PERFORMANCE BENCHMARKING OF ATM SIGNALING

Douglas Niehaus
EECS Department
University of Kansas
Lawrence, KS
niehaus@eecs.ukans.edu

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Introduction

- Motivation for ATM Benchmarking
  - ATM - emerging high performance networking technology
  - Worldwide focus and interest
  - Objective comparison of different vendor equipment
- Goal : Benchmark ATM Signaling Performance
  - Overhead associated with SVCs
- Outline of the Presentation :
  - Related Work
  - ATM Signaling Overview
  - Benchmarking Framework
    - Test-bed Configuration
    - Signaling Software Utility : The **Call Generator**
    - Classes of Tests, Test Parameters and Metrics
  - Performance Results
  - Conclusions and Future Work

Related Work

- ATM Forum Benchmarking Specifications
- ATM Forum's Goals for Benchmarking :
  - Help compare ATM equipment performance.
  - Independent of switch or NIC architectures.
  - Include metrics for network management, *connection setup* and data transfer.
  - Precise methodology for measurement of metrics
  - **"Non-goal"**: No measurements to be performed by the Forum.
- ATM Benchmarking Laboratory at Ohio State University.
- Signaling performance results for a FORE based WAN studied at NRL.
- Signaling system performance for ATM networks studied at AT&T Research.

ATM Signaling Overview

- Q.2931 protocol, ATM Forum UNI 3.1 specifications RELEASE, RELEASE COMPLETE, RESTART, etc.

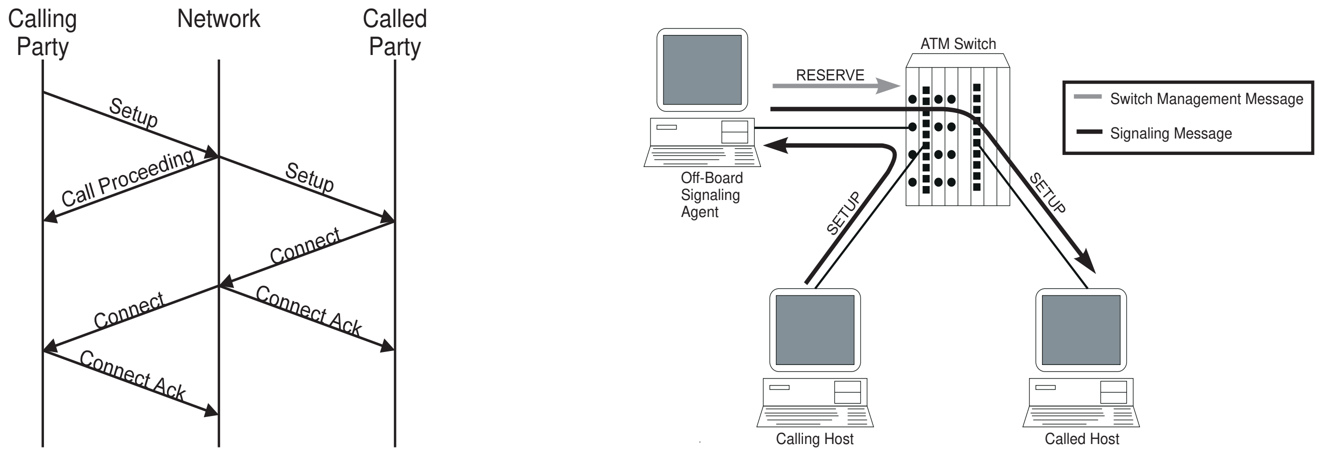

Figure 1: Signaling Message Flow for a Successful Call Setup and Off-board signaling outline

- Off-board Signaling
  - Separate processor to control signaling traffic to a switch
  - General Switch Management Protocol (GSMP)
- *Q.port Portable ATM Signaling Software* (Release 1.3) from Bellcore

Signaling Benchmark Framework

- Test-bed Environment
  - **ATM Switches** :
    - DEC AN/2 (development prototype of Giga switch)
    - GeoSwitch from UB Networks
    - FORE ASX-200BX : Software versions 4.0 and 4.1
    - FORE ASX-200WG : Software versions 4.0 and 4.1
    - Nortel Magellan Vector (Software version 4.0) : For WAN testing
    - Q.port off-board signaling agent (100 MHz Pentium system running Linux)
  - **ATM Adapter Cards** : FORE SBA-200e, Efficient Networks PCI, DEC Otto.
  - **Hosts** : DEC Alphas, SUN Sparc stations, Pentium PCs running Linux.
  - **WAN Environment** : Connections to ATM WANs like MAGIC Gigabit test bed and ACTS ATM Internetwork (AAI).
- The **Call Generator**
  - Q.port host-side signaling stack
  - Creates and releases SVCs according to behavioral profile.

Performance Tests, Parameters and Metrics

- Network Size Tests : LAN vs WAN Tests
  - Parameter : Number of switches in the network.
- Multiple Switches Tests : Measures PNNI performance.
  - Parameter : Number of Hops between Source and Destination.
- Multiple Hosts Tests : Evaluates switch performance under parallel load.
  - Parameter : Number of Source-Destination Pairs.
- Call Arrival and Duration Distributions
  - Call Sequence Test with Zero Duration Calls
    - Non-overlapping Setup Requests, Performance under Minimum Load
  - Call Sequence Test with Long Duration Calls
    - No Tear-down of Calls, Varying number of Active Calls
  - Call Rate Test with Long Duration Calls
    - Overlapping Setup Requests, Overload condition
  - Random Arrivals with Random Duration Calls
    - Realistic Call Arrival and Release Pattern

Performance Tests, Parameters and Metrics...(continued.)

- Benchmarking Tests Table

<table>
<tr><th>Network Size</th><th>Multiple Peer Groups</th><th>Number of Hops</th><th>Src-Dest. Pairs</th><th>Call Arrival and Duration Distributions</th></tr>
<tr><td rowspan="4">LAN</td><td rowspan="4">No</td><td rowspan="4">1</td><td>1</td><td rowspan="2">Call Sequence Test with Zero Duration Calls</td></tr>
<tr><td>2</td></tr>
<tr><td>4</td><td rowspan="2">Call Sequence Test with Long Duration Calls</td></tr>
<tr><td>8</td></tr>
<tr><td rowspan="4">WAN</td><td rowspan="2">No</td><td>2</td><td rowspan="4">1</td><td rowspan="2">Call Rate Test with Long Duration Calls</td></tr>
<tr><td rowspan="2">4</td></tr>
<tr><td rowspan="2">Yes</td><td rowspan="2">Random Arrivals with Random Duration Calls</td></tr>
<tr><td>8</td></tr>
</table>

- Number of Tests for each Signaling Architecture = 80 vs. 256
- <u>**Performance Metrics**</u>
  - Mean SVC Setup Time
  - Minimum, Maximum and Standard Deviation for SVC Setup Time
  - SVC Failure Percentage

Performance Results

- LAN setup times for Call Sequence Tests with Long Duration Calls
  - For Different Signaling Architectures

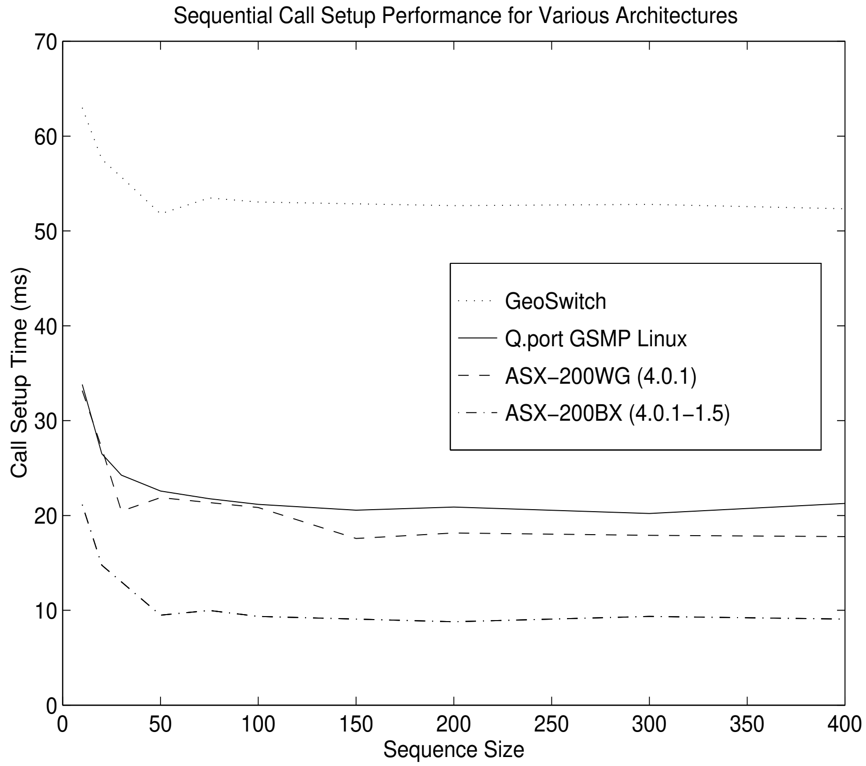

Figure 2: LAN Setup times for different switches

Performance Results (continued...)

- LAN, Call Sequence Long Duration Tests
  - For FORE Switches with software versions 4.0 and 4.1

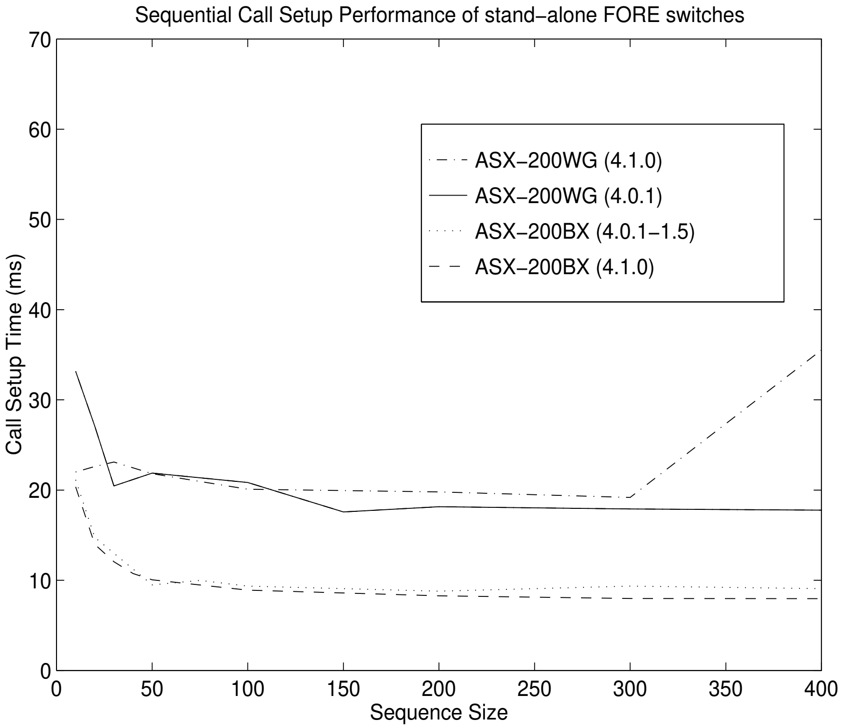

Figure 3: LAN Setup times for FORE switches

Performance Results (continued...)

- WAN, Call Sequence Long Duration Calls Test
  - WAN setup times for FORE switches under different software versions
  - Each switch connected to AAI (a WAN with approx. 150 switches)

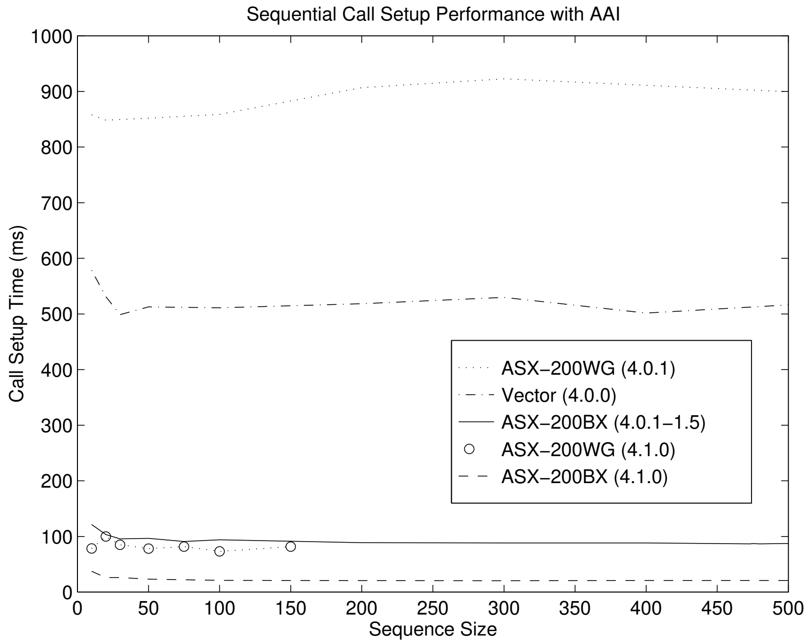

Figure 4: FORE WAN Setup times

Performance Results (continued...)

- Call Rate Long Duration Tests : For 200 calls at varying arrival rates.
  - LAN : 50 calls/second supported by both WG and BX in LAN mode
  - WAN setup times shown in Figure 5

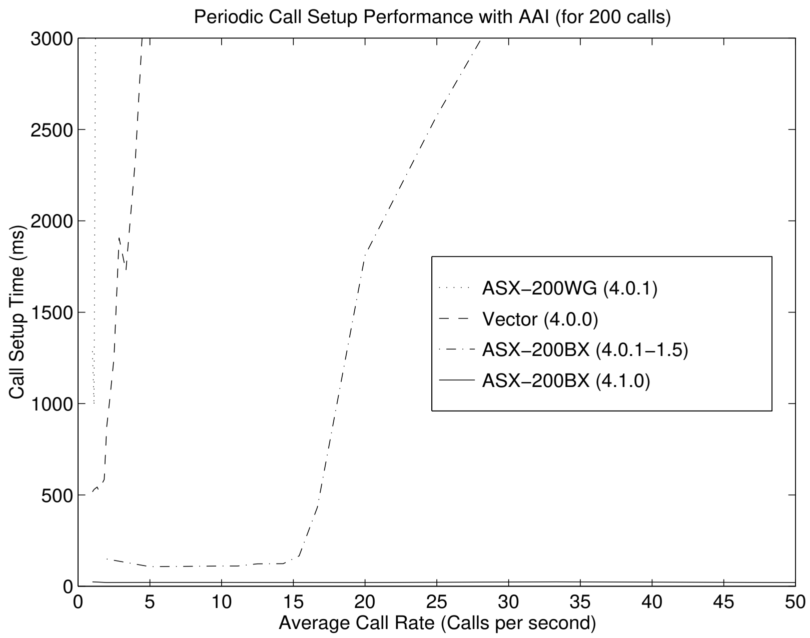

Figure 5: WAN periodic setup times

Performance Results (continued...)

- WAN Failure Percentage
- Call Rate Long Duration Test for FORE switches : 200 calls at varying arrival rates

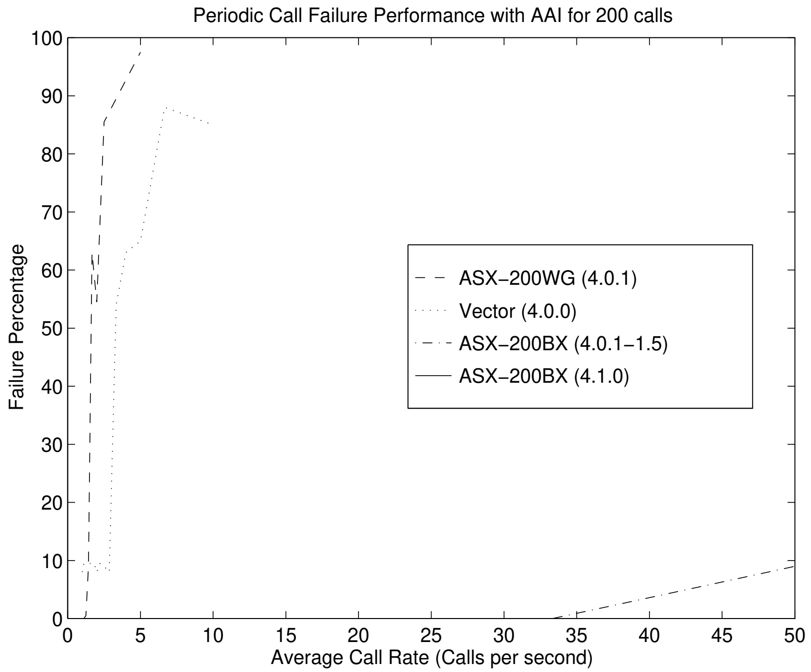

Figure 6: WAN periodic failure rate

Performance Results (continued...)

- Multiple Hosts Tests

Architecture	Individual Pairs (Separate)		Multiple Pairs (Simultaneous)	
	Pair 1	Pair 2	Pair 1	Pair 2
Q.port GSMP Linux	21 ms	26 ms	30 ms	59 ms
ASX-200BX (4.1)	8 ms	8 ms	10 ms	10 ms
GeoSwitch	52 ms	54 ms	98 ms	106 ms

Table 2 : Call Setup Times for Multiple Hosts Tests

- Multiple Switches Tests
  - Results to be obtained for different combinations of FORE switches

Conclusions and Future Work

- Framework for a comprehensive benchmark suite for ATM signaling
- Results reveal significant behavioral differences among various switches and softwares
- Off-board signaling at least a plausible alternative to on-board signaling
- Future Work
  - Extending the benchmarking suite to different configurations
  - Integration with **Netspec**
  - Implementing more Arrival and Duration distributions
  - More Multiple Hosts and Multiple Switches tests
  - Obtaining Decision Trees for Benchmarking Tests
  - Querying the network state to obtain information like buffer size, allocation policies, switch concurrency handling techniques, etc.
  - Signaling performance of UNI 4.0 involving study of QoS and traffic parameters