

A Portable and Elastic Edge Computing Network for Disaster First Responders

Toshikazu SAKANO*, Babatunde OJETUNDE*, Masahiro SUZUKI*, Katsuhiro TEMMA*, Akira NAKAMURA**, Toshiaki FUKADA**

* *Wave Engineering Laboratories, (Advanced Telecommunications Research Institute International), Japan*

** *ATR-Trek Co., Ltd., Japan*

t.sakano@atr.jp, ojetunde@atr.jp, masa.suzuki@atr.jp, temma@atr.jp, akira.nakamura@atr-trek.co.jp, toshiaki.fukada@atr-trek.co.jp

Abstract— With the worldwide increase in disaster occurrences and their scale of damage, a resilient Information and Communication Technology (ICT) system that remains available in disaster-affected areas despite Internet, telecom, or mobile service disruptions is strongly desired. In particular, disaster first responders who rush to disaster-stricken areas to carry out investigations, search and rescue operations for people, require tools to collect, share, report, and record disaster information. This paper proposes a portable and elastic edge computing network to support the activities of disaster first responders. The portability and elasticity features enable us to adaptively apply the proposed edge computing network in various disaster situations. In the edge computing node, Artificial Intelligence (AI) functions, such as automatic speed recognition, are equipped to offer hands-free operation and on-site intelligent image processing for first responders. We developed a pilot model of an edge computing node and confirmed the requirements to include AI functionality through experimental evaluation.

Keyword— Disaster response, edge computing, portable ICT system, speech recognition



Toshikazu Sakano received his B.E., M.E. and Ph.D. degrees in communication engineering from Tohoku University, Sendai, Japan in 1985, 1987 and 1998, respectively. He joined Nippon Telegraph and Telephone Corporation (NTT) in 1987, where he had engaged in R&Ds on optical signal processing and super-high-definition imaging system. From 2001 through 2008, He was with NTT Communications where he had engaged in grand design installation of NTT's nationwide network including Next Generation Network (NGN). In 2008, he moved back to NTT's Network Innovation Labs. and had engaged in R&Ds on 100Gbps digital coherent optical transmission system, photonic network, and ICT for disaster countermeasure. In 2015, he joined Advanced Telecommunications Research Institute International (ATR) in Kyoto, where he has engaged in business development of the company and several R&D projects related to wireless communications. Currently, he is director of Wave Engineering Laboratories in ATR. He received IEICE (the Institute of Electronics, Information and Communication Engineers) Young Engineer Award in 1995. He is a member of IEEE and senior members of IEICE and Optica.



Babatunde Ojetunde received his HND degree in Computer Science from Osun State Polytechnic, Iree, Osun, Nigeria, in 2003, and his PGD in Computer Science from Lagos State University, Ojo, Lagos, Nigeria, in 2006. He joined Zenith Bank Plc, Nigeria, in 2005 and then Wema Bank Plc, Nigeria, in 2009. He received his M.E. and Ph.D. in Information Science from Nara Institute of Science and Technology, Japan, in 2015 and 2018, respectively. Currently, he is a researcher at the Advanced Telecommunications Research Institute International (ATR), where he is engaged in research and development on wireless communication and ICT for disaster countermeasures. His research interests include wireless communication, mobile computing, AI, blockchain, ubiquitous computing, and IoT networks. He is a member of IPSJ and IEICE.



Masahiro Suzuki graduated from the electrical department at Kagawa National College of Technology and has been engaged in digital and analog circuit design for 30 years. Currently, as a research engineer at the International Telecommunications Research Institute (ATR), he is working on developing communication equipment for information exchange for active forces at disaster sites. His hobby is tinkering with motorcycles on the weekends.



Katsuhiko Temma received the B.E., M.E., and Ph.D. degrees in communications engineering from Tohoku University, Sendai, Japan, in 2010, 2012, and 2016, respectively. From April 2013 to March 2015, he was a Japan Society for the Promotion of Science (JSPS) research fellow. Since January 2024, he has been with Advanced Telecommunications Research Institute International (ATR). He was a recipient of the IEEE VTS Japan Chapter 2011 Young Researcher's Encouragement Award. He is a member of the IEICE. His research interests include signal detection techniques and autonomous distributed algorithms for wireless communication systems.



Akira Nakamura received his M.E degree in electrical engineering from Nagoya University, Japan, in 1991. He joined Sanyo Electric Co. Ltd. In 1991, seconded to Panasonic Corporation in 2011. He also received his Ph.D. in Information Systems Engineering from Gifu University, Japan, in 2011. Since 2014 he has been engaged in technology development in ATR-Trek Co. Ltd. in the field of speech recognition, natural language processing and audio signal analysis.



Toshiaki Fukada received his M.E and Ph.D. in Information Engineering from Tokyo Institute of Technology in 1990 and 1999, respectively. He joined Canon Inc. in 1990. From 1995 to 1998, seconded to the ATR Interpreting Telecommunications Research Laboratories at Advanced Telecommunications Research Institute International (ATR). Conducted research as a visiting researcher at Carnegie Mellon University from 1997 to 1998. Served as President of Canon Information Technology (Beijing) from 2012 to 2013. Since 2014, he has been the President and CEO of ATR-Trek Inc. and since 2024, he has been a Director at AI, Inc.. Engaged in research and product development in the fields of speech recognition, speech synthesis, and natural language processing.