Intraflow Performance Diagnostics

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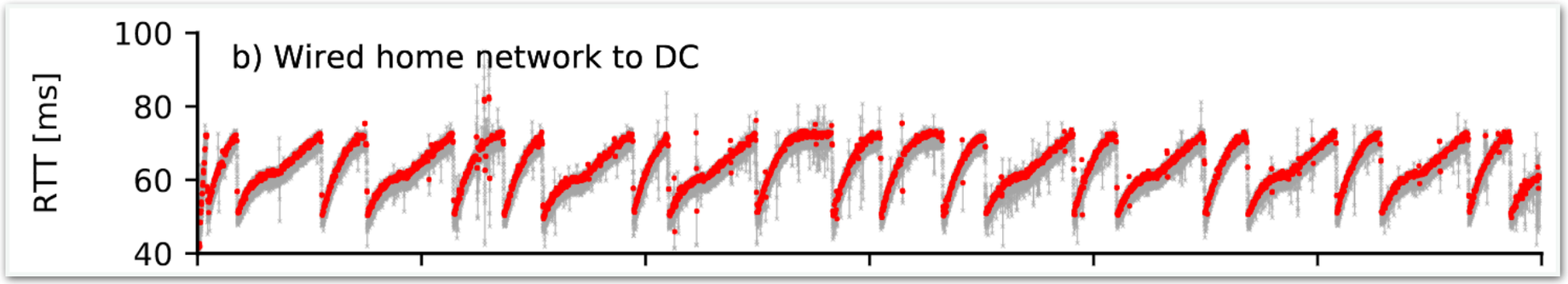
RTT measurement

(the story so far)

- Latency is a key metric for understanding network dynamics, so RTT measurement is useful on its own.
- TCP (accidentally) exposes information that can be used for passive RTT measurement in its wire image.
- Spin bit (or spin+VEC): minimal, intentional information exposure to provide equivalent RTT measurability in a QUIC-dominated, post-TCP world.

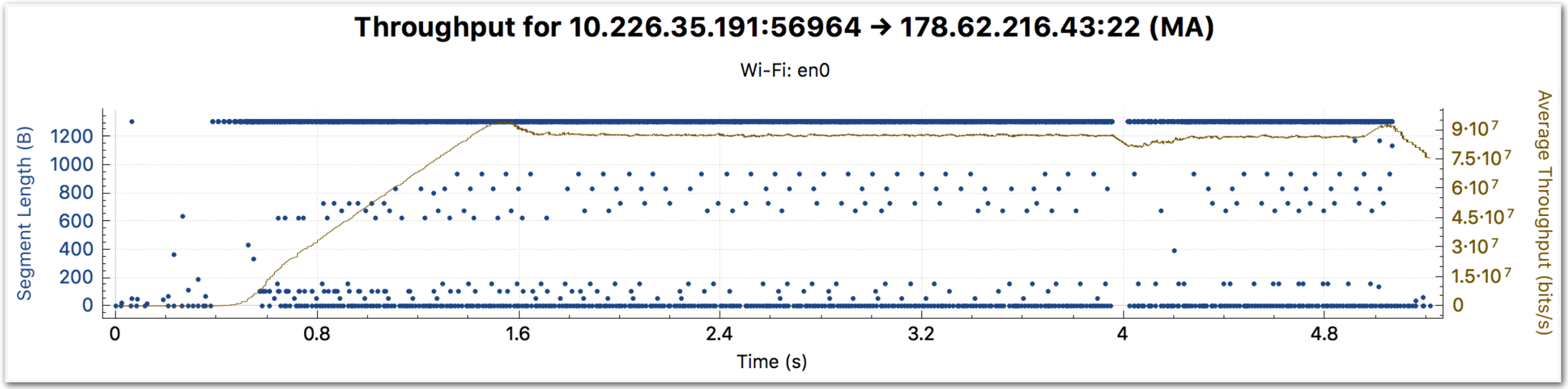
but wait, there's more!

- RTT is useful on a per-flow basis: transmission dynamics and buffering are visible.



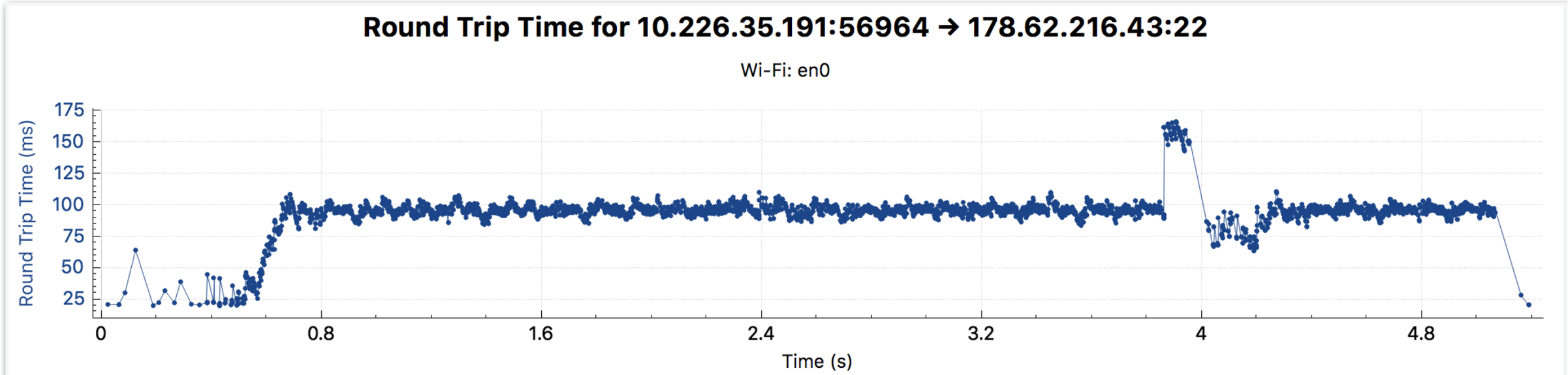
- Other metrics (available via Wireshark) useful for per-flow diagnostics, too:
  - loss / congestion echo
  - instantaneous inflight and sender dynamics
- Can we support on-path measurement of these in QUIC
  - without adding more bits?

Throughput evoluton



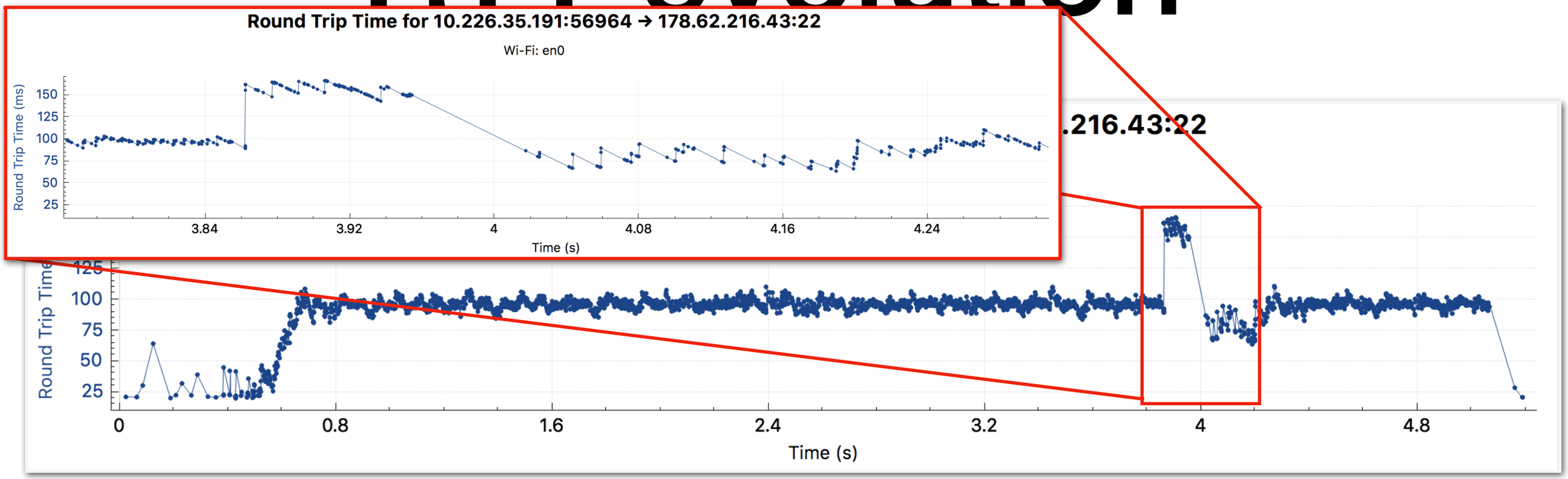
- Throughput evolution: count the size of (non-RTX) packets, divide by time.
- This analysis basically works with QUIC as-is, as long as RTX load is low.

RTT evolution



- RTT evolution for QUIC requires the spin bit (or previous heavier-weight proposals, like PN echo).
- RTT evolution is already much more useful for answering network-focused *why?* questions than throughput.

RTT evolution



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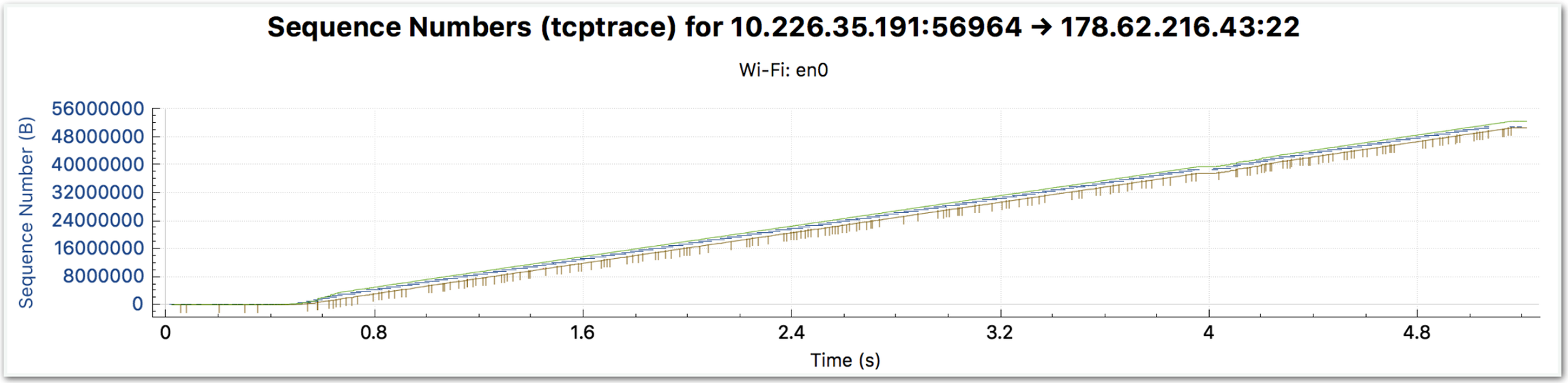
tcptrace

(or, how the TCP-savvy debug networks)



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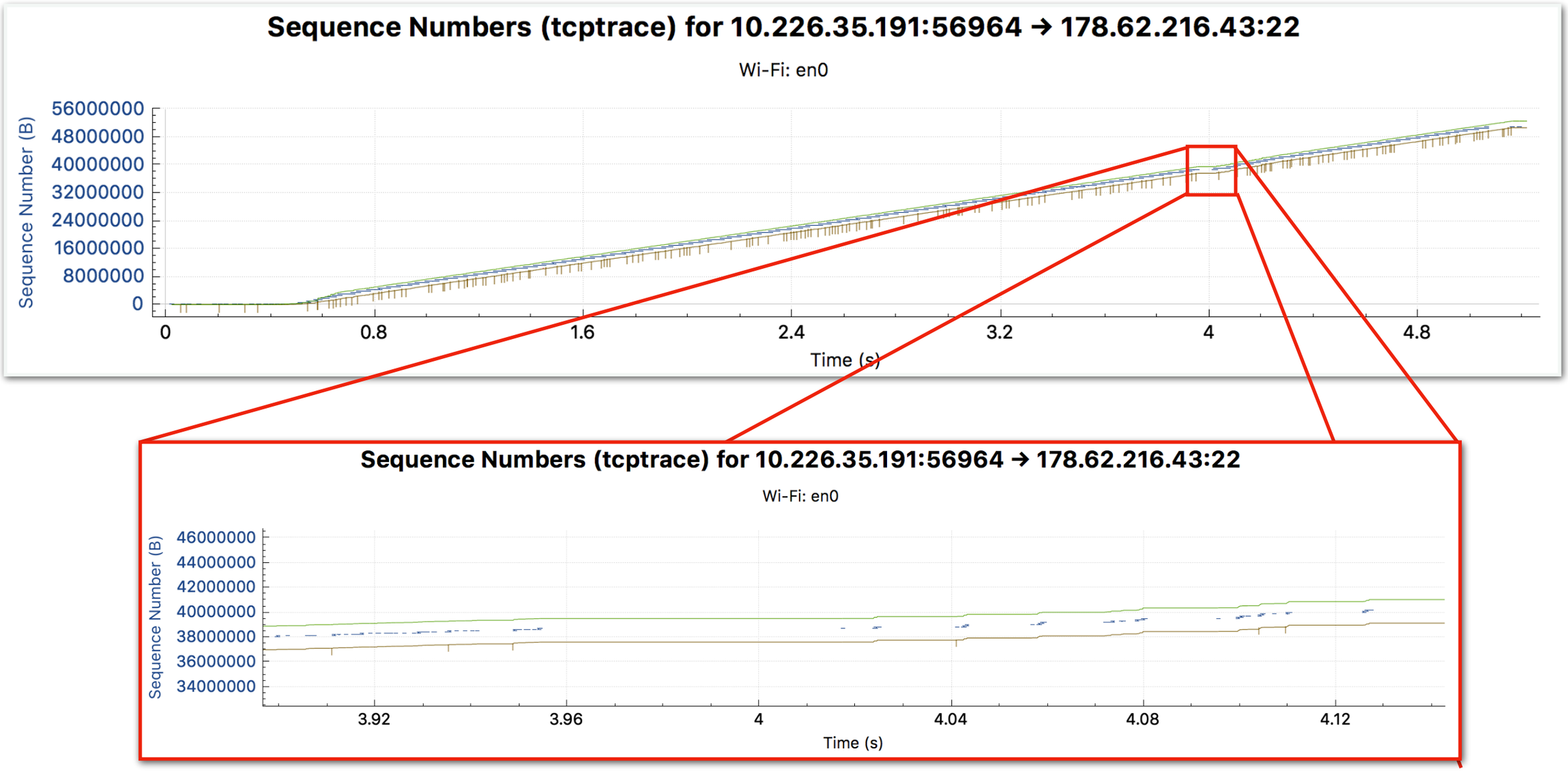

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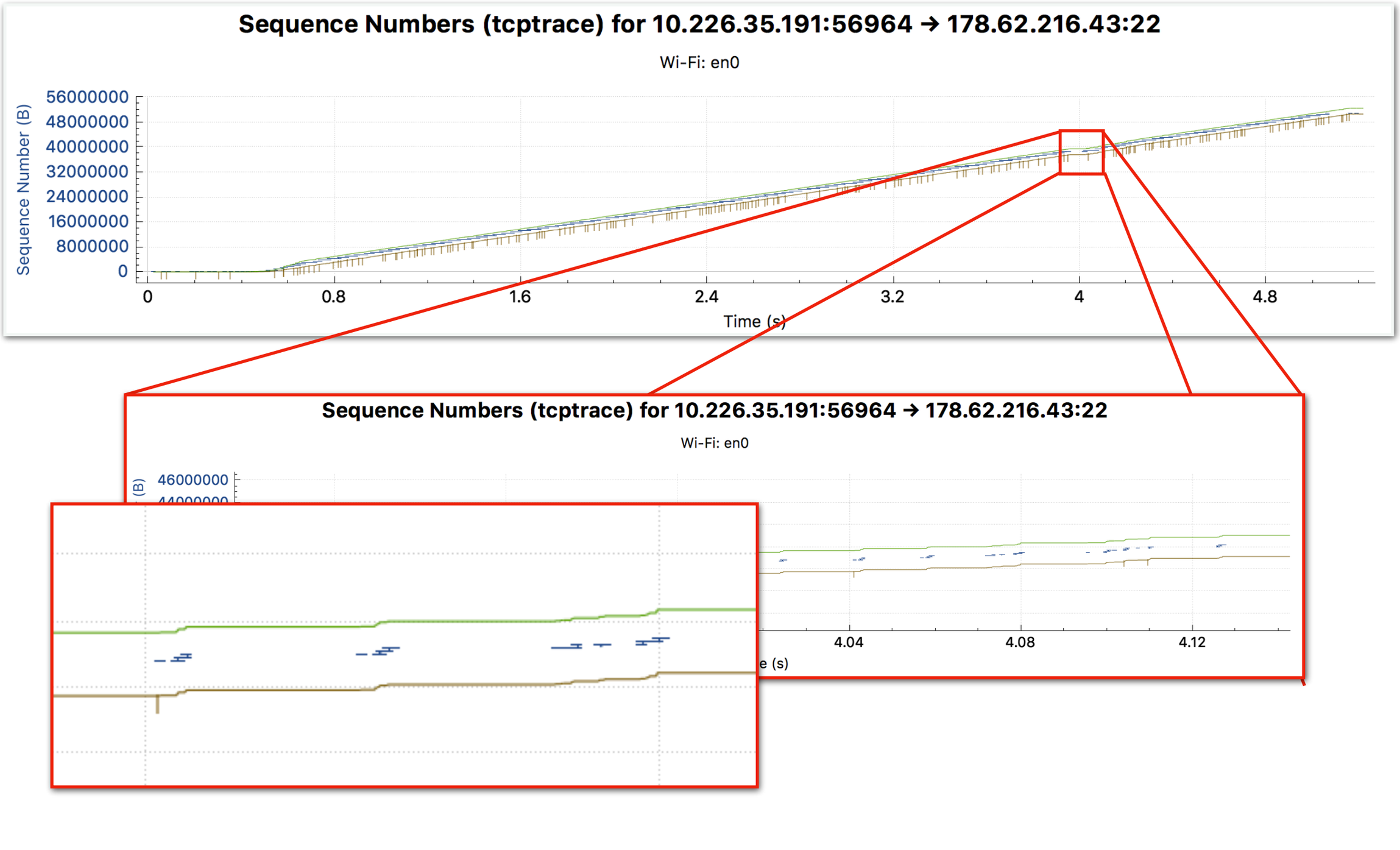

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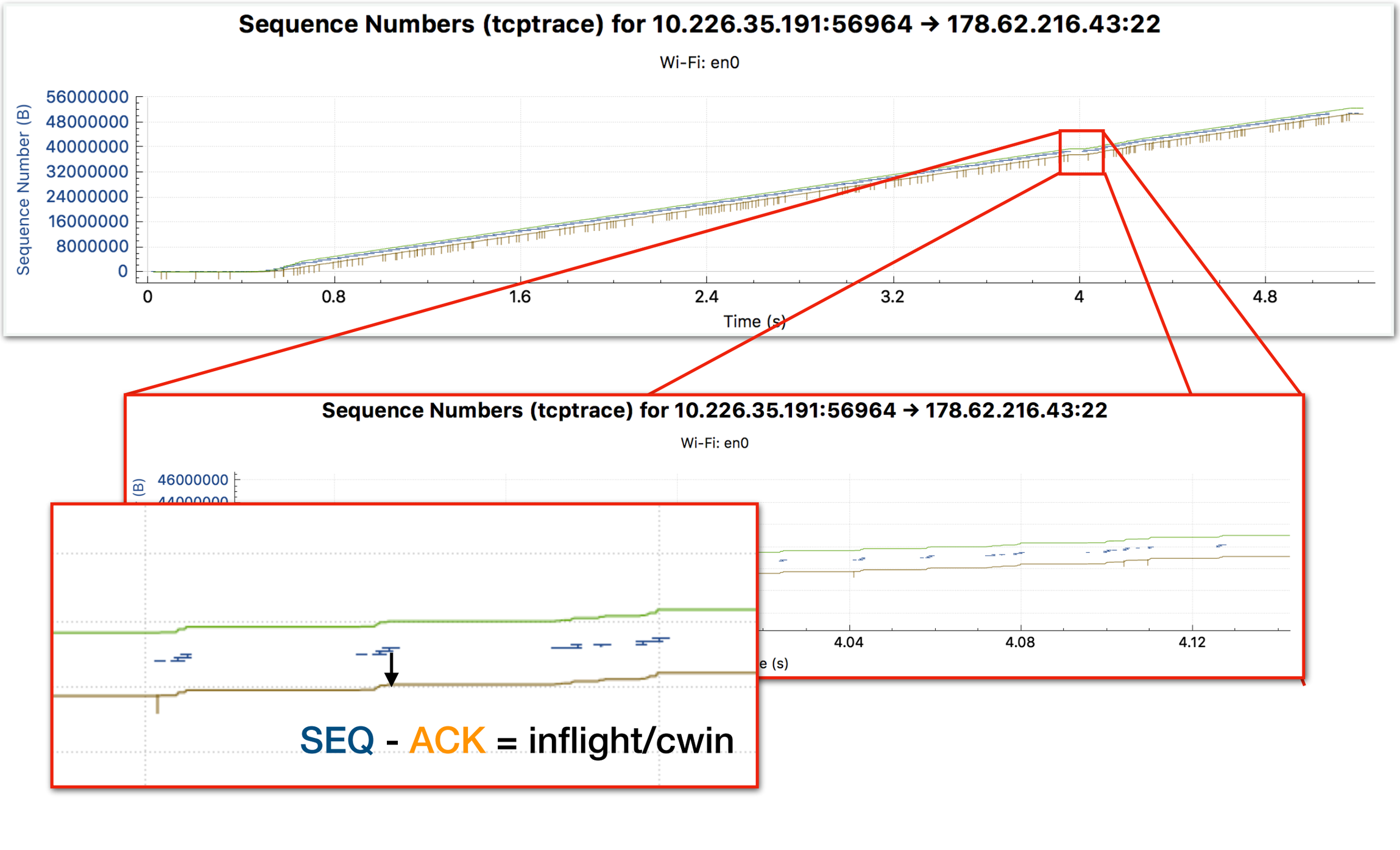

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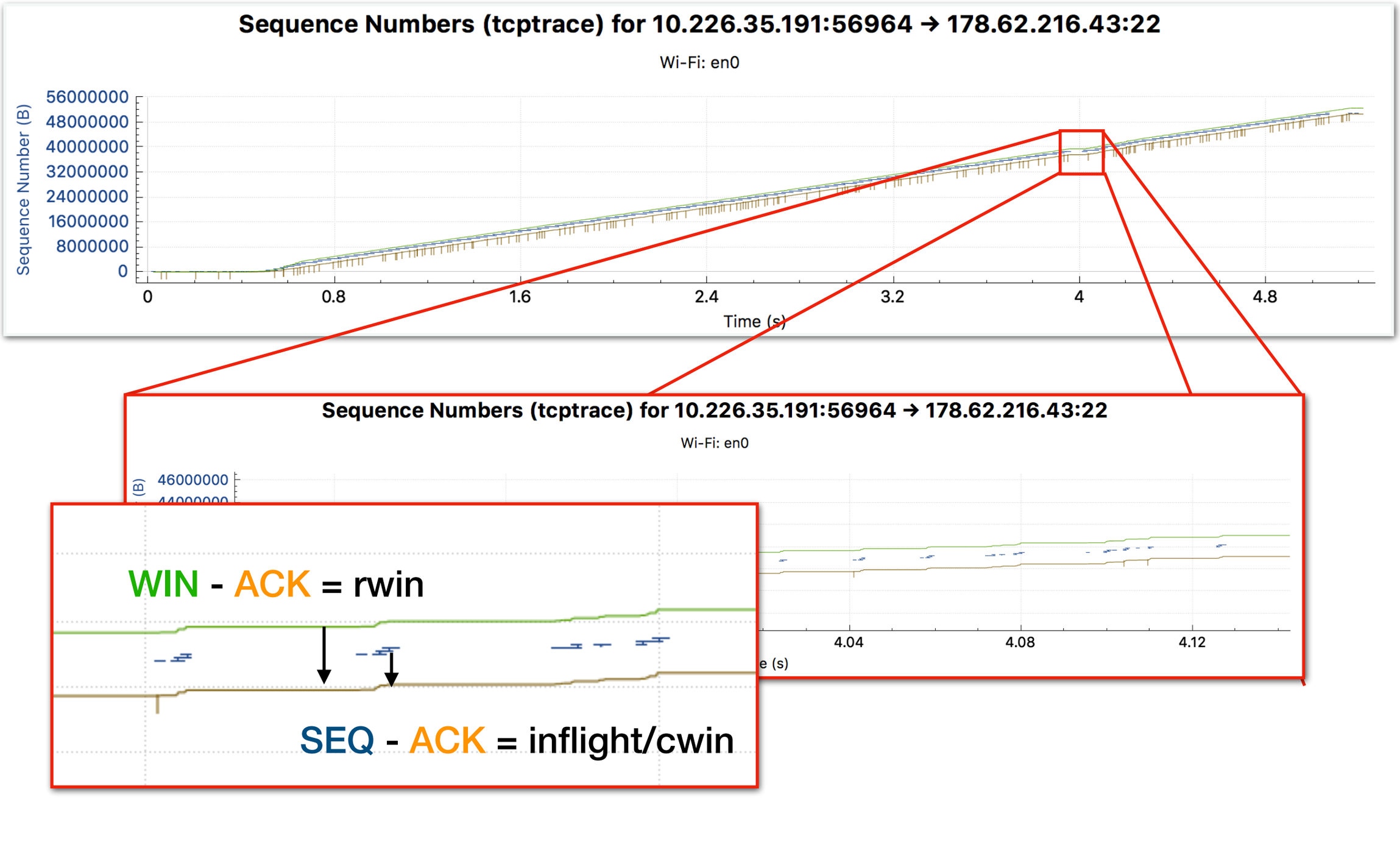

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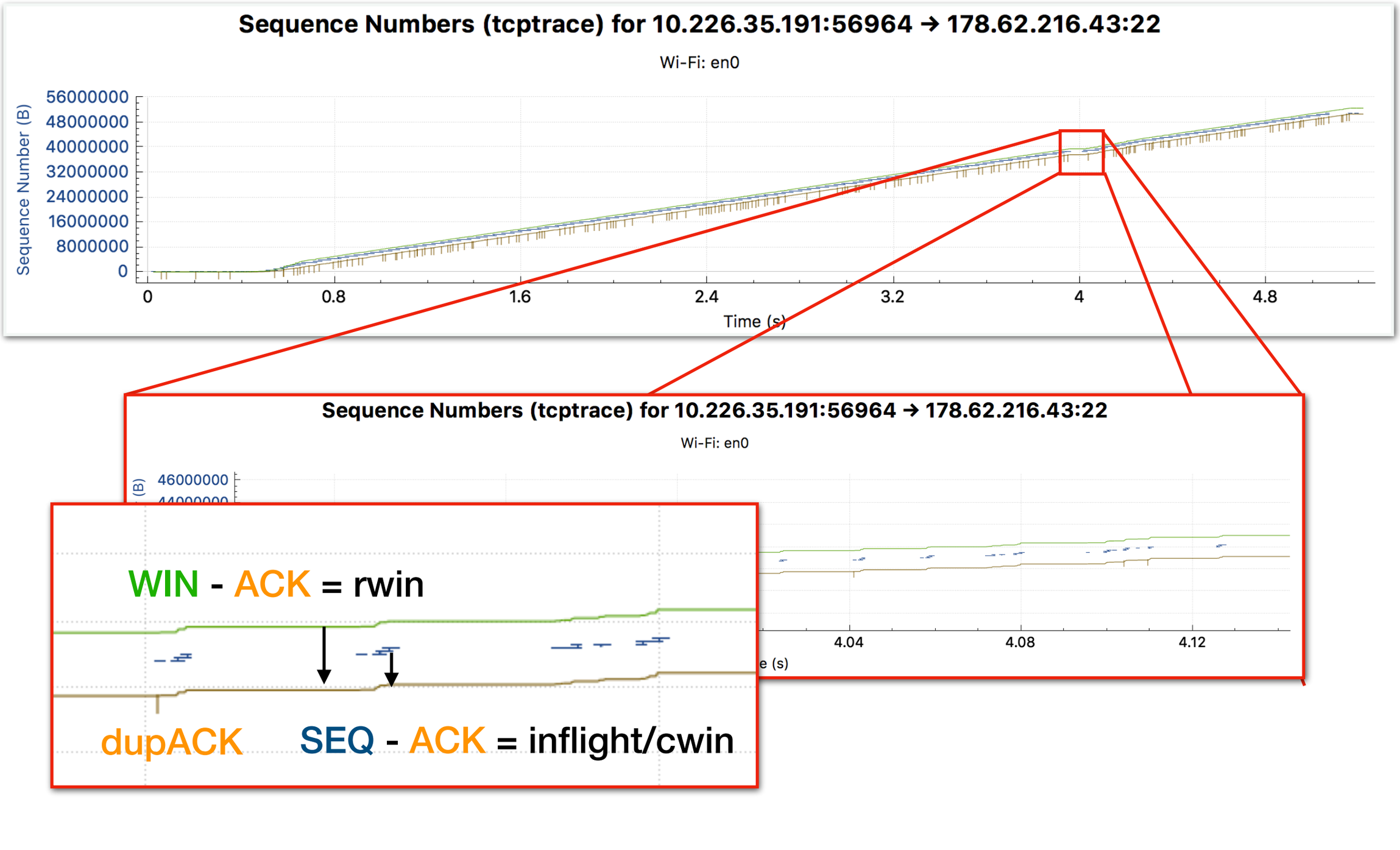

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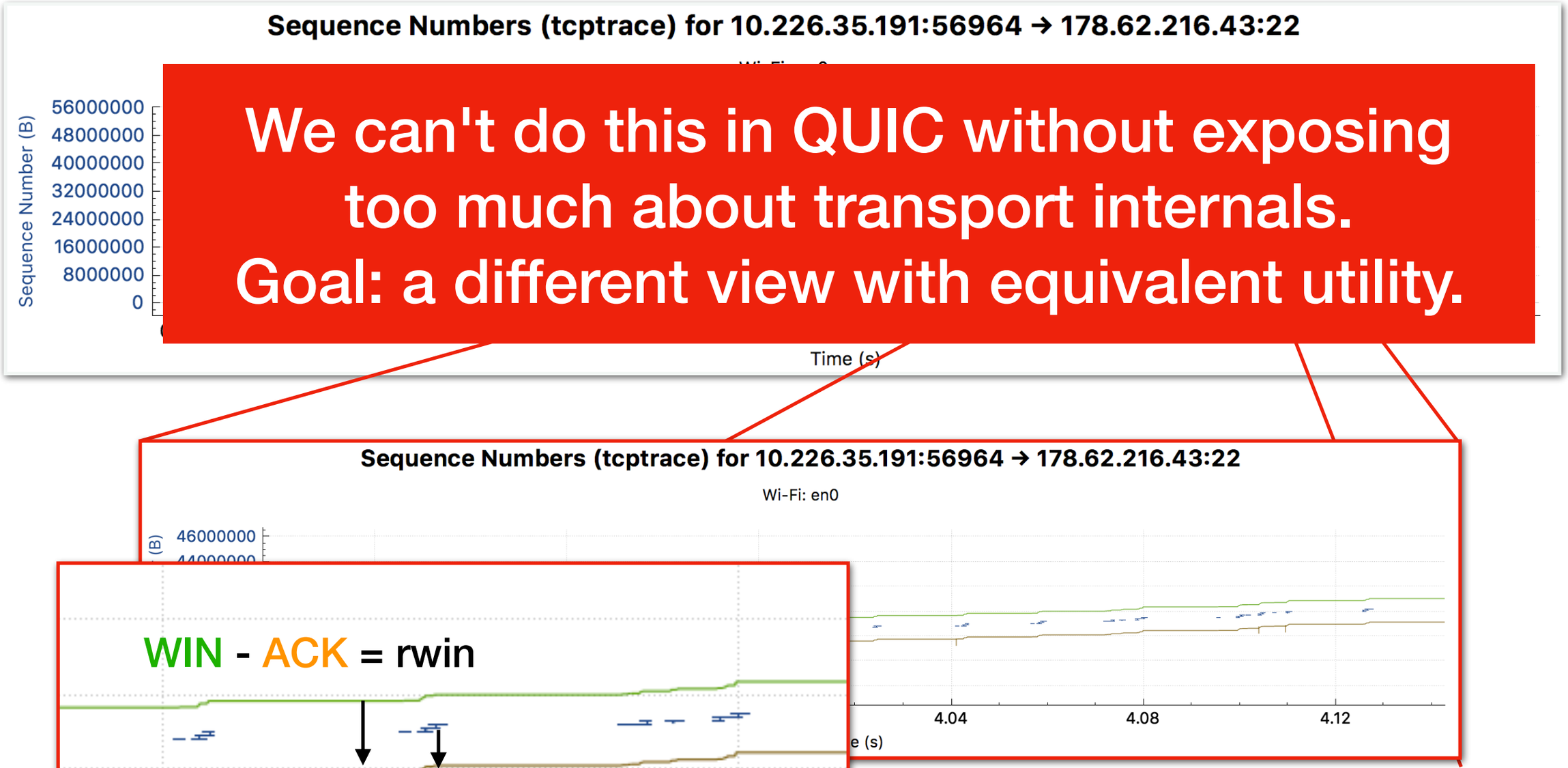

Questions to Answer

- Can RTT evolution + throughput evolution (i.e., inflight/cwin/pacing evolution) allow useful tcptrace-like analysis for QUIC flows?
- Can the VEC provide additional input to this analysis?
  - VEC sample rate is related to loss and reordering by

$$r_s = \frac{(1 - p_{L \cup R})^3}{RTT} \longrightarrow p_{L \cup R} = 1 - (r_s \times RTT)^{-3}$$

- These (and related questions) are the subject of an MSc thesis at ETH to run October 2018 - April 2019

A Way Forward

- The *fitness for purpose* of the spin bit seems certain.
- VEC / other approaches not as certain before Bangkok.
- So let's accommodate continued experimentation as well as early deployment of one-bit spin:
  - Server SHOULD set bit S to the value of bit S received on highest-numbered packet from client.
  - Client behavior undefined in -transport, MUST grease if no other purpose.
  - Reference to draft-*-tsvwg-spin for client-side RTT behavior.
  - Remaining two measurement/experiment bits held for experimentation, MUST grease if not experimenting.