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Optical signal transmission through fiber and its optimisation

Ved Nath Jha*
Faculty of Physical Sciences, Mangalayatan University, India
***Corresponding Author:** Ved Nath Jha Faculty of Physical Sciences, Mangalayatan University, India, E-mail: ved.jha@mangalayatan.edu.in*

ABSTRACT
The channel between transmitter and receiver is the most important part of the optical fiber networks like LAN, FTTH, EPON, NBN, OTN etc. So, in order to make successful communication, it is important to think what amount of signal is transmitted and how long it is transmitted through the fiber. Now the role of Frequency range of optic signal with the Optimisation tools in broadband communication for long haul transmission is to be discussed. Finally, it is said that the optical fiber network will appears as the backbone of 5th generation communication completely by the elimination of several limitations (nonlinearities) like, Cross Phase Modulation (XPM).

Key words: Linear Impairment; Non-Linear Impairment; EPON; FiOS; OTN; XPM; SPM

INTRODUCTION

The optical signal-to-noise ratio (OSNR) is one of the most useful parameters for estimating the quality of a signal directly in the optical layer. This is mainly because the OSNR can be correlated to the end-terminal bit error rate (BER) of the transmitted optical signal through an optically amplified link.1 In addition, since the OSNR is transparent to both the bit rate and the modulation format of the optical signal, it is ideally suited for use in dynamically reconfigurable optical networks. In fact, the OSNR can be used in these networks for link setup and optimization, root-cause analysis of system problems, the setup of an early signal degradation alarm, resilience mechanism activation, service-level agreement (SLA) verification, and so on. Thus, for the efficient operation and maintenance of such dynamic optical networks, it is highly desirable to have the capability to monitor the OSNR of each wavelength-division multiplexed (WDM) channel. Previously, the OSNR has been measured by using the linear interpolation technique, in which the power of amplified spontaneous emission (ASE) noise is measured at wavelengths between the WDM channels and then interpolated into the signal's wavelength. This technique could accurately estimate the OSNR in a conventional point-to-point transmission system (where the noise spectrum is more or less uniform).

However, in a modern dynamically reconfigurable network, WDM signals are added/dropped or crossconnected directly in the optical layer.2 Thus, each signal could traverse different routes and pass through a different number of optical amplifiers. In addition, the noise spectrum in these networks may not be uniform due to the optical filtering that occurs in various network elements, such as a reconfigurable optical add/drop multiplexer (ROADM) and optical crossconnect (OXC). As a result, the accumulated noise levels in these networks could be quite different from channel to channel. Thus, ASE noise residing within a signal's bandwidth (and, consequently, the true value of the OSNR) cannot be measured by using the conventional linear interpolation technique. During the past decade, many researchers have attempted to develop a technique capable of monitoring the true value of OSNR (i.e., in-band OSNR), even in a dynamic networking environment.3–5 For this purpose, it is necessary to differentiate and detect small noise components hidden behind the large signal. For example, such differentiation (and the detection of in-band noises) could be achieved by utilizing the different optical characteristics of the signal and noises (i.e., ASE noises are unpolarized and incoherent, while the optical signal is polarized and coherent). In this chapter we review various OSNR monitoring techniques that are based on these principles.

security performance, which is very suitable for the establishment of backbone transmission network. Wavelength division multiplexing(WDM) network based on optical fiber has been widely used. Using optical fiber for information transmission can give full play to the nearly unlimited transmission capacity of optical fiber. With the advent of the information age, data service has become the mainstream business, replacing the original telephone voice service. The great development of data transmission service further promotes the continuous development of WDM network technology. Among all kinds of services in optical network, IP service accounts for the largest proportion. In optical networks, switching is an important technology. Network performance is directly related to switching technology. With the development of optical communication technology, a variety of optical switching devices are introduced into WDM optical network, such as optical packet switching, optical burst switching and so on. This makes WDM layer have the ability of dynamic path establishment and removal similar to IP layer. In order to improve the performance of the optical network and reduce the blocking rate of the network, in WDM optical network, the services are designed in different levels. For some very important services, the highest priority is given, and the optical path channel with better survivability and higher fault tolerance is selected. For general services, it can be designed as a lower level service, and choose the appropriate optical path channel for transmission. The experimental results show that this hierarchical service design method can make more effective use of network resources, reduce the network blocking rate, and improve the overall performance of the network.

Today optical transmission is the standard technology in backbone and metro region telecommunication networks. However, in local access networks (LAN), which connect customers or business units with the next metropolitan aggregation point, optical transmission is still not ubiquitous. In many countries the data flows in this so-called “last-mile” of the network hierarchy from the backbone towards the end-user are still electrically switched. They are transported over copper cables from old telephone networks via digital subscriber line (DSL) technology. Bit rates beyond 50 Mbps can, in principle, also be obtained using the TV cable infrastructure (co-axial cables) or fourth generation wireless technology (long-term evolution—LTE). Optical fiber, though, is superior to copper cables and radio access in many aspects: (a) the high data rates and the available bandwidth ensure a future-proof scalability of optical transmission, which is very important in light of the increasing demand for new multimedia services; (b) the lower energy consumption benefits efforts to increase sustainability in telecommunications; (c) the immunity to electromagnetic interference and crosstalk and the practically non-existent radiation increase security and efficiency of the networks and allow for much longer reach of signal transmission. These advantages drive network operators to renew their infrastructure in the last mile.

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