Meeting a Challenge: Modeling Self-Similar LAN/MAN Traffic

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Outline

- LAN Traffic Measurements
- Testing for Self-Similarity
- Models
  - Chaotic maps
  - Superposed ON-OFF source model
  - Fractional Gaussian Noise model
- Performance Results
- Conclusion & Future Research

LAN Traffic Measurements

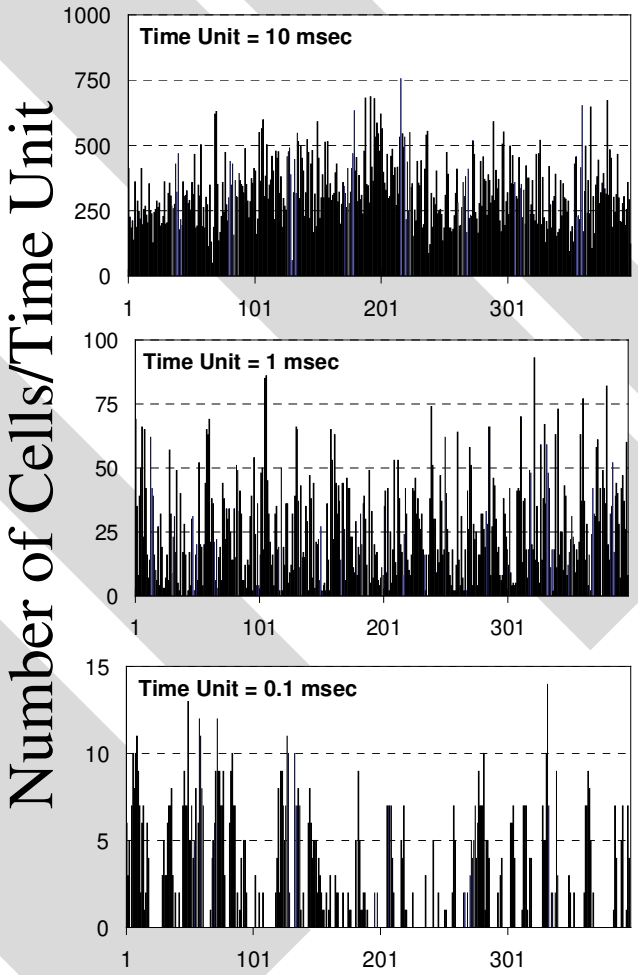
- Self-Similarity

  A S-S process behaves the same way at every time scale.

  "Similarity across time"

- Long-range dependence

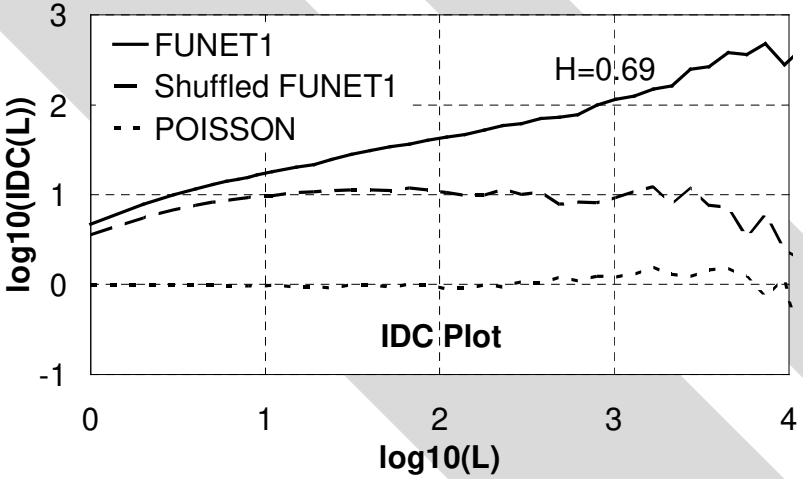
  Significant correlations across arbitrarily large time scales.

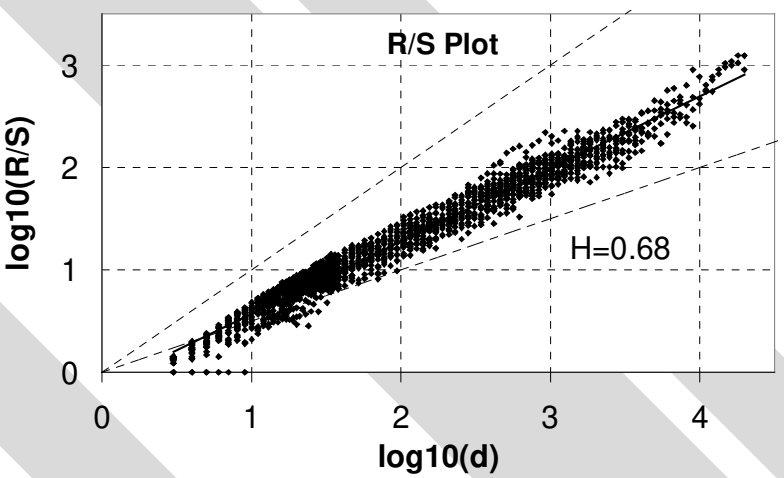


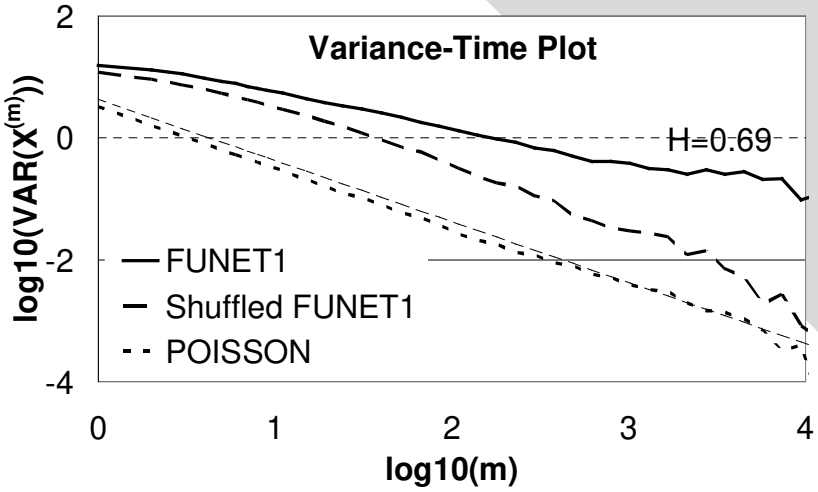
Testing for Self-Similarity

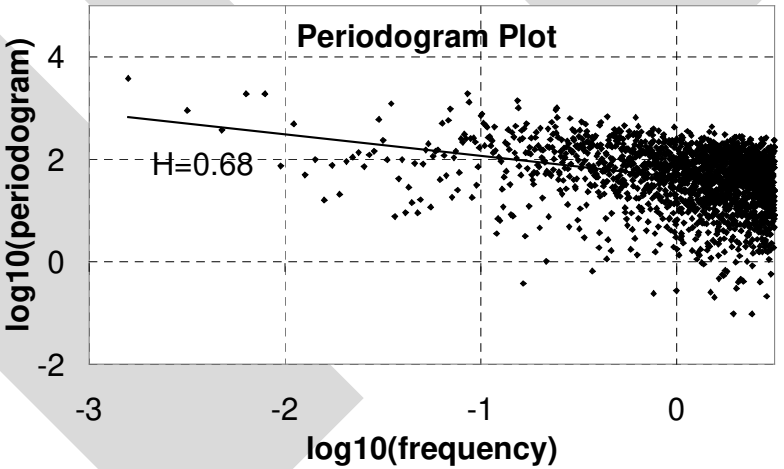
- Fractal properties of packet traffic
  - Long-range dependence
  - 1/f-noise
  - Non-degenerate correlation structure
  - Slowly decaying variances
  - Hurst-effect
- Statistical methods testing for self-similarity
  - Variance-time plots
  - IDC plots
  - R/S-diagrams
  - Periodograms

Analysis Results









Models

- Chaotic maps

  A source model based on *deterministic chaotic map*.

  $x_{n+1} = f(x_n)$, where $f(.)$ nonlinear, chaotic

- Superposed ON/OFF source model

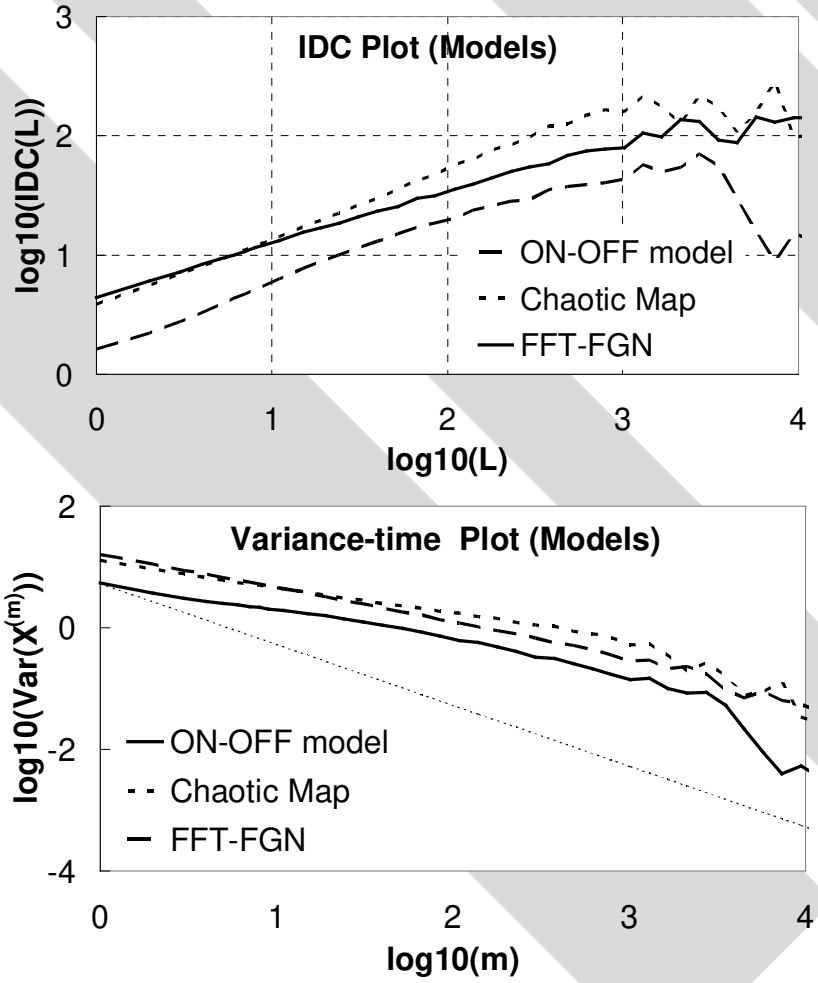
  ON/OFF periods: Pareto

  arrivals in ON periods: Poisson

- Fractional Gaussian Noise model

  An exactly self-similar model based on *fractional Gaussian motion*.

Performance Results



Conclusions

- Fractal nature of measured traffic
  - Self-similarity parameter $H \sim 0.7$
- Comparison of the models

- Engineering considerations
  - measuring, buffer dimensioning, traffic control, shaping, etc.

Future Work

- Impact of S-S on protocol design
- Self-similarity vs. non-stationarity
- Estimation of Hurst-parameter
  - accuracy!
- Estimation of characteristics of S-S traffic
  - methods!
  - sample size!