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Towards 5G: impact and requirements on front hauling

Significant effort is currently ongoing to support the next generation mobile and wireless communication system, called 5G. 5G is expected to be fully implemented by 2020, with pioneering deployments targeting the Winter Olympic games in 2018 in South Korea. Compared to 4G, 5G poses extremely challenging objectives:

- 1000 times higher mobile data volume per area;
- 100 times higher number of connected devices;
- 10 to 100 times higher typical user data rate;
- 10 times longer battery life;
- 5 times reduced end-to-end latency.

These objectives could be reached through the joint action of three factors:

- 10 times spectrum efficiency improvement;
- 10 times more available radio spectrum;
- 10 times the number of utilized base stations.

All these aspects will induce a direct impact on fronthaul networks. In particular, they pose relevant questions on the Common Public Radio Interface (CPRI) interface. CPRI was originally designed as an internal interface within a base station. However, it has been subsequently considered in the context of Centralized Radio Access Network (C-RAN). As a consequence, CPRI is not optimized for such scenario, where high bit-rates are required. Initiatives are ongoing to improve the CPRI efficiency, such as CPRI compression or new open interfaces optimized for 5G, able to also meet fronthaul latency and synchronization requirements.

For more details, we recommend:

[1] A. Pizzinat et al., “Things You Should Know About Fronthaul”, Journal of Lightwave Tech., March 2015

Filterless Networks

Filterless optical architectures, also called Drop and Waste (D&W), are attracting significant interest for the design of metro/aggregation optical networks. In D&W, the key idea is the use of 100G coherent transponders in routers/switches and only splitters/couplers and amplifiers in the transport optical network. That is, no expensive Reconfigurable Optical Add/Drop Multiplexers (ROADMs) and Wavelength Selective switches (WSS) are envisioned in D&W solutions. Indeed, thanks to the coherent technology, each transmitted signal can be properly selected at the receiver. However, since each signal occupies the entire network, a significant waste of spectrum resources is typically experienced [2]. In D&W, significant cost savings are achieved in CAPEX due to the use of inexpensive hardware in the optical network. Moreover, relevant OPEX savings are also expected, thanks to the simple control and management operations.

A D&W pilot network has been successfully implemented by Croatian Telecom, considering a horseshoe topology [3]. Additional tests are on-going by Deutsche Telekom to assess the transponder

capability to safely operate in the required optical power ranges and to fully support interoperability among different transponder vendors.

For more details please see:

[2] G. Mantelet et al., "Establishment of dynamic lightpaths in filterless optical networks," Optical Communications and Networking, J. of, vol. 5, no. 9, pp. 1057–1065, 2013.

[3] B. Zaluski et al., "Terastream implementation of all IP new architecture," in MIPRO Conf., 2013

Photonics in Computing Systems

Future computing systems will have to support distances ranging from a few cm in silicon waveguides up to several km in single-mode optical fibers, while providing high compact waveguide-to-fiber connectivity. WDM single-mode silicon photonic links can meet this need.

Preliminary demonstrations of high-density silicon photonic links have been shown by Oracle Systems, in a commercial, foundry-based 130 nm digital-CMOS silicon-on-insulator (SOI) platform. Other demonstrations based on this technology have been presented, including an 8-channel 100 Gbps tunable silicon photonic WDM ring-resonator-based multiplexed transmitter array, successfully achieving high-quality transmission for distances up to 40 km. Recent progresses have been also achieved in efficient, tunable silicon-assisted lasers. Based on these components, it is possible to target ∼1 pJ/bit link for photonically-interconnected manychip modules. However, significant challenges still remain in system packaging, alignment, and assembly.

For more details, we recommend:

[4] Krishnamoorthy, A.V. et al., "Energy-Efficient Photonics in Future High-Connectivity Computing Systems," Journal of Light. Technology, Feb. 2015

New Textbooks Series

Springer has launched a new book series "Textbooks in Telecommunication Engineering". After six years of hard work led by Dr. Tarek S. El-Bawab, former chair of TAOS, and member of IEEE Communications Society Board of Governors, the field of Telecommunications Engineering education was recognized by the Accreditation Board for Engineering and Technology (ABET) on November 1, 2014. The new series capitalizes on this milestone and aims at designing, developing and promoting high-quality textbooks to 2fulfil the teaching and research needs of this discipline.

Book proposals are solicited in all topics of telecommunications engineering. Details and call for proposals available at:

http://www.springer.com/series/13835

For questions and further information, please contact: Dr. Tarek S. El-Bawab, Series Editor, Department of Electrical and Computer Engineering, Jackson State University, telbawab@ieee.org; or Mary James, Senior Editor, Springer, mary.james@springer.com

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