# Quinn Workbench Update

Simulating QUIC traffic in deep space

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# Why?

- We are investigating the suitability of QUIC on top of IP for deep space communication
- First step is to run experiments in a simulated network, to gather insights before testing more advanced setups
- Quinn workbench offers an easy way to test various transport configurations under specific network conditions

# What?

- A command line tool to simulate request-response traffic
- Measures total time to transfer and time to recover after packet loss
- Deterministic output (same parameters always yield the same results)
- Finishes instantly, allowing simulation of huge RTTs
- Works fully in-memory (no real IO), but generates a synthetic pcap file to allow inspection by standard tools (e.g. Wireshark)
- Open source, available here along with usage instructions

# What’s new?

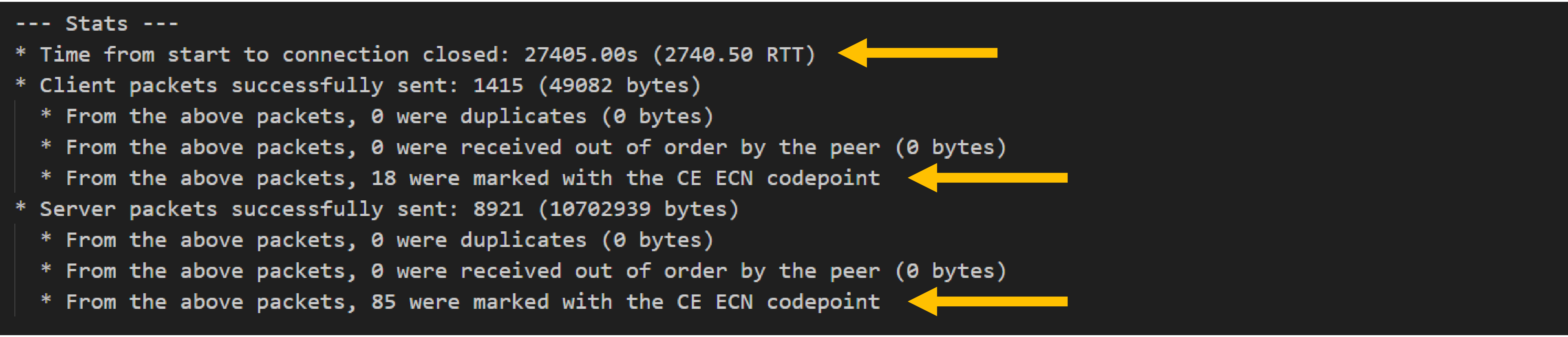
- Simulate Explicit Congestion Notification (ECN) events at the network level
- Added custom congestion controller that reacts to ECN but not to packet loss
- Opens the way to experimenting with ECN-based congestion control for deep space QUIC

# ECN simulation

- Configure \`congestion_event_ratio\` parameter to a value in [0, 1]
  - Tells the *network simulator* to randomly mark the specified ratio of packets with a CE ECN codepoint
- Set \`use_ecn_based_reno\` parameter to true
  - Tells the *QUIC client and server* to use the New Reno congestion control algorithm, modified to ignore packet loss and to react to ECN events
  - Not necessarily the best algorithm for deep space, but enough for a POC
- Set CLI flags to make a single request and serve a 10 MiB response

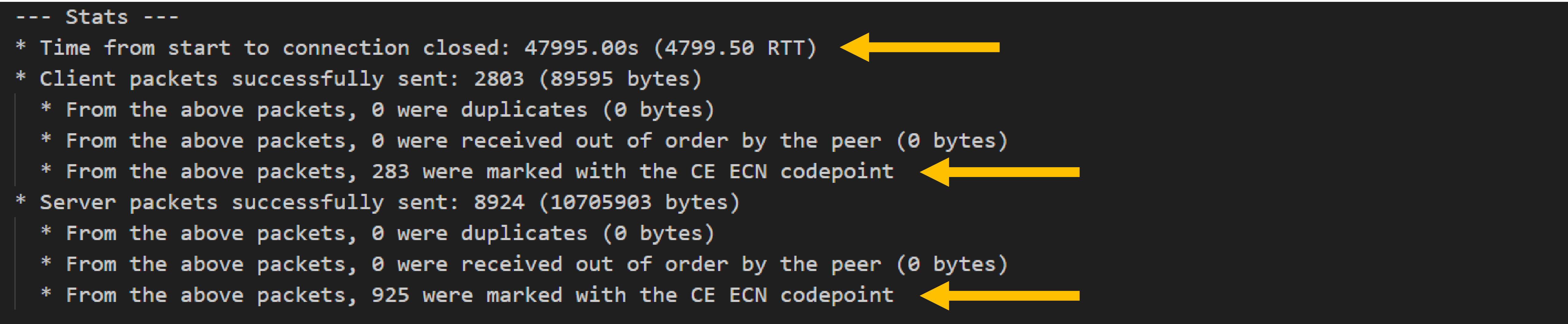
Example scenarios:

- 1% of packets marked with “congestion experienced” codepoint



```
--- Stats ---
* Time from start to connection closed: 27405.00s (2740.50 RTT)
* Client packets successfully sent: 1415 (49082 bytes)
  * From the above packets, 0 were duplicates (0 bytes)
  * From the above packets, 0 were received out of order by the peer (0 bytes)
  * From the above packets, 18 were marked with the CE ECN codepoint
* Server packets successfully sent: 8921 (10702939 bytes)
  * From the above packets, 0 were duplicates (0 bytes)
  * From the above packets, 0 were received out of order by the peer (0 bytes)
  * From the above packets, 85 were marked with the CE ECN codepoint
```

- 10% of packets marked with “congestion experienced” codepoint



```
--- Stats ---
* Time from start to connection closed: 47995.00s (4799.50 RTT)
* Client packets successfully sent: 2803 (89595 bytes)
  * From the above packets, 0 were duplicates (0 bytes)
  * From the above packets, 0 were received out of order by the peer (0 bytes)
  * From the above packets, 283 were marked with the CE ECN codepoint
* Server packets successfully sent: 8924 (10705903 bytes)
  * From the above packets, 0 were duplicates (0 bytes)
  * From the above packets, 0 were received out of order by the peer (0 bytes)
  * From the above packets, 925 were marked with the CE ECN codepoint
```