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QCGR: A QOS SUPPORTED ROUTE ALGORITHM FOR DTN-BASED DEEP SPACE NETWORKS

Abstract

Humans' deep space exploration missions have attracted great interest in the past decade and Delay Tolerant Networking (DTN) architecture has already evolved as a pragmatic solution to deep space networks, especially in terms of Interplanetary Networking (IPN). By adopting store-carry and forward transmission strategy without the assuming of persistent connectivity, DTN is fundamentally well suited to the deep space networks that are characterized by a dynamic network topology, and disruptive and intermittent connectivity. In DTN-based deep space networks (DDSN), typically a complete path from source to destination does not exist on the most part of the time. Among the consolidation of system architecture and DTN main building blocks, such as the Bundle protocol (BP), the Licklider Transmission Protocol (LTP) and routing algorithms, the routing algorithm is critical part that should make the best use of the tight resources available in network nodes to create a multi-hop path that exists over time. Therefore, this paper put emphasis on the routing algorithm in DTN, and put forward a QoS (Quality of Service) supported route algorithm. This paper firstly describes the hierarchical architecture of DDSN and analyzes its characteristics on space communication operations. Then, Contact Graph Routing (CGR) is studied comprehensively, which is proposed by NASA and widely used in DTN networks. In order to maximize delivery ratios and minimize delays, CGR typically direct traffic towards particular nodes based on pre-generated static contact plan, without considering the impact of the traffic load and topology change. However, as network traffic demands increase these nodes may become unusable, resulting in increased end-to-end latency, even transmission failure. To solve this problem, we take traffic volume and topology updating mechanism into consideration, and put forward a QoS CGR (QCGR) routing algorithm that differentiates services between different traffics to make sure that high priority services are not delayed by node blocking. In addition, QCGR is able to decreases the probability of multiple traffics competing for node resources by update network topology in real time. Finally, we set up the simulation platform based on STK (Satellite Tool Kit) and ONE (Opportunistic Network Environment simulator) to compare the performance between QCGR and CGR. The results show that QCGR can guarantee the quality of service and has an advantage in terms of average delay for critical data in multiple traffics scenario.