T4.1-P10 Free Space Optics (FSO) Systems as Alternative Back-Up Links for NDCs and IMS Stations

Cheikh A. B. Dath, Modou Mbaye, Aliou Niane and Ndèye Arame Boye Faye

Laboratoire Atomes Lasers, Departement de Physique, Faculté des Sciences et Techniques, Université Cheikh Anta Diop, de Dakar (UCAD) ; Email: bambadath@yahoo.fr

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ABSTRACT

Free Space Optics (FSO) systems can provide high data bite rates up to 10 GB/s. They are also easy to install and low cost compared to wired optical fiber. In that regard, FSO can play a key role in link back-up for the infrastructure of the CTBTO in the field and even for the infrastructure at the headquarters in Vienna in terms of rapid deployment for securing links and data rate transmission.

I. OVERVIEW OF CTBTO NETWORK AND OPERATION

The FSO systems have capability similar to fiber optic in term of speed and bandwidth. The advantages of FSO over fiber are time and cost of deployment. However they are useful in many emergencies case like communication in disaster events or link back up in securing network transmission core and other strategic link availability.

The Preparatory Commission of the Comprehensive Nuclear Test ban Treaty (CTBTO) have established the International Monitoring System (IMS) that consists of 321 monitoring stations and 16 laboratories built worldwide. These 337 facilities monitor the planet for any sign of a nuclear explosion. The IMS is supported by an International Data Centre (IDC), located at the headquarter of the CTBTO in Vienna, Austria. The IDC processes and analyses the data registered at the monitoring stations, and produces data bulletins that are submitted to the Member States for their evaluation and judgment.

The IDC assists Member States in assuming their verification responsibilities by providing capacity building services necessary for effective global monitoring, like training, and National Data Centers (NDCs) infrastructure; NDCs are representing IDC at country level.

The GCI ensures global coverage. Data are received and distributed through a network of six satellites. The satellites route the transmissions to three hubs on the ground, and the data are then sent to the IDC by terrestrial links.

Besides for the treaty monitoring purposes, t he data from IMS network and the products derived from them at the IDC can serves civil and scientific applications

II JUSTIFICATIONS AND ADVANTAGES OF THE FSO BACK- UP LINK

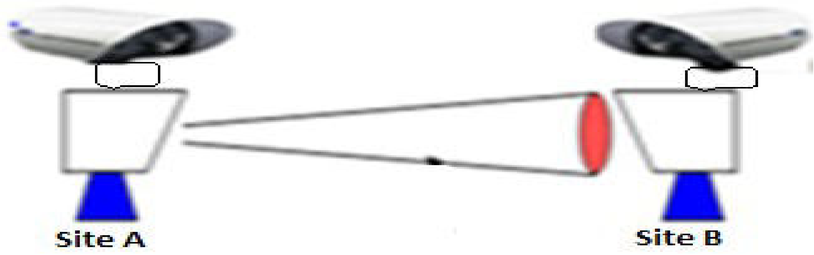

Fig 1: **Block diagram of free optical space (FOS) communication system**

II.1. PROPOSED ARCHITECTURE

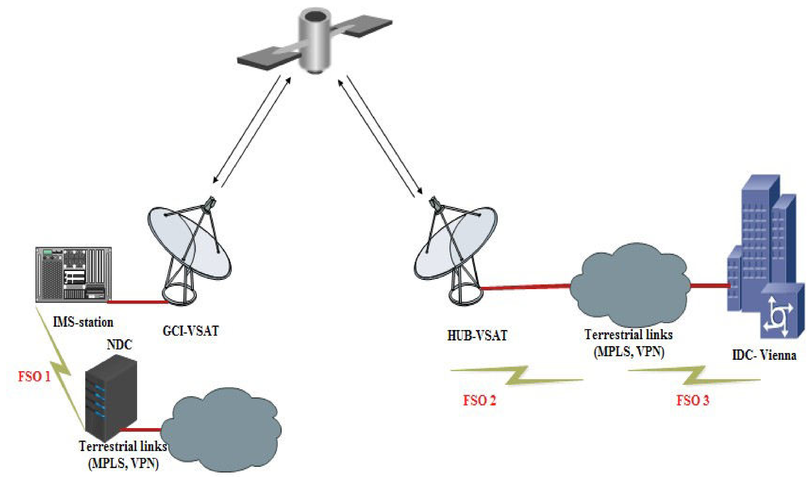

Fig. 2 architecture of link with FSO-backup

The IMS stations should meet the requirements of 98% of availability. The circuits availability are up to 99.5 for VSAT and approximately 99.95% for terrestrial link of the time over any consecutive 365 days, meaning, by the way, a total outage time less than 44 hours per year and 4,4 hours per year respectively.

In that regards, the IMS stations could be secured by necessary back up links to ensure data and network availabilities. The Solution proposed is justified by many considerations.

Communication links employing FSO technology are highly immune to electromagnetic interference and operate around 850 and 1550 nm, which corresponds to frequencies around 200 THz, this is a very important fact because many national regulatory authorities do not regulate frequency use above 300 GHz [1]..

FSO transmitters and receivers are highly invulnerable to interference from other optical radiation sources [2, 3].Once established; FSO links are extremely immune to interference and interception [4].

The installation of a fiber based solution to connect the end-user to the optical network can cost between $100,000 and $200,000 per kilometer in metropolitan areas where as much as 85 percent of the cost is attributed to trenching and installation costs [5]. However, the purchase and installation cost in FSO is estimated from $10,000 USD to $25,000 USD for medium and long-distance link during 2003 [10]. A network of optical fiber could be built in FSO with only 10% of the cost.

II.2. DISCUSSION

In that work, the FSO solution is investigated in three scenarios mentioned as: FSO1, FSO2 and FSO3.

FSO1 is a back-up scenario, connecting an IMS station and NDC together with internet via terrestrial link like a VPN or MPLS. Therefore two routes are possible for both NDC and IMS, the VSAT and the terrestrial link.FSO 2 consists of a back up link between satellite hub and potential NDC or data center placed at the hub to terrestrial link. FSO 3 is the back-up at the headquarter in Vienne, between the IDC facilities and the terrestrial links extending hubs connexions.

IV. CONCLUSION

The major challenge FSO solution is faced consists of the capability to ensure the long haul connexion needed. FSO terrestrial systems still being limited to several kilometers and some times, distances between IMS station and NDC or others nodal facilities are long.

But lasers have already been demonstrated as a viable communications medium for inter-satellite Communications [6-**7**] and are being investigated for use in deep-space communications links [8- 9]. These deveolppements make FSO, a reliable technology for the future advancement of information and communications systems.

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