaster recovery with experiments.

Disaster-resilient wireless communication technology

(a) Technology for enhancing regional networks

In a conventional system, the load is concentrated on VPN servers and it is not possible to establish multi-stage connections. To improve on this, we need mesh gateway functions to facilitate load distribution through the use of a mesh configuration for direct communication, improved reliability through redundancy, and improved security for IoT devices and the like in local independent networks. To implement such functions, we have developed new technology for the construction of logical independent networks in a mesh configuration using an L2 overlay network via a completely new wide-area network that combines mesh network technology, software switching technology, and multi-layer SSL-VPN connection technology that we have already developed (Fig.3).

(b) Agile network configuration technology

In order to keep network functions available for as long as possible using limited terminal batteries in the event of a disaster or the like, we are developing a smartphone app that can control multiple wireless devices installed in a smartphone to allow neighboring smartphones to work cooperatively. According to a computer simulation, the use of this app can be expected to result in an overall reduction in power consumption of about 30%. Also, in the development of a seismic observation system that can be immediately deployed across a wide area, we have built a prototype LoRa system that can remotely alter setting parameters. By measuring the actual file transfer speeds, we have confirmed that this system is fast enough for transferring data in the event of an earthquake.

(c) Social demonstration and social implementation

In training for the support of people who have difficulty in returning home in Tokyo's Chuo ward, and preparatory training for the establishment of a central Cabinet Office Disaster management headquarters in the Tachikawa district where there is a large-scale backup disaster management facility, we have contributed to training through use of the NerveNet system that we developed as a means of ensuring communications between disaster management centers if the public telecommunications network is disabled. Also, in the R&D project aimed at the early detection of disasters by a network of acoustic and electromagnetic sensors that we are working on as a SCOPE research project for the Ministry of Internal Affairs and Communications, we have partnered up with Tohoku University to develop an infrasound sensor device that combines a MEMS sensor with a

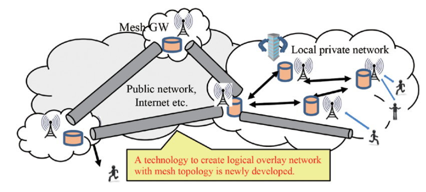

Fig.3 : Development of mesh-like logic overlay network

Raspberry Pi. This device costs approximately a hundred times less than conventional equipment. In field tests, we successfully observed the infrasound waveforms accompanying a volcanic eruption.

Real-time analysis of disaster information from social knowledge

During real disasters such as extreme rainfall in the northern part of Kyushu, people were able to make effective use of our disaster information analyzer system (DISAANA), which uses deep semantic analysis to analyze information posted to Twitter during a disaster, and our disaster summarizer system (D-SUMM), which makes it easy to understand the disaster status of specified local authorities. These systems were also used in map-based disaster prevention drills in Oita Prefecture and Tokyo, and for civic protection training in Iwate Prefecture.

In order to provide information of greater accuracy by analyzing not only Twitter tweets (the original target of these systems), but also real-world observation data, we have developed a framework that crawls websites that provide weather forecasts and traffic information, and integrally analyzes this information in DISAANA and D-SUMM together with Twitter contributions.