Microwave photonics as a solution for the convergence of radio and optical fiber networks on the physical layer

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The lowest level of communication network, the physical layer, is nowadays a combination of optical fiber transmission technology for fixed network nodes and a wireless radio communication system to also facilitate mobile users. Wired fiber optic connections provide low transmission losses and unique broadband transmission, while wireless links based on radio, micro-wave an even millimeter frequencies provide users with mobility, although these connections are limited in terms of broadband and have a high energy consumption. The next generation of efficient, high-speed, wireless internet with the support of high bandwidth and high mobility is requiring a number of technologies to converge, coexist, interoperate and cooperate. A key field within this next-generation puzzle is the integration of radio networks and optical fiber networks to provide high-bandwidth, scalable and manageable networks with a very simple interface structure.

The convergence of radio access networks and optical fiber access networks [1] in a physical layer is leading to a new technological field called microwave photonics (MWP). It will bring new functionalities to access networks to allow for ultra-high-capacity data transmission with low latency. The advantages of using MWP are multiple. It provides a scalable technology that provides the smooth integration of the optical access network and the transmitting antenna. For remote antenna base-stations the low transmission loss of the optical fiber allows the centralization of the wireless carrier generation, since, without doubt, the advantage of photonics is when generating and transmitting spectrally broad and spectrally efficient ultra-high-capacity data signals.

Nowadays, the research challenge in optical access networks [2] is to incorporate discrete sub-systems into photonic integrated circuits. Similarly, current MWP communication systems are based on optical fiber and discrete components, which limits the high-volume applications and by using integrated MWP in optically supported wireless networks the solutions that are especially suitable for a high-capacity radio system based on micro-wave and millimeter-wave frequency bands can be provided.

This invited lecture will provide an overview of the technological contributions of MWP to the physical layer of next-generation, high-speed wireless networks and present the COST Action CA16220 [3] working group "Integrated MWP for 5G". The example of the presented solution for combining optical and radio technologies, and thus the transmission of the radio-frequency signal between the central-station and the numerous base-stations, reduces the size and complexity of the remote antenna base-stations. The integrated MWP technology offers cost and energy efficiency based on a reduction in size and complexity.

REFERENCES

[1] B. Batagelj, et al., Informacije MIDEM 41, 144 (2011).
[2] B. Batagelj, et al., Informacije MIDEM 44, 177 (2014).
[3] https://euimwp.eu/