Paper ID: 12420
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Using the ISS to Prepare for Exploration (01)
Exploration Technology Demonstrations Using ISS (2)

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CROSS-LAYER DESIGN OF SPACE COMMUNICATION WITH QOS GUARANTEE BASED ON IP OVER CCSDS AOS

Abstract

In order to meet the multiple requirements of the increasing space explorations, especially the development of the International Space Station (ISS), The Advanced Orbiting Systems (AOS) Space Data Link Protocol is designed by The Consultative Committee for Space Data Systems (CCSDS) to transfer space application data of various types and characteristics over space communication links. Apart from the conventional telemetry and remote data, many systems require transmitting many different types of data, such as audio, video, image, scientific experimental data, etc. on space links. As a result, the problem of providing Quality of Service (QoS) for different traffic data is proposed.

It is considered as a reasonable and efficient way to adopt IP over CCSDS AOS protocol model in future ground-space integrative network. So a novel cross-layer design of QoS guarantee for space communication is proposed in this paper based on IP over CCSDS AOS model. The design combines the differentiated service mechanism at network layer and dynamic scheduling mechanism of AOS virtual channels at link layer. Reference to the ISS, all traffic data in a space communication system are classified into several priorities by marking the Type of Service (ToS) field in the IP packets. ToS is then mapped to the AOS Virtual Channels ID (VCID) through a distribution algorithm. The virtual channels are divided into three types correspondingly, including VIP VCs (transferring data with the highest priority), realtime VCs and non-realtime VCs, and the boundaries of their transfer time slices are changeable. A dynamic scheduling algorithm is designed to schedule all the virtual channels. Moreover, the feedback of the data link layer's state can also be sent to the network layer to control the data flow.

The simulation is done based on throughput, buffer capacity requirement and delay of each traffic type. Simulation results show that the cross-layer design of QoS guarantee proposed in this paper can provide realtime transmission and guarantee the fairness. Meanwhile it can ensure the rational and efficient utilization of the physical channel.