Simulation and Wavelet Analysis of Packet Traffic

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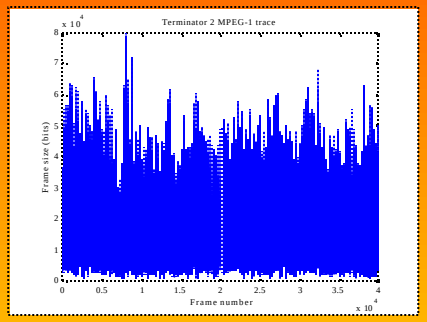
1. Traffic:

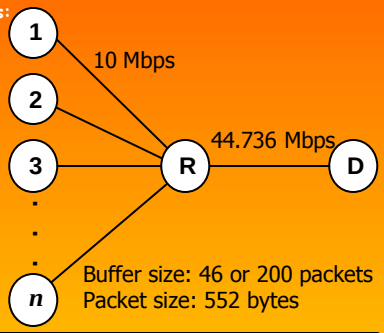
- Complex traffic patterns arise from multiplexed data, voice, and video
- Traditional traffic models fail to capture essential traffic characteristics
- Traffic often exhibits long-range dependent (self-similar, fractal) behaviour
- Current traffic models should capture long-range dependent traffic characteristics

Trace	Mean bit rate (Mbps)	Hurst parameter
Silence of the Lambs	0.18	0.89
Terminator 2	0.27	0.89
MTV	0.49	0.89
Simpsons	0.46	0.89
Talk Show 1	0.36	0.89
Jurassic Park 1	0.33	0.88
Mr. Bean	0.44	0.85
News	0.38	0.79
Star Wars	0.36	0.74
Talk Show 2	0.49	0.73



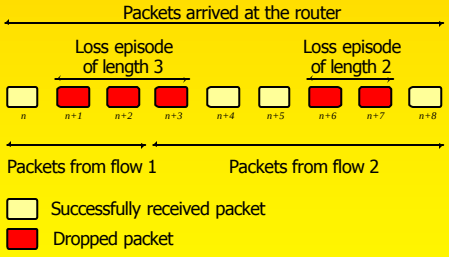
2. Simulation topology and scenario:

- We analyze the impact of traffic on the Quality of Service (QoS) in packet networks
- We use trace-driven network simulations (using ns-2)
- MPEG-1 traffic is transmitted over UDP/IP (User Datagram Protocol/Internet Protocol)
- UDP is suitable for real-time applications because of small delay
- Buffer size of the router is set according to delay requirements
- Router employs five different queuing schemes:
  1. FIFO/ DropTail
  2. Random Early Drop (RED)
  3. Fair Queuing (FQ)
  4. Stochastic Fair Queuing (SFQ)
  5. Deficit Round Robin (DRR)

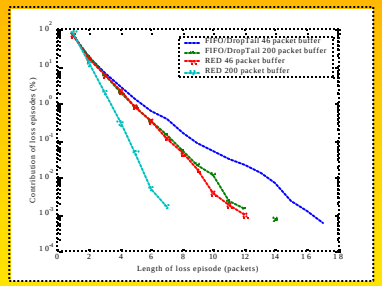


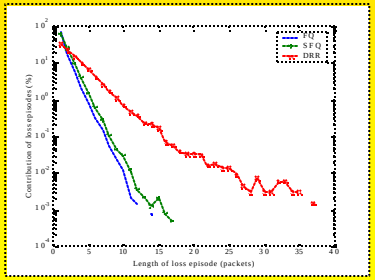
3. Packet loss:

- Simple loss statistics cannot capture complexity of loss patterns
- We characterize packet loss using loss episodes
- Real-time applications often more susceptible to consecutive packet losses
- Loss episodes reflect the burstiness of packet loss



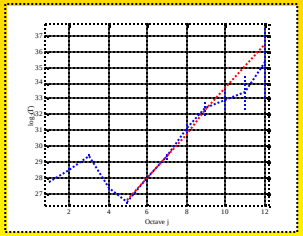
Aggregate loss: Two loss episodes, one of length 3 the other of length 2
Per-flow loss:
Flow 1: One loss episode of length 2
Flow 2: Two loss episodes, one of length 1 the other of length 2



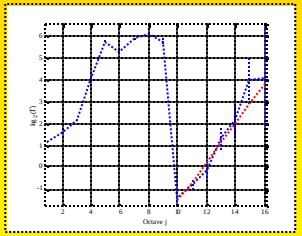


4. Wavelet analysis of packet loss:

- Traffic traces exhibit long range dependency (LRD) for time scales of 2^5 ⏱ 40ms » 1s.
- Loss traces also exhibit LRD for time scales of 2^{10} ⏱ 1ms » 1.2s
- The loss process capture the LRD characteristic of the traffic



Wavelet LRD estimator of 30-minute News traffic trace



Wavelet LRD estimator of loss trace
Buffer sizes: 46, 100, 200 packets
Packet size: 552 bytes

- The LRD behaviour is present regardless of the buffer size
- These properties indicate self-similarity in loss processes