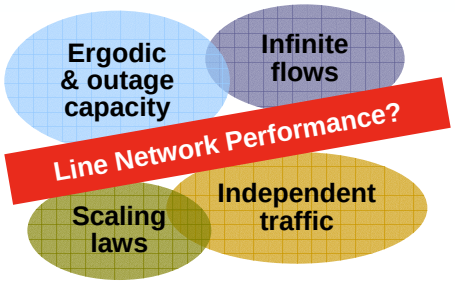
Throughput-delay-reliability analysis of line networks

STATUS QUO



Correlations and queuing-channel access delays are ignored, resulting in:

(1) Loose performance bounds

(2) inefficient protocols and architectures

(3) Time scales and finite sources prohibit application of law of large numbers.

NEW INSIGHTS

(1) PHY- and IT-based queuing analysis;

(2) *dynamic* connectivity;

(3) branching and first-passage percolation with interference.

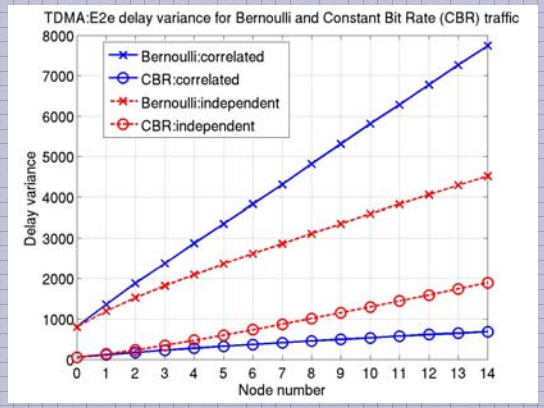
Result: Accurate analysis of queueing delay and speed of information propagation.

NEQUIT ACHIEVEMENT(S)

First analysis of end-to-end delay statistics!

Example:

Ignoring correlations grossly under- or over-estimates the e2e delay variance.



HOW THE ANALYSIS WORKS:

- Line-network of non-saturated coupled queues with a single flow.
- Instantaneous channel quality depends on entire network history due to interference.
- *Fundamental limits:* Optimize packet sizes and channel access (time scale *engineering*).

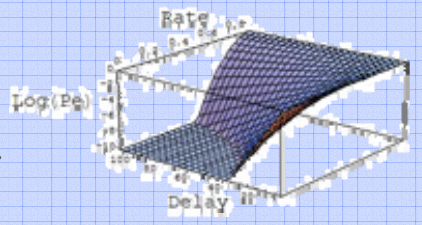
ASSUMPTIONS AND LIMITATIONS:

- Fixed line topology
- Use PHY- and IT-based service models.
  PHY: SINR exceeds threshold
  IT: Error exponents, Shannon capacity
- Interference treated as noise.

END-OF-PHASE GOAL

Use of randomized techniques (similar to Shannon's random coding argument) to derive fundamental performance limits.

Incorporate feedback and extend to multiple sources to obtain bounds on the TDR region.



COMMUNITY CHALLENGE

What is the optimum resource allocation in line networks (time, bandwidth, power)?

To which extent can time scales be engineered to improve performance?

How can MANET TDR regions be derived from line network results (TDR calculus)?

TDR analysis of line networks is an important step more general MANET bounds