LETI DEMONSTRATES NEW WAVEFORM FOR 5G LOW-POWER WIDE-AREA INTERNET OF THINGS NETWORKS

Trials Outperform Existing Solutions in Data-Rate Flexibility & Transmission Range, Technology Especially Suitable for Massive Machine-Type Communication Systems

GRENOBLE, France – June 25, 2018 – Leti, a research institute of CEA Tech, today announced that field trials of its new Low Power Wide Area (LPWA) technology, a waveform tailored for Internet of Things (IoT) applications, showed significant performance gains in coverage, data-rate flexibility and power consumption compared to leading LPWA technologies.

Leti's LPWA approach includes its patented Turbo-FSK waveform, a flexible approach to the physical layer. It also relies on channel bonding, the ability to aggregate non-contiguous communication channels to increase coverage and data rates. The field trials confirmed the benefits of Leti's LPWA approach in comparison to LoRa™ and NB-IoT, two leading LPWA technologies that enable wide-area communications at low cost and long battery life.

The results indicate the new technology is especially suitable for long-range massive machine-type communication (mMTC) systems. These systems, in which tens of billions of machine-type terminals communicate wirelessly, are expected to proliferate after 5G networks are deployed, beginning in 2020. Cellular systems designed for humans do not adequately transmit the very short data packets that define mMTC systems.

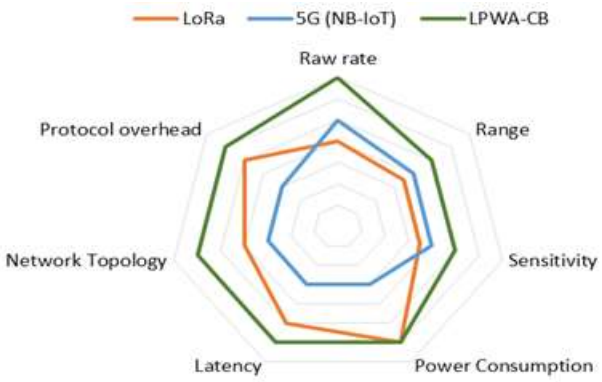

Figure 1: Performance chart comparison

Designed to demonstrate the performance and flexibility of the new waveform, the field-trial results stem primarily from the system's flexible approach of the physical layer. The flexibility allows data-rate scaling from 3Mbit/s down to 4kbit/s, when transmission conditions are not particularly favorable and/or a long transmission range is required.

Under favorable transmission conditions, e.g. a shorter range and line of sight, the Leti system can select high data rates using widely deployed single-carrier frequency-division multiplexing (SC-FDM) physical

layers to take advantage of the low power consumption of the transmission mode. Under more severe transmission conditions, the system switches to more resilient high-performance orthogonal frequency division multiplexing (OFDM). When both very long-range transmission and power efficiency are required, the system selects Turbo-FSK, which combines an orthogonal modulation with a parallel concatenation of convolutional codes and makes the waveform suitable to turbo processing. The selection is made automatically via a medium access control (MAC) approach optimized for IoT applications.

"Leti's Turbo-FSK receiver performs close to the Shannon limit, which is the maximum rate that data can be transmitted over a given noisy channel without error, and is geared for low spectral efficiency," said Vincent Berg, head of Leti's Smart Object Communication Laboratory. "Moreover, the waveform exhibits a constant envelope, i.e. it has a peak-to-average-power ratio (PAPR) equal to 0dB, which is especially beneficial for power consumption. Turbo-FSK is therefore well adapted to future LPWA systems, especially in 5G cellular systems."

In the new system, the MAC layer exploits the advantages of the different waveforms and is designed to self-adapt to context, i.e. the usage scenario and application. It optimally selects the most appropriate configuration according to the application requirements, such as device mobility, high data rate, energy efficiency or when the network becomes crowded, and is coupled with a decision module that adapts the communication depending on the radio environment. The optimization of the application transmission requirements is realized by the dynamic adaptation of the MAC protocol, and the decision module controls link quality.

About Leti

Leti, a technology research institute at CEA Tech, is a global leader in miniaturization technologies enabling smart, energy-efficient and secure solutions for industry. Founded in 1967, Leti pioneers micro-& nanotechnologies, tailoring differentiating applicative solutions for global companies, SMEs and startups. Leti tackles critical challenges in healthcare, energy and digital migration. From sensors to data processing and computing solutions, Leti's multidisciplinary teams deliver solid expertise, leveraging world-class pre-industrialization facilities. With a staff of more than 1,900, a portfolio of 2,700 patents, 91,500 sq. ft. of cleanroom space and a clear IP policy, the institute is based in Grenoble, France, and has offices in Silicon Valley and Tokyo. Leti has launched 60 startups and is a member of the Carnot Institutes network. Follow us on www.leti-cea.com and @CEA_Leti.

CEA Tech is the technology research branch of the French Alternative Energies and Atomic Energy Commission (CEA), a key player in innovative R&D, defence & security, nuclear energy, technological research for industry and fundamental science, identified by Thomson Reuters as the second most innovative research organization in the world. CEA Tech leverages a unique innovation-driven culture and unrivalled expertise to develop and disseminate new technologies for industry, helping to create high-end products and provide a competitive edge.

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