Intelligent Dynamic Network Traffic Management for Global Network Access Terminal

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Keywords: Deep reinforcement learning, GEO, NGSO, SATCOM, Traffic management, Traffic distribution

Leveraging a mixture of government-owned and commercial SATCOM systems to provide global coverage with improved network throughputs and reliability has attracted attention from both academia and industry for years. However, utilizing multiple SATCOM services simultaneously through different satellite networks requires sophisticated traffic management and the handling of large differences in connection properties. For example, commercial Non-GeoStationary Orbit (NGSO) Satellite Communication (SATCOM) networks have advantages of higher network throughputs, much lower propagation delay and more flexible on demand services compared to Geosynchronous Equatorial Orbit (GEO) SATCOM systems. Global Network Access Terminal (GNAT) is one of the solutions designed and developed to provide Internet access utilizing multiple SATCOM services for improved throughput, delay, and reliability.

In this paper, we propose a novel intelligent dynamic network traffic management solution based on Deep Reinforcement Learning (DRL) to better distribute the application traffic to different SATCOM networks. Specifically, we employ DRL to the GNAT control unit to generate a policy that maps measured network states to the optimal traffic distribution. The GNAT system periodically measures the network states, in terms of bandwidth, latency, and loss rate, as the input for the management agent training, and determines the actions on distributing the traffic flows toward better performance. Besides, DRL based solution will initially learn a policy and then improve this policy by continuously interacting with the GNAT system. We also highlight significant challenges facing real-world adoption of DRL based network traffic management, including fairness, implementation, and generalization, which are not trivial to address within conventional DRL. To evaluate our solution and facilitate further research, we implement a testbed consisting of the GNAT hardware integrated with our proposed solution and a simulated network environment. Evaluation results are presented to prove our solution outperforms the current state-of-the-art.