

Burstiness and Scaling in Low Power Wireless Simulation

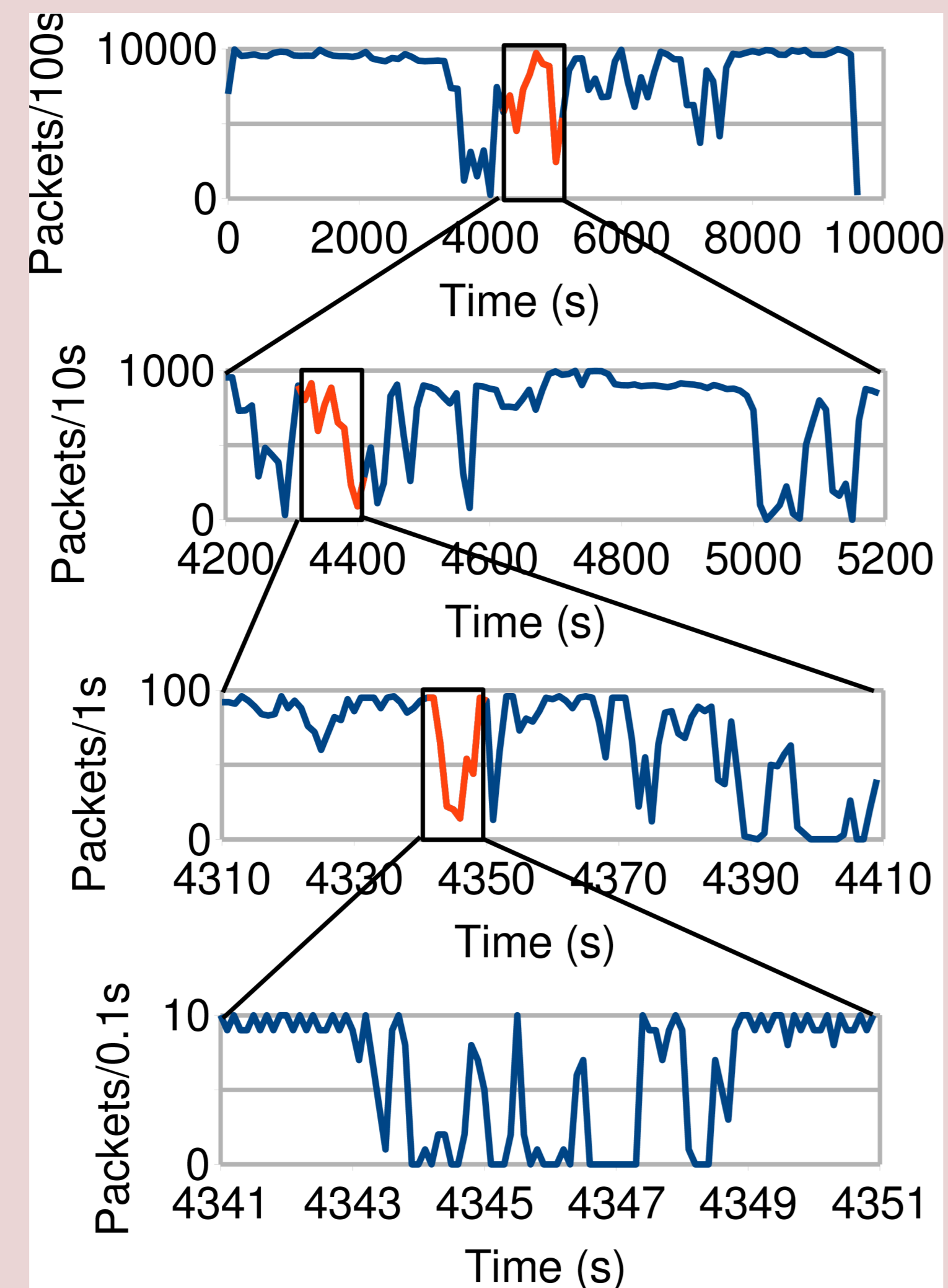


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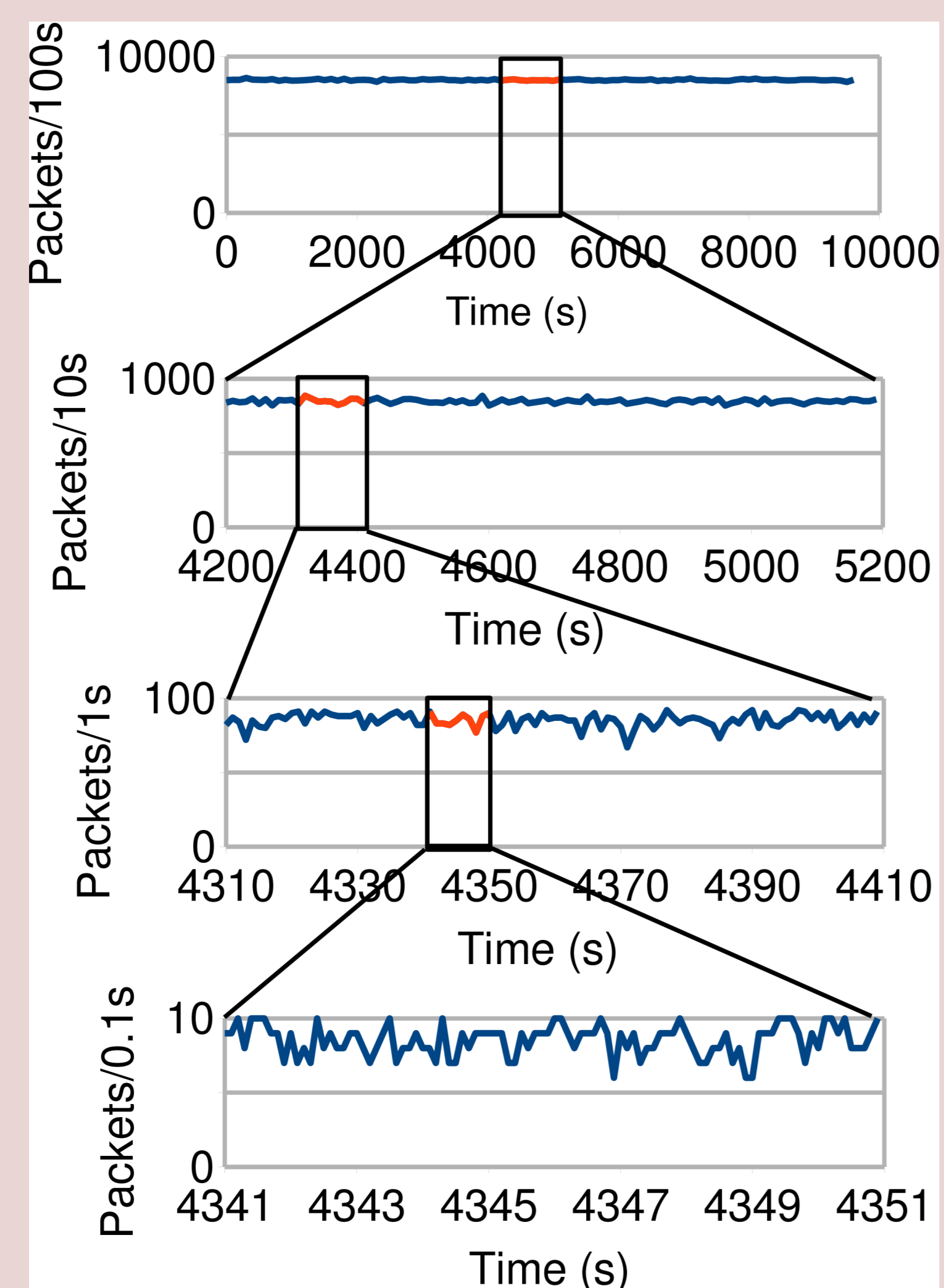
Link-Layer Burstiness

Number of packets received over different timescales

Real IEEE 802.15.4 sensor network link:



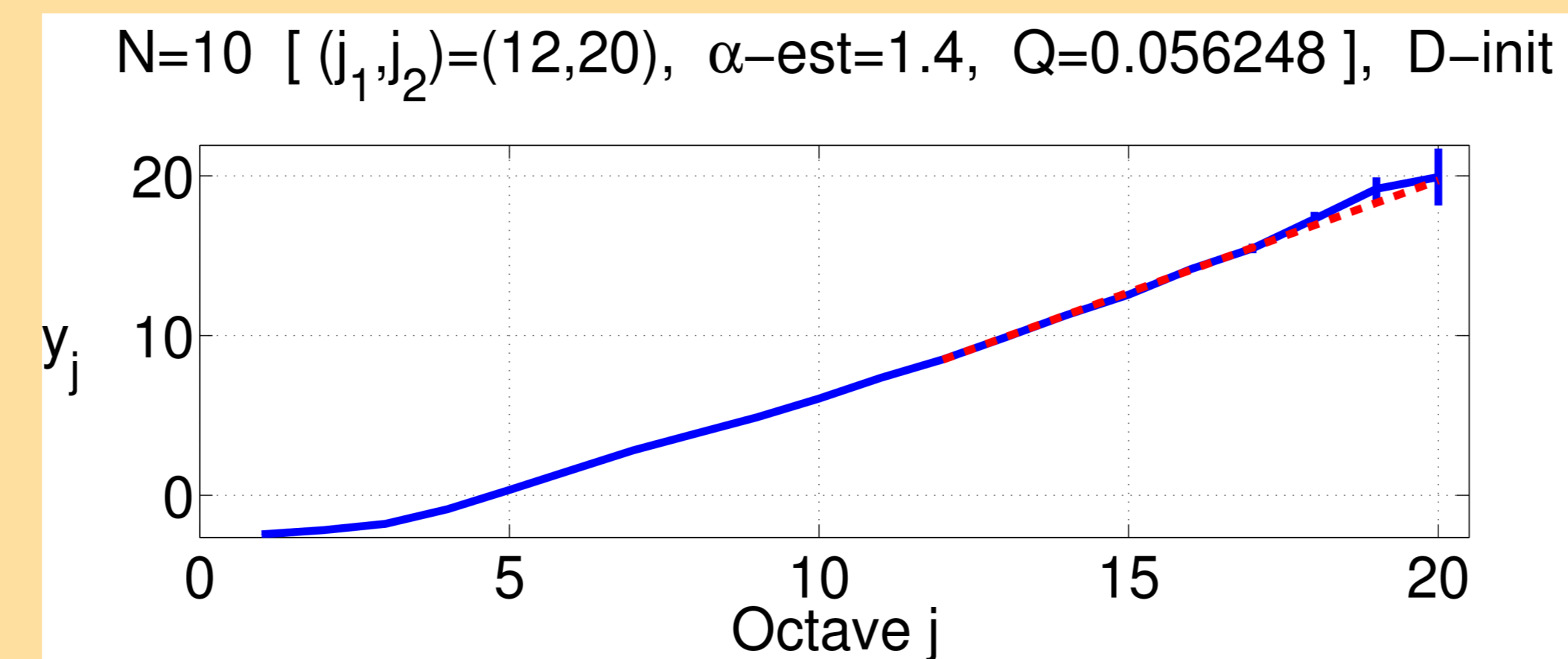
TOSSIM sensor network simulator:



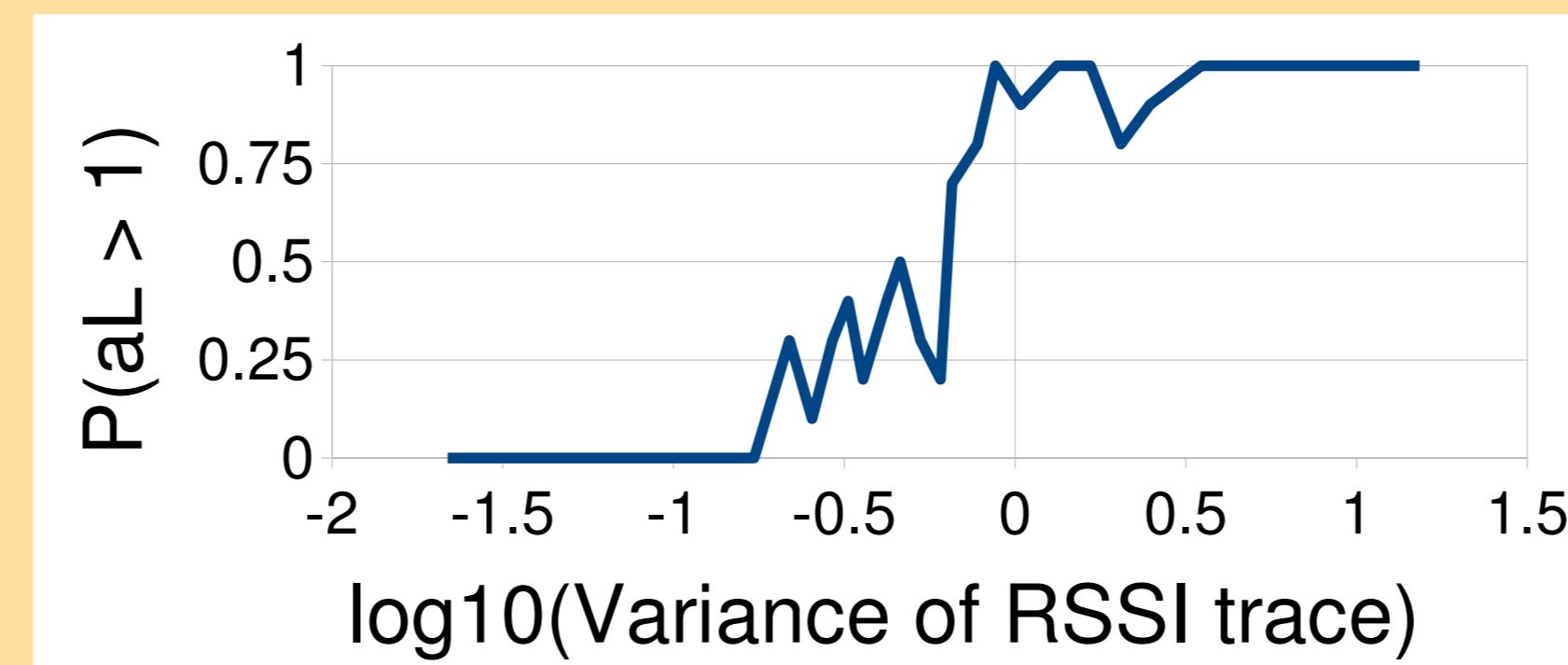
Burstiness is observed at almost all time scales in the real link, but not in the simulated link.

Analysis of RSSI Scaling

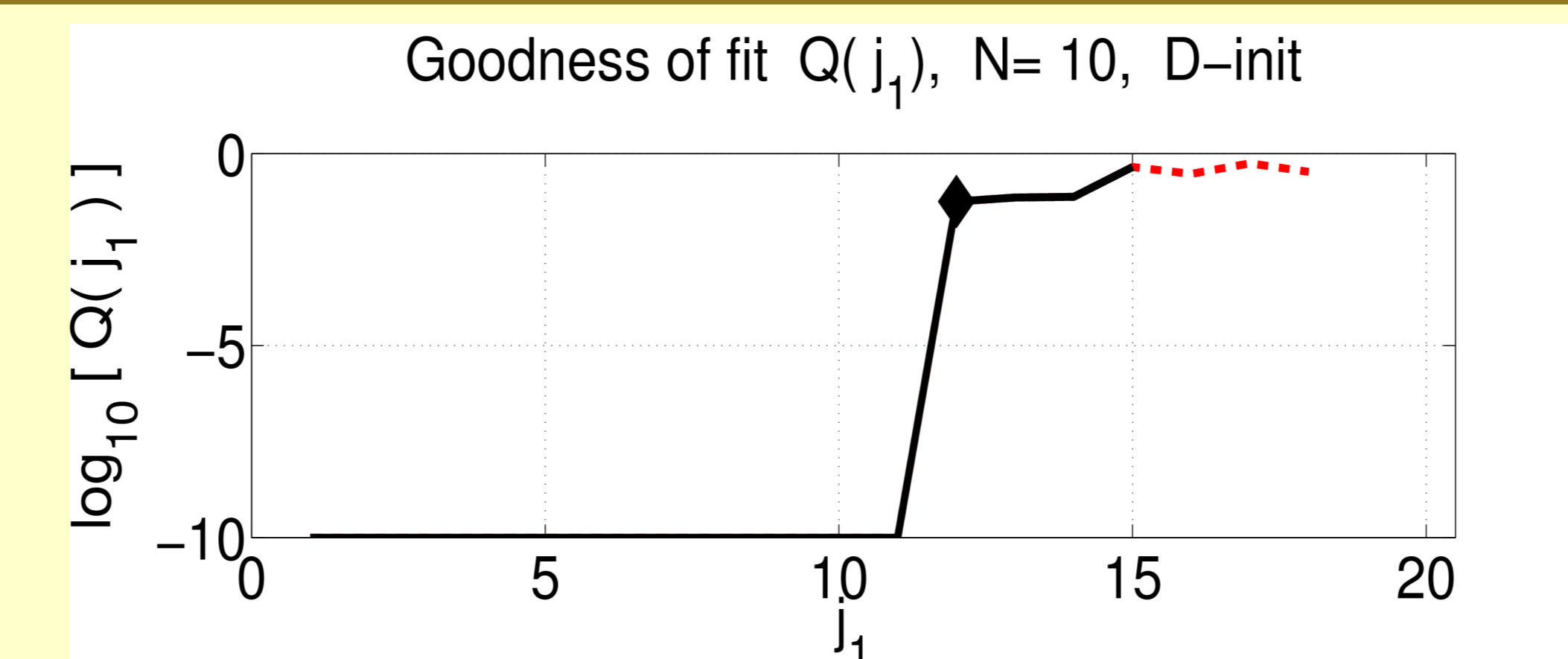
We conducted an analysis of RSSI scaling using a rigorous wavelet estimator, the *logscale diagram* [1].



- α is the slope of the logscale diagram.
- If $\alpha > 1$, then the data may be consistent with *statistical self similarity* or *asymptotic self similarity*, but not with long range dependence.
- Relationship between average variance over groups of ten links investigated to probability that $\alpha > 1$:



Estimation of Onset Point



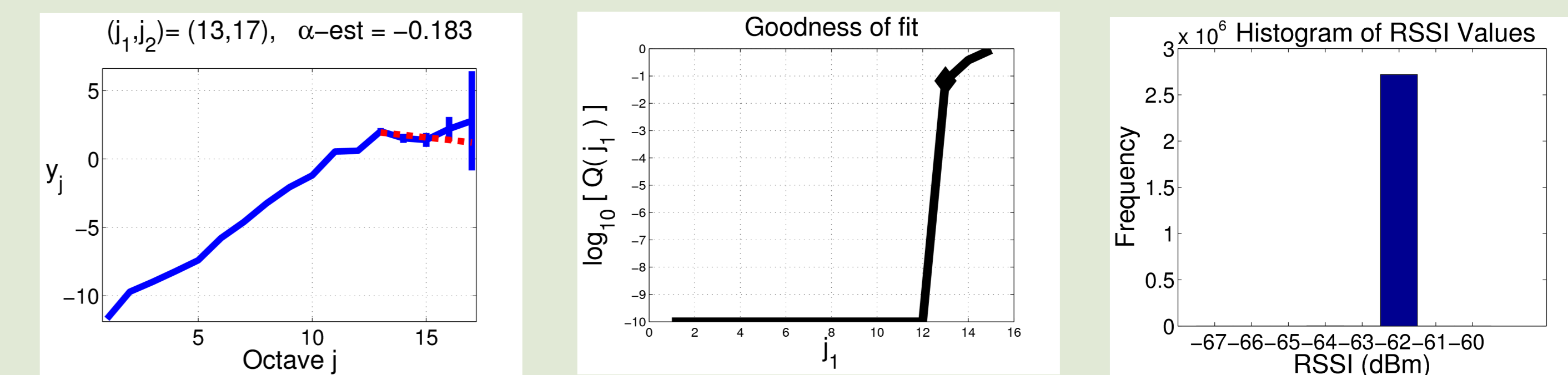
- Onset point is timescale where scaling starts [2].
- It was previously observed by Srinivasan et. al. [3] that waiting 500 ms before retransmissions improves link reliability. 500 ms may be the onset point for that study.

Mirage Link Examples

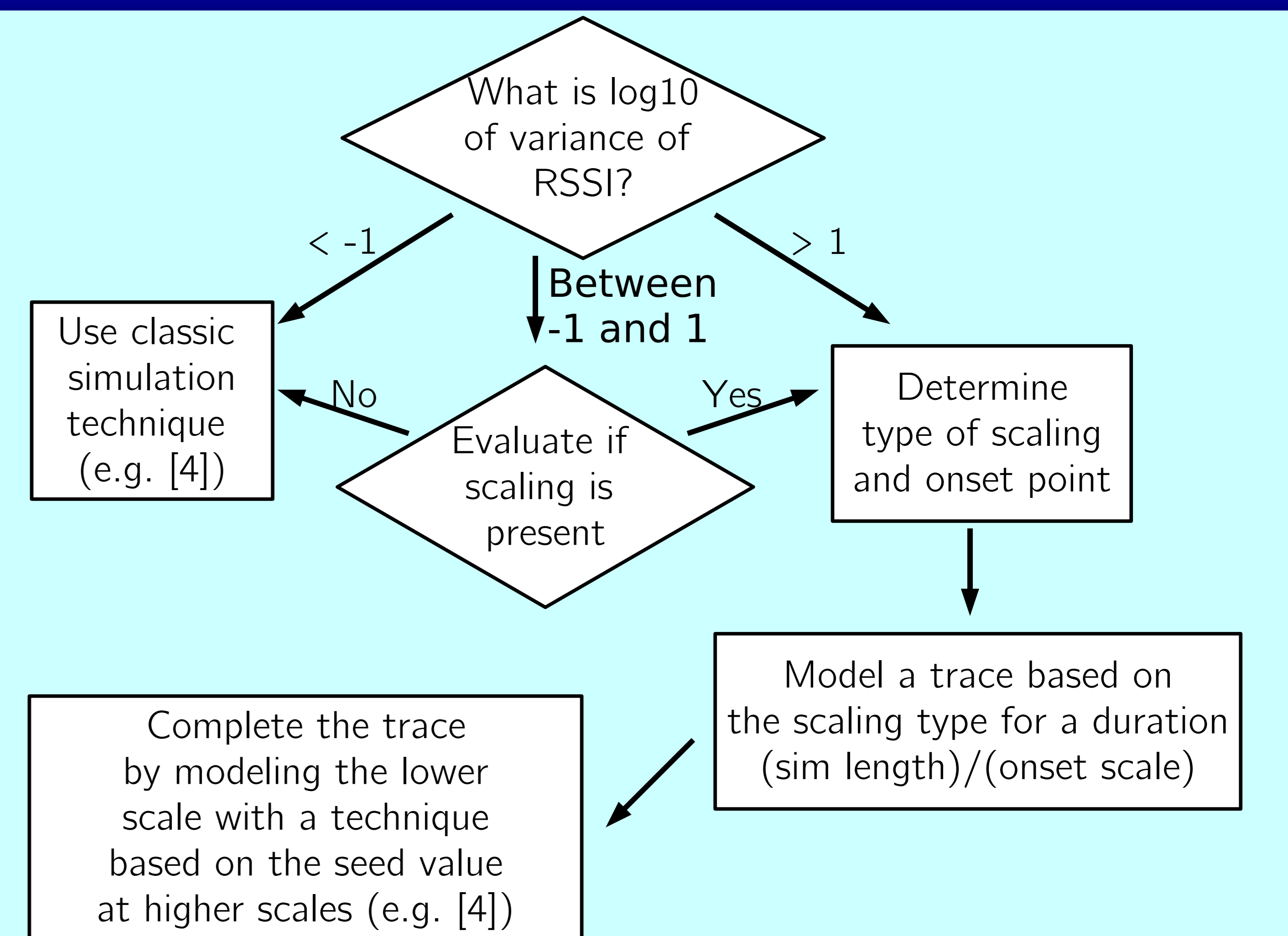
Node 31 to 32; 8 PM 7/26 to 2 AM 7/27



Node 31 to 37; 2 PM 7/28 to 10 PM 7/28



Implications for Simulators



References

[1] P. Abry, P. Flandrin, M. Taqqu, and D. Veitch. Wavelets for the analysis, estimation, and synthesis of scaling data. In K. Park and W. Willinger, editors, *Self-Similar Network Traffic and Performance Evaluation*, pages 39-88. Wiley, 2000.

[2] D. Veitch, P. Abry, and M. Taqqu. On the automatic selection of the onset of scaling. *Fractals*, 11(2), June 2003.

[3] K. Srinivasan, M. Kazandjieva, S. Agarwal, and P. Levis. The beta-factor: Measuring wireless link burstiness. In *ACM SENSYS*, 2008.

[4] T. Rusak and P. Levis. Investigating a physically-based signal power model for robust low power wireless link simulation. In *ACM MSWiM*, 2008.