

WAN in Lab

CISE RI Program: 2003-05

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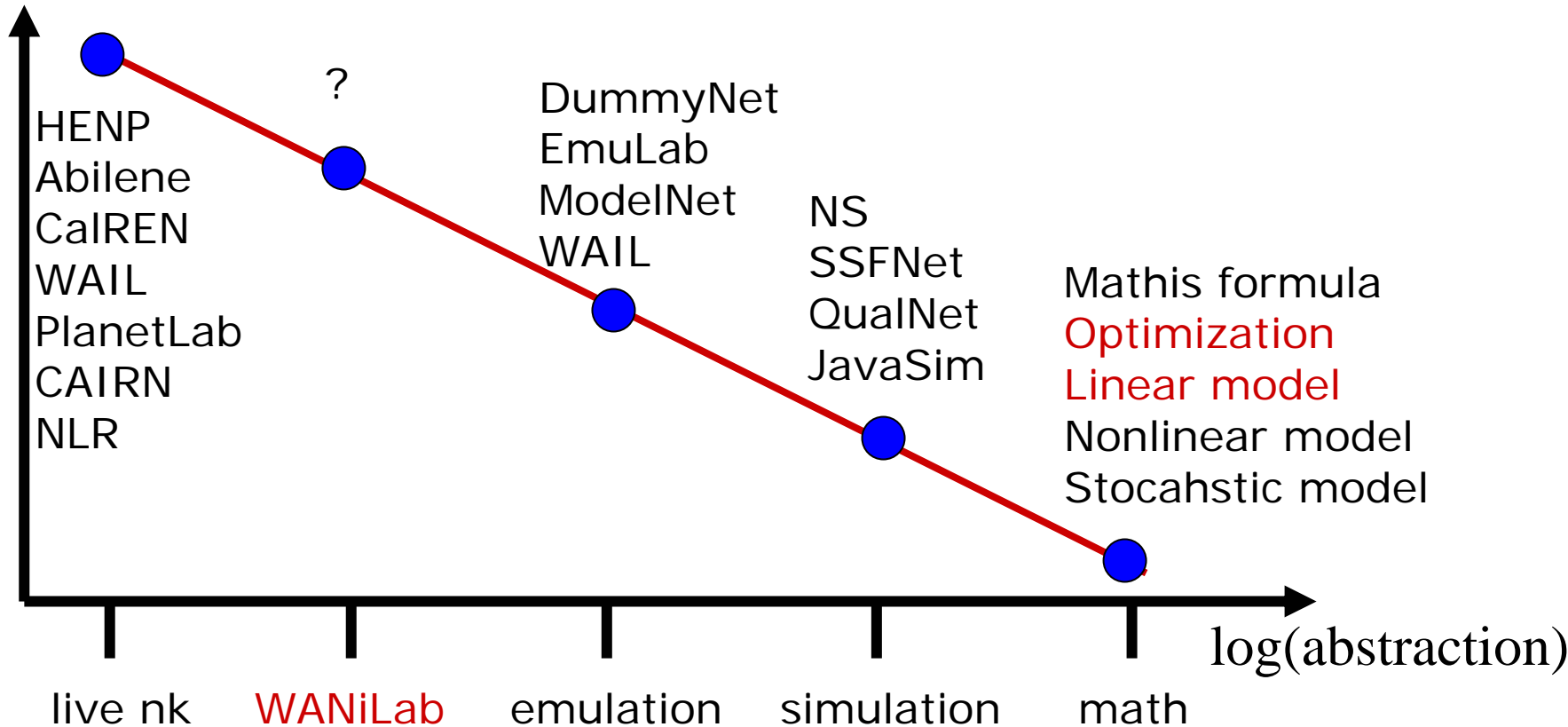
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Spectrum of tools

log(cost)

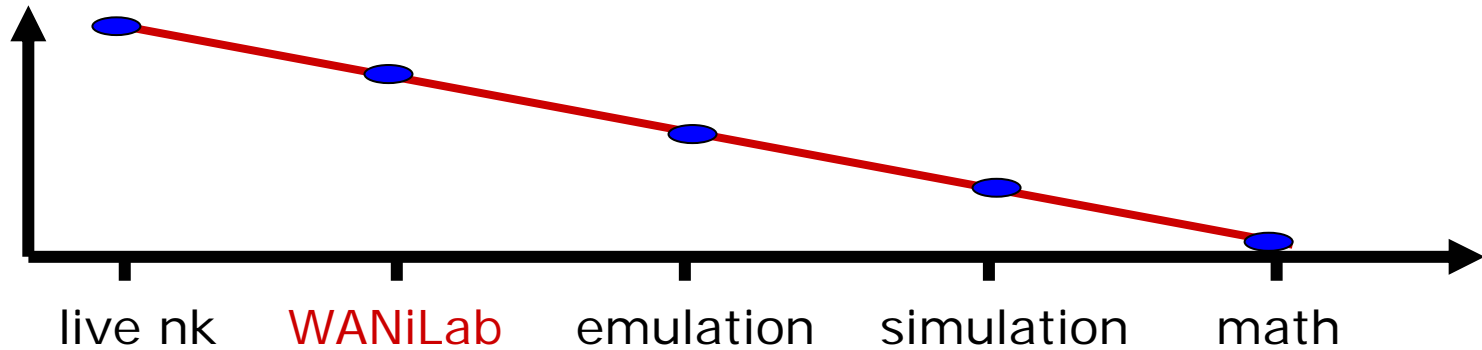


...we use them all

Network debugging

- Performance problems in real network
 - Simulation will miss
 - Emulation might miss
 - Live network hard to debug
- WAN in Lab
 - Passive monitoring inside network
 - Active debugging possible

Spectrum of tools



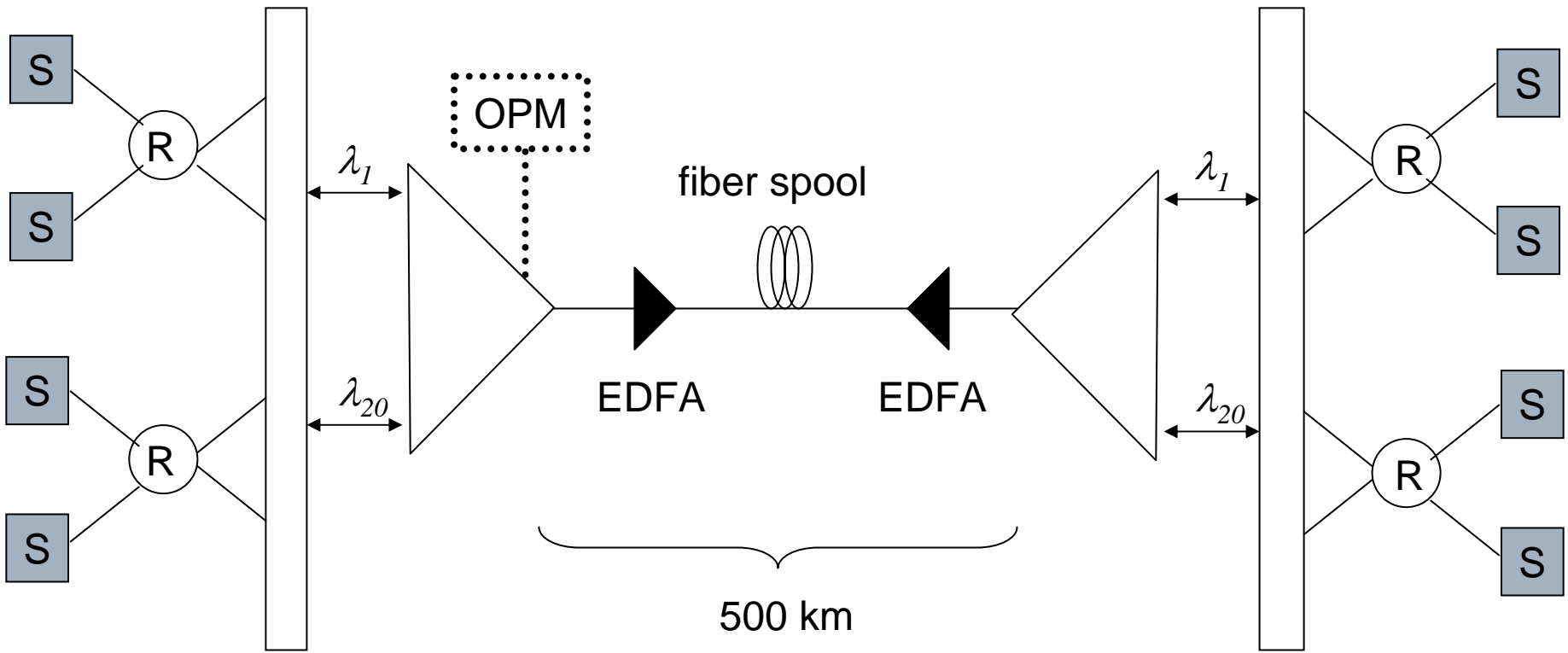
Distance	High	High	High
Speed	High	High	Low
Realism	High	High	Low
Traffic	High	Low	Low
Configurable	Low	Medium	High
Monitoring	Low	Medium	High
Cost	High	Medium	Low

Critical in development e.g. Web100

Goal

State-of-the-art WAN

- High speed
 - 2.5G → 10G
- Large distance
 - 50 – 200ms
- Controlled & repeatable experiments
- Reconfigurable & evolvable



H : server

R : router

Max path length = 10,000 km
 Max one-way delay = 50ms

electronic
crossconnect



Example equipment

- 26 Servers
 - GbE cards (→ 10GbE cards)
- 12 routers
 - 10 Cisco 15454 with router blades
 - 2-port GbE, 8-channel OC48
 - 2 Force10 E600
 - 24-port GbE, 2-port OC48
- DWDM gears
 - 500km fiber
 - 6 EDFA
 - 2 Dispersion compensation modules
 - 2 optical mux/demux
- Tektronix TDS7404 Oscilloscope
- Integration with global network

Unique capabilities

□ WAN in Lab

- Capacity: 2.5 – 10 Gbps
- Delay: 0 – 100 ms round trip

□ Configurable & evolvable

- Topology, rate, delays, routing
- Always at cutting edge

□ Flexible

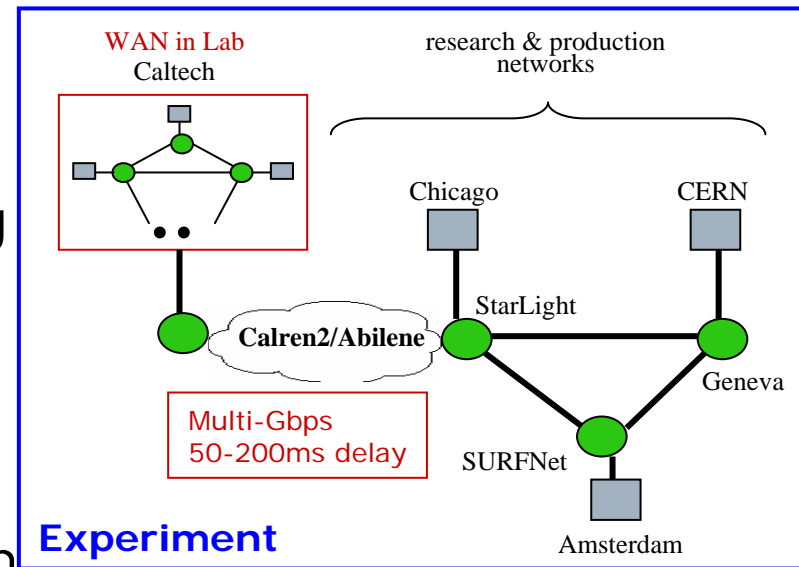
- Passive monitoring, AQM

□ Integral part of R&A networks

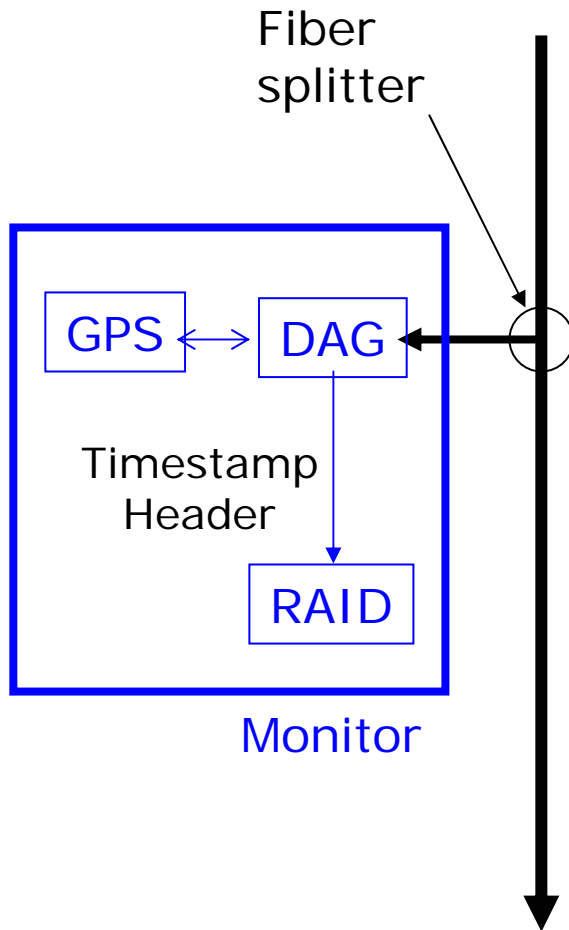
- Transition from theory, implementation, demonstration, deployment
- Transition from lab to marketplace

□ Global resource

- Federated Netlab (Emulab)

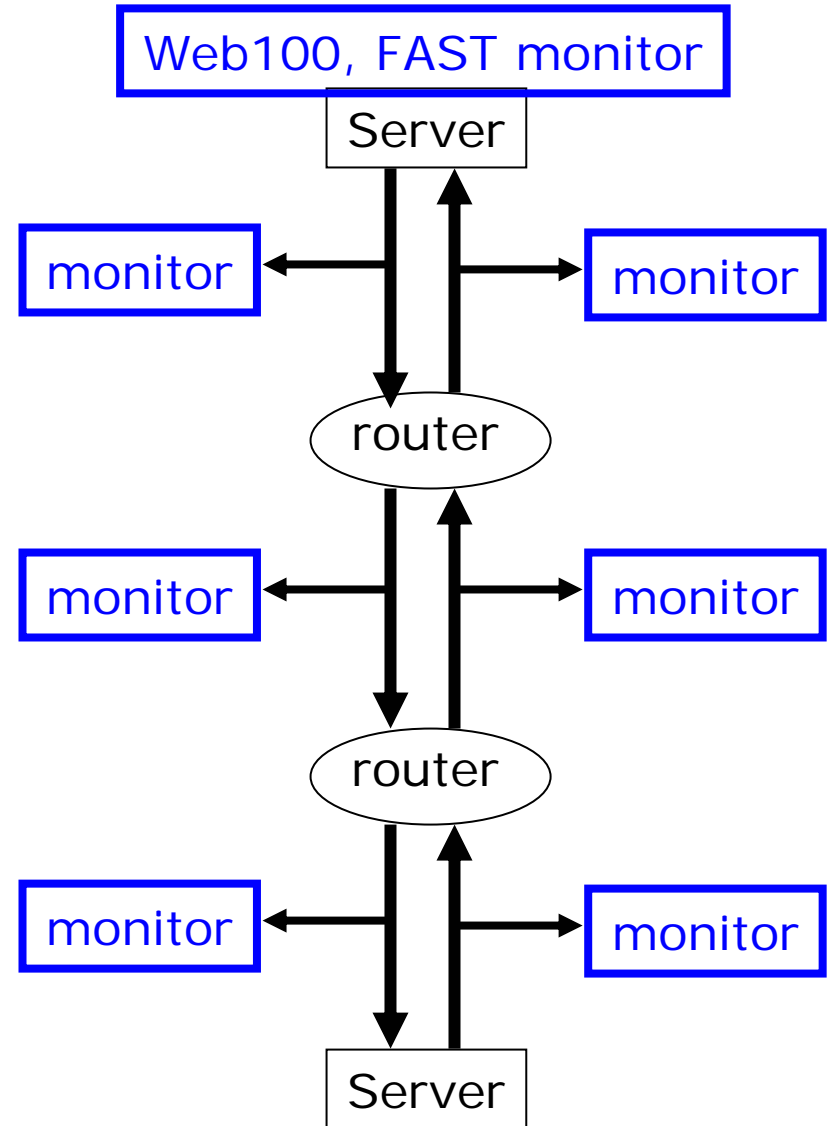
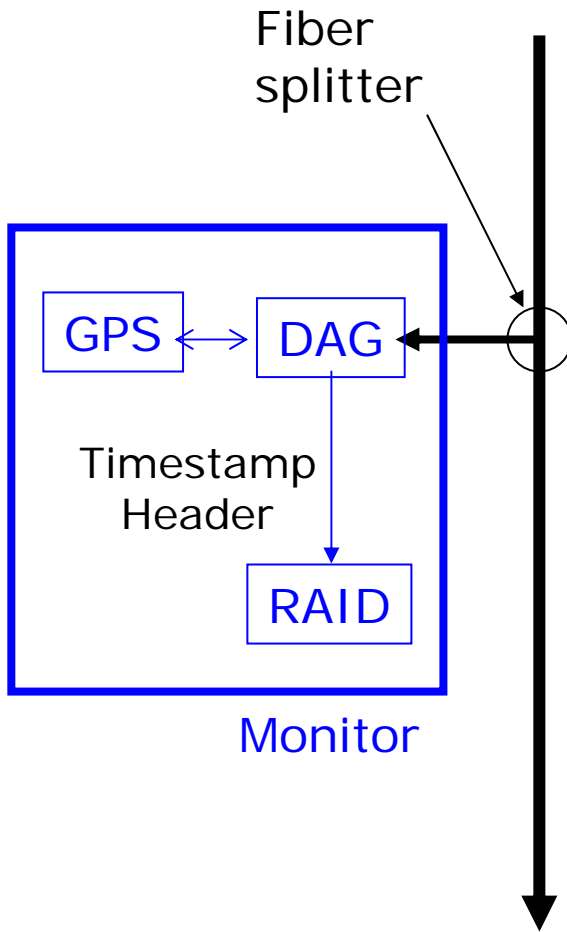


Passive monitoring



- ❑ No overhead on system
- ❑ Can capture full info at OC48
 - UofWaikato's DAG card captures at OC48 speed
 - Can filter if necessary
 - Disk speed = $2.5\text{Gbps} * 40/1500 = 66\text{Mbps}$
- ❑ Monitors synchronized by GPS or cheaper alternatives
- ❑ Data stored for offline analysis

Passive monitoring



David Wei (Caltech)