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LINK BUDGET CONSIDERATIONS AND NETWORK ARCHITECTURE FOR VARIOUS APPLICATIONS OF CARRIER-IN-CARRIER TECHNIQUE IN SATELLITE COMMUNICATIONS

Abstract

For any satellite-based service, space segment costs are the major operating expense and directly affect the viability and profitability of the service. In order to ensure the normal functioning of the satellite link, a complete analysis of the link budget is required as an essential step. The link budget analysis defines what size antenna to use, power requirements, link availability, and error rate. However, the cost of leasing a satellite transponder is determined by the amount of bandwidth and power consumed. It is always difficult to achieve a delicate balance between power and bandwidth requirements. The conventional method of balancing a satellite link involves a trade-off between modulation and coding. Lower-order modulation uses less transponder power while using more bandwidth. On the other hand, higher-order modulation requires less bandwidth but significantly increases power.

This paper is a further study on the innovative technique that added a new dimension to satellite communication optimization and provides a significant improvement in bandwidth and power utilization over and above what is possible with FEC and modulation alone, allowing users to achieve unprecedented savings.

Namely, Carrier-in-Carrier technique, also known as Bandwidth Cancellation, is a creative method for point-to-point and point-to-multipoint communications as it enhances resource efficiency by minimizing leased bandwidth, lowering HPA requirements, reducing transmission and receive antenna sizes at earth stations, and increasing link margin. The implementation of a CnC network considers the processes for bandwidth and interference cancellation, the commissioning and deployment needs at hubs and remote earth stations, the operational and margin requirements for link optimization, as well as the satellite transponder specifications.

There are various applications of Carrier-in-Carrier technique, such as symmetric data, asymmetric data, and Paired Carrier Multiple Access (PCMA) links. Together with a theoretical analysis of the various uses, link budget calculations are performed for each of them, and the results are compared to those obtained using more traditional techniques.