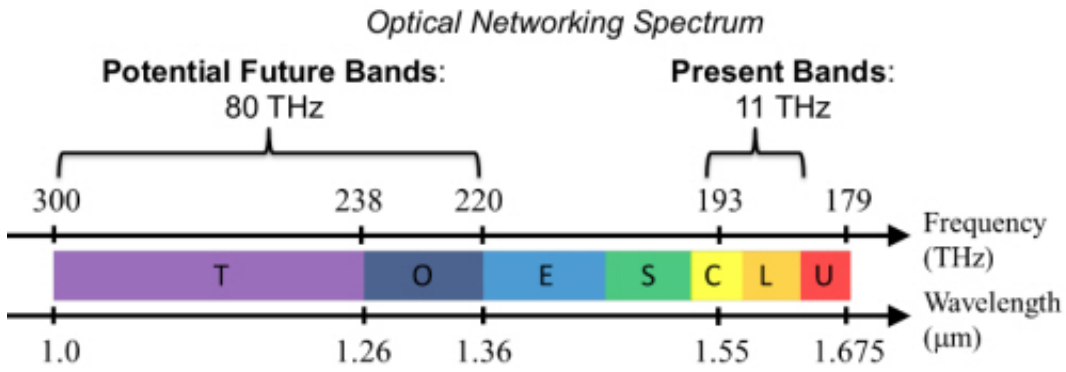
New frontiers in communication systems

February 2 2016



Data centres such as the ones used by Google and Facebook are the fundamental backbone for a range of services and applications including cloud and fog computing, big data, Internet of Things (IoT), social networking, weather forecasting, earthquake and tsunami prediction and cyber security. As such they are a hidden, yet integral part of modern life and human progress. New research by the universities of Bristol, Keio and industrial partners have unlocked 80 THz of fibre-optic bandwidth that will enable future exascale data centres and transform 5G

networks.

The research on optical communication technologies, wavelength division multiplexing and networks form the backbone of every wired network across the whole internet. Work until now has been focused and limited on utilizing ~11 THz of bandwidth (C and L Band) centred at 193 THz.

Optical networks based on this frequency bands have been able to support up to 230 channels at 50 GHz spacing. Due to constant growth of networked infrastructures, from internet of everything to data centres, the fibre capacity is reaching its limits.

The collaboration between the University of Bristol's Department of Electrical and Electronic Engineering, Keio University and numerous Japanese industrial partners, have designed, developed and prototyped a pioneering all-optical router that can unlock 80 THz of bandwidth across a newly defined frequency band named T-Band (thousand band) and O-Band (original band). The adjacent bands span from 1.0 μm (300 THz) to 1.36 μm (220 THz) and are able to support 1600 channels at 50 GHz spacing.

Dr Georgios Zervas, Senior Lecturer in Optical and High Performance Networks in the Department of Electrical and Electronic Engineering, said: "The technology and system proposed and prototyped will unlock the new frequency band and networks to support future exascale data centres, 'zero-latency' tactile optical internet, internet of everything, smart cities, fog computing and big data infrastructure among others. This is the outcome of a recent collaboration between Bristol, Keio and other Japanese institutions that brings together people with complementary yet common vision and pioneering concepts."

The technology fabricated and tested is based on cascaded arrayed

waveguide gratings (AWGs) and is designed to potentially construct a 1600 x 1600 wavelength router that can guide data at the speed of light. Also, specially designed quantum dot chips are used for light sources, which were originally developed by NICT, Japan.

This single passive optical system can route immense information offering manifold increase from current systems. It can single-handedly interconnect over one million end points such as, broadband home users, IoT devices, data centre servers, while offering at least ten Gb/s per end point. Critically it is also future proof since it's transparent to any communication signal and it can also potentially consume zero power due to its passive nature.

Hiroyuki Tsuda, Professor of Faculty of Science and Technology at Keio University, added: "The enabling technologies for the new frequency band are the quantum dot based optical devices and the silica planar lightwave circuits designed for the new band.

"The collaboration between the University of Bristol who has extensive knowledge of the network architecture, and our Japanese research group with device technologies will create an ultra-high capacity, power-saving optical network system, in particular, for data centres."

More information: Nazirul A. Idris et al. Full-mesh T- and O-band wavelength router based on arrayed waveguide gratings, *Optics Express* (2016). DOI: 10.1364/OE.24.000672

Provided by University of Bristol