APPLYING THE QUIC PROTOCOL FOR FUTURE INTERNET SATCOM TRAFFIC
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Objectives

Explore New QUIC Transport Mechanisms
Represent SATCOM industry opinions to IETF
Influence details of transport and loss recovery specifications
Seek to ensure satellite is a first-rate Internet citizen

Opportunities to enhance QUIC for GEO satellite
Propose updated transport mechanisms
Guidance for using QUIC with satellite

Overview

Satellite Internet Performance
Satellite Internet Performance with QUIC
Could QUIC be Quicker?
Implications for Satellite Operators
Conclusions

Satellite Internet Performance (TCP)

TCP no PEP
TCP with PEP

PEPs provide important acceleration for TCP

Encrypted data can’t be read or changed

Satellite service: 10 Mbps GEO Hylas-1

TCP no PEP
TCP with PEP
HTTP Web Transport

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<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>No of Parallel Flows</td>
<td>6-12</td>
<td>~1</td>
<td>~1</td>
</tr>
<tr>
<td>Encryption</td>
<td>(SSL)</td>
<td>TLS1.2</td>
<td>TLS1.3</td>
</tr>
<tr>
<td>TCP PEP</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Application PEP</td>
<td>+</td>
<td>-</td>
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- Reduced Head of Line (HoL) blocking
- Updated Congestion Control
- Ubiquitous use of Single TCP flow with compression
- Encrypted

HTTP/2 [RFC7540] [RFC 8164] is increasingly deployed
In 2011, Google deployed SPDY to replace HTTP/1.1

Satellite Internet Performance (QUIC)

- TCP no PEP
- Quicly (TLS 1.3) - no PEP
- TCP with TLS 1.3 using a PEP

QUIC similar to H2/TCP with no PEP!
QUIC not as good as H2/TCP with a PEP!
QUIC expected to further improve!

Could QUIC be Quicker?
- Going beyond QUIC v1

We found issues that PEPs would fix for TCP
1. QUIC specifies a TCP-like acknowledgment policy
2. QUIC congestion control performance impacted by satellite delay
3. Implementations being improved & QUIC under-specifies flow control
4. QUIC loss recovery is impacted by satellite delay

The same set of issues appear when a VPN is used over satellite
New extensions to QUIC could remove these limits on satellite performance
QUIC Extension for Reducing the Satellite Capacity on the Return/In-Bound Link

25%-50% more byte overhead than TCP

Expected to reduce when the QUIC ACK Frame is used!

Return/In-Bound link often shared between terminals and apps

A proposed IETF QUIC Extension allows this to be tuned by a server

Satellite service: 10 Mbps GEO Hylas-1

Return traffic for emulated 600ms Path, 10MB transfer

Conclusions

PEPs have been widely used, and all are different
- Many Internet TCP Apps currently benefit from a PEP
- Limited benefit when using VPNs
  - With the increasing use of VPNs over GEO due to telework, have operators received complaints about lack of performance?

Deployed PEPs can’t enhance performance for QUIC!
- The satellite community have not been looked forward to QUIC
- QUIC/H3 generally works well
- QUIC can be further improved for satellite
  - Can CDN nodes be changed to make satellite a first-class citizen?
  - How much QUIC traffic do European Satellite ISPs observe?

Implications for Satellite Operators and Vendors supporting QUIC

Satellite needs to be ready for more encrypted UDP traffic
- Expect to see more encrypted packets with VPN & QUIC
- Expect to see more UDP packets with QUIC

Satellite operators no longer control protocol trade-offs
- IP Header Compression can be beneficial (on the return link)
- New approaches needed to further accelerate performance
- These need to be standardised and deployed (in CDN nodes etc)

Satellite operators no longer see protocol headers
- Can’t categorise QoS by observing traffic
- Can’t use traditional network operations tooling

QUIC Extension for Mitigating the Satellite Delay on the Congestion Control

Forward link capacity can be under-utilised
Congestion Control not matched to the delay
Experimental 0-RTT BDP Extension could help
Appropriately configure server (hyjump)

Estimated performance using QUIC for a 10 Mbps Forward path and 600ms delay

As rate and transfer size increase, the opportunities for Hystart also increase.

Model of a GEO Satellite service
Main goal is to optimise time to complete page. Often actually, time to display first readable content.

HTTP/1 reached the limit for a single TCP session.

Providers sharded/sprited content across multiple servers.

Web clients open multiple TCP connections (typ. 6 flows).

Web content also moved closer to user (CDN cache).

Satellite delay has a huge impact on the web experience.

Questions?

Web Transport Evolution


Throughput - measure of data sent/sec = packets x size of packet.

How well does TCP work over satellite?

TCP was designed to link SATNET and ARPANET.

Maximum throughput 1.5 Gbps - Faster than any satellite.

What of the Future?

QUIC’s design considered satellite characteristics. .... It was designed to work over all networks and to evolve. ... Networks need also to evolve to best support encrypted traffic.

The share of QUIC traffic likely to increase for all networks.

QUIC protocol implementations are likely to evolve. … some current bugs impact satellite performance and need to be fixed. … faster evolution because implemented above UDP in UserSpace.

QUIC extensions can offer further performance benefit for satellite.