

Recommendations for Future Free Space Optical Networks Research

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1 RESEARCH PROBLEMS

I believe that both the advantage and disadvantages of free space optical networks (as compared to other PHY such as RF, mmWave, THz, acoustic etc.) stem from its ability to produce beams with very low beamwidth in the range of micro radians. A high degree of spatial signal containment reduces or eliminates medium access contention and interference, thus enabling reliable and ultra-low latency mobile ad hoc wireless networks. In fact, I believe that FSO networks can offer significant advantages in latency and not just data rate when compared to competing PHY solutions.

However, distributed control of multiple narrow beams in wireless networks (i.e, the medium access and topology control) becomes challenging. There is a need for new Pointing, Acquisition and Tracking (PAT) techniques that can reduce current PAT times by several orders of magnitude (e.g., by using multiple beams). New and innovative hardware technology (such as MEMS) should be investigated to solve these problems. Optical circuit and packet switching technology found in datacenters can also be exploited here.

There is a need for affordable, small form factor (a.k.a low-SWaP), reprogrammable and software configurable FSO transceivers (especially amplifiers) that offers a high degree of control over beam management and signal processing, in order to combat multipath, turbulence and other PHY phenomena. The mmWave research community has made progress in this area (especially software defined architectures and signal processing), and this should be leveraged. A large-scale testbed that offers prototyping and deployment of FSO hardware should be established.

2 COMMUNITY BUILDING AND OUTREACH

I found this workshop extremely useful and I recommend that this workshop be held regularly, maybe on a biannual basis. The meeting venue could rotate between academic settings, federal research labs, and industry. Holding joint workshops with other communities focused on directional networking research (e.g., the NSF mmWave Research Coordination Network) will be very instrumental in outreach.

Recent successes in FSO networks research (such as deployments that demonstrate high data rates over long distances) should be evangelized and brought to the attention of the “sub-6GHz” and other RF research communities. The advantages that FSO has in the areas of underwater networking as well as localization, positioning, navigation, and timing should be emphasized. Tutorials should be organized at leading communication and networking conferences - especially those organized by the IEEE and ACM, since the FSO community frequents conferences held by other professional societies such as SPIE and OSA. This cross pollination is extremely essential and should be a high priority.