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

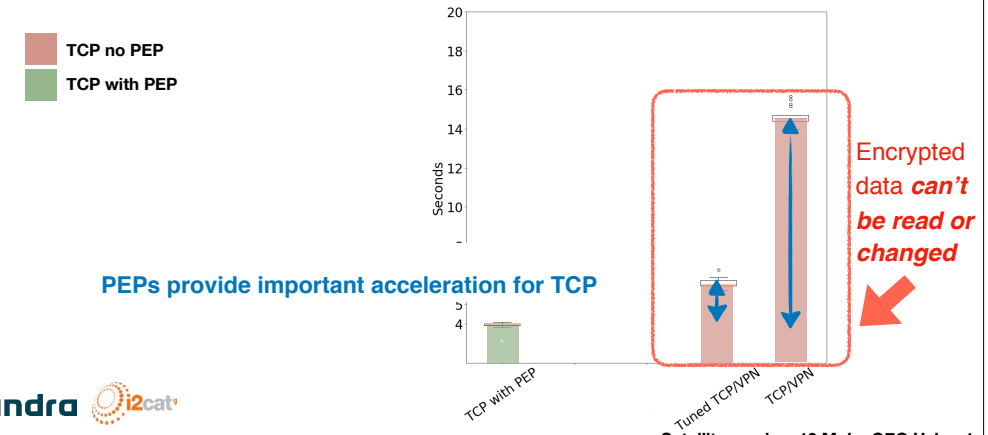
Opportunities to enhance QUIC for GEO satellite

Propose updated transport Mmechanisms
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)



HTTP Web Transport

	HTTP/1.1 (1999)	HTTP/2 (2015)	HTTP/3 (2021)
Transport	TCP	TCP	QUIC/UDP
No of Parallel Flows	6-12	~1	~1
Encryption	(SSL)	TLS1.2	TLS1.3
TCP PEP	+	+	-
Application PEP (HTTP acceleration)	+	-	-

HTTP/1 RFC2616; RFC7231]
HTTP/2 [RFC7540; RFC 8164]
TLS-1.2 [RFC5246]
QUIC [RFC 9000; RFC 8899;RFC 8999; RFC 9002]
TLS 1.3 [RFC 8446; RFC 9001]

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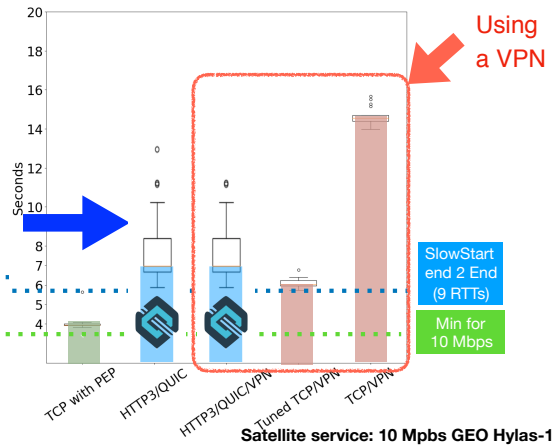
Satellite Internet Performance (QUIC)

- 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!



Satellite service: 10 Mpbs GEO Hylas-1

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HTTP/3 over QUIC: How much difference?

Web Client test

Page: 243 small flag icons

https://flags.safemetrics.org/flags/

Satellite service: 10 Mpbs GEO Hylas-1

HTTPS/1.1+PEP

30 secs

~ 6/12 parallel HTTP1/TCP connections

HTTPS/2+PEP

10 secs

One multiplexed HTTP2/TCP connection

HTTP/3 No PEP

11 secs

One multiplexed HTTP3/UDP connection

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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

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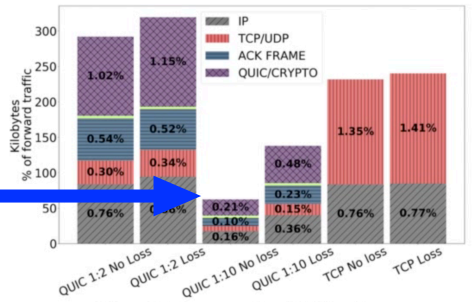
QUIC Extension for Reducing the Satellite Capacity on the Return/In-Bound Link

25%- 50% more byte overhead than TCP



Expected to reduce when the QUIC ACK Frame is used!

[draft-fairhurst-quic-ack-scaling]
[draft-ietf-quic-ack-frequency]

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 Mpbs GEO Hylas-1

Return traffic for emulated 600ms Path, 10MB transfer

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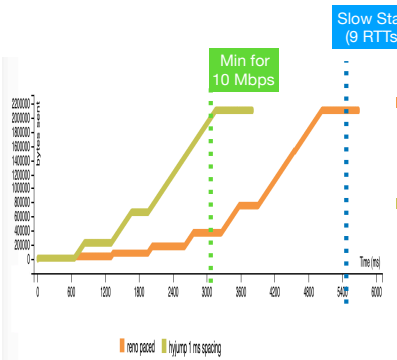
QUIC Extension for Mitigating the Satellite Delay on the Congestion Control



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

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)

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

Model of a GEO Satellite service

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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

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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?*

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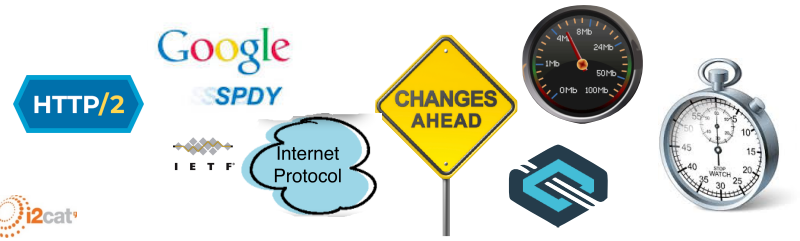
Questions?



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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

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At the core

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