Reducing Data Gaps and Latency

Berkeley Seismology Lab

PNSN
Pacific Northwest Seismic Network

Reducing Data Gaps and Latency

"…there are known knowns; there are things we know we know.

We also know there are known unknowns; that is to say we know there are some things we do not know.

But there are also unknown unknowns—the ones we don't know we don't know. And if one looks throughout the history of our ~~country and other free countries~~ wiggles, it is the latter category that tends to be the difficult ones"

apologies to the late D. Rumsfeld

Who cares? A couple examples…

- Science-y folks who want continuous data for ambient noise studies
- Earthquake catalog determination of events wants low latency
- Earthquake early warning requires* sub 3.5 s latency, ideally sub-second

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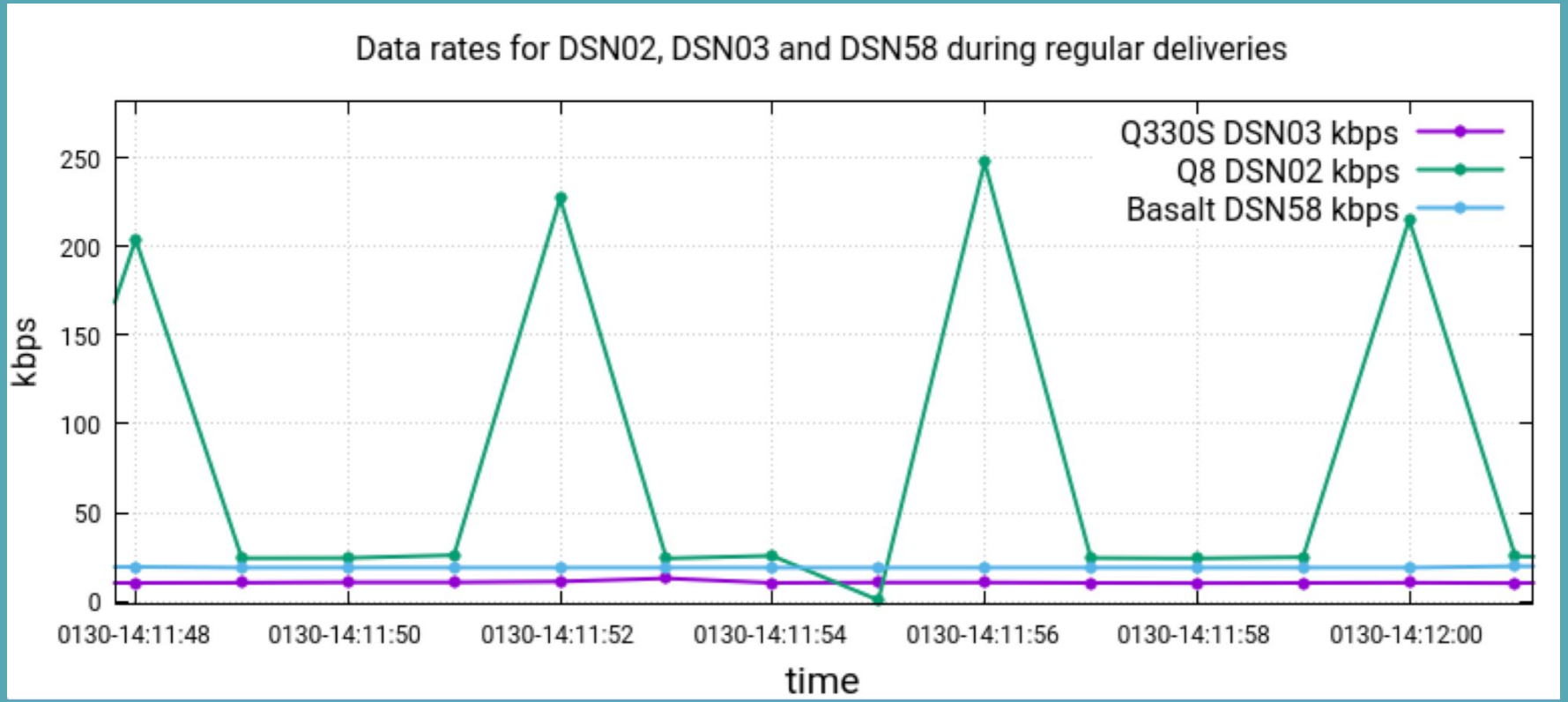
Q8, Q330, Rock data rates

Stop data flow for 15 min, measure data and packet rates with Mikrotik and Wireshark. Guralp 3T + ES-T sensors, lab environment

Regular data delivery, all 3-4 pkts/s

Q330S	10 kbps
Q8	25 kbps (250kbps jumps every 4 sec)
Basalt	20 kbps

Q8, Q330, Rock data rates



Q8, Q330, Rock data rates

Stop data *flow* for 15 min, measure data and packet rates with Mikrotik and Wireshark. Guralp 3T + ES-T sensors, lab environment.
Simulate increased data volume for large events.

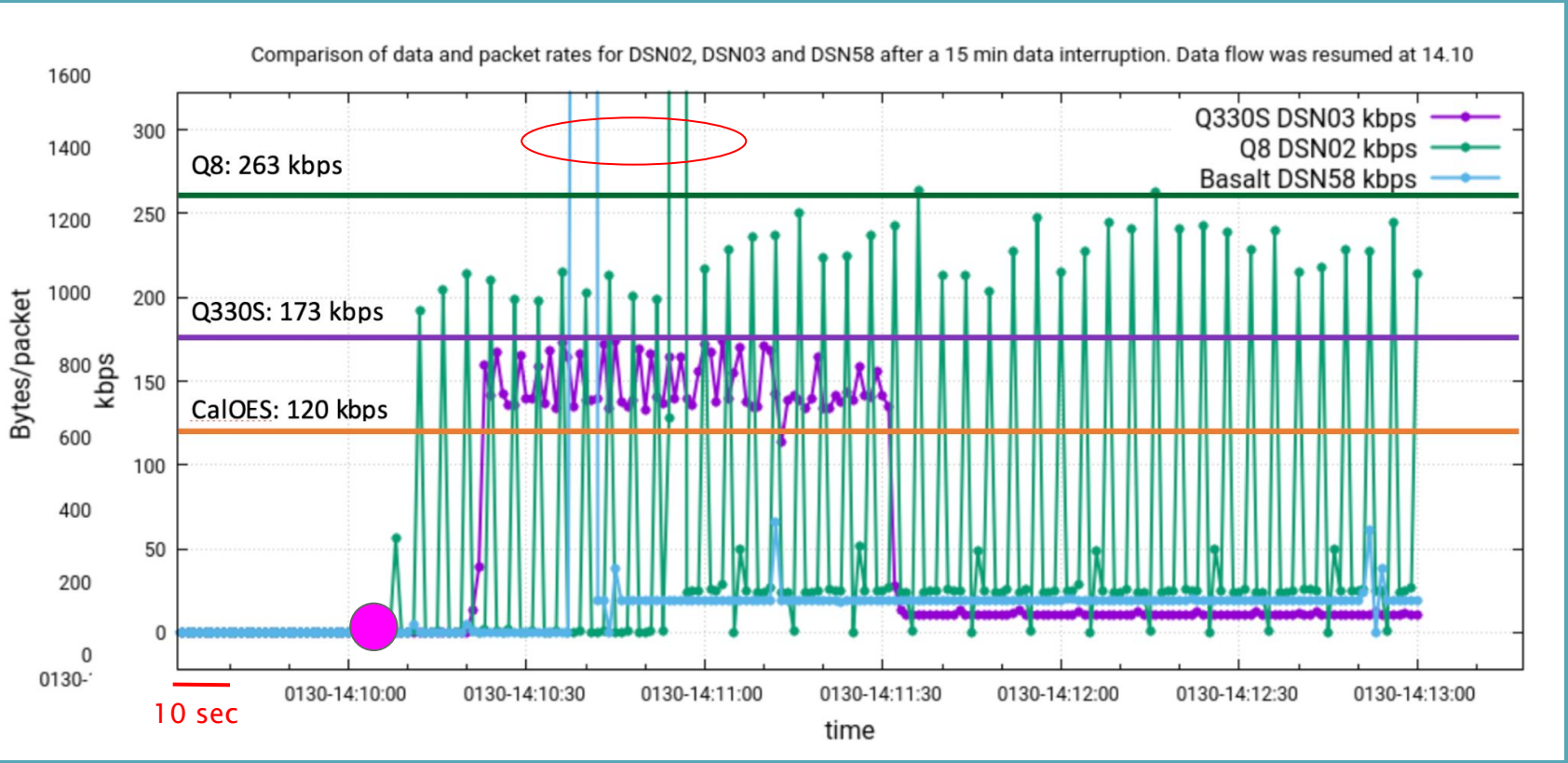
15 min buffered data delivery, max rates, ethernet connection:

Q330S	170 kbps
Q8	2200 kbps - 17 Mbits/s
Basalt	8 Mbits/s

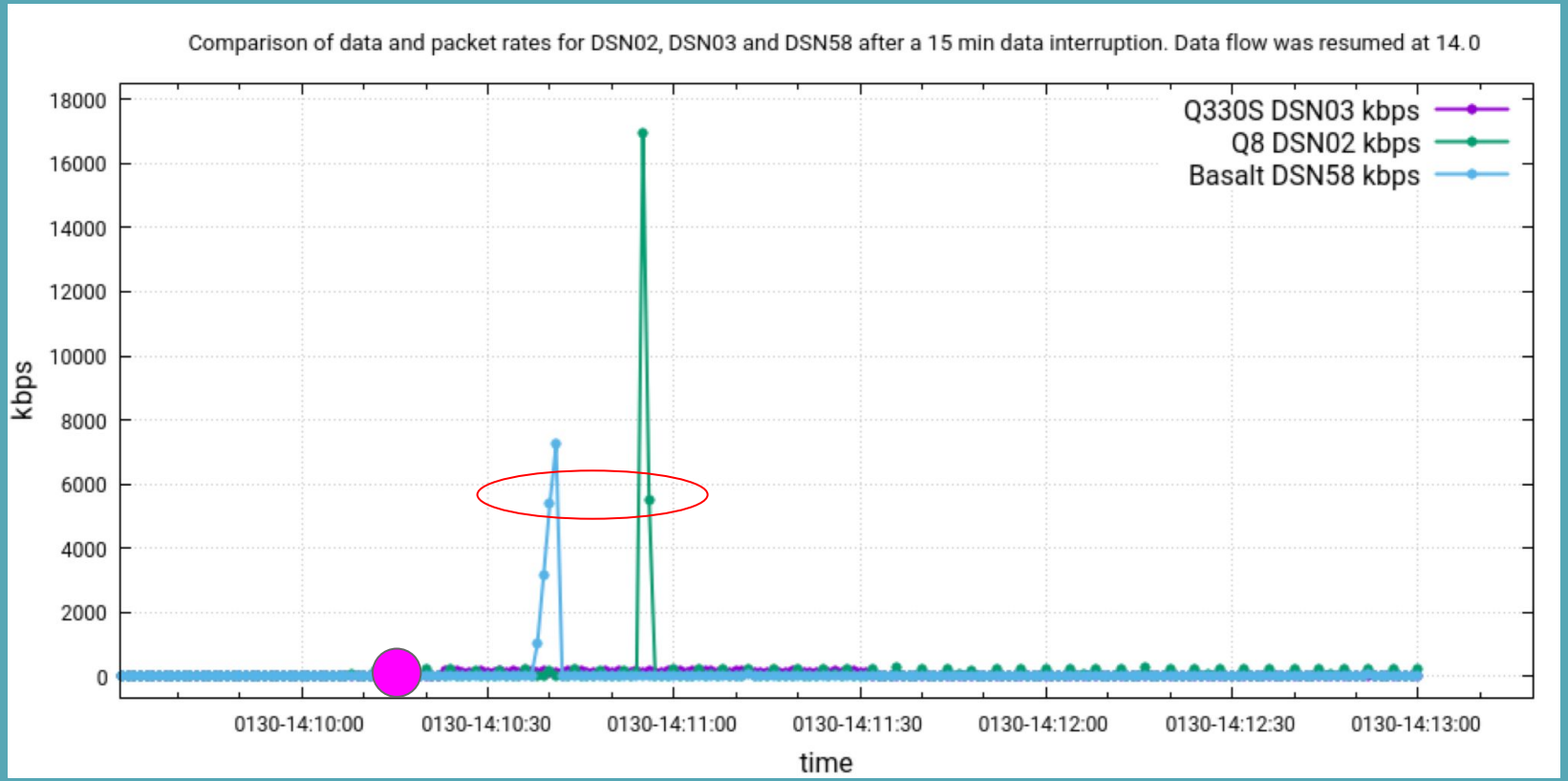
The data volume increased, the **Bytes/packet remained the same** and **only the number of packets increased**.
Overwhelms data acquisition side, creates data gaps in the archive.
Many Q8s after a telemetry disruption is a problem!

Q8, Q330, Rock data rates

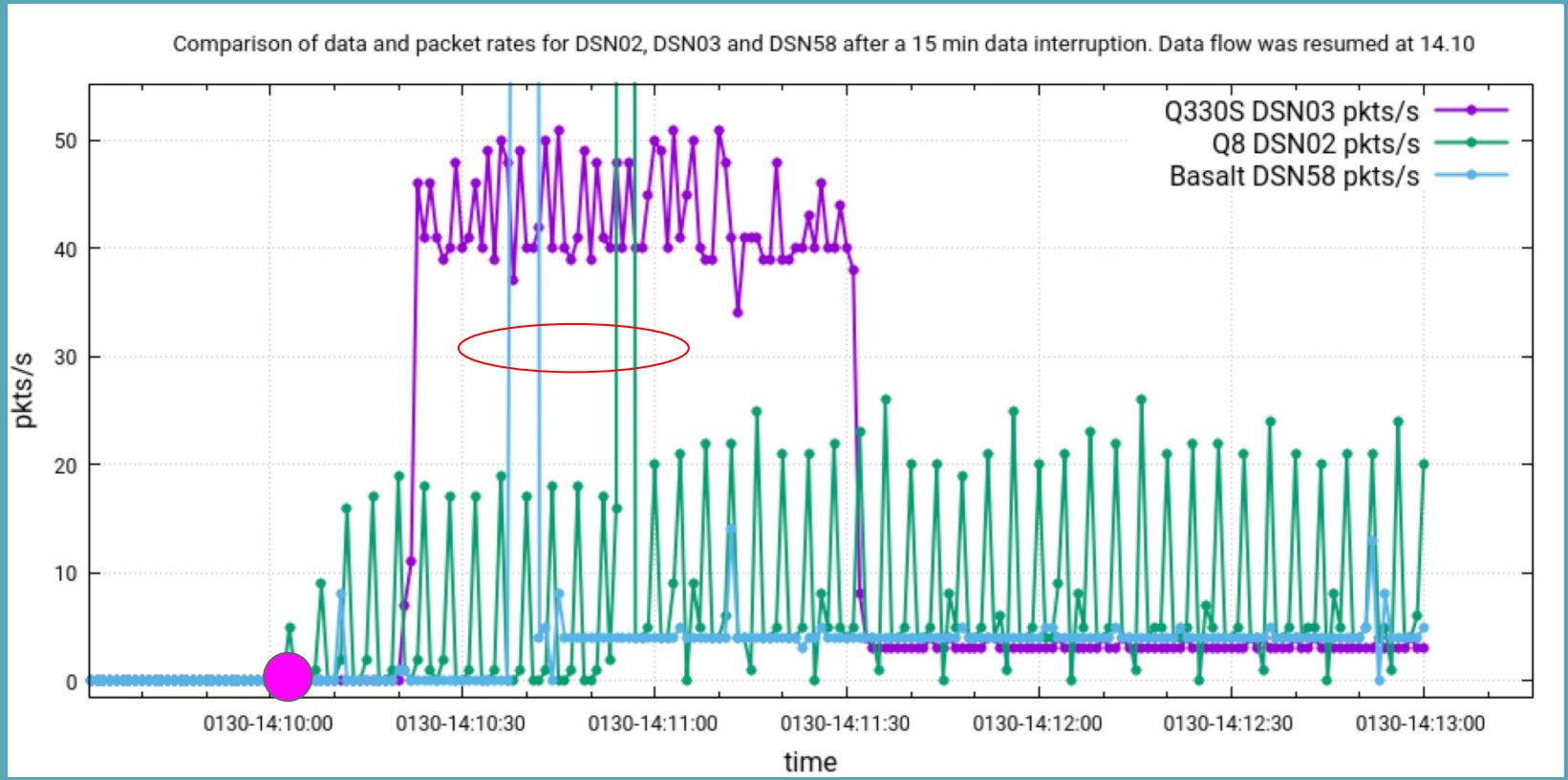
Notice reconnection times (earthworm).



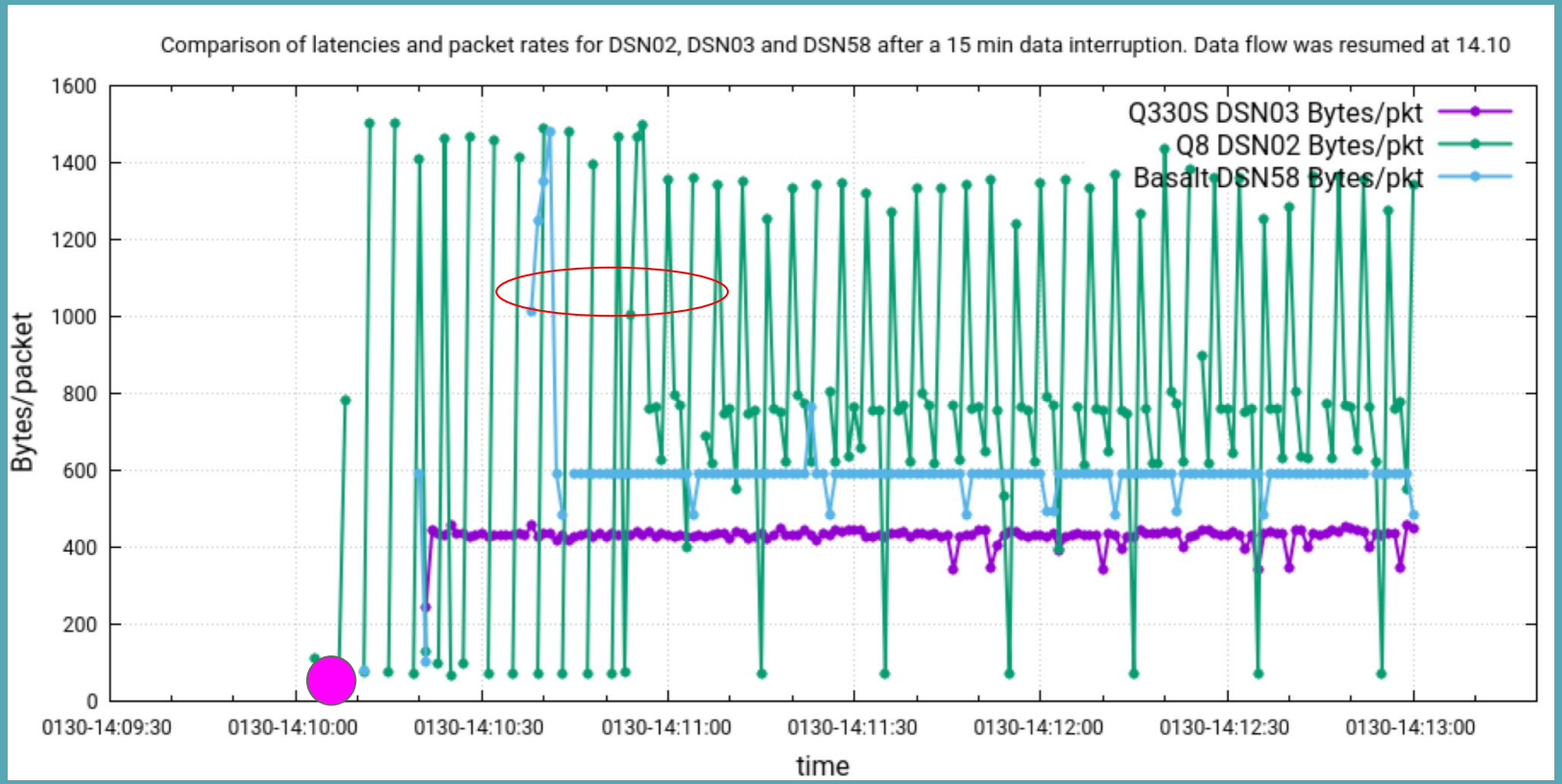
Q8 and Rock deliver all at once



Number of pkts increased



Bytes/pkt remain the same



How to deal with the increases

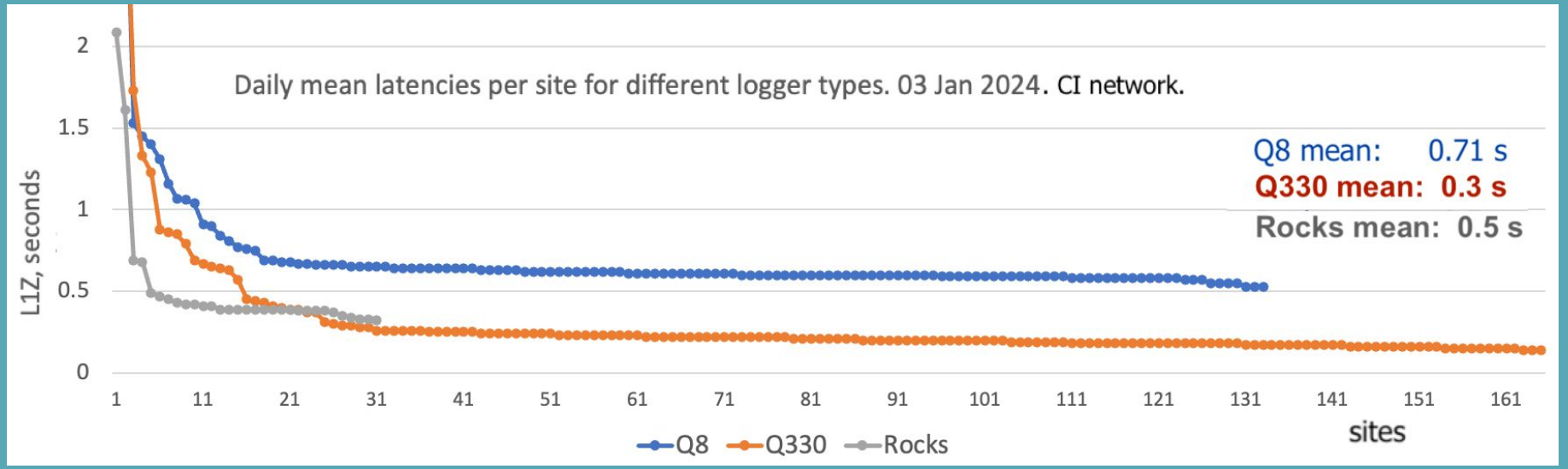
New Q8 firmware/q8serv included

- throughput throttling

- simulated uncompressed data flow

Q8 and 1 sec packets

Q8 mean latency is ~ 0.4s higher than Q330 mean latency.
Q8 mean latency is always > 0.5 s. Why?



Q8 and low-latency packets

Low-latency packets: designed to meet a specified delivery latency. Packets may contain a random number of samples and < 1 sec.

Shorter latency => smaller packets => more packets per sec

How do telemetry devices handle smaller and more frequent packet deliveries?
Especially during strong events with large data volume.

Q8 and low-latency packets

Low-latency packets demand greater bandwidth (per Joe Steim publication), why?

Q8 low-latency (LL) configuration:
Can we deliver LL packets only or do we have to do
both, 1 sec packets + LL ?

If yes, do we cut the available bw in ~ half (i.e., double the data volume)? Bad for telemetry links? Congestion?

Data Gaps and Latency

Things we have control over	Things we have no control over (yet?)

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Reducing Data Gaps and Latency

Data Gaps - How many? Classification?

-Source? Ex., backup power, dual telemetry, too fast data delivery
-Methods to reduce electronic noise? Grounding, magnetic shielding,

-What other factors contribute to data gaps?

Latency - How long is too long?

-Is this a problem?
-How to reduce?
-What are the causes?
-Archive in L1Z, analyse.

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