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

```
--- Params ---
<snip>
* Delay: 5.00s (10.00s RTT)
<snip>
* Packet loss ratio: 1.00%
* Packet duplication ratio: 0.00%
* ECN ratio: 10.00%
--- Requests ---
0.00s CONNECT
10.00s GET /index.html
20.00s GET /index.html
30.00s GET /index.html
35.00s WARN Server packet lost (#13)!
78.44s GET /index.html
78.44s WARN Client sent packet marked with CE ECN (#20)!
88.44s GET /index.html
98.44s GET /index.html
108.44s GET /index.html
113.44s WARN Server sent packet marked with CE ECN (#33)!
<snip>
148.44s Done sending 10 requests
153.44s Connection closed
--- Stats ---
* Time from start to connection closed: 153.44s (15.34 RTT)
```