6G-RIC
Research and
Innovation Cluster

GEFÖRDERT VOM
Bundesministerium
für Bildung
und Forschung

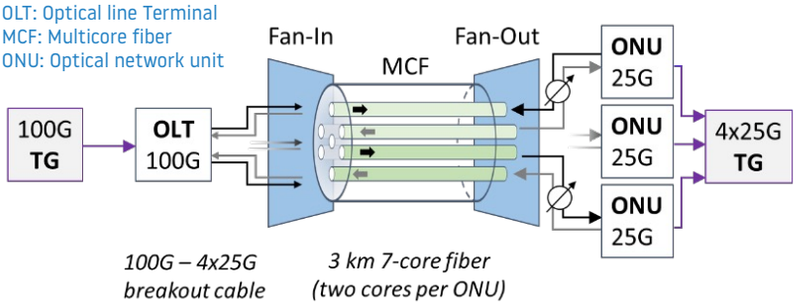
Demonstration of a Real-Time Bidirectional 100G Ethernet Space Division Multiplexing – Passive Optical Network

SEPIDEH KOUHINI / SARAH CWALINA / KAI HABEL / VOLKER JUNGNICKEL / RONALD FREUND

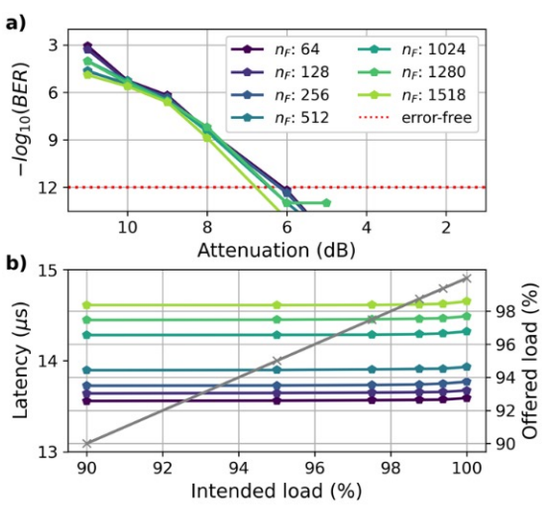
How can we deploy front-haul for advancements beyond 5G and 6G to enable high throughput?

Setup of 100 G Ethernet SDM – PONT

TG: Traffic Generator
OLT: Optical line Terminal
MCF: Multicore fiber
ONU: Optical network unit



Compared to conventional PON – fronthaul solutions, space division multiplexing - PON (SDM- PON) offers high capacity without complex multiple – input multiple – output digital signal processing (DSP). At mmWave/sub-THz frequencies, the key challenge for implementing fronthaul is how to provide high throughput for each single user. Our results demonstrate that it is possible to achieve nearly optimal performance while keeping the simplicity of non-coherent fronthaul transmission.



a) Calculated BER from frame loss with added attenuation
b) Average latency comparison for different frame size

KEY FINDINGS

Data streams from 5G/6G mobile technology need to be transmitted at high frequencies and are attenuated by propagation in free space, through walls and other materials. By transporting radio signals over the existing fiber infrastructure, path loss can be reduced. However, as societal and economic digitization progresses, it is apparent that the current network infrastructure is approaching its capacity limits. Furthermore, the prevailing energy consumption associated with data traffic poses another challenge. To address these issues, a scalable network infrastructure and associated components must be developed to improve energy efficiency and minimize costs when meeting future capacity needs. Space division multiplexing (SDM) is known to increase the capacity of optical networks and it was widely studied for optical long-haul networks. SDM typically requires complex multiple-input multiple-output (MIMO)-digital signal processing (DSP), which makes application unlikely in near future. However, the use of a weakly coupled multicore fibre (MCF) reduces the complexity of DSP, allowing SDM to be used also in optical access networks, e.g., with data rates of 10 Gb/s and more per single user. Here, we propose the use of SDM for 5G/6G fronthaul (FH) architectures. Our proposed FH solution demonstrates the operation of 100G Ethernet over a multi-core fiber in a point-to-multipoint architecture. We confirm that crosstalk between the cores is below -50dB/km at 1300nm, i.e., negligible in practice, and loss is only 0.4dB/km. For demonstration, we used a 3 km long MCF, no additional DSP and commercially available TRX with breakout cables, specifically realizing a 100G link by a 4x25G split. The RFC 2544 test showed error-free transmission with no frame loss up to 6 dB added attenuation at all frame sizes.

Sarah Cwalina, Sepideh Mohammadi Kouhini, Kai Habel, Volker Jungnickel, Ronald Freund: "Demonstration of a Real-Time 100G Ethernet Space Division Multiplexing PON using a Weakly Coupled Multicore Fiber", Fiber Optics in Access Networks 2023, Gent