Frame Duration for 802.16a

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Purpose:

Present simulations concerning frame duartion in the 802.16a

Is frame duration related to efficiency?

- In the downlink the answer is clearly NO
- In the uplink
  - In the FDD case, uplink burst may continue from frame to frame, so burst length is not limited
  - In the TDD case, every burst has to end within a single uplink period
- It seems that a problem may exist only for the TDD case in the uplink

Why efficiency might be degraded

- Every uplink burst includes a preamble
- The preamble is one symbol long, and carriers no MAC information
- Efficiency may be effected if the scheduler chooses to allocate BW to every SS, every frame
- The worst case (Theoretical) is 1.5MHz channel
  - About 183uS symbol duration (with GI=1/4)

How to prevent efficiency degradation

- Use 10mS frame duration (maximum allowed)
  - Includes about 54 OFDM symbols
- Do scheduling over a period longer than one frame
- Transmit data only when enough data is queued, such that the preamble overhead is tolerable
- Use MAC fragmentation and concatenation mechanisms to MAP data efficiently to OFDM symbols

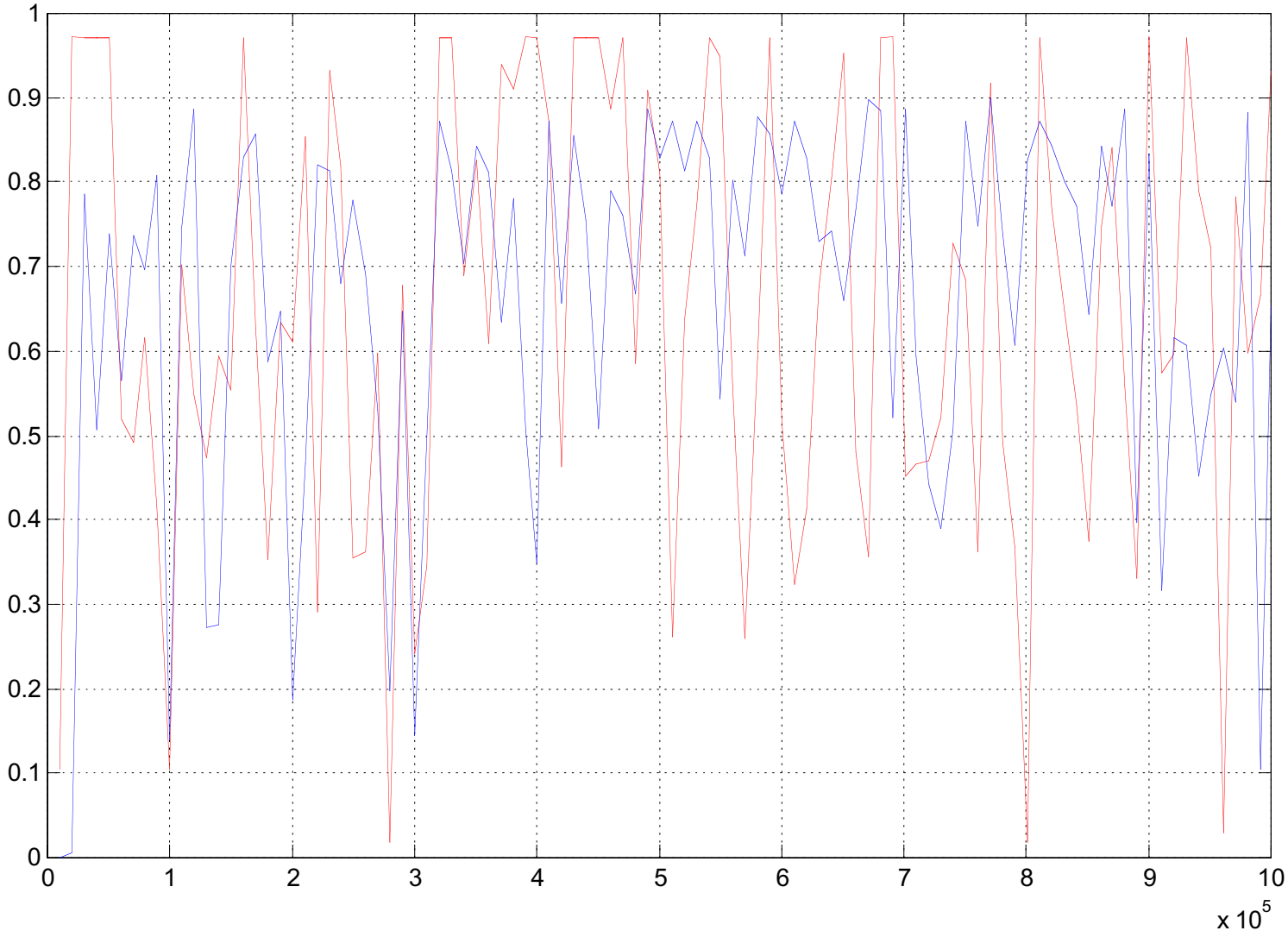
Why is long frame duration problematic

- Latency
  - The average latency in the DL is about half frame
  - The average latency in the UL is at least One frame and a half
- Slow response to changing link conditions
  - Slower power control loop response
  - Slower DL channel estimation
- More storage required in the PHY and low-MAC levels (especially for broad channels)
  - 14MHz x 4bit/sec/Hz x 20msec = ~1Mbit memory

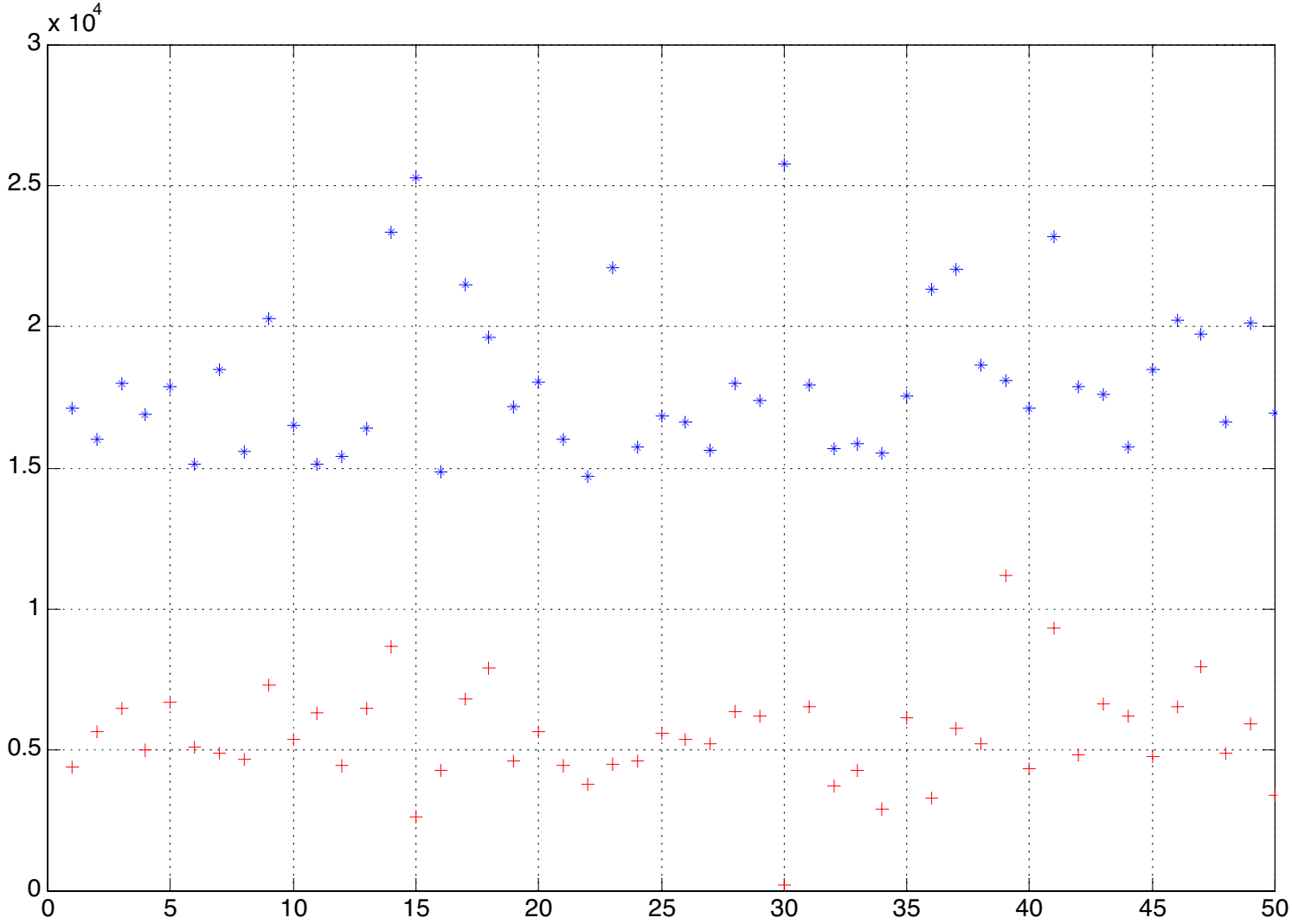
Some simulation results

- Compare frame durations of 10mS and 20mS
- TDD operation, 50% duty cycle
- Traffic modeled according to 4IPP model (IEEE 802.16.3c-01/30r1)
- 50 SS units, normal distribution of traffic load among them
- Simulated over 1 Second
- Used 7MHz channel, G/I = _, QAM16, _
- Run under heavy traffic load and under moderate load

10mS frame – Heavy Load



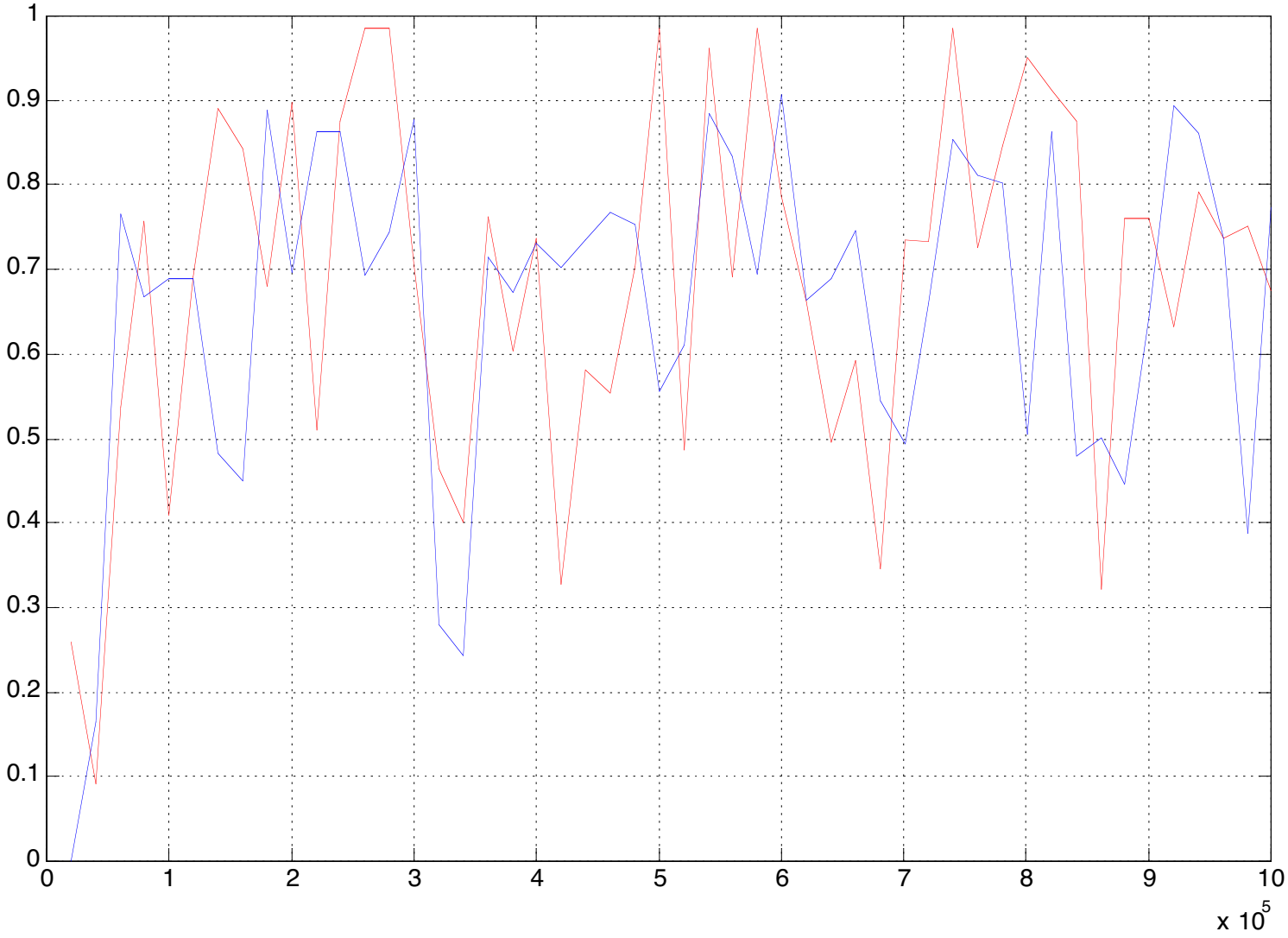
10mS frame – Heavy load



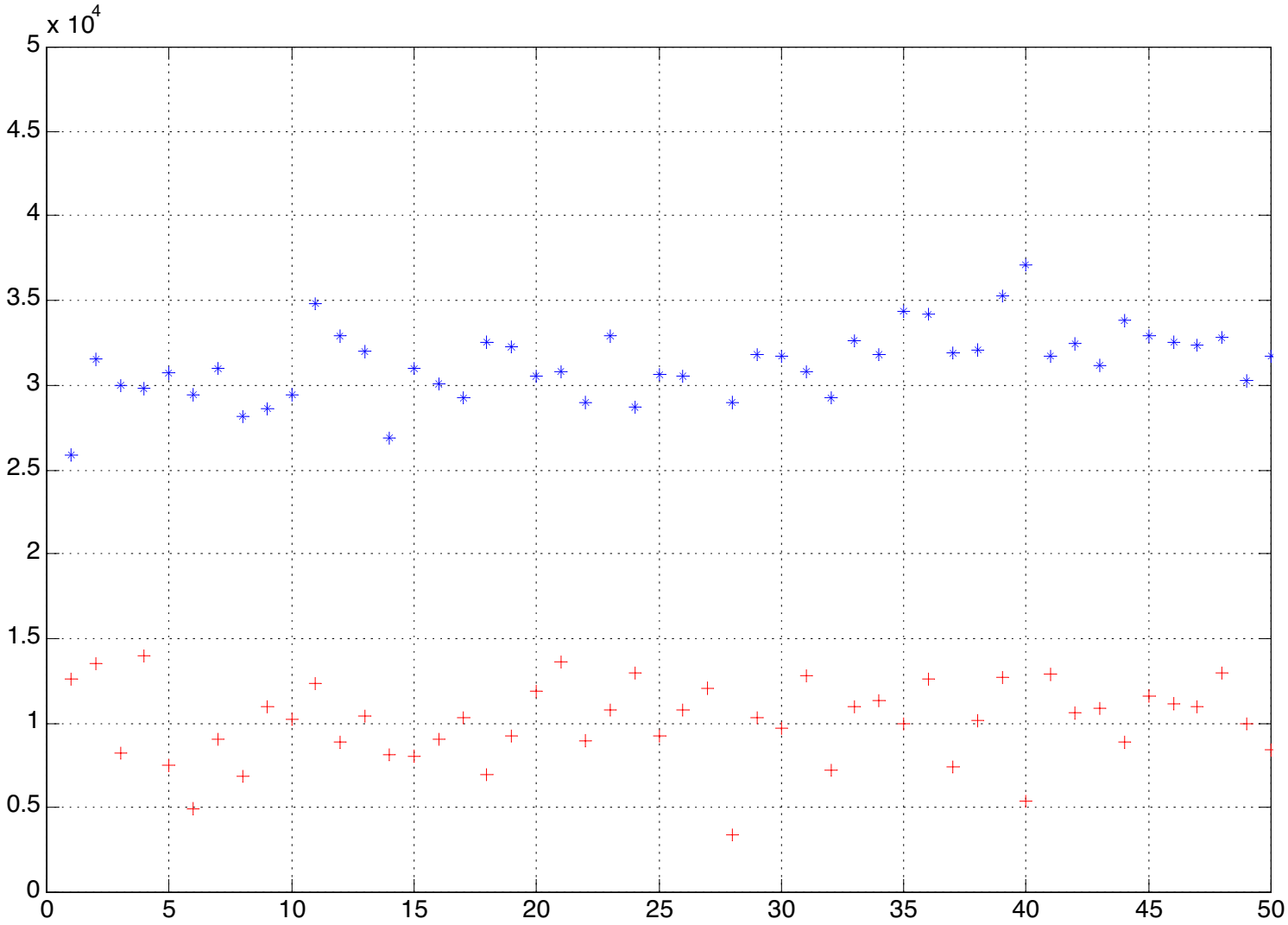
10mS frame – Heavy load

- Statistics:
  - Average DL throughput: 65.3%
  - Average UL throughput: 66.6%
  - Average DL latency: 5.5mS
  - Average UL latency: 18.1mS

20mS frame – Heavy Load



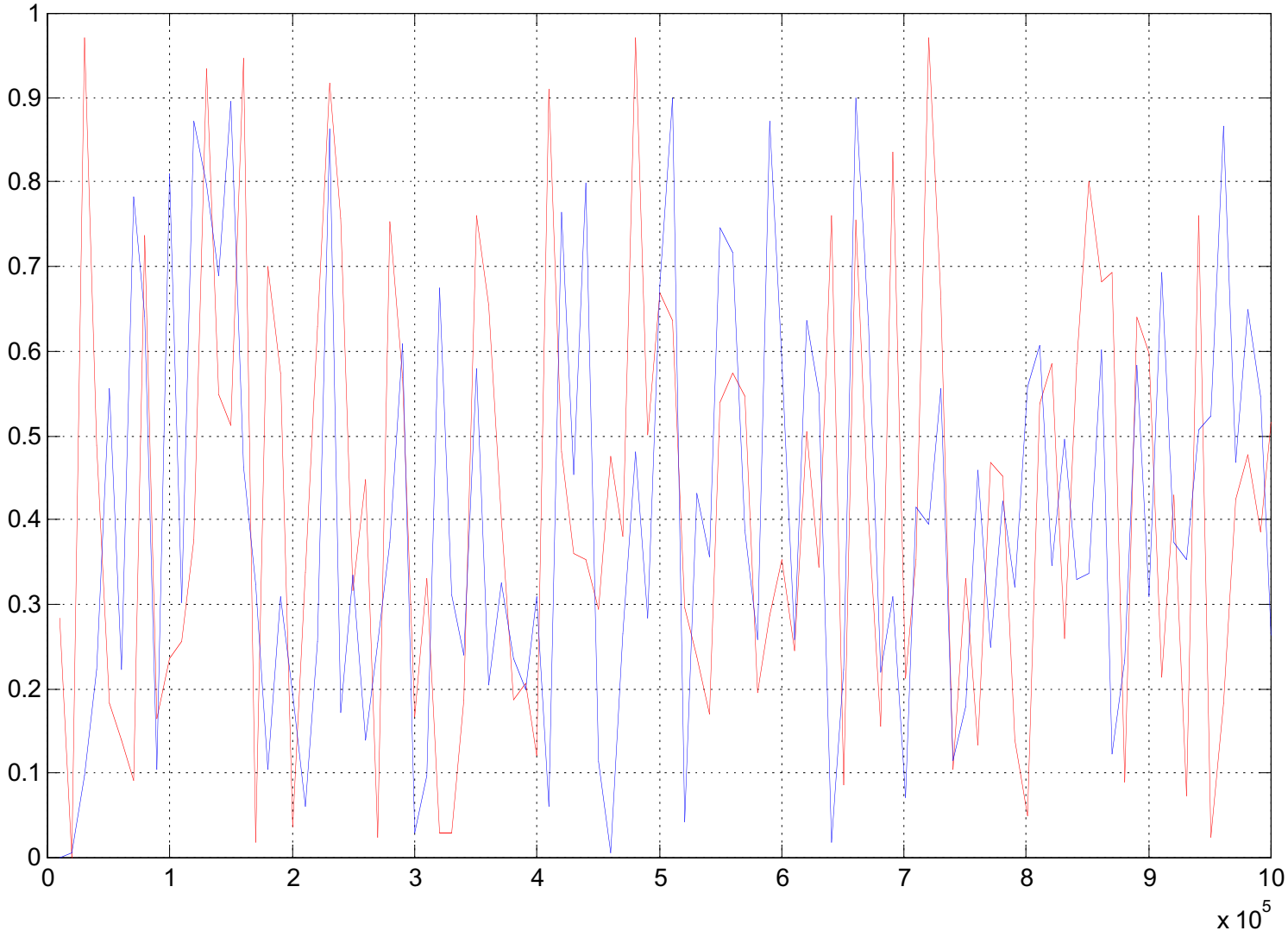
20mS frame – Heavy load



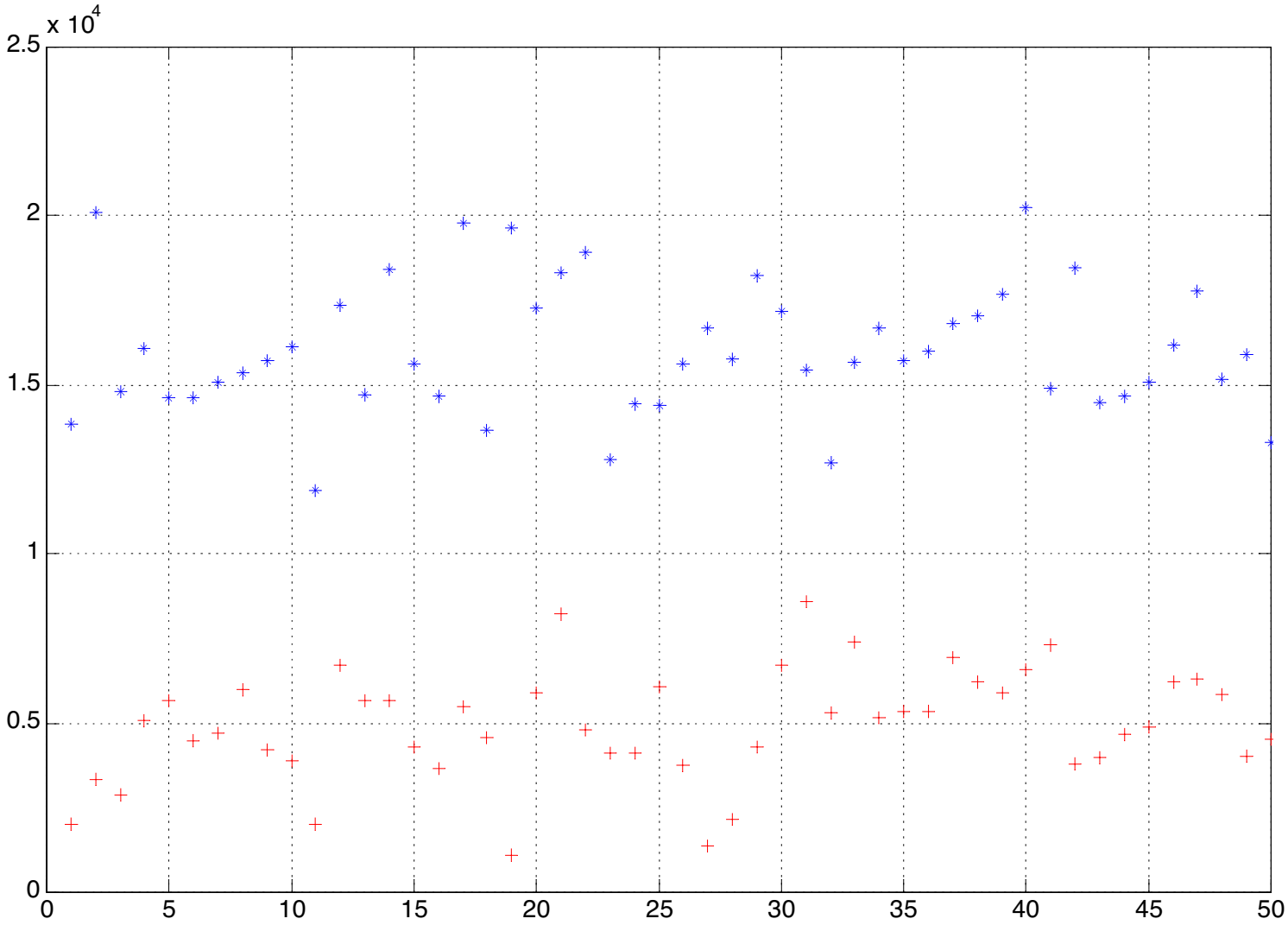
20mS frame – Heavy load

- Statistics:
  - Average DL throughput: 68.8%
  - Average UL throughput: 66.0%
  - Average DL latency: 10.1mS
  - Average UL latency: 31.3mS

10mS frame – Light Load



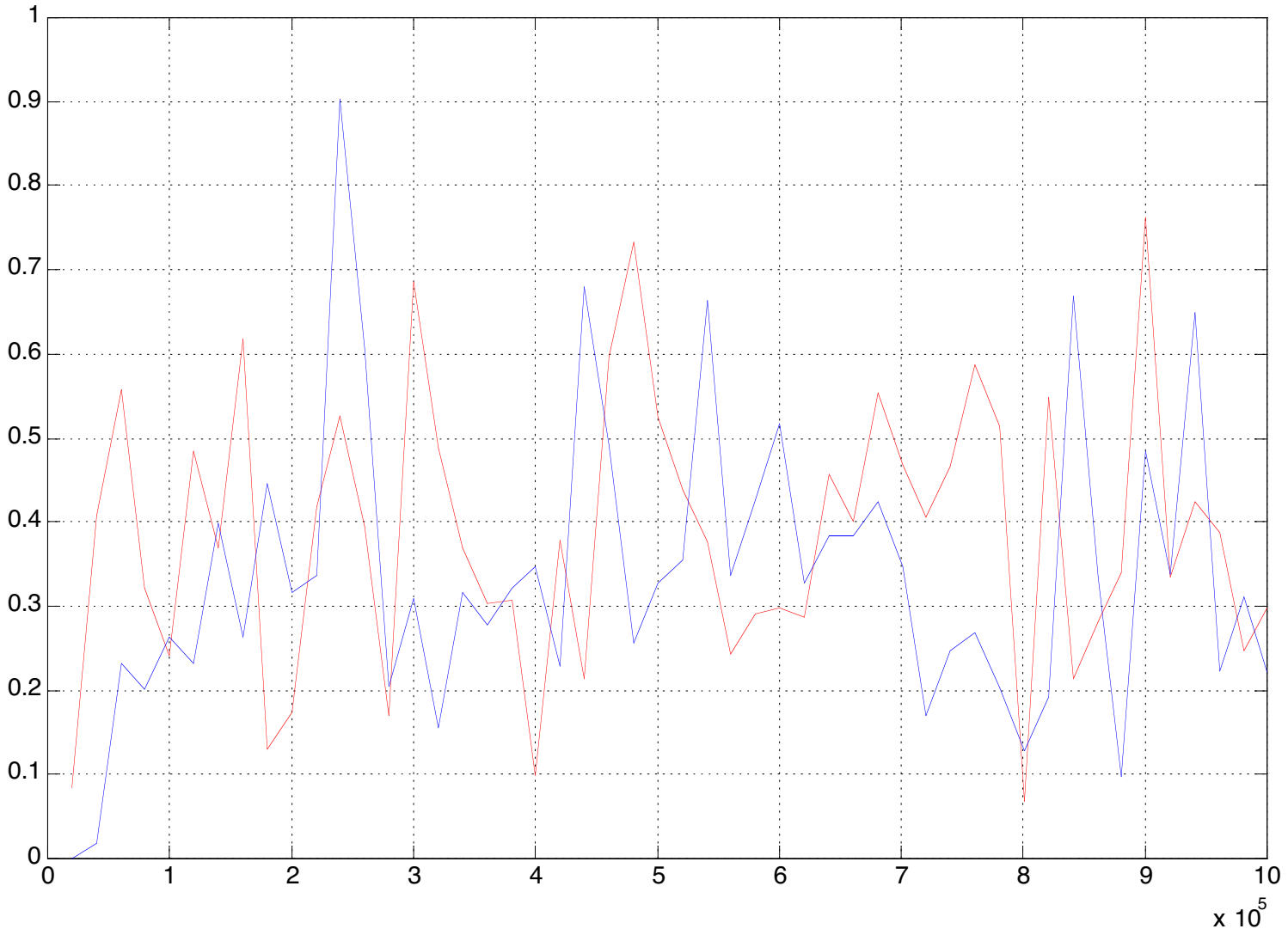
10mS frame – Light load



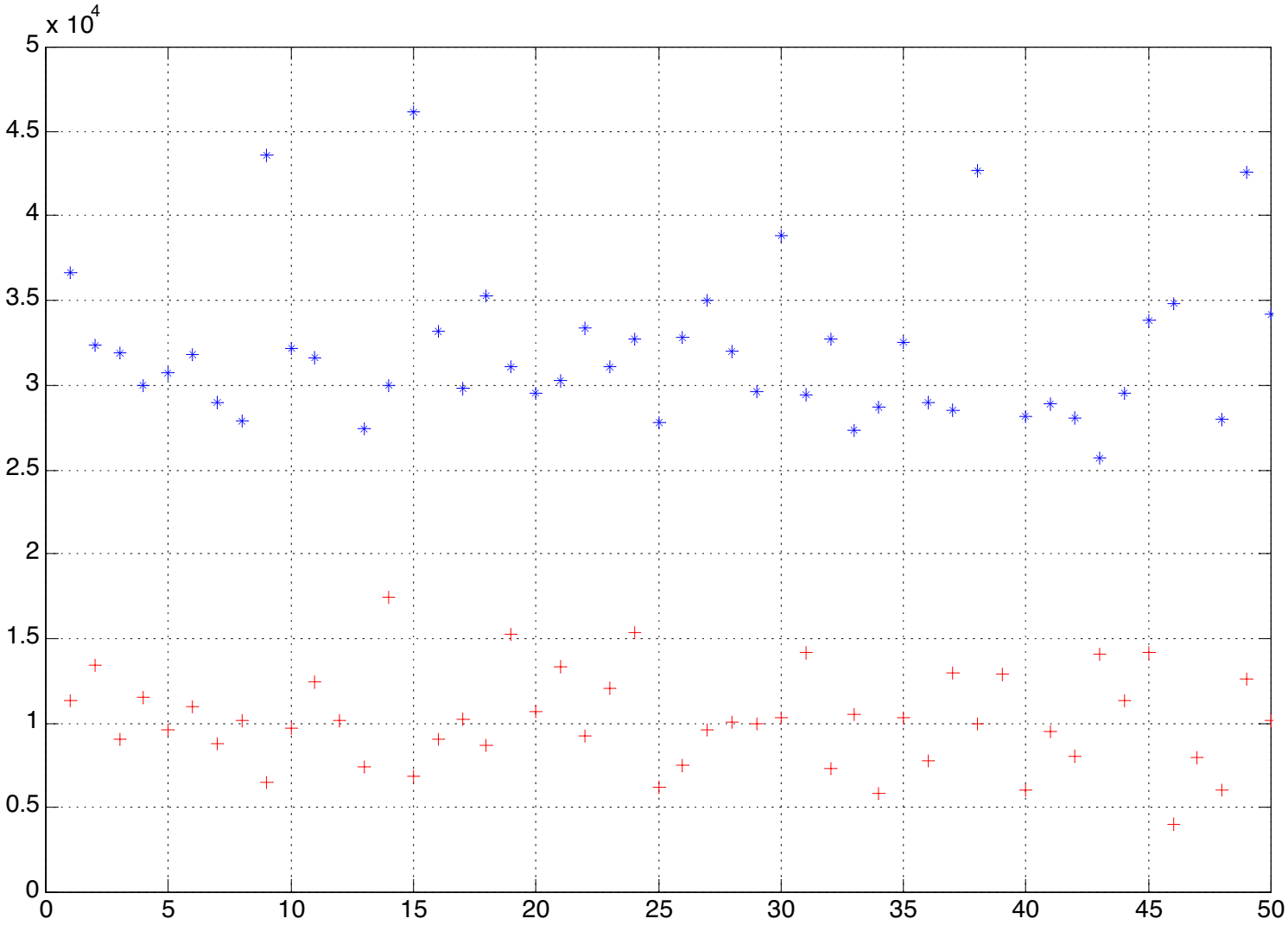
10mS frame – Light load

- Statistics:
  - Average DL throughput: 42.1%
  - Average UL throughput: 40.5%
  - Average DL latency: 4.9mS
  - Average UL latency: 16.0mS

20mS frame – Light Load



20mS frame – Light load



20mS frame – Light load

- Statistics:
  - Average DL throughput: 38.6%
  - Average UL throughput: 33.6%
  - Average DL latency: 10.2mS
  - Average UL latency: 34.4mS