Ultra high-capacity wireless communications enabled by free-space optics

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The recent standardization of 5G has opened new opportunities for the exploitation of high-frequency communications, such as millimeter-wave (above 30 GHz). Nevertheless, in order to face the ever-increasing bandwidth requirements and the scarcity of spectrum, the current research efforts for beyond 5G communications are now being shifted towards the development of THz-wave transmission (above 300 GHz). However, the utilization of such high-frequency communications is strongly limited by the tremendous technical challenges, complexity and cost of the required components. In contrast, the use of free-space optics (FSO) in the near-infrared region provides a much simpler and cost-effective implementation, owing to the use of off-the-shelf lasers and photodetectors inherited from fiber-optic communications. In addition, FSO provides an unprecedented potential for ultra-wide bandwidth wireless communications over an unregulated spectrum.

Exploiting the imminent advantages of FSO communications, we have recently demonstrated the seamless transmission of 5G-compatible wireless signals over an outdoor 50 m link, while guaranteeing its retro-compatibility with full-fledged legacy 4G networks. Targeting ultra-high capacity applications, such as dense mobile backhaul or inter-datacenter links, we have also experimentally demonstrated a phase-coherent 200 Gbps FSO transmission using a single photodiode detector enabled by the Kramers-Kronig transform. The results were presented at the most prestigious international conference on optical communications, being ranked as a top-scored paper. Even more recently, we have demonstrated 400G+ transmission under adverse weather conditions enabled by the exploitation of digital coherent transceivers together with adaptive probabilistic constellation shaping.

Overall, the obtained results clearly demonstrate the potential of FSO for cost-effective ultra-high-capacity wireless transmission for beyond 5G communications.

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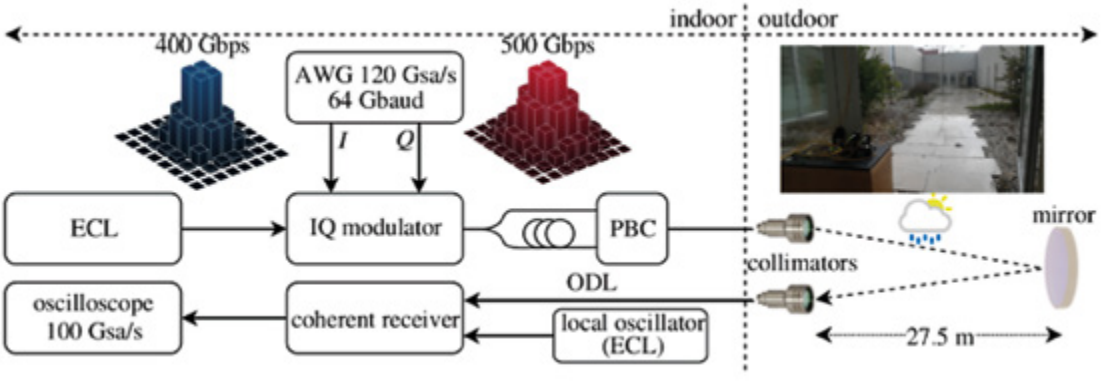

FIGURE 1
Experimental setup implemented in the optical communications laboratory of Instituto de Telecomunicações, enabling the demonstration of 400G+ optical signal transmission and detection with a 55-m free-space optics link.