

QUIC in Space

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Use Case

- Going back to Moon
 - at a fast pace: hundreds of missions planned
 - Deployment of WIFI and 5G on the planetary body
 - Moon is seconds away of latency
- Going to Mars and else
 - Deployment of WIFI and 5G on the planetary body
 - Mars is minutes (~4-20) away of latency
- Spacecrafts are essentially mobile networks
- Key characteristics: delay, (un-)planned disruptions, ...
- Can we use IP between Earth and Space? To which extent?
 - Alternative is to use Bundle Protocol (RFC9171). See dtn working group.
- Multiple layers: IP, Transport, Application transport(aka HTTP), Application.

Transport: QUIC

- QUIC has the right design to possibly work in this use case: UDP, tolerant to change of IP address/port, streams, HTTP3, TLS, ...
- TODO:
 - Verify if QUIC can work
 - Implementations (not exhaustive list):
 - Quiche (Cloudflare, Rust), Quiche (Google, C++), Neqo (Mozilla, Rust), Picoquic(Huitema, C), Msquic(Microsoft, C, .NET)

Done So Far

- Testbed of Linux VMs, http3 client and server
- Using Linux Netem for introducing delays
- Using Picoquic (Christian Huitema)
- Testbed with various delays and changing various QUIC stack parameters:
 - Initial RTT, Retransmit timeout, Idle timeout

Results so far

- Christian wrote a test for long delays (20 min.) using its simulated time warp machine (instant results!). it worked (with some mods)
 - See [blog](#)
- With no modification to QUIC stack and introducing delays: a storm of retransmissions, takes a long time to converge. So does not work as is.
- Changes to parameters in code/cmdline
 - Setting initial_rtt close equal to 2 x delay introduced in netem. Setting up very large idle timeout (because other parameters are computed based on it). Setting high retransmission timeout.
- Tested and « worked »: 10s, 30s, 1m, 2m, 2.5m, 274s.
 - Flow works, not optimized, to be analyzed
 - Netem max possible delay is 274s... : so need to modify setup. Dummynet on FreeBSD max: 10s.
- Found issue if some intermediary (known or unknown) nodes are doing NAT or « transparent » firewalling: UDP timeout of 30s.... (Cloud VMs...)

Help!

- Join to enable IP networks in space!
 - Setup a testbed
 - Modify implementations to make it work. Draw conclusions of what needs to be done.
 - Maybe some internet-draft if extensions or modifications to QUIC are necessary and found.
 - Already wrote one ([draft-blanchet-quic-peer-hints](#)) for giving hints to QUIC stack for some destinations.
 - Contact me: marc.blanchet@viagenie.ca
 - Join the mailing list to discuss (<https://groups.google.com/g/quic-long-delays>, quic-long-delays@googlegroups.com)