Satelite routing network communication

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Abstract

A lot of research is done to tackle the challenges of high-performance and energy-efficient data center networking. Use of wireless links for DCNs to eliminate these disadvantages is an important research topic. Aerospace-based communications can be managed more efficiently through the construction of an integrated space/air information network. Such a network would best fit the advent of delay- and disruption-tolerant networking, such as under a store-carry-forward mechanism. A novel ACO-based cross-layer routing algorithm for space-air-ground integrated networks (SAGINs) is proposed. We show how to design a routing paradigm that accounts for traffic conditions at a node. The resulting algorithm routes around congested areas while preserving the desirable properties of IP routing mechanisms. Our simulations indicate significant improvements in end-to-end delay and jitter when compared to standard shortest path routing algorithms.

Introduction

End-to-end techniques, such routing for best effort traffic, have historically been used to control congestion on the Internet. Even though there may be alternate channels open, each stream receives just a portion of the bandwidth when many traffic streams share a bottleneck link. This queueing latency may vary depending on the flow of traffic, increasing jitter. Circuit-based routing combined with traffic engineering approaches can address the issue of end-to-end latency and jitter. In this scenario, calculations are carried out along pre-calculated pathways with the assumption that the traffic demands between source-destination pairs are known a priori. In this research, we propose an alternative steepest gradient search-based approach for traffic-aware routing.

The Internet's concept of hop-by-hop routing is preserved via PB-routing, which does not need previous knowledge of node-to-node traffic requests. It can adjust to changes in traffic circumstances without needing a global recalculation of routes since packets are not source routed. By making the potential at each NE a weighted sum of the potential for the shortest path plus a measure that symbolizes the potential for traffic at the NE, the PB-routing algorithm may be made traffic-aware. The routing algorithm sees the entire network as a landscape with numerous congested barriers that may be overcome.

In this paper, we describe the design of a potential field for traffic-aware routing that guarantees desirable properties such as loop-free routing. In our simulations, we have observed significant improvements in end-to-end delay and jitter over a variety of networks and traffic conditions without requiring too much control overheads. We believe that the general framework could be adapted for optimizing various other metrics through careful design of potential functions.

In this article, we outline the architecture of a possible field for traffic-aware routing that ensures desirable qualities including loop-free routing. In our simulations, we have seen substantial reductions in end-to-end jitter and latency across a range of networks and traffic situations without the need for excessive control overheads. Through careful design of alternative functions, we think the overall architecture might be modified for maximizing a number of different measures.

Overview

Algorithms have been developed to optimize network delays and loss rates. One of the earliest works in this area was Gallager's minimum-delay routing algorithm [10]. Another class of algorithms uses link utilization as a measure of traffic and attempts to minimize the maximum (or worst-case) link utilization, given a set of point-to-point traffic demands. We believe that it is possible to use PB-routing with the methods described in this work to route the long lived flows.

The steepest gradient search technique has previously received much research. Numerous optimization problems have been solved using this approach, and it has been utilized in a variety of fields including path planning in robotics, artificial intelligence, and monte-carlo simulations in statistical physics. The fundamental goal of steepest gradient search is to find the best point for a (non-linear) function by first evaluating it at a starting point and then making incremental steps in the steepest gradient's direction.

The area of traffic-aware routing (i.e., routing techniques that take into account traffic conditions) has been studied extensively both from both practical and theoretical perspectives. In our work, we have adapted this method to identify the direction in which to route packets in a data network such that highly congested areas in the network are avoided. This is accomplished by assigning carefully designed potentials based on traffic experienced at a network node. We believe it is possible to use PB-routing with the methods described in this work to route the long lived flows. Almost all of the algorithms that have been developed require a point-to-point traffic demand matrix to be specified.

One class of algorithms uses link utilization as a measure of traffic and attempts to minimize the maximum (or worst-case) link utilization. Another technique is to reduce delay by assigning static OSPF link weights based on a known traffic demand matrix.

**Routing with Potentials**

**Multipath QoS routing**

Multi-path QoS aware routing enhances information exchange in the SAGIN ecosystem despite utilizing a single transmission performance indicator. To improve high arrival rate and very low latency aware data transfer, 6G-SAGIN must provide multi-path routing between two operation centers. Such routing can be calculated at operation centers on the ground or in the air. Later, pre-computed routing policy is reviewed in order to modify QoS requirements to meet SAGIN's needs. Utilizing numerous connection resources allows load balancing to be carried out among several operation centers. Pre-computing on-board systems located at ground, aerial, or satellite centers and real-time computing on board should be separated into two phases in 6G-SAGIN multipath QoS routing. There are three main processes in pre-computation, such as creating the position and ISL knowledge repository (PISLIK) based on the position information that is currently accessible and an ISL log. Additionally, it combines near-real time feedback ISL with the potential QoS demand and traffic persistence, as well as forecast of satellite position in the following slot (e.g., bandwidth availability, delay, etc.).

**combined routing**

6G-SAGIN would be benefited by involving the hierarchical routing (HR) algorithm. The HGHR outperforms traditional DTN, topology characterization and predicted node movement mechanisms. It is capable of predicting the UAV position, contact time, contact probability, sojourn time probability, and state transition probability[19].

**Joint service placement routing**

SAGIN's QoS is enhanced by carefully choosing the path to the routing services. In order to address these issues, 6G-SAGIN would use pre-sent air-to-ground (A2G) and direct-A2G (DA2G) connectivity. In A2G or DA2G networks, there are three key variables that might change: cost, bandwidth, and latency [17,18]. The JSPR's ability to support two different modes, such as static and mobility-aware, can greatly reduce the overall cost. By putting virtual computers (VMs) in the issue area, the approach is further enhanced.

**Limitations**

Early routing systems for satellite networks interpreted the deterministic network as a long sequence, turning the dynamic routing issue into a static one. however there hasn't been any effort to create an integrated network with reliable and prescriptive subnetworks. The routing issue in DTN networks made up of numerous classes of nodes with various features and traffic conditions was explored by the authors in [19] but left unsealed due to routing-awareness variants.

Methodology

We go through our adopted process in more detail below.

When a client sends an IP packet, the switch inspects the packet and, in accordance with any configured policies or rules, passes the packet via a specific route.

The packet is sent to the controller if the switch has no installed policies or rules. After identifying the type of packet (TCP, UDP, HTTP, etc.) and inspecting the packet header and/or payload, the controller puts a policy or rule on the switch instructing it to forward packets via a certain path.

**Implementation**

Opportunistic routing

Numerous heuristic techniques have been put forth by researchers to enhance routing speed and reduce resource overhead. The two most often employed methods were Direct Transmission [12] and Epidemic Routing[13]. Probability estimate is the foundation of the Probabilistic Routing Protocol utilizing History of Encounters and Transitivity (PROPHET) [16]. Based on their past contact frequency, each node would calculate its P-value, or likelihood of reaching the specified destination.

**Properties of the routing algorithm**

True Time Delay Unit(TTDU)

Competative routing algorithms

The Ant colony Optimization (ACO) has continued [3,5,6] despite the fact that it still requires energy.

**Things to note**

**Algorithms have not been formulated well and results and figures have been shown due to time**

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