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First Hybrid 1Gbps/0.1 Gbps Free-Space Optical /RF System Deployment And Testing In The State Of Qatar

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Abstract

I. BACKGROUND & OBJECTIVES

Owing to its high-bandwidth, robustness to EMI, and operation in unregulated spectrum, free-space optical communication (FSO) is uniquely qualified as a promising alternative or complementary technology to fiber optic and wireless radio-frequency (RF) links. Despite the vibrant advantages of FSO technology and the variety of its applications, its widespread adoption has been hampered by rather disappointing link reliability for long-range links due to atmospheric turbulence-induced fading and sensitivity to detrimental climate conditions. A major challenge of such hybrid systems is to provide a strong backup system with soft-switching capabilities when the FSO link becomes down. The specific objective of this work is to study for the first time in Qatar and the GCC the link capacity, link availability, and link outage of an FSO system with RF back up (i.e. hybrid FSO/RF) under harsh environment.

II. METHODS

In this work, a practical demonstration of hybrid FSO/RF link system is shown. The system has a capacity of 1 Gbps and 100 Mbps for FSO and RF, respectively. It is installed in Qatar University at two different buildings 600 m away and 20 feet high. This system is basically a point-to-point optical link that uses Infrared laser lights to wirelessly transmit data. Moreover, the proposed system has capability to make parallel transmission between links. In order to analyze the two transport media, we used the tool IPERF. This Java based GUI (jperf) application can either act as a server or client, and is available on a variety of platforms. We have tested end-to-end throughput by running IPERF tool in server mode on one Laptop and in client mode on another.

III. RESULTS

Figure1 shows a block diagram of the system used. Initial results were obtained for the two links under same climatic and environmental conditions, where the average ambient temperature reached 50°C and RH above 80% (July-August 2014). Both FSO and RF links allowed transfer rates of around 80% of their full capacity. During all experiments while running both links simultaneously, there was no FSO link failure. In case of an FSO failure, the RF is expected to back up within 2 seconds (hard switching), which might cause a loss of data. Detailed results on FSO-to-RF switching and induced packet loss will be reported in the full manuscript and during the presentation.

IV. CONCLUSION

Tests on FSO/RF link have been carried for the first time in Qatar. Initial results showed that both FSO and RF links operated close to their capacity. During summer, Qatari weather did not induce FSO link outage. The team is focusing on developing a seamless FSO-RF soft switching using NetFPGA boards and raptor coding.