Testing QUIC for long delays networks such as 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)