The WONDER Testbed: Architecture and Experimental Demonstration

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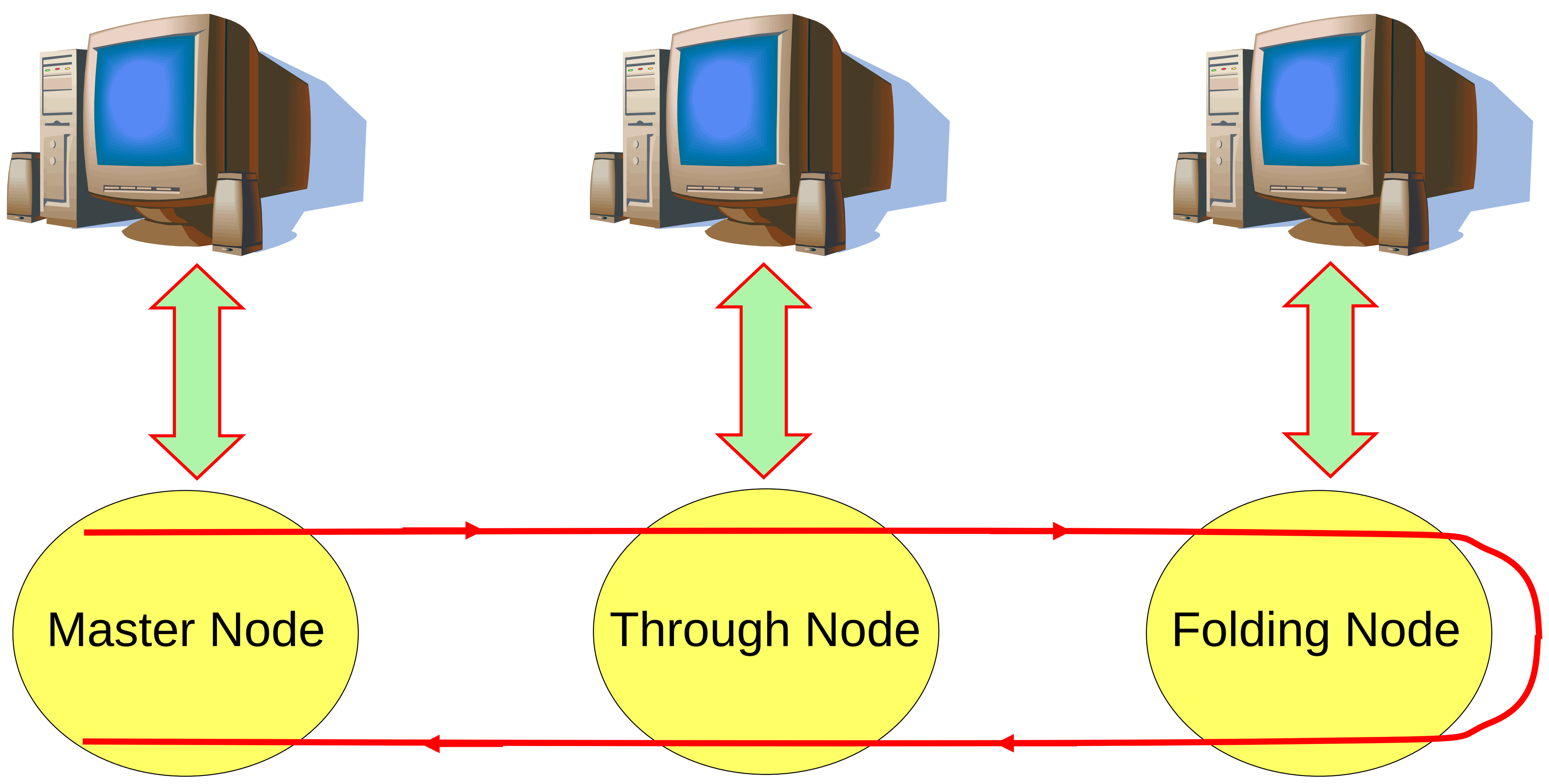
Introduction and Context

The WONDER (WDM Optical Network DEmonstrator over Rings) project aims at the demonstration of an advanced packet-based WDM architecture.

- High-capacity Metropolitan Area Networks (MANs) environment
- Cost-effective combinations of Optics and Electronics technology
- Capability to transfer real application data (to/from Linux PCs) over a packet-switched optical network

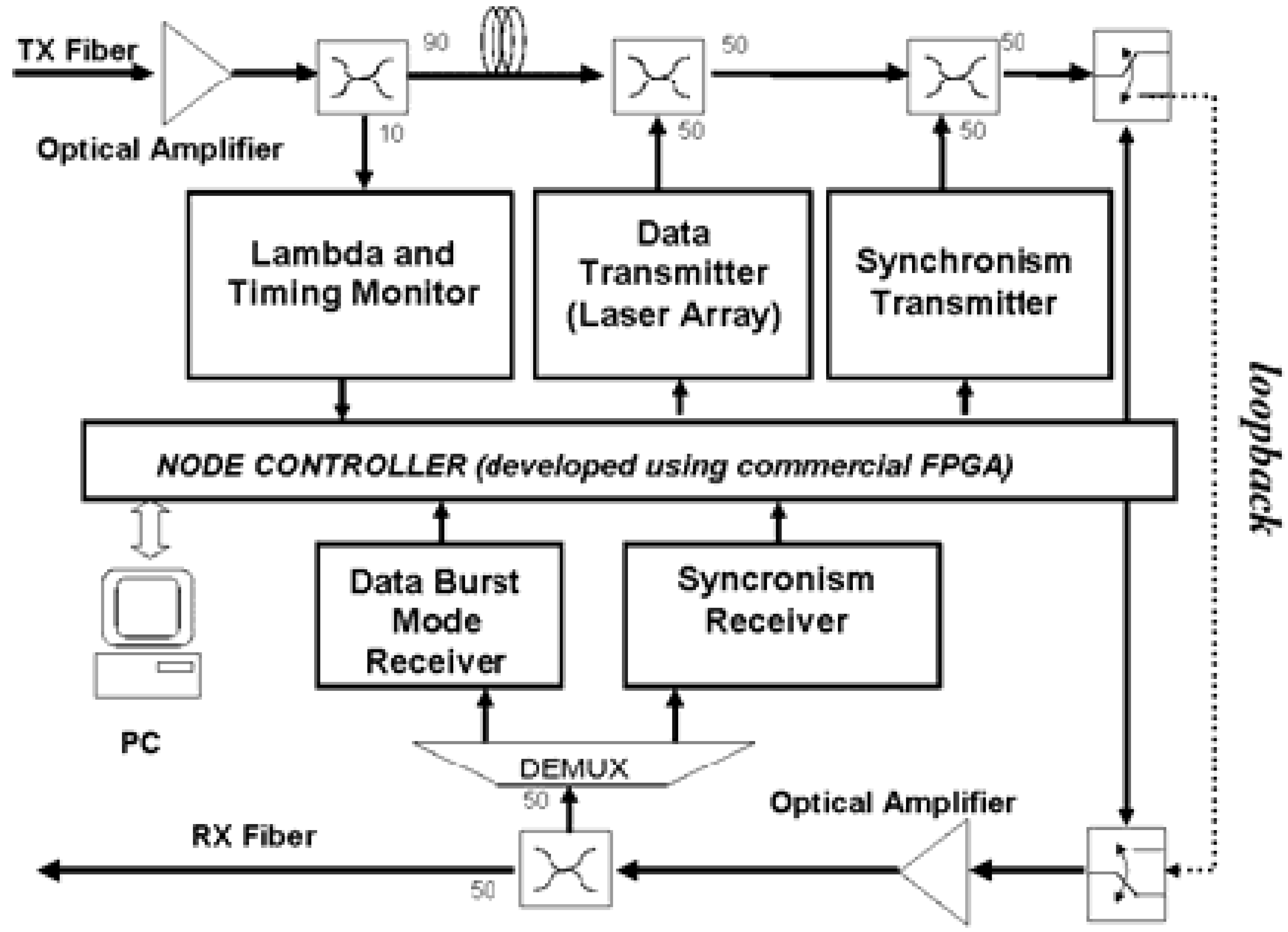
Network Demonstrator Architecture



A three node experimental testbed is demonstrated:

- Bidirectional optical ring folded at one node
- Three fully-equipped nodes
- Each node implements all layers from the physical up to the application layer
- Application layers "see" the WONDER testbed as a "standard" Ethernet network card through a custom-made driver

Node Demonstrator Architecture



A tunable-transmitter, fixed-receiver architecture

- Efficient and dynamic packet multiplexing, thanks to a direct packet-over-optics slotted approach and virtual-output queuing at the transmitter side
- Maximum simplification of the physical layer:
  - at the TX side use of an array of standard DFB lasers to obtain wavelength tuneability
  - on the optical path use only of optical amplifiers and passive optical couplers/splitters
  - on the RX side: use of standard DWDM demultiplexers and GPON burst-mode receivers
- High-performance commercial FPGA board, for Medium Access Control

The project rationale

A "gradual approach" toward optical packet switching, without exceedingly complex optical component technology requests

Proof-of-concept experimental demonstration of the tunable-transmitter, fixed-receiver architecture

OPTCOM www.optcom.polito.it

TNG www.tlc-networks.polito.it

PhotonLab www.photonlab.org

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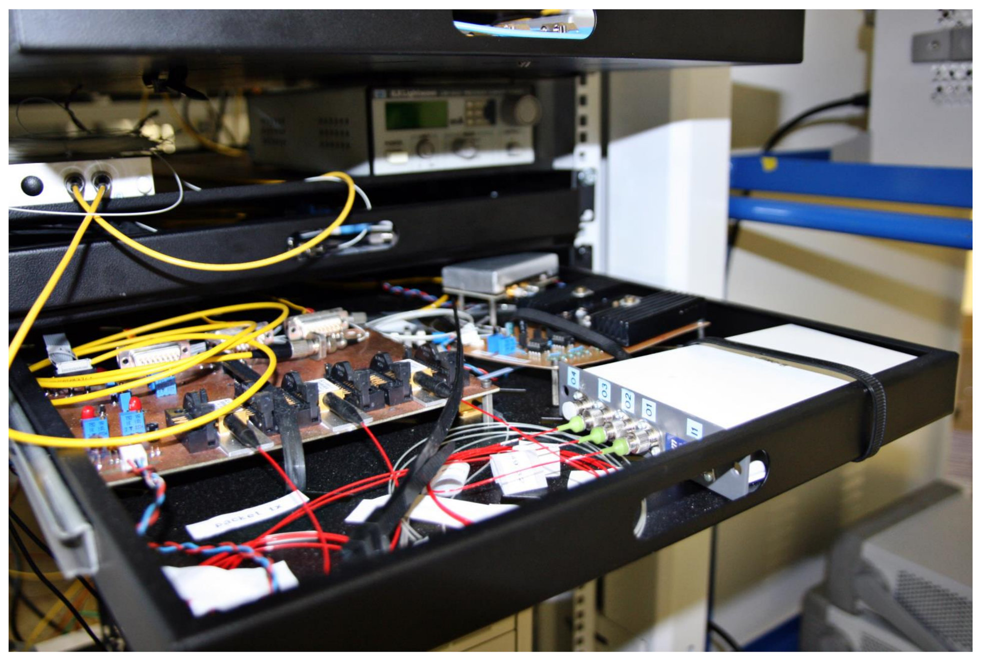
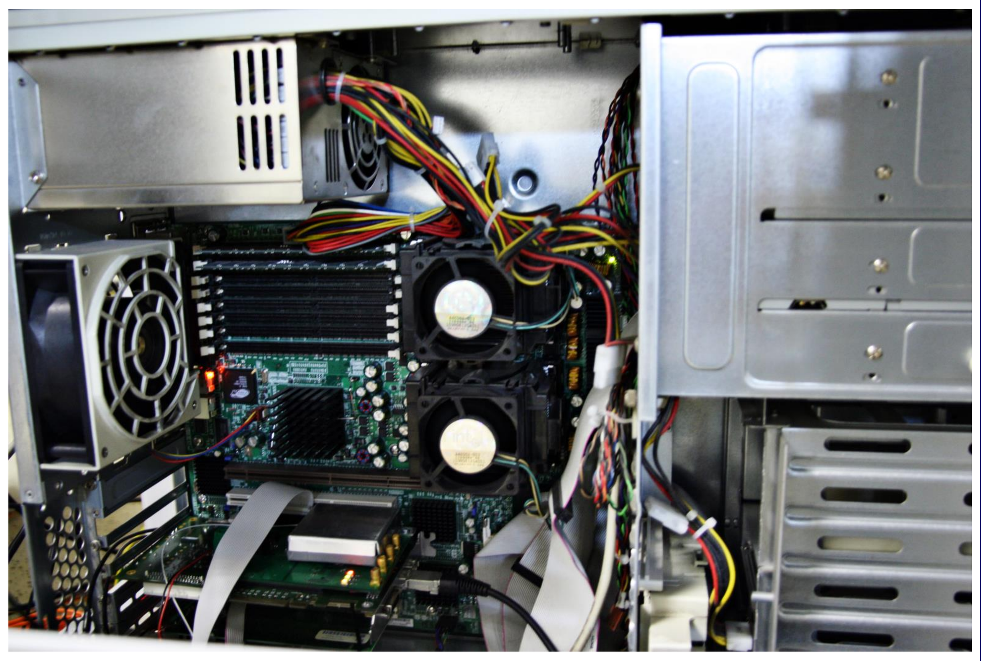
Technical Specifications

- Three wavelengths (100 GHz spacing, C-Band)
- Each wavelength is running at 1 Gbit/s data rate (1.25 Gbit/s line rate after 8B/10B coding)
- 2 µs packet length, 100 ns guard-time (i.e. 2000 bits per packet)
- One additional wavelength with data running at 125 Mbit/s for synchronization issues, provided by the master node

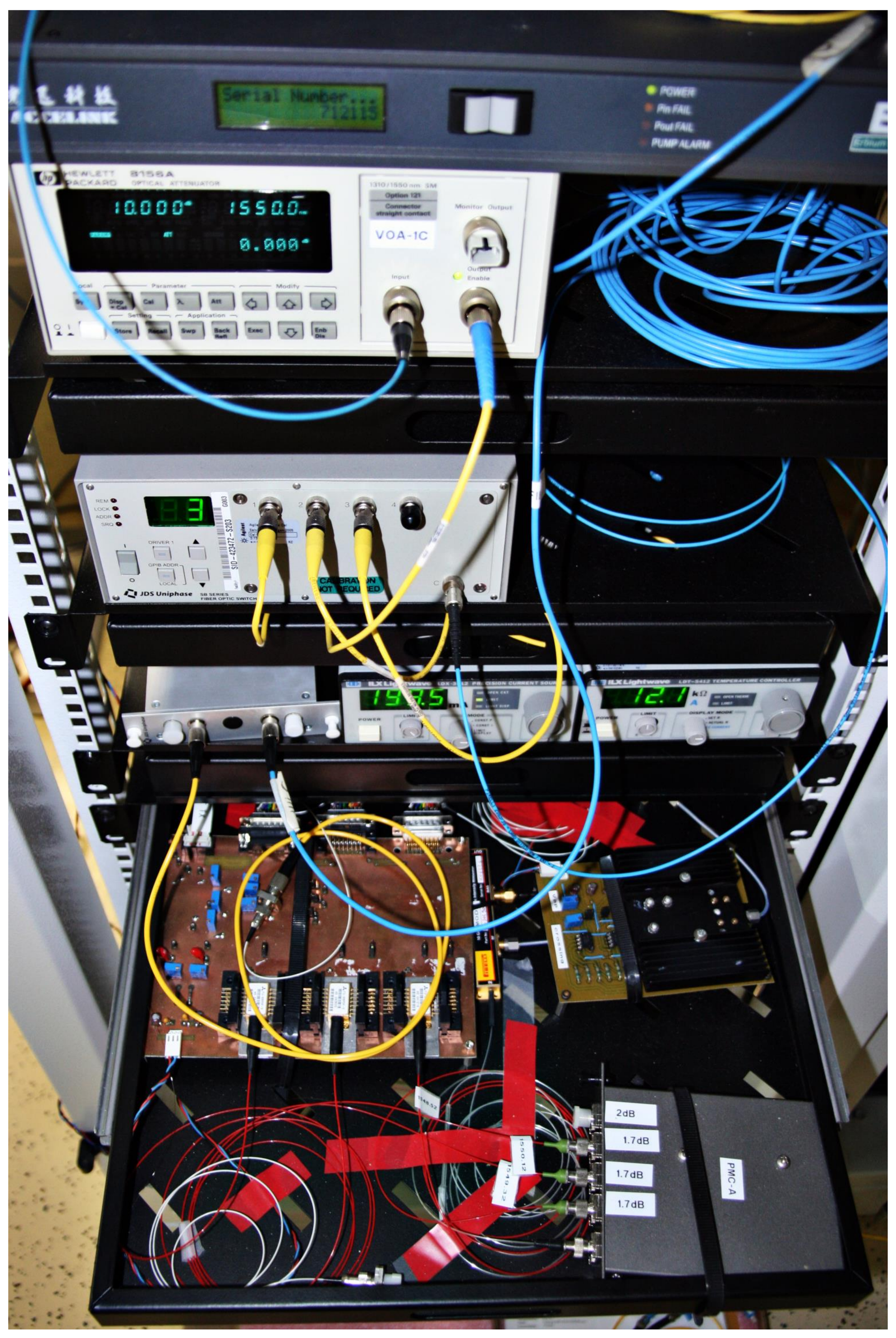
Testbed Implementation



Data transmitter



Node controller (FPGA) + Burst Mode Rx



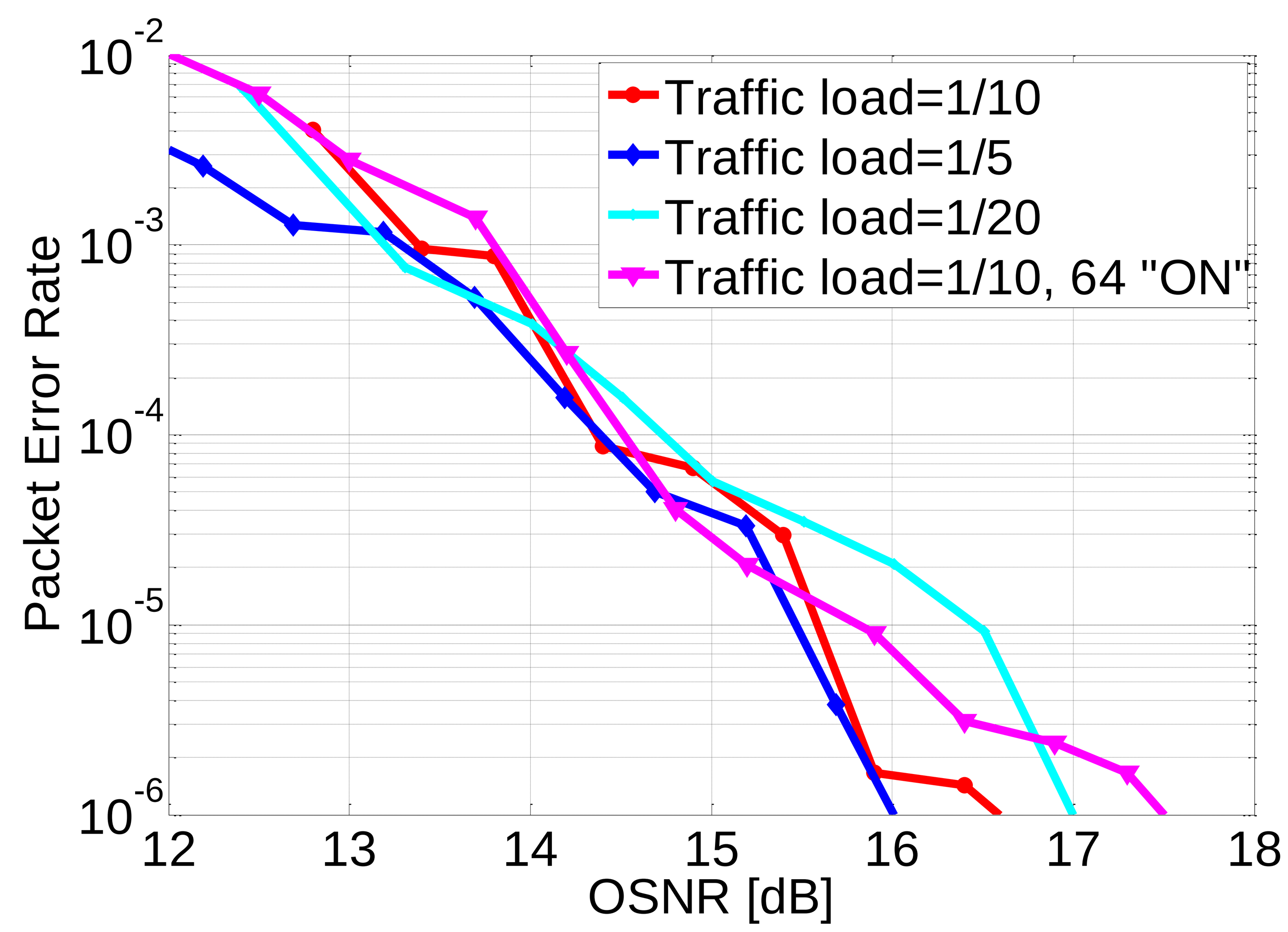
Fully equipped node

Video Streaming application running on one testbed node

Two operating nodes

Experimental results

Packet Error Rate (PER) as a function of the OSNR (over 0.1nm) at the input of the receiver for different network loads (packet/slots) and traffic burstiness (up to 64 consecutive packets)



Reported results were obtained directly from a Linux software driver (the test packets have thus passed through all network layers).

Conclusions

We have demonstrated a fully operational optical packet demonstrator exhibiting very low complexity of its optoelectronic components. Data from real applications on Linux PCs have been exchanged among the nodes.

The presented architecture can find interesting applications also in areas other than metro networks, like interconnect networks of next-generation high-capacity computing systems.

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