



Motivation, Deployment, and Experiments

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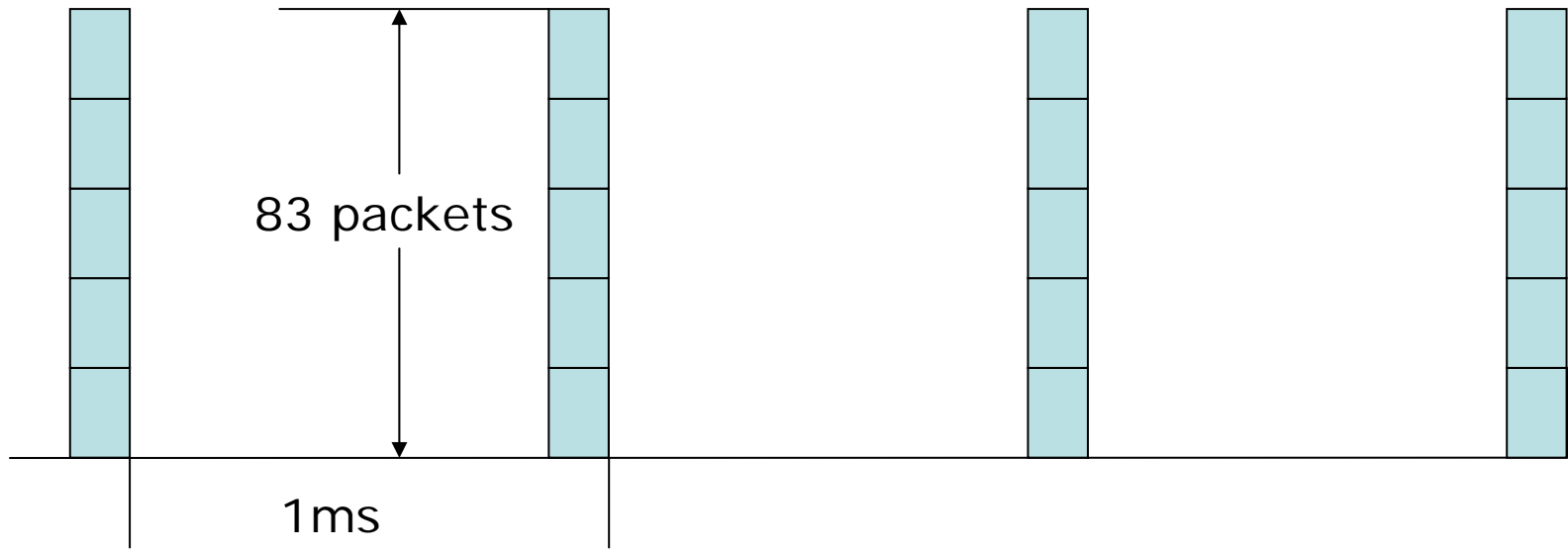
Game Plan

- Motivation
- Design considerations
- Infrastructure
- Example topologies
- Benchmark suite
- Conclusion

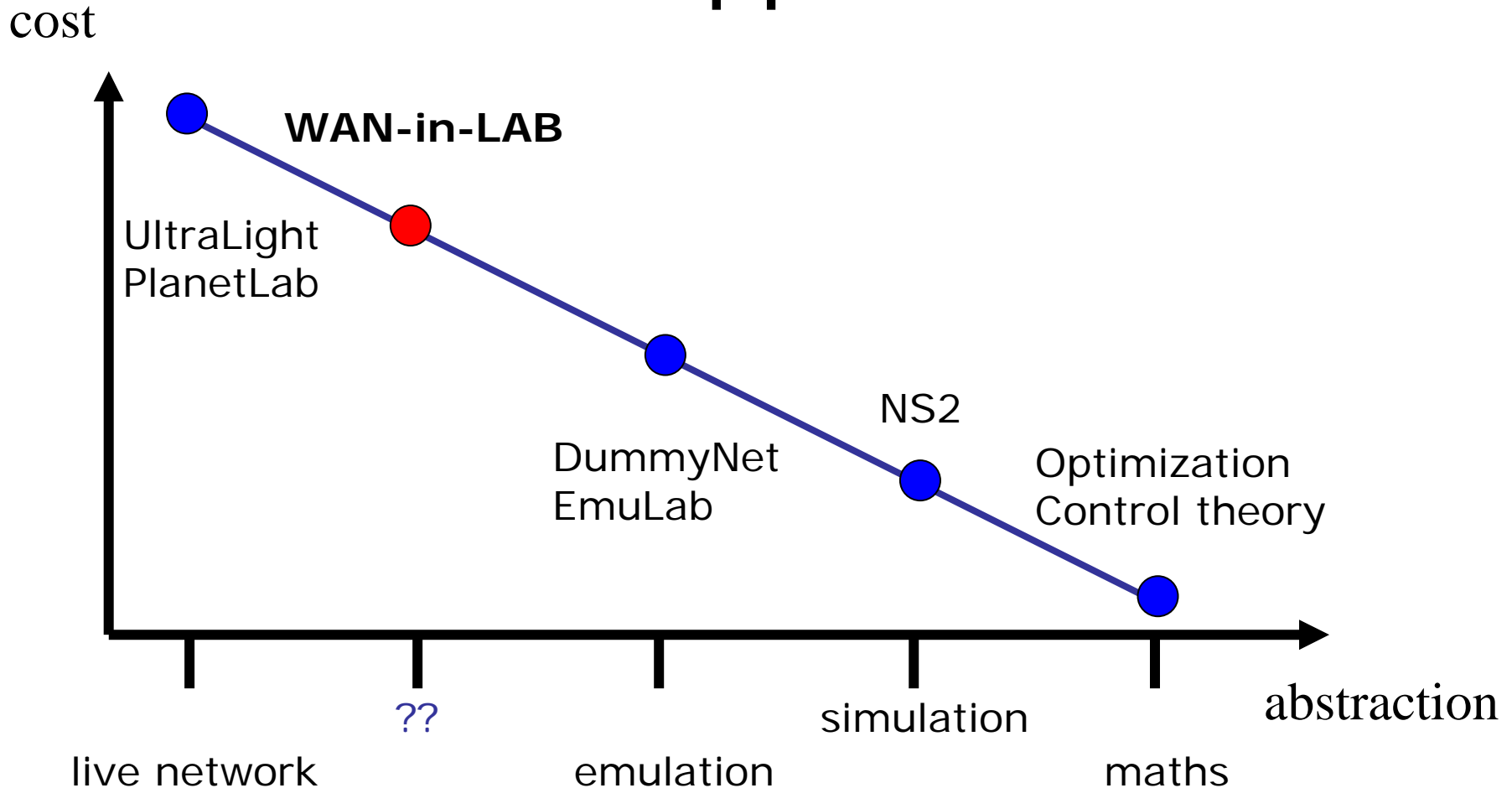


Artifacts of software delays

- Packets sent on 1ms “ticks”
- 1Gbps = 83,333 pk/s



Cost vs. Approximation



All scales are important– WAN-in-Lab fills a gap



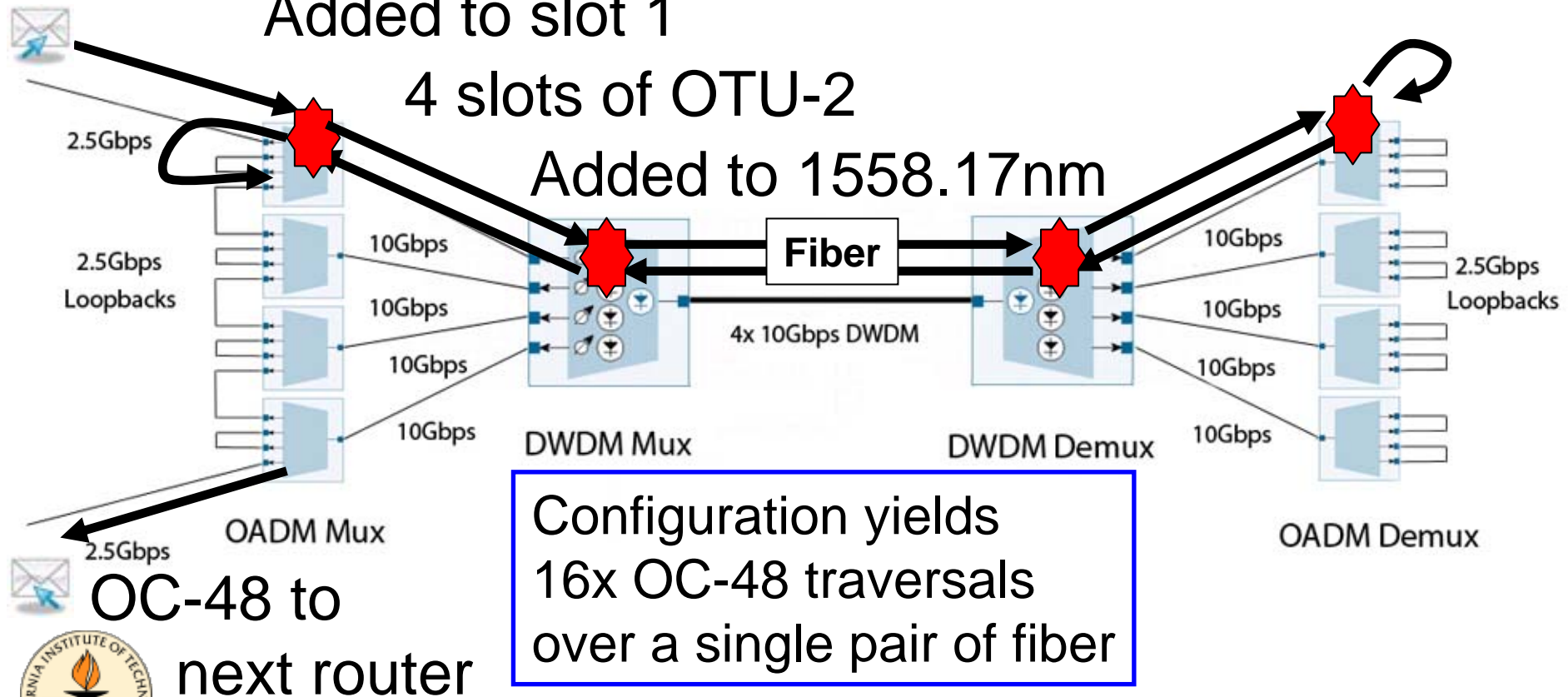
Maximize OC-48 capacity using DWDM

OC-48 from router

Added to slot 1

4 slots of OTU-2

Added to 1558.17nm

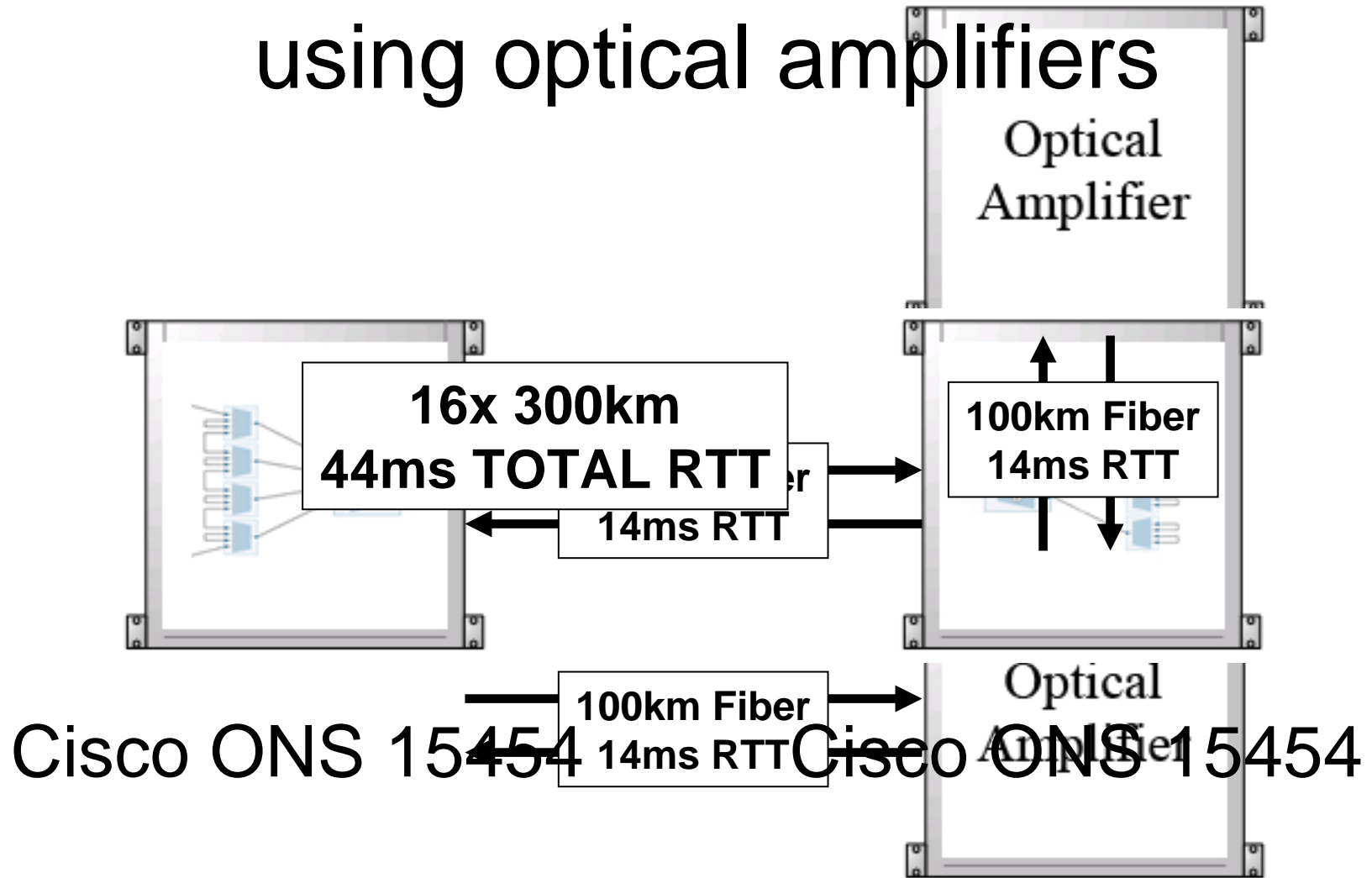


OC-48 to next router

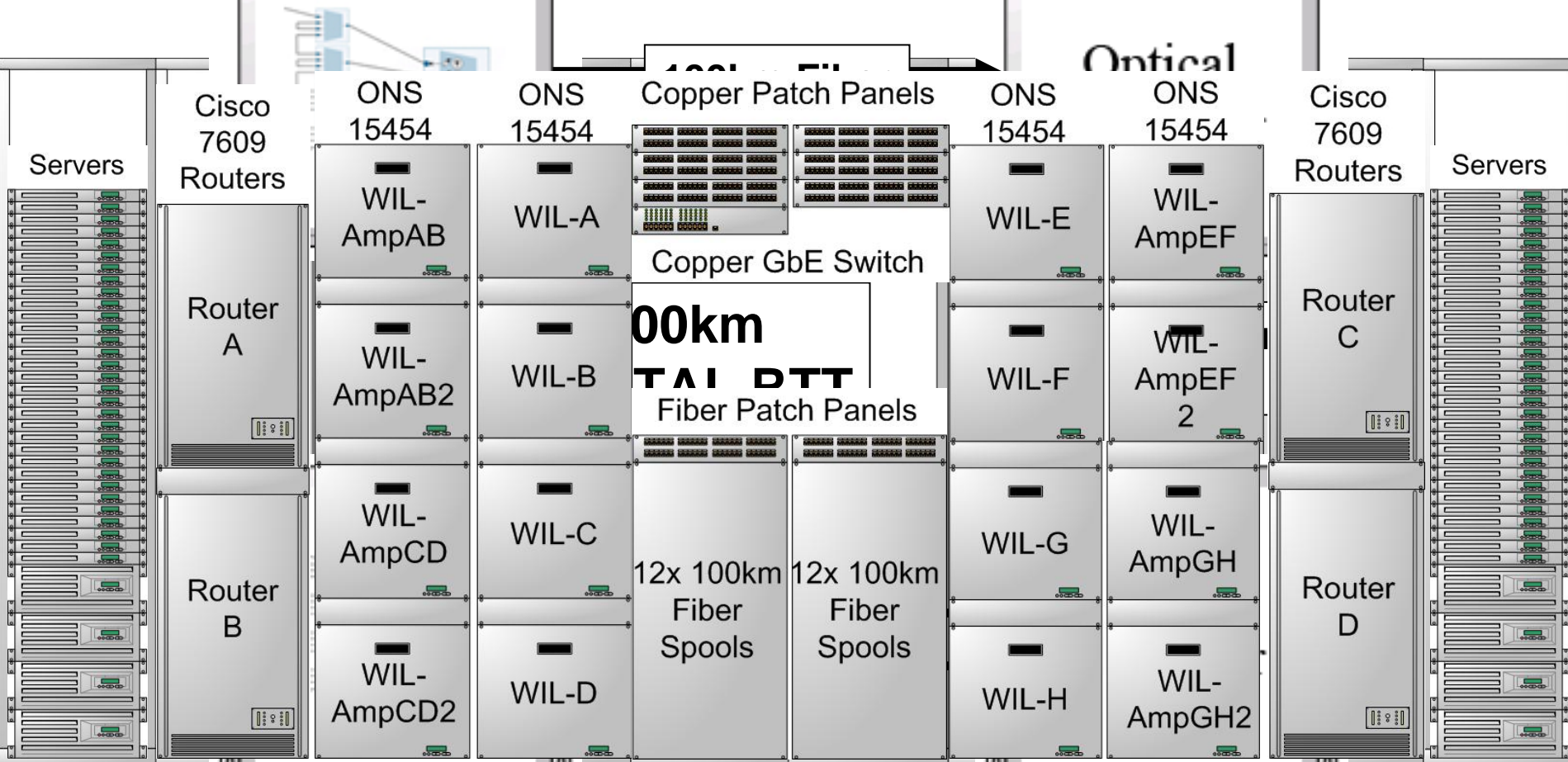
Configuration yields
16x OC-48 traversals
over a single pair of fiber



Maximize RTT using optical amplifiers



WAN-in-LAB Infrastructure



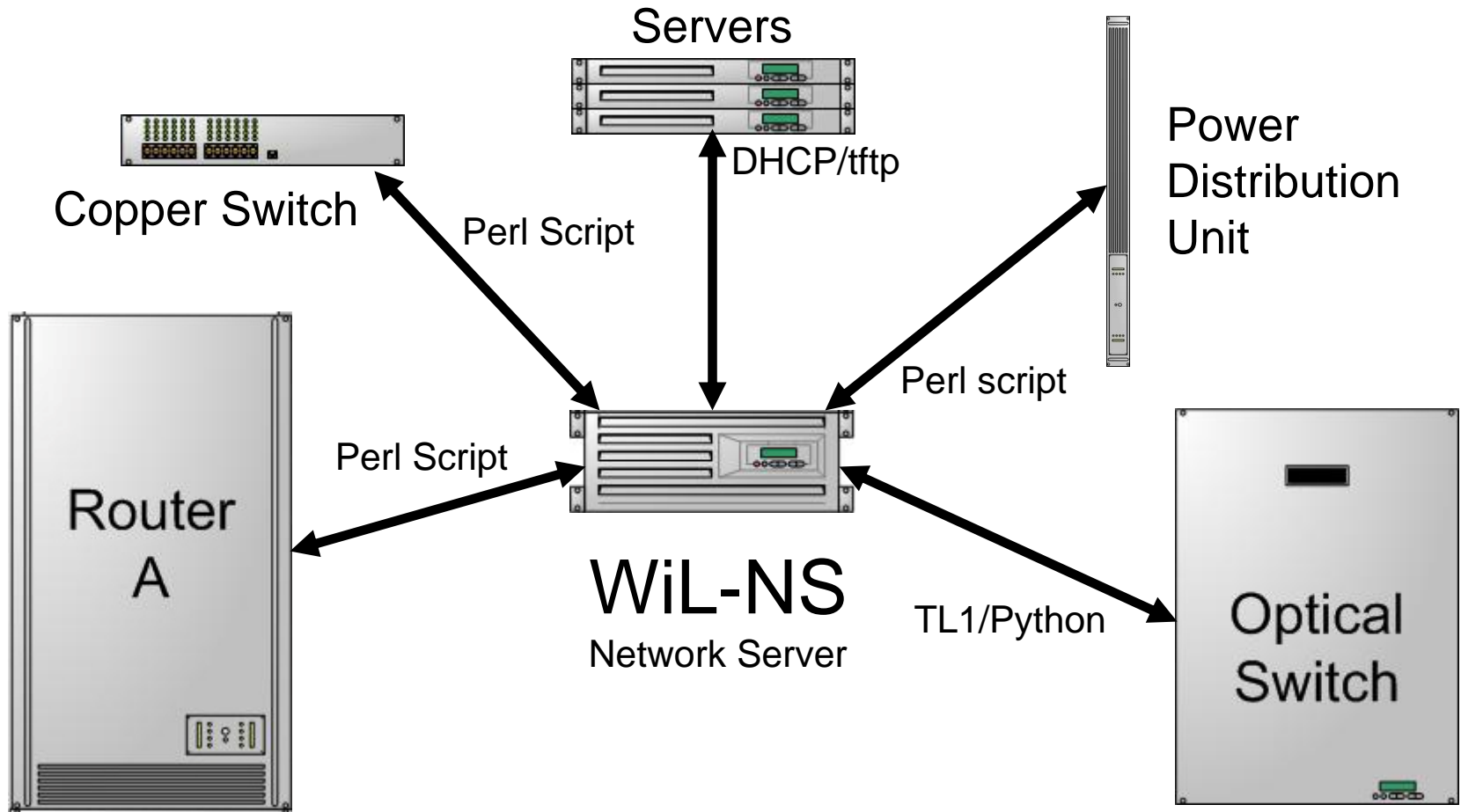
Total Capacity: 132ms OC-48, 9ms 10GbE

PFLDnet 2007: WAN-in-LAB

February 8, 2007



Management Network



Optical Switch Control Panel

DiamondWave Connection Center _ □ ×

Center View Help

Connection Center Thu Feb 08 00:25:23 PST 2007

TAP

12 24 36 48 60 72 84 96

R11FOT1SC

RA1 RA9 RB1 RB2 RB9 RC1 RC9 RD1 RC71 RD71 26I32 38I44 RC74 RD74 UL1 UL2

R4FOT1LC

01 04 07 10 13 16 19 22 02 05 08 11 14 17 20 23 03 06 09 12 15 18 21 24

R7FOT1LC 600KMAW

01 04 07 10 13 16 19 22 02 05 08 11 14 17 20 23 03 06 09 12 15 18 21 24

Connection Details

Owner: admin

Light Band: WBAND

Direction: BI

Created: Tue Dec 09 12:26:46 PST 1989

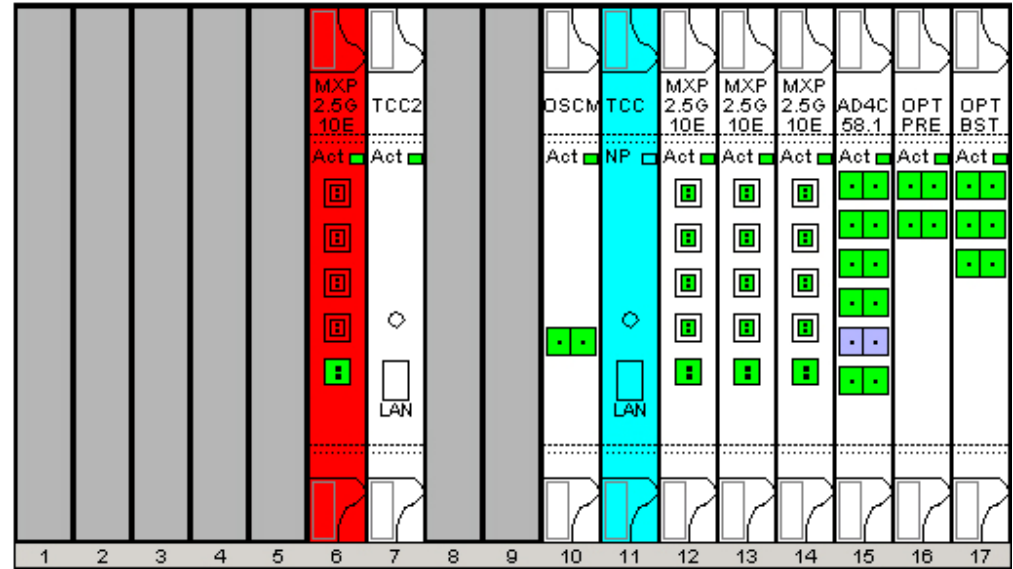
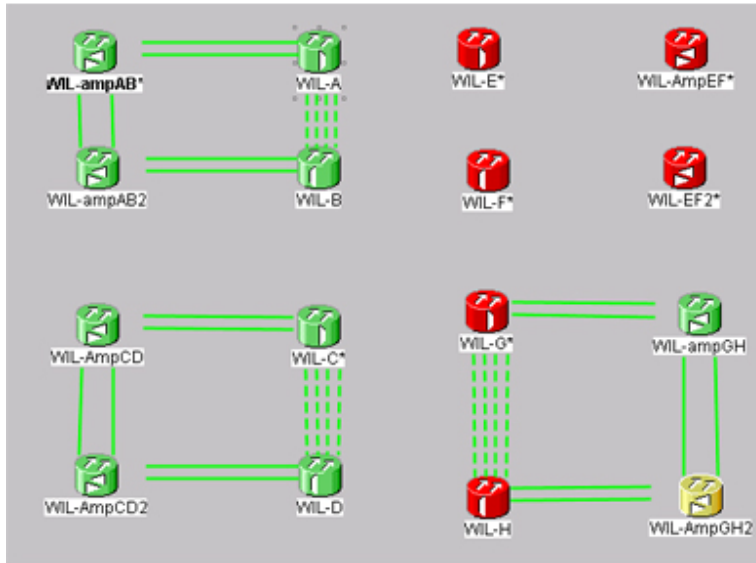
Optical Power Level Details

| Connection | Input Power | Output Power | Loss | Status | Disconnect |
|------------|-------------|--------------|---------|--------|-------------|
| RD74>UL2 | -40 dBm | -40 dBm | 0 dB | OOS | Prot Switch |
| UL2>RD74 | 2.09 dBm | 0.42 dBm | 1.67 dB | IS | Tap |

Connection summary updated Thu Feb 08 00:24:16 PST 2007 ADMIN



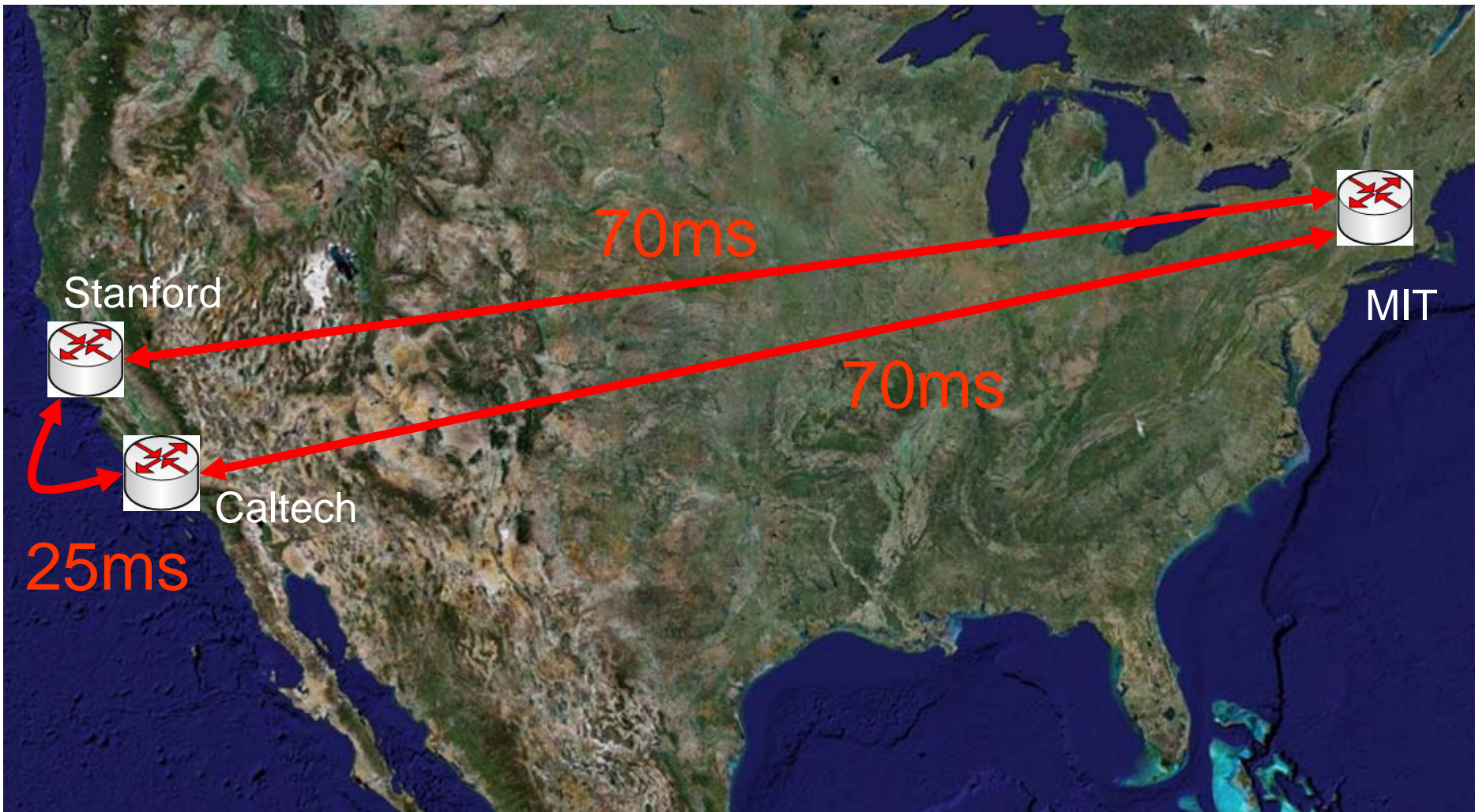
ONS Control Panel



| Alarms | | | | | | | | | | | | | Conditions | History | Circuits | Provisioning | Inventory | Maintenance |
|--------|------|-----|-----------------------|-----------|------------|------|------|-------|-----|----|----|------------|------------------|---------|----------|--------------|-----------|-------------|
| Num | Ref | New | Date | Object | Eqpt Type | Slot | Port | Pa... | Sev | ST | SA | Cond | | | | | | |
| 15 | 15 | | 01/18/07 10:04:56 PST | SLOT-11 | TCC | 11 | | | MN | R | | IMPROPRMVL | Improper Removal | | | | | |
| 2689 | 2689 | | 01/25/07 13:18:39 PST | FAC-6-4-1 | MXP_2.5... | 6 | 4-1 | | CR | R | ✓ | LOS | Loss Of Signal | | | | | |
| 3303 | 3303 | | 01/27/07 06:33:22 PST | FAC-6-2-1 | MXP_2.5... | 6 | 2-1 | | CR | R | ✓ | LOS | Loss Of Signal | | | | | |
| 3304 | 3304 | | 01/27/07 06:33:22 PST | FAC-6-3-1 | MXP_2.5... | 6 | 3-1 | | CR | R | ✓ | LOS | Loss Of Signal | | | | | |
| 3313 | 3313 | | 01/27/07 06:33:22 PST | FAC-6-1-1 | MXP_2.5... | 6 | 1-1 | | CR | R | ✓ | LOS | Loss Of Signal | | | | | |



Automatic Re-configurability



Automatic Re-configurability

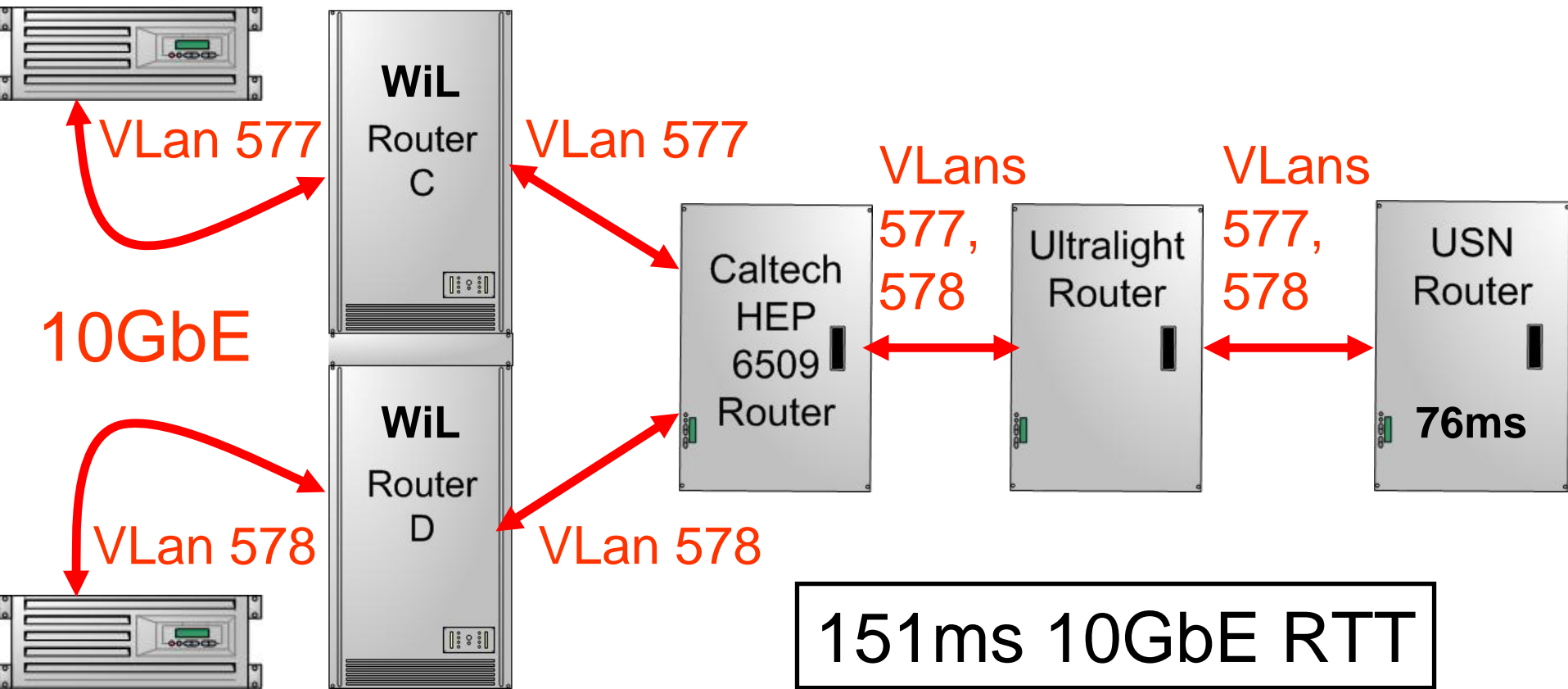


Automatic Re-configurability



WiL 10GbE L2 Vlan Network

WiL Servers



Benchmarking Suite

```
<flow start="${GAP}" algorithm="${ALG2}" lasts="${LEN}"
  <name="2:RTT-${RTT2}" class="HS">
  <sender machine="serverB1" />
  <receiver machine="serverD1" />
  <average start="#{($LEN-3*${GAP})/2}" end="${LEN}" />
</flow>

<graph title="Rate" ylabel="Rate (MBit/s)">
  <ycoord flows="1:RTT-${RTT}" source="web100" dir="recv"
    process="smooth{8*[-DataBytesIn]/[-Duration]}" />
  <ycoord flows="2:RTT-${RTT2}" source="web100" dir="recv"
    process="smooth{8*[-DataBytesIn]/[-Duration]}" />
  <ycoord flows="cls:HS" source="web100" dir="recv"
    process="smooth{8*sum([-DataBytesIn]/[-Duration])}" />
</graph>
```





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Welcome to the WAN-in-Lab Benchmarking page

From here, you can schedule benchmarking experiments or upload experimental kernels.

Kernel:

Protocol:

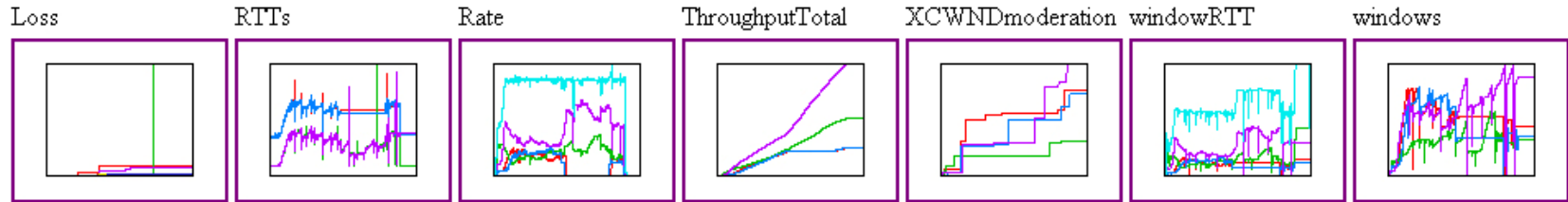
- Brief
- Cross-BIC
- Inter-prot HSTCP
- Staggered Vegas
- Hybla

- RTT fairness
- Vary RTT
- Vary bandwidth
- Vary cross-traffic
- Vary hop-count
- Arrival/departure test

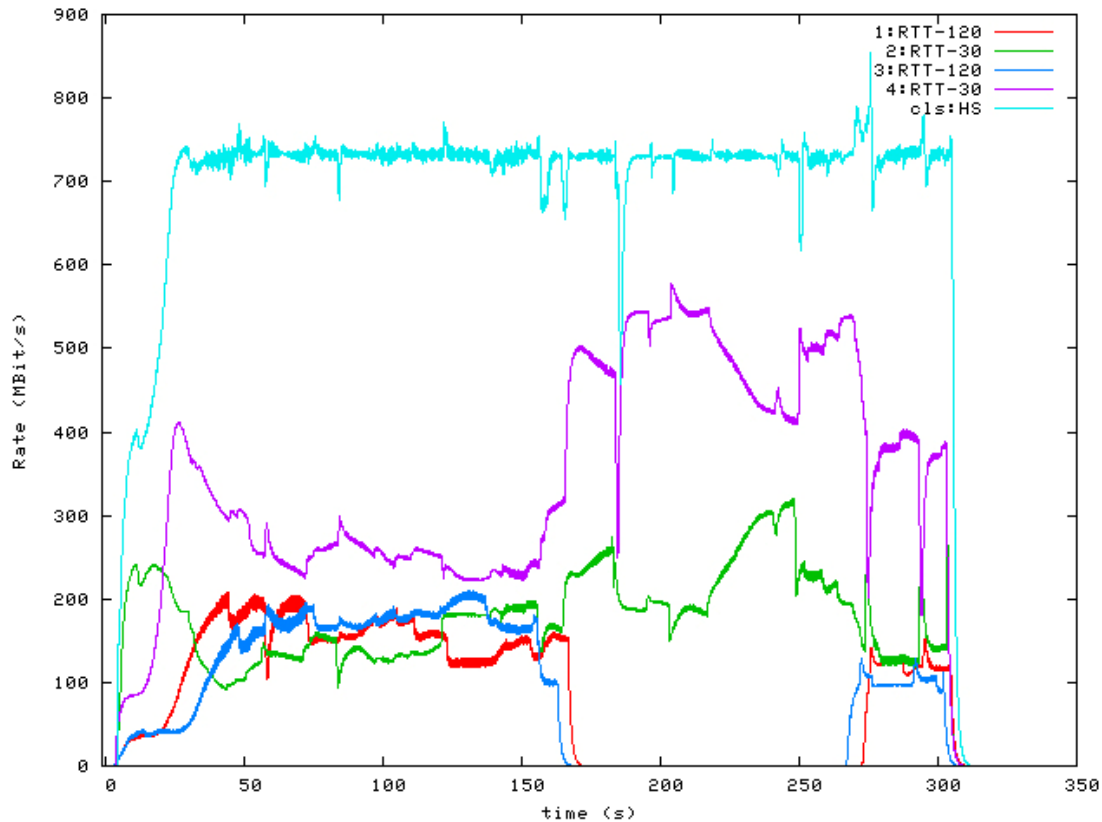
Real-time updates

Benchmarks of RTTfair--ALG=cubic-BUF=8192-BW=800M-CRS=10.0-RTT=120-RTT2=30--1

Recorded Tue Feb 6 16:01:30 2007



Rate



Conclusion

- Common Fast Long-Distance Network for testing TCP protocols
- Open to the research community and FREE!
- Complimentary to other testbeds
- WiL Tour:
Friday 9 February 2007 (14:00-16:00)
- Questions and comments?

