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(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)