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 (Huijema, 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)