Internet Connectivity: Is Free Space Optics the Solution?

SS Rais1, H Husni2

1School of Electrical Engineering, College of Engineering, University Teknologi Mara Cawangan Terengganu Kampus Dungun, 23000 Dungun, Malaysia
2School of Electrical Engineering, College of Engineering, Pusat Asasi UiTM, Universiti Teknologi MARA Malaysia Kampus Dengkil, 43800 Dengkil, Selangor

*Corresponding author’s email: sitisara851@uitm.edu.my

Abstract. During the Coronavirus disease 2019 pandemic era, poor internet availability hampered online activity, particularly in the sector of education in Malaysia. The most effective way to address this situation is through the construction of telecommunications towers. However, it takes time due to the significant costs involved. Outdoor use of FSO appears to be more advantageous due to the absence of licensing requirements and the high bandwidth it offers. However, there are limitations. We will explore these FSO restrictions in this paper.

Keywords: Outdoor FSO; Internet access connectivity; Online Education

1. Introduction
Kosmo reported that the poor internet access in the rural areas of Gua Musang district in Kelantan is a significant challenge for Orang Asli students to follow Online Home-Based Learning (OHBL) [1]. They could not access the internet when they were at home and had to go out to the hilly areas of the village to access the internet [1]. The same goes for some students who had to stand outside their house to attend OHBL in Kuantan, Pahang, reported by Kosmo on April 29 2021[2]. On June 16 2021, the Borneo Post reported that a group of students from Kampung Entakong, Sarawak made part of the dirt road a classroom. They had to study on the dirt road due to poor internet access during OHBL [3]. Since the Covid-19 outbreak, we continue to hear about poor internet connections in some suburbs and rural places in Malaysia to this day.

As a result of poor internet connection, many things happen, such as difficulty in implementing OHBL by teachers, students are increasingly stressed, students cannot attend or complete assignments, and risks when engaging in OHBL. These situations have been reported by the news in [4-8].

The most effective way for internet connection is to build numerous additional telecommunications towers, as shown in Figure 1. If it is that simple, why has it not been done long ago? Even if these telecommunications towers are constructed, not all residents, especially the less fortunate, can afford a paid internet subscription [9]. According to Utusan Malaysia, students shared their mother's internet data for OHBL [10]. Malaysia Kini also stated that some families could not purchase internet data for their children's OHBLs due to budgetary restraints. For them, even purchasing basic necessities was already a challenge [11].
Recognizing Malaysia’s internet access challenges, the government should be more proactive in ensuring internet connectivity across the entire nation, be it urban or rural areas. Besides that, the private sectors through their Corporate Social Responsibility as well as individual contributors can support in providing internet access towards their local communities.

This article addressed how to implement internet connectivity via free space optical communication (FSO). Can it be implemented practically in Malaysia to address the issues raised? However, further options exist that are not covered in this study.

2. Internet Access Coverage

We present two (2) instances of circumstances with limited internet connectivity in this paper: (a) the Internet Service Providers (ISPs) coverage is limited, and (b) there is no fiber or cellular coverage, just satellite communications, as depicted in Figure 2. Throughout Malaysia, satellite broadband internet services are available [12]. However, it is not widely adopted due to the high cost involved. Both the end-user satellite devices and the internet plan are expensive for individual subscription [13]. In February 2021, the same ISP, in collaboration with the Malaysian government, presented another strategy in providing affordable internet plans [14]. Although the package offered is relatively affordable without paying the devices in rural areas of Sabah and Sarawak, the coverage is only limited to 100 meters from the transceiver station [15].

3. Internet Access Coverage Outdoor Free Space Optical (FSO) Communications

FSO is one of the branches of optical wireless communications (OWC) technologies [16]. Radio-based wireless communications have been widely used to address the rising demand for wireless capacity, but their scalability and bandwidth are limited [17]. Therefore, FSO technology is deployed to overcome these drawbacks. In addition, FSO has no spectrum licensing requirements [18].

Outdoor FSO networks provide long-distance point-to-point outdoor optical communications using the Line-of-Sight (LOS) mechanism in the atmosphere [19]. When a fiber-optic cable is unavailable or too expensive to build, outdoor FSO is an option for last-mile connectivity [18], as
demonstrated in Figure 3. In the market today, optical wireless Point-to-Point connection distance up to 15 km [20]. Thus, through deployment of FSO, network coverage can be further expanded and benefit more people within that area.

Figure 3. FSO links to scalable the network.

However, FSO has limitations based on the context as illustrated in Figure 2.

- Outdoor and last mile access: it can be deployed by service providers [21]. Thus, it does not differ from satellite communication systems. It will involve a higher cost, and there will be delay in its implementation.
- Building-to-building applications such as LAN-to-LAN, enterprise network or a campus network [20].
- Due to atmospheric loss, it needs a hybrid network design such as radio-based communication (RF) + FSO to provide optimum connectivity [17].

4. Conclusion

As it turns out, FSO is extremely valuable in the context of broadband internet services. However, several constraints are to be addressed in a situation such as that depicted in Figure 2. It entails ISPs, costs, and a relatively lengthy deployment phase. We recommend a few quick deployment techniques, but they are not discussed here. These techniques are our future works.

5. References

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