

BPv7 QUIC

A gentle attempt at rapprochement

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Background

There was recently some ~~heated~~ active debate on two (?!) mailing lists with the publication of [draft-many-deepspace-ip-assessment](#) by Marc Blanchet, et.al. questioning whether the requirements of communication in deep space could be addressed by a pure IP solution, particularly through the use of QUIC.

I participated in the discussion with interest, and wanted to present my **personal opinions** here.

QUIC/IP in Deep Space

The core points of the argument for using QUIC/IP in deep space are:

- IP works. It's proven technology.
- IP hardware and software exists and is mature.
- Although TCP/IP was proven (20 years ago?) to struggle with long RTT, QUIC is more than capable of handling long-lived sessions with long RTT.
- IP management and routing protocols exist and are capable of handling the complexities of deep space deployments.

(Apologies to the authors if I have missed a point)

QUIC/IP in Deep Space

All of these points are valid

But... Deep Space

"Space ... is big. Really big. You just won't believe how vastly, hugely, mindbogglingly big it is. I mean, you may think it's a long way down the road to the chemist, but that's just peanuts to space."

The Hitchhiker's Guide to the Galaxy

Does size matter?

The size of *deep* space matters, because it introduces physical problems the Internet does not have:

- Delay
 - The distances have to be measured in AU. The speed of light starts to become a dominating factor in RTT calculations.
 - Things move. Orbits may be predictable, but link-states change over time.
- Disruption
 - Planetary bodies are very good occluders.
 - Pointing beams over long distances is hard.
 - Operating technology in deep space is fundamentally about power budgets. The longer you have to travel, the less you want to keep your communication equipment powered up.

Delay/Disruption Tolerant Networks

The current approach to communication in deep space is to build store and forward communication networks that can survive the delay and disruption caused by the realities of deep space.

The approach of the IETF DTN working group is to standardise an *Information-centric, Store and Forward, Overlay Network* built around the Bundle Protocol.

(A rude observer could describe it as “email done right”)

Information-centric, Store and Forward, Overlay Network

- **Information-centric:** The basic unit of communication is the “Infogram” - a large self-contained, self-describing bundle of information
 - As compared to a datagram, or an octet stream, which generally requires some context state to become informative.
- **Store and Forward:** It is explicitly understood that an end-to-end path between the source and destination of bundle may not exist at the time the bundle is sent.
 - Bundles can be held by nodes along the path for a long time, and BPsec is designed to support encryption at rest: *CommSec* not *TransSec*.
- **Overlay Network:** BP-based DTNs rely on underlying communication between nodes *provided by other communication protocols*, as “Convergence Layers”
 - BP is a protocol for moving bundles across a network of nodes joined by intermittent, heterogeneous communication links

assert(BP != IP);

It makes no sense to compare and contrast Bundle Protocol with the Internet Protocol. They serve different purposes, as they address different use cases.

However:

- IP is already part of the BP stack: TCP/CL, UDP/CL both rely on IP to provide inter-BP-node communication.

And it is important to remember that what BP considers “1 hop” may be many hops in the underlying network. E.g. a single TCP/CL “hop” may transit half of the terrestrial Internet.

Rapprochement

- QUIC has some fantastic properties that would make it an ideal “Convergence Layer”, as laid out in the deepspace-ip draft.
- IP networks exist in LEO, GEO and eventually on other planetary bodies.
- Long-lived IP links could be built as backhaul between planetary bodies.
- QUIC would be an ideal candidate to carry bundles, alongside other IP traffic, across these networks.
- TCP/CL details the primitives required to carry bundles over TCP. These primitives can be easily forward-ported to QUIC.

Further work

- Keep working out how to make QUIC/IP work with long RTT.
- Standardise a BP Convergence Layer for QUIC (in scope of the WG charter).
- Roll out IP + QUIC + BP wherever it makes sense.
- (Have **one** mailing list)

And because we are talking about space:

“Live long and prosper”

Questions?