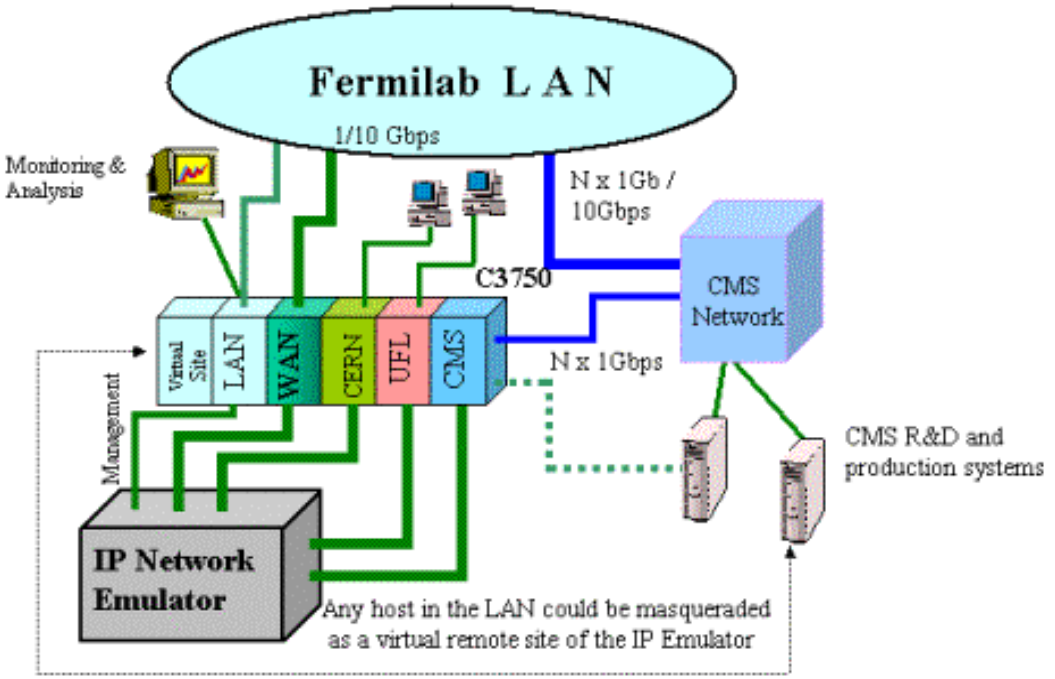
WAN Emulation development and Testing at Fermilab.

Why do we need IP emulation ?

There is a gap in performance that existing networks can provide and applications were able to achieve so far. It requires intensive investigation and developing on all architectural layers involved into date moving. It results in the necessity to transfer a huge amount of data under reproducible traffic conditions. Obviously, that it is very difficult to achieve by using of production facilities.

Architecture of the IPEL



• A dedicated switch Cisco Catalyst 3750G, partitioned into multiple VLANs to reproduce networks of the workgroups and remote sites
• 3+ high-performance end-systems to run an IP Emulator software (currently NISTNet) and act as an end-system at a remote site. Dedicated systems for monitoring and data analysis.

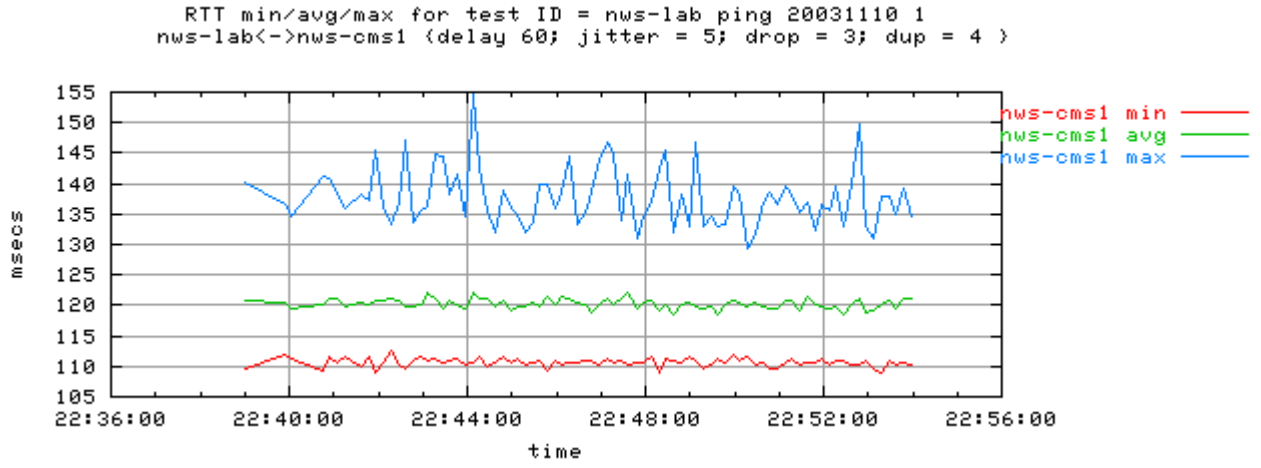
Traffic Impairments

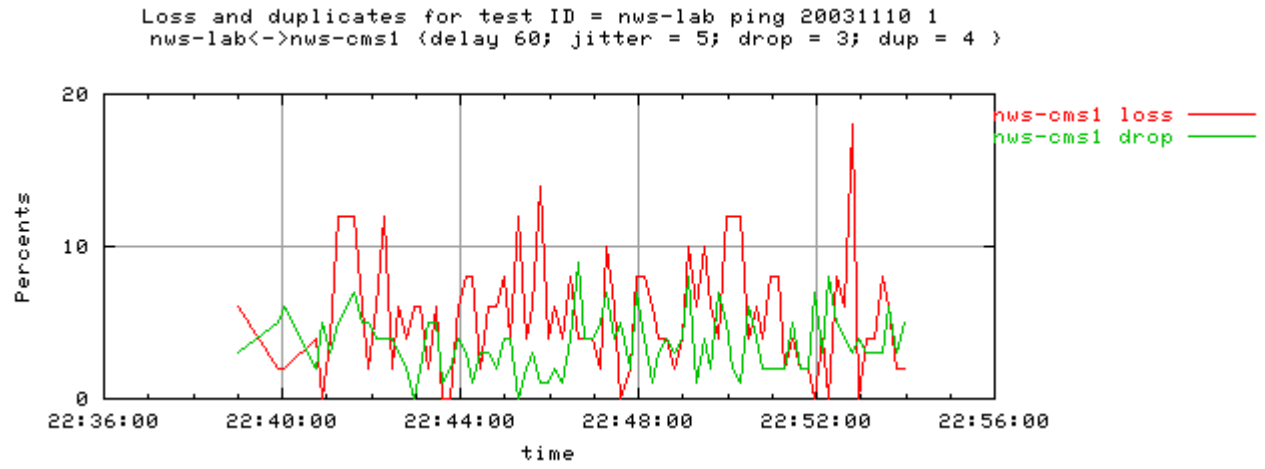
- delay or latency to packets
- jitter, a random variation in the arrive of packets
- drop – a random elimination of one or more packets
- traffic shape, or bandwidth emulation
- traffic asymmetry
- duplication of packets
- jumbo frames
- background traffic
- emulation of high bandwidth > 1Gbps

Tests and Results

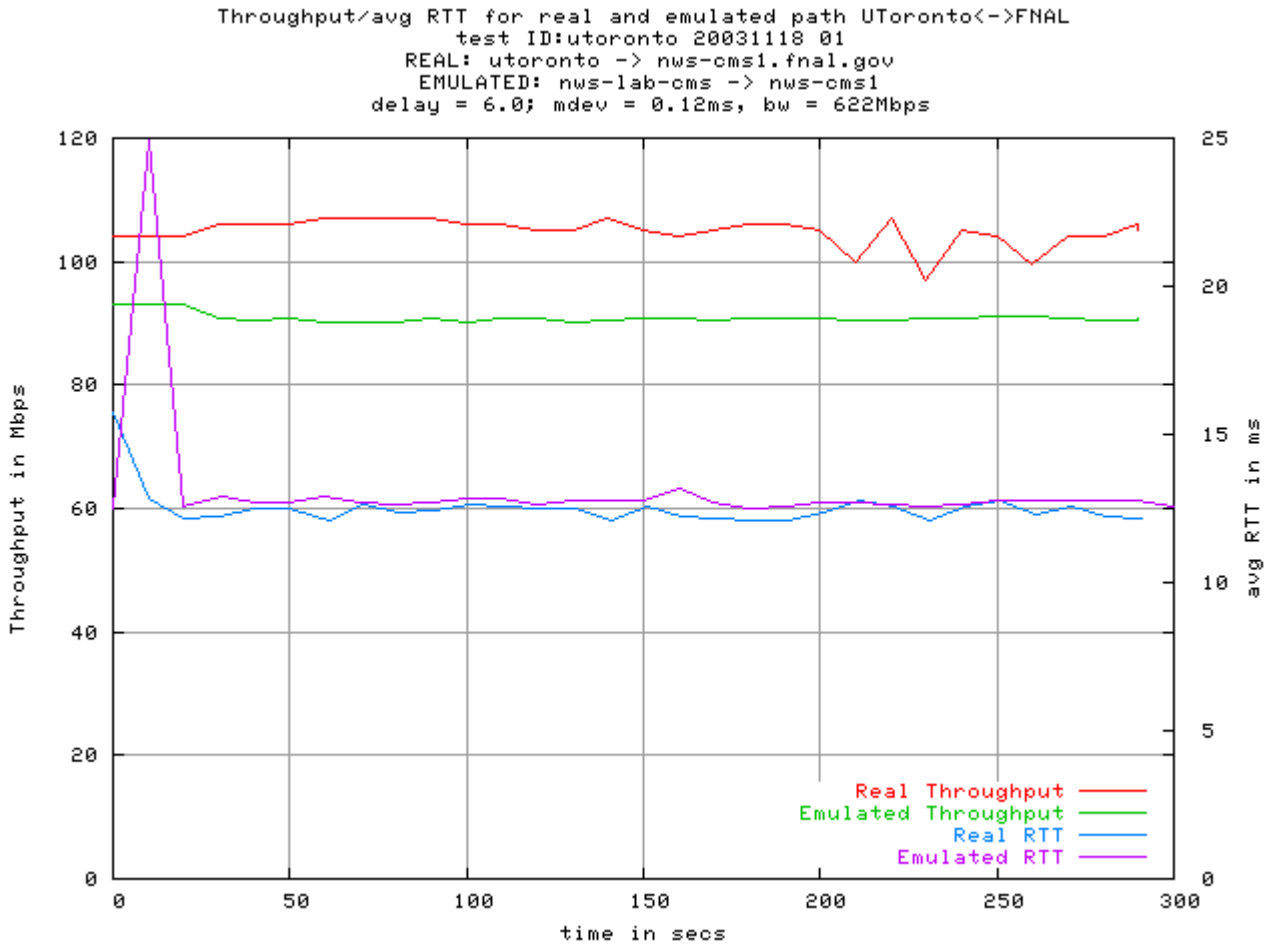
- A lot tests on validation of the NISTNet Software to reproduce the basic traffic impairments for a bandwidth up to 1Gbps, show that accuracy is sufficient
- a comparison of performance characteristics (throughput) in an emulated and the real environment (iperf, GridFTP)
- statistical evaluation of GridFTP performance with different options (a number of streams, socket and block sizes) for traffic conditions similar to the paths between Fermilab, CERN, University of Toronto, other sites.
- in-house made changes to TCP stack in order to recover from loss and retransmissions much quickly to increase achievable throughput.

Making the basic traffic impairments



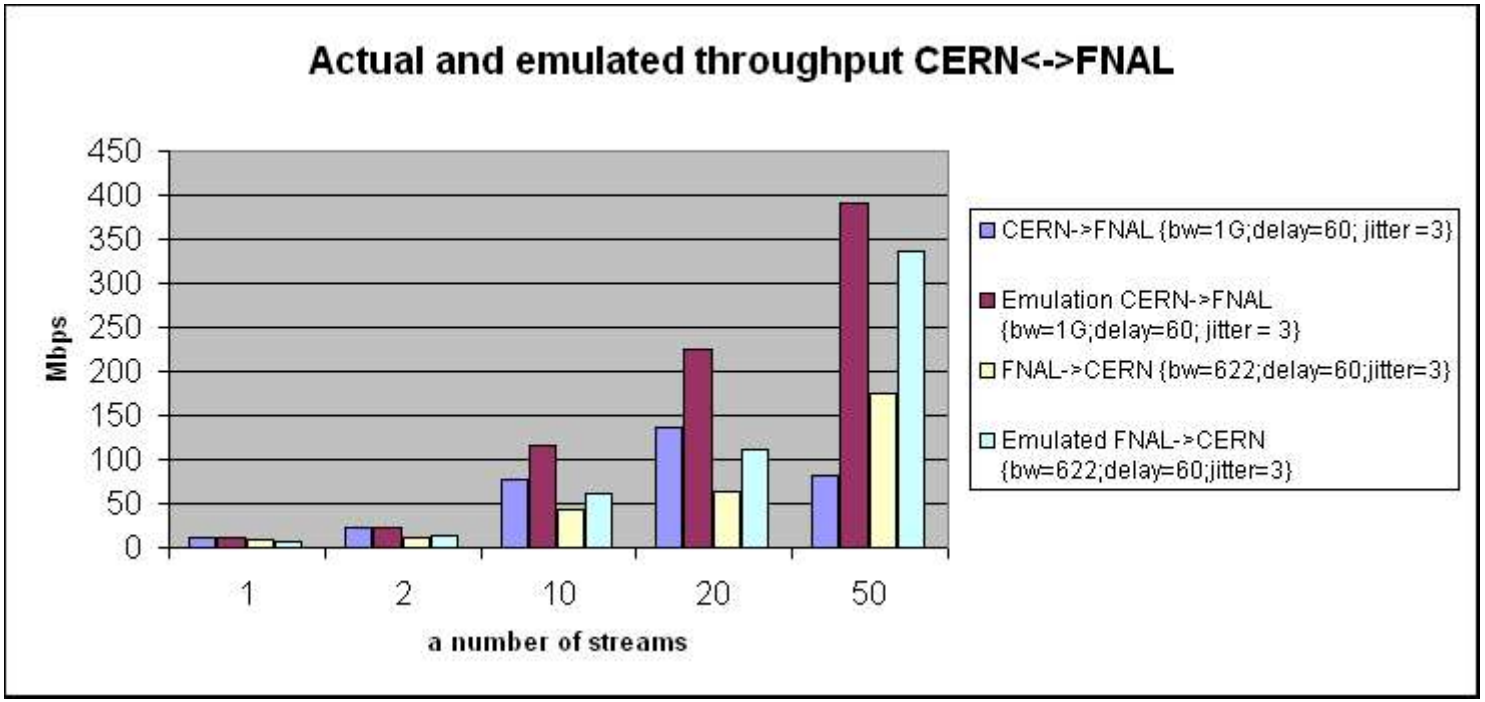


Emulation vs. the Real World



A performance in the emulation and in the real world looks very close in this test, but it is not always the case.

GridFTP in emulation and in the real world



Short-term plans or work in progress..,

- a background traffic generator as an internal feature of the IPEL
- emulation of bandwidth above 1Gbps, eventually ~ 10Gbps
- still work in optimizing/modifying of TCP stack and GridFTP
- make emulation as a site wide service available for the end users