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SATELLITE TELE-COMMAND TRANSFER FRAME LENGTH OPTIMIZATION METHODOLOGY FOR IMPROVING SPACE UPLINK EFFICIENCY

Abstract

A space link refers to a physical channel constructed in both directions between a space segment and a ground segment. Korea's low-Earth orbit (LEO) satellites use S-band (2-4 GHz) as a space link for control, where the TC/TM format complies with the Space Data System Consultative Committee (CCSDS) standard, and the TC uses the Command Link Transmission Unit (CLTU) composed of header and Transfer Frame (hereafter TF) defined in this standard as transfer units. Among them, TF is not limited to the standard and can be defined by development agencies. Accordingly, the TF format is changed by the mission goal and the unit or subsystem that constitutes the satellite. However, little consideration has been given to link efficiency, which is the ratio of the time it takes to transmit frames (or frames) of data to the total time it takes to transmit and approve frames in these design changes. In addition, Space Policy Directive (SPD)-5, a space cybersecurity policy announced by the United States in September 2020, recommends effective and proven encryption measures to protect space links. Since satellite TC encryption uses symmetric keys, the length of the cipher text increases as the length of the plain text increases. This can degrade uplink efficiency. In this paper, we propose a satellite TC TF optimization methodology to improve spatial uplink efficiency. To this end, Chapter 2 will look at the TF format under development or development of Korea's LEO satellite project. In addition, we will look at the length and quantity of TC arguments allocated and used in each project. Chapter 3 proposes a method to obtain the optimal TF length based on the TC allocated for each satellite project. (To find the optimal TF length, we consider the TC of the three projects and use them.) The last chapter describes conclusions, constraints, and further research plans.