

Frame-level Performance Benchmarking Work at ATM Forum

Raj Jain

Professor of Computer and Information Science

**Raj Jain is now at
Washington University in Saint Louis
Jain@cse.wustl.edu
<http://www.cse.wustl.edu/~jain/>**



- ❑ Why OSU?
- ❑ Why Frame-level?
- ❑ What is being done at ATM Forum?
- ❑ Current Status

Dictionary Definition

- **Benchmark** *v. trans.* To subject (a system) to a series of tests in order to obtain prearranged results not available on competitive systems.

From: The Devil's DP Dictionary
S. Kelly-Bootle

OSU National ATM Benchmarking Lab

- ❑ “The Art of Computer Systems Performance Analysis”
+ ATM Forum involvement
⇒ ATM benchmarking at OSU
- ❑ Modeled after Harvard benchmarking lab for routers
- ❑ Benchmarks run in our lab
- ❑ The benchmark scripts can be run by any manufacturer
- ❑ Presentations at Networld+Interop Atlanta (Sep 1995)
- ❑ Leading the work at ATM Forum since Oct 1995
- ❑ Currently defining metrics and measurement methodology

Why?

- ❑ For ATM to succeed, it is important that performance of user application on ATM be better than that on competing technologies.
- ❑ Confusion caused by differing terminology and differing benchmarks will eventually lead to customer dis-satisfaction
- ❑ Imagine the confusion if the definitions of cell loss rate (CLR), Cell transfer delay (CTD), etc. were not standardized. Performance benchmarking work is required to do the same at the frame level. CLR of 1% \neq Frame loss rate of 1%
- ❑ Better customer information will contribute to more customer satisfaction and more sales and hence success of ATM.

Cell Level vs Frame Level

- ❑ Performance benchmarking
 - = Performance seen by the user
 - ≠ Cell level QoS
 - For example,
CLR = 0.1% may mean a frame loss rate of 0.1% in one switch or 0.001% in another.
- ❑ Data applications care for frame loss rate and not CLR.
- ❑ Video applications care for
 - ❑ Frame loss rate
 - ❑ Frame delay variation
 - ❑ Frame transfer delay

SCOPE: Goals

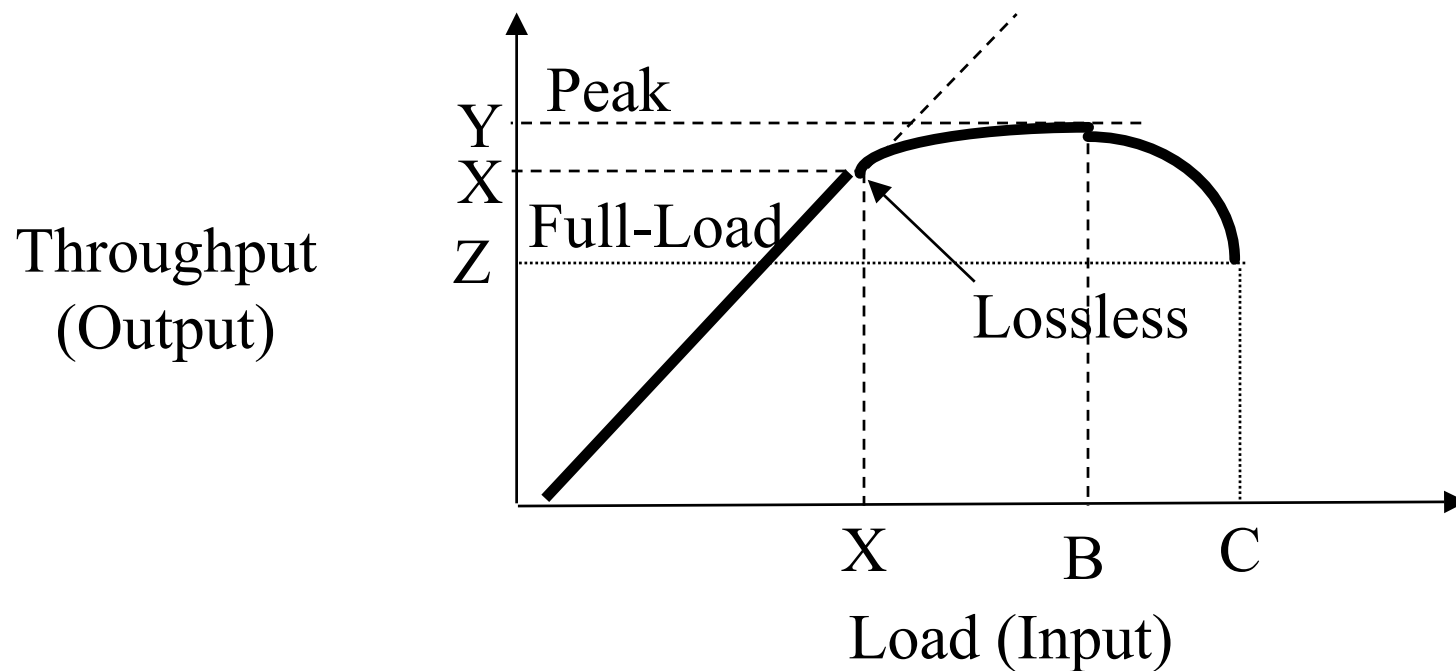
- ❑ Define metrics that help the customer compare various ATM (and possibly non-ATM) equipment.
- ❑ The metrics should be independent of switch architectures. They should apply to all architectures.
- ❑ Develop precise methodologies for measuring these metrics.
Methodology = Procedure + Configuration + Traffic Pattern
⇒ Anyone (user or vendor) can conduct it and come up with the same result.
- ❑ Any extensions of the above that enhance the marketability of ATM can be added to the scope
- ❑ AAL layer metrics will be done before higher layers.

Non-Goals

- ❑ ATM Forum will not do any measurements.
- ❑ Forum will not certify any measurements.
- ❑ Will not set any performance thresholds
 - ❑ Setting thresholds can kill the performance-cost tradeoffs
 - ❑ Example 1: Frame loss rate should be no more than 1%
 - ❑ Example 2: Switch delay should be less than 1 ms.

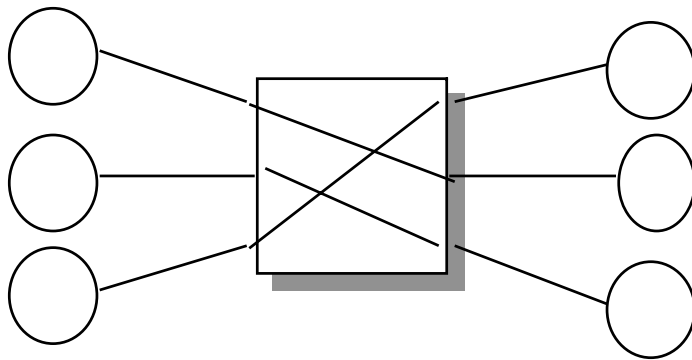
Throughput

- Lossless, Peak, Full-load
- Unit = bits/sec

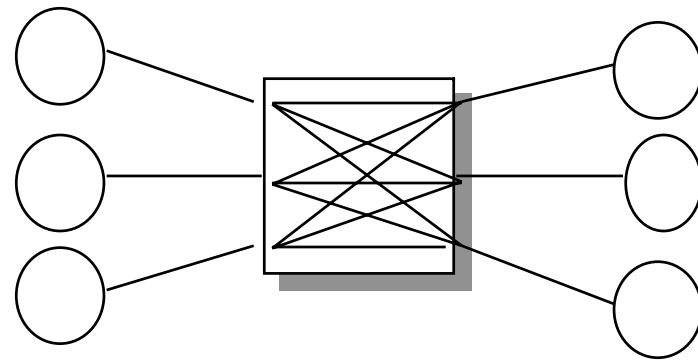


Traffic Pattern

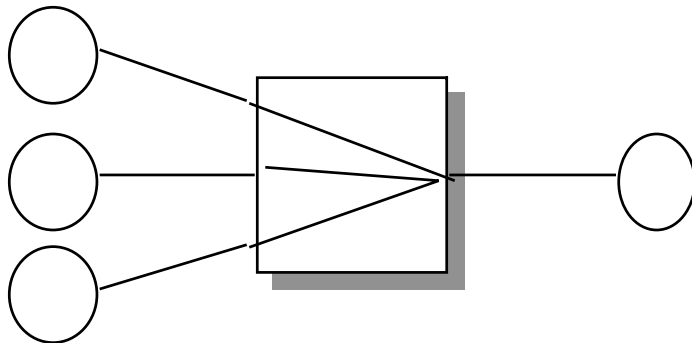
- n-to-n Straight: n Vcs
i to $i+1 \pmod n$



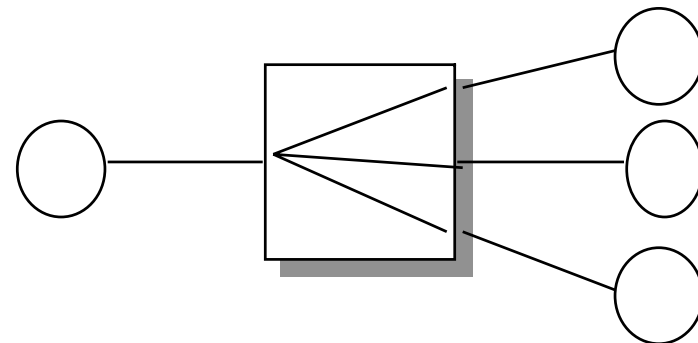
- n-to-n Cross: n^2 Vcs



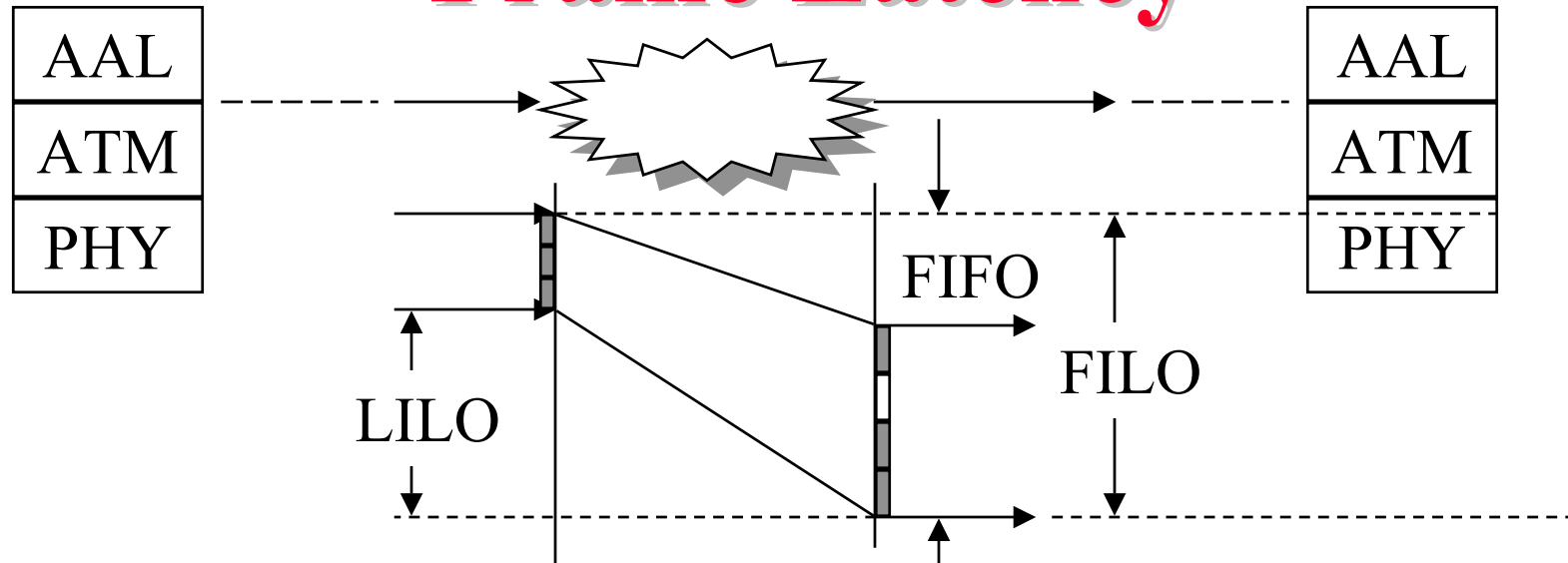
- n-to-1: n Vcs



- 1-to-n Straight: 1 Vc

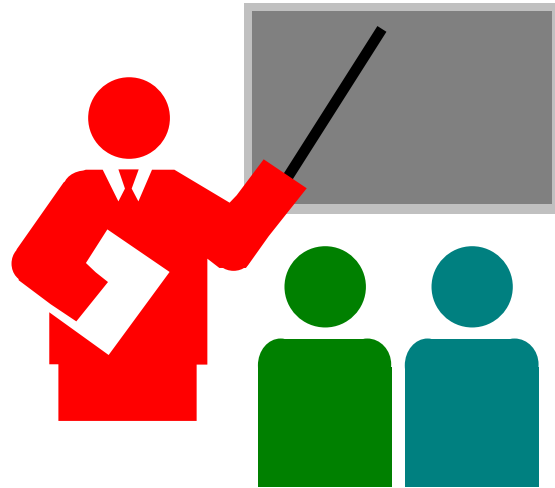


Frame Latency



- ❑ **MIMO** = Message in Message out latency
= $\min\{\text{LILO}, \text{FILO-Normalized Frame Output Time}\}$
- ❑ NFOT = Frame size/output link rate
- ❑ Applies even when: Input rate \neq Output rate
Even when frames are not contiguous
- ❑ Unit: μs

Summary



- ❑ OSU National ATM Benchmarking Lab
- ❑ Frame-level performance is more important for user than cell-level QoS
- ❑ ATM Forum is standardizing frame-level metrics and methodologies. Forum will not certify or measure.
- ❑ Throughput: Lossless, peak, full-load
Latency = $\text{Min}\{\text{LILO}, \text{FILO- NFOT}\} = \text{MIMO}$

Our ATM Forum Contributions

All contributions are available **on-line** at

<http://www.cis.ohio-state.edu/~jain/>

- ❑ R. Jain, G. Babic, and B. Nagendra, “Performance Testing - Baseline Draft,” AF-TEST 96-0810, June 1996
- ❑ R. Jain, G. Babic, and B. Nagendra, “Frame-level throughput and letency metrics - proposed text,” AF-TEST 96-0811, June 1996
- ❑ R. Jain, G. Babic, and B. Nagendra, “Considerations for throughput and latency measurements of ATM switches,” AF-TEST 96-0520, April 1996

- ❑ R. Jain, B. Nagendra, and G. Babic, “General considerations for frame-level performance benchmarking of ATM switches,” AF-TEST 96-0519, April 1996
- ❑ R. Jain and B. Nagendra, “Scope For ATM Forum's Performance Benchmarking Work Item,” ATM Forum/96-0180, February 1996.
- ❑ R. Jain, “Performance Benchmarking BOF,” AF-ALL 95-1347, October 1995