Record for fastest data rate set

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A new record for the fastest ever data rate for digital information has been set by UCL researchers in the Optical Networks Group. They achieved a rate of 1.125 Tb/s as part of research on the capacity limits of optical transmission systems, designed to address the growing demand for fast data rates.

Lead researcher, Dr Robert Maher, UCL Electronic & Electrical Engineering, said: "While current state-of-the-art commercial optical transmission systems are capable of receiving single channel data rates of up to 100 gigabits per second (Gb/s), we are working with sophisticated equipment in our lab to design the next generation core networking and communications systems that can handle data signals at rates in excess of 1 terabit per second (Tb/s).

"For comparison this is almost 50,000 times greater than the average speed of a UK broadband connection of 24 megabits per second (Mb/s), which is the current speed defining "superfast" broadband. To give an example, the data rate we have achieved would allow the entire HD Games of Thrones series to be downloaded within one second."

The study, published today in *Scientific Reports*, used techniques from information theory and digital signal processing to custom build an optical communications system with multiple transmitting channels and a single receiver. As part of the EPSRC-funded UNLOC programme, the project set out to investigate ways to improve the optical network infrastructure to support the explosion of digital content, cloud and e-health services, as well as the ubiquitous connectivity of smart devices

referred to as the Internet of Things (IoT).

Professor Polina Bayvel, the principal investigator of the UNLOC programme at UCL, said: "This result is a milestone as it shows that terabit per second optical communications systems are possible in the quest to reach ever higher transmission capacities in optical fibres that carry the vast majority of all data generated or received. A high-capacity digital communications infrastructure underpins the internet and is essential to all aspects of the digital economy and everyday lives."

The team determined the best way of encoding information in optical signals, taking into account the limitations of the transmitter and receiver. They then applied coding techniques commonly used in wireless communications, but not yet widely used in optical communications, to ensure the transmitted signals are adapted to distortions in the system electronics.

Using UNLOC's state-of-the-art lab facilities, the researchers built the new optical system and measured its performance. Fifteen channels, each carrying an optical signal of different wavelength were modulated using the 256QAM format typically used in cable modems, combined and sent to a single optical receiver for detection. By grouping the channels together, the team created a 'super-channel' which although not yet commercially available, is widely believed to be a way forward for the next generation of high-capacity communication systems.

"Using high-bandwidth super-receivers enables us to receive an entire super-channel in one go. Super-channels are becoming increasingly important for core optical communications systems, which transfer bulk data flows between large cities, countries or even continents. However, using a single receiver varies the levels of performance of each optical sub-channel so we had to finely optimise both the modulation format and code rate for each optical channel individually to maximise the net

information data rate. This ultimately resulted in us achieving the greatest information rate ever recorded using a single receiver," said Dr Robert Maher.

In this study, the researchers connected the transmitter directly to the receiver to achieve the maximum data rate. They will now test the system and measure the achievable data rates in a long distance transmission scenario where optical signals can become distorted as they travel through thousands of kilometres of optical fibres.

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