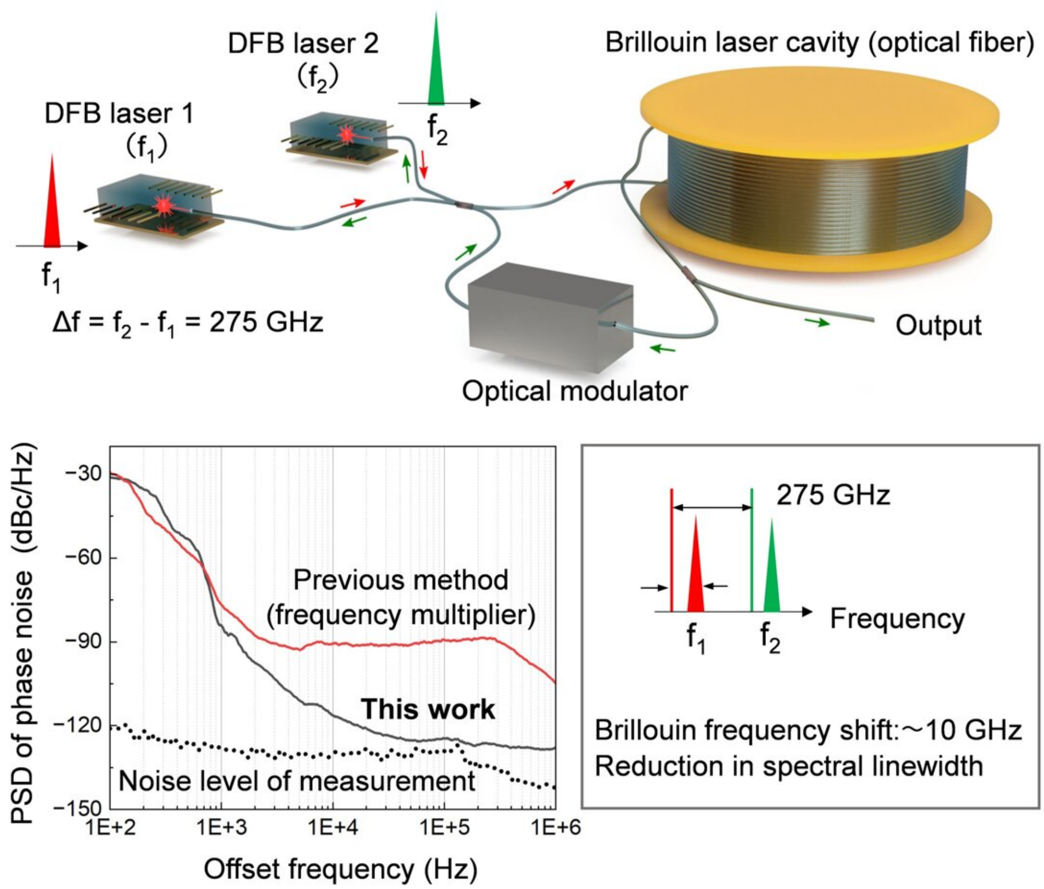
Photonics-based wireless link breaks speed records for data transmission

February 1 2024



Configuration of the two-tone Brillouin laser system and phase noise measurement result (comparison of electrical- and photonics-based local oscillator signals). Credit: Osaka University

From coffee shop customers who connect their laptops to the local Wi-Fi network to remote weather monitoring stations in the Antarctic, wireless communication is an essential part of modern life. Researchers worldwide are currently working on the next evolution of communication networks, called "beyond 5G" or 6G networks.

To enable the near-instantaneous communication needed for applications like augmented reality or the remote control of surgical robots, ultra-high data speeds will be needed on wireless channels.

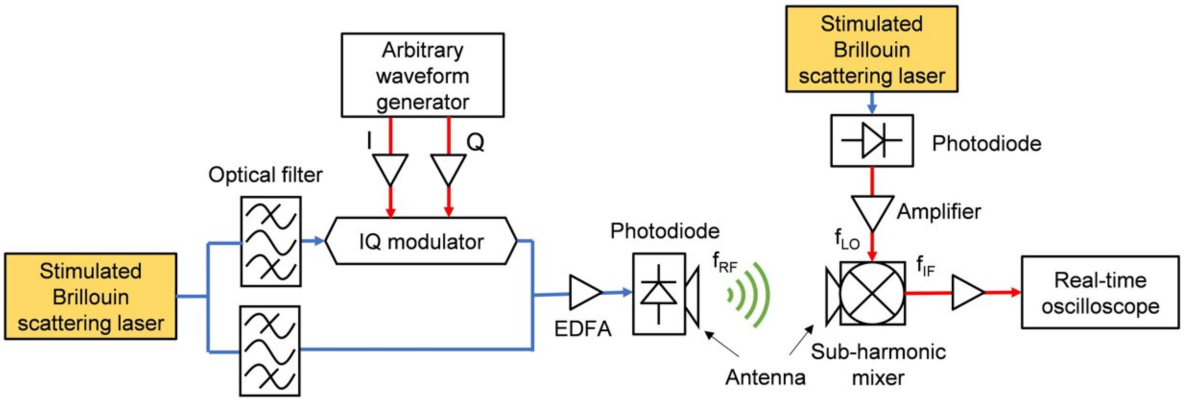
In a study published in *IEICE Electronics Express*, researchers from Osaka University and IMRA AMERICA have found a way to increase these data speeds by reducing the noise in the system through lasers.

To pack in large amounts of data and keep responses fast, the sub-terahertz band, which extends from 100 GHz to 300 GHz, will be used by 6G transmitters and receivers. A sophisticated approach called "multi-level signal modulation" is used to further increase the data transmission rate of these wireless links.

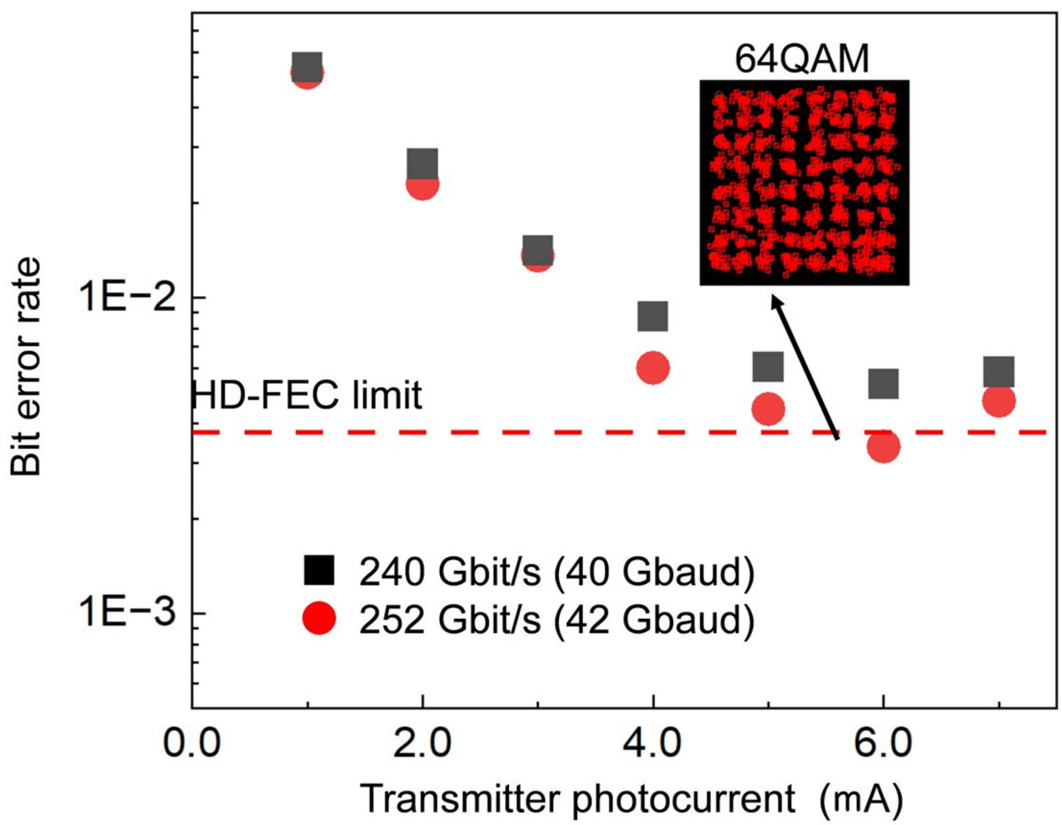
However, when operating at the top end of these extremely high frequencies, multi-level signal modulation becomes highly sensitive to noise.

To work well, it relies on precise reference signals, and when these signals begin to shift forward and backward in time (a phenomenon called "phase noise"), the performance of multi-level signal modulation drops.

"This problem has limited 300-GHz communications so far," says Keisuke Maekawa, lead author of the study. "However, we found that at high frequencies, a signal generator based on a photonic device had much less phase noise than a conventional electrical signal generator."



Ultra-low noise photonics-based sub-terahertz wireless communication system.
Credit: Osaka University



Bit error rate vs. photocurrent of the photodiode in the transmitter using photonics-based signal generators (64QAM). Credit: Osaka University

The team used a stimulated Brillouin scattering laser, which employs interactions between sound and light waves, to generate a precise signal. They then set up a 300 GHz-band wireless communication system that employs the laser-based signal generator in both the transmitter and receiver. The system also used on-line digital signal processing (DSP) to demodulate the signals in the receiver and increase the data rate.

"Our team achieved a single-channel transmission rate of 240 gigabits per second," says Tadao Nagatsuma, PI of the project. "This is the highest transmission rate obtained so far in the world using on-line DSP."

As 5G spreads across the globe, researchers are working hard to develop the technology that will be needed for 6G, and the results of this study are a significant step toward 300GHz-band wireless communication.

The researchers anticipate that with multiplexing techniques (where more than one channel can be used) and more sensitive receivers, the data rate can be increased to 1 terabit per second, ushering in a new era of near-instantaneous global communication.

More information: Keisuke Maekawa et al, Single-channel 240-Gbit/s sub-THz wireless communications using ultra-low phase noise receiver, *IEICE Electronics Express* (2023). DOI: 10.1587/elex.20.20230584

Provided by Osaka University

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