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LINK BUDGET ANALYSIS OF VARIOUS LINK SCENARIOS FOR ADAPTIVE OPTICAL SATELLITE NETWORK

Abstract

Communication demands for satellite communications have been increased due to the emergence of Earth-observation (EO) services and satellite Internet services. Satellite optical communication is a key technology to deliver a large volume of data in the space environment. Research and development for various types of satellite optical communications have been worked worldwide, by using Geostationary Earth Orbit (GEO) satellites and Low Earth Orbit (LEO) satellites.

Under the scenarios, several types of satellite optical communication links, such as GEO-to-LEO, LEO-to-LEO, ground-to-GEO and ground-to-LEO satellite optical communication links, will be operated in the future. Various types of optical modulation and detection methods and data rates will be used in such the systems. It has been considered that system operations for optical satellite links are being more complicated and operational expenses are rapidly increasing in order to manage a variety of links and optical signals, which will exist in satellite optical network systems.

The Adaptive Optical Network (AON) has been studied in terrestrial optical fiber networks. AON is a concept of optical fiber network, which conducts system operation and maintenances automatically, by monitoring the status of optical fiber links and controlling the link parameters of optical nodes. In the previous work, the Adaptive Optical Satellite Network (AOSN) which utilizes AON concept for next-generation optical satellite network is proposed. The AOSN operates the optical satellite networks automatically, by monitoring status of optical satellite links and controlling the link parameters of Laser Communication Terminals (LCT).

In this paper, link budget analysis of various link scenarios for the AOSN is conducted. These link scenarios include the inter-satellite links such as GEO-to-LEO and LEO-to-LEO links, and the ground-to-satellite links such as ground-to-GEO and ground-to-LEO links. The satellite constellation model and the atmospheric turbulence effects are considered. The AOSN utilizes digital coherent reception, Forward Error Correction (FEC) schemes and Wavelength Division Multiplexing (WDM) technology. The link parameters are mainly defined as follows: the maximum symbol rate of 10 Gbaud, number of channels and the optical modulation methods including Binary Phase Shift Keying (BPSK), Quadrature Phase Shift Keying (QPSK) and 16 Quadrature Amplitude Modulation (16QAM). The paper describes the analytical results for link budget design of various link scenarios to realize the AOSN.