iWARP: Its Not Just For The LAN Anymore

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Commodity Cluster Symposium
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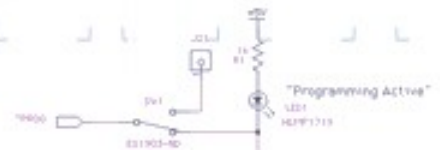
Agenda

- Introduction to iWARP
- iWARP Hardware History
- Current iWARP Research
- iWARP Road Map



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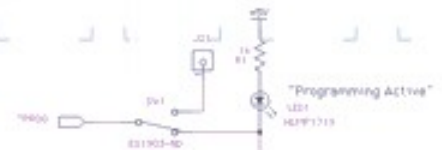
What is the problem with TCP/IP anyway?

- Network processing = lots of CPU
  - Costly at **1Gbps,** imagine **10Gbps**
- Why?
  - Complex protocol stack processed by CPU
  - Movement of data from memory to NIC by CPU



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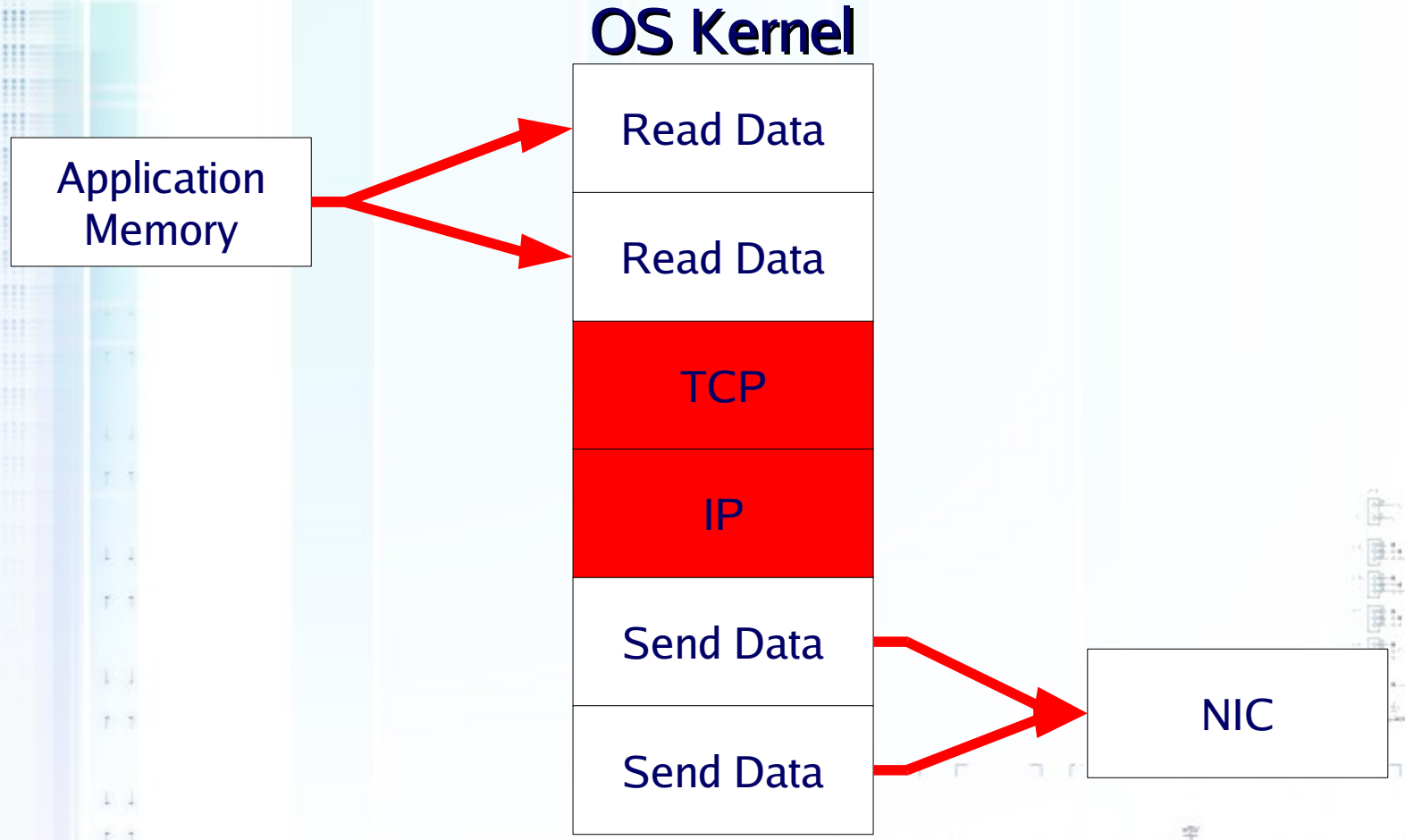
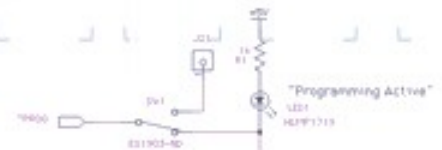
Why TCP/IP is so costly



Possible solutions

- TCP Offload Engine (TOE)
  - Offloads processing of TCP/IP stack
  - Good but not enough
- Remote Direct Memory Access (RDMA)
  - Offloads processing of TCP/IP stack
  - Also has Zero-Copy



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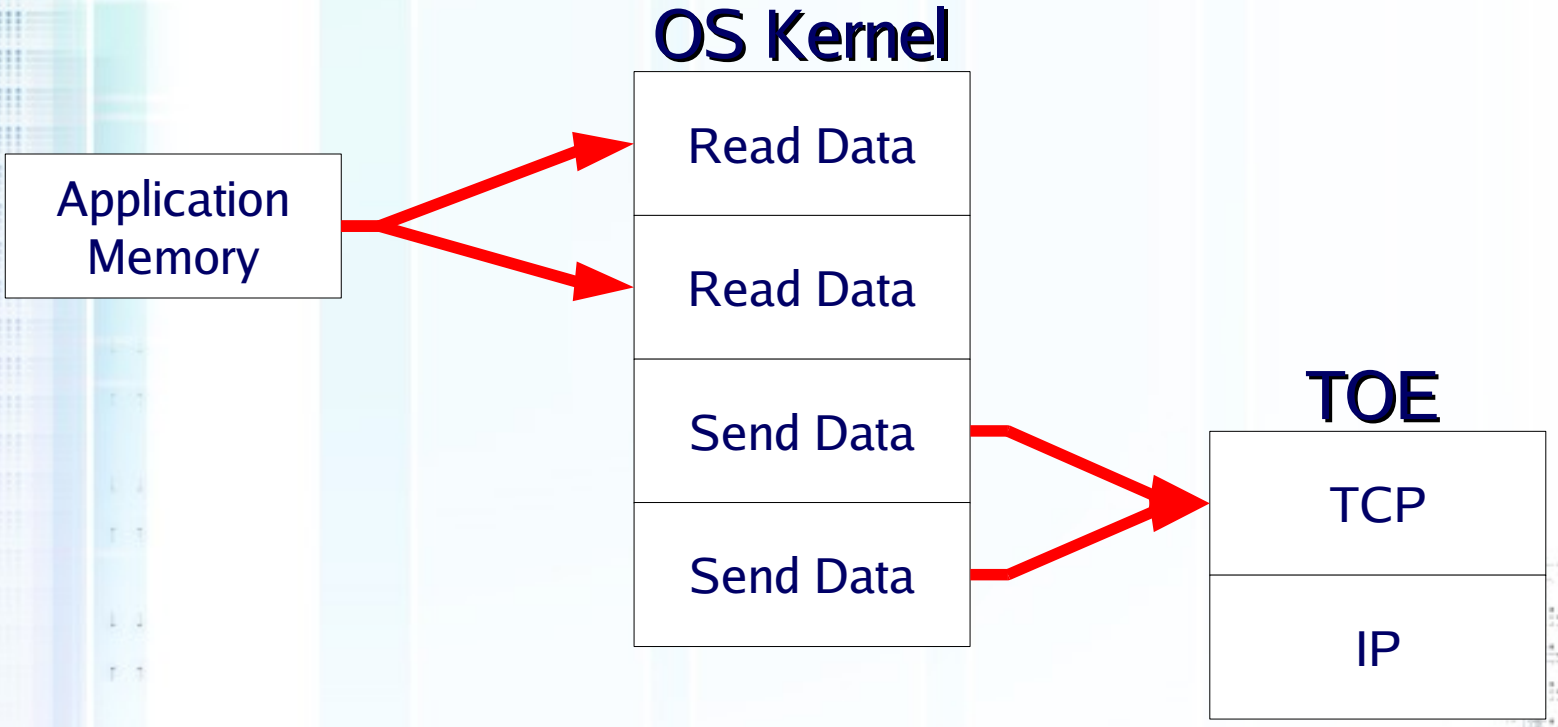
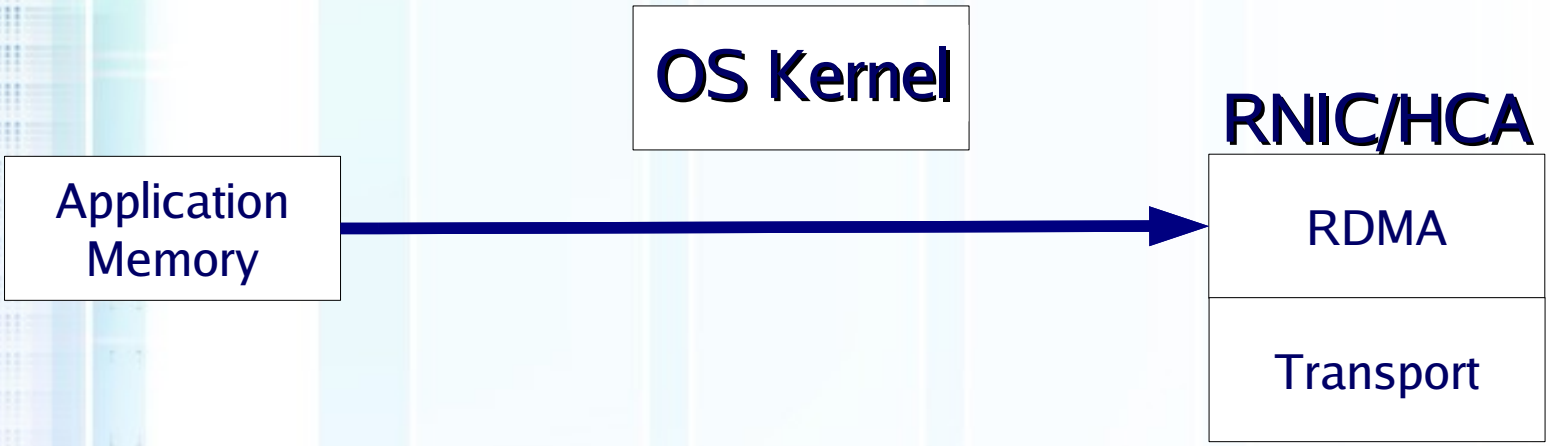
TOE Card



Protocol work offloaded, but CPU still moves the data through OS

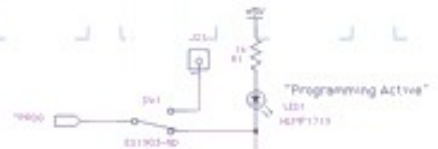
RDMA



Protocol offloaded, and CPU does not move data.

Examples of RDMA

- **InfiniBand, Myrinet, Quadrics**
- Require special infrastructure
  - Do not work in the WAN
- Great performance
  - Latency can't be beat
- Tried and true
  - IB very common



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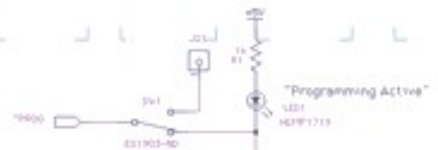
iWARP - The new kid on the block

- iWARP = RDMA over Ethernet (TCP/IP)
  - Runs over existing network infrastructure
    - WAN Capable!
- IETF RFC specifications
  - RDMAP, DDP, MPA
- Downside
  - Switch cost for 10 Gigabit
  - New technology



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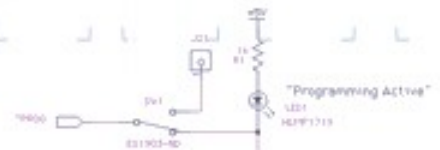
Hardware History

- Ammasso Inc
  - First commercially available
  - Only 1 Gigabit
  - Blazed the trail
  - Allowed researchers to experiment with iWARP
  - Ceased operations late 2005
- Allowed researchers to continue iWARP work
  - Everything learned is still applicable
- Ammasso presence still felt
  - OpenIB - now OpenFabrics driver



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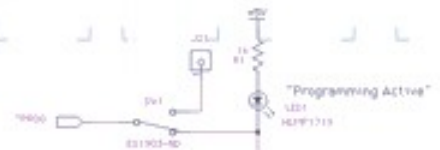
New players on the scene

- NetEffect
  - 10 Gigabit iWARP adapter
  - **Outperforms IB in terms of throughput**
  - Boards are selling now
  - OSC leading the way
    - Paper to appear at RAIT'06 (IEEE Cluster 2006)
      - September 28 in Barcelona, Spain
- Chelsio
  - Has an adapter as well
    - Driver in OpenFabrics source tree
- Broadcom
  - ??????



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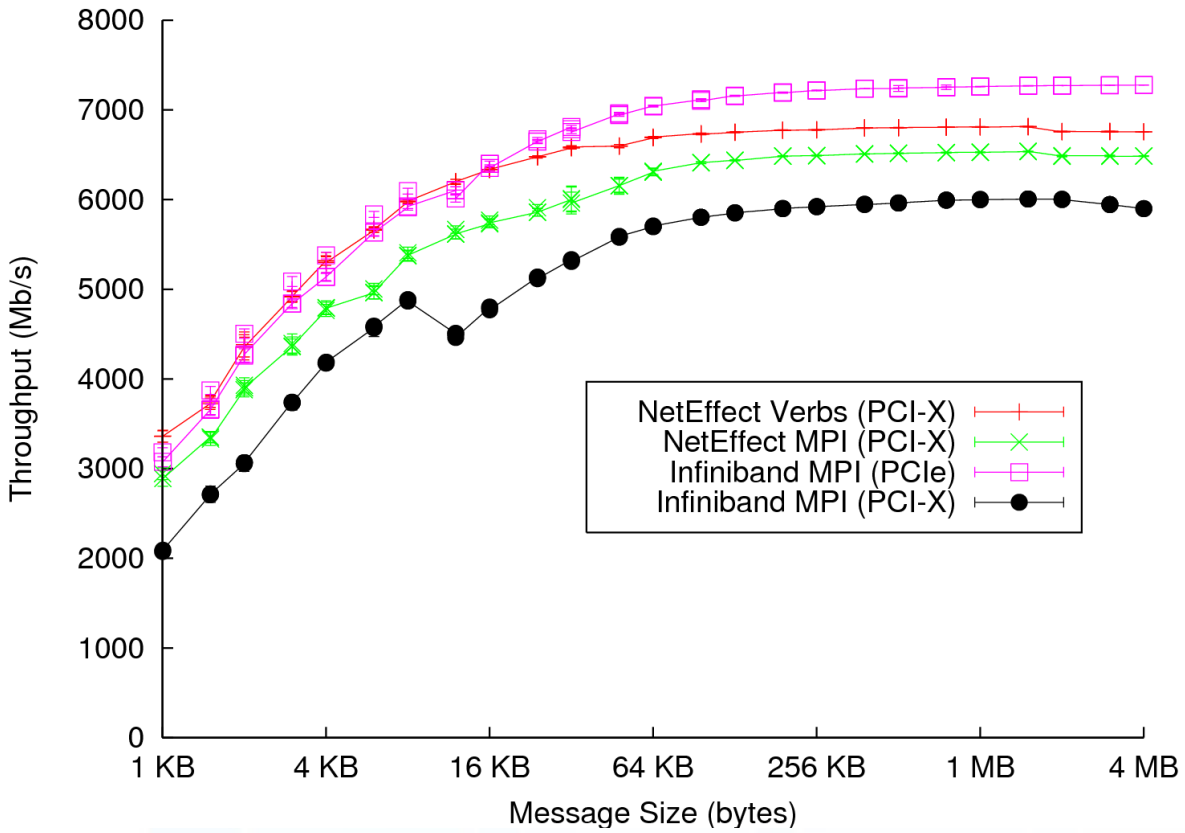
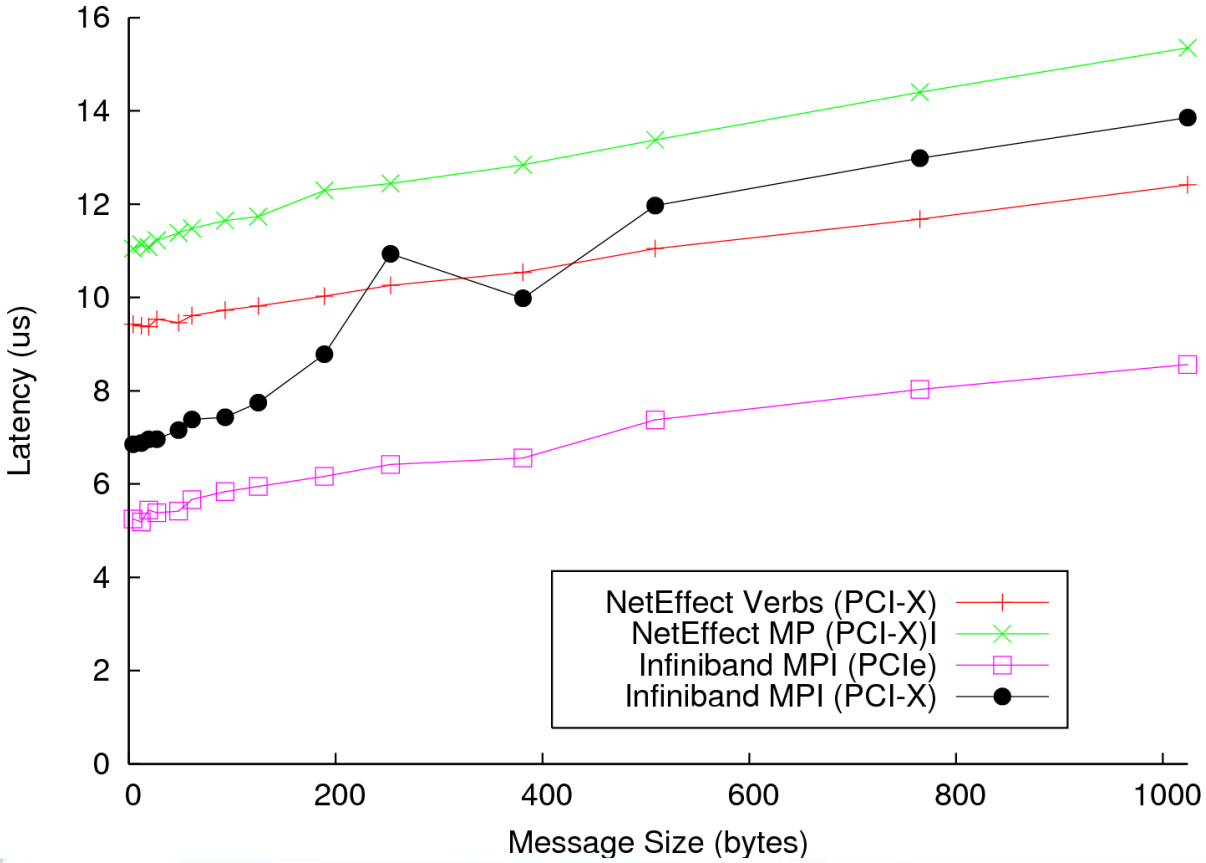
NetEffect performance



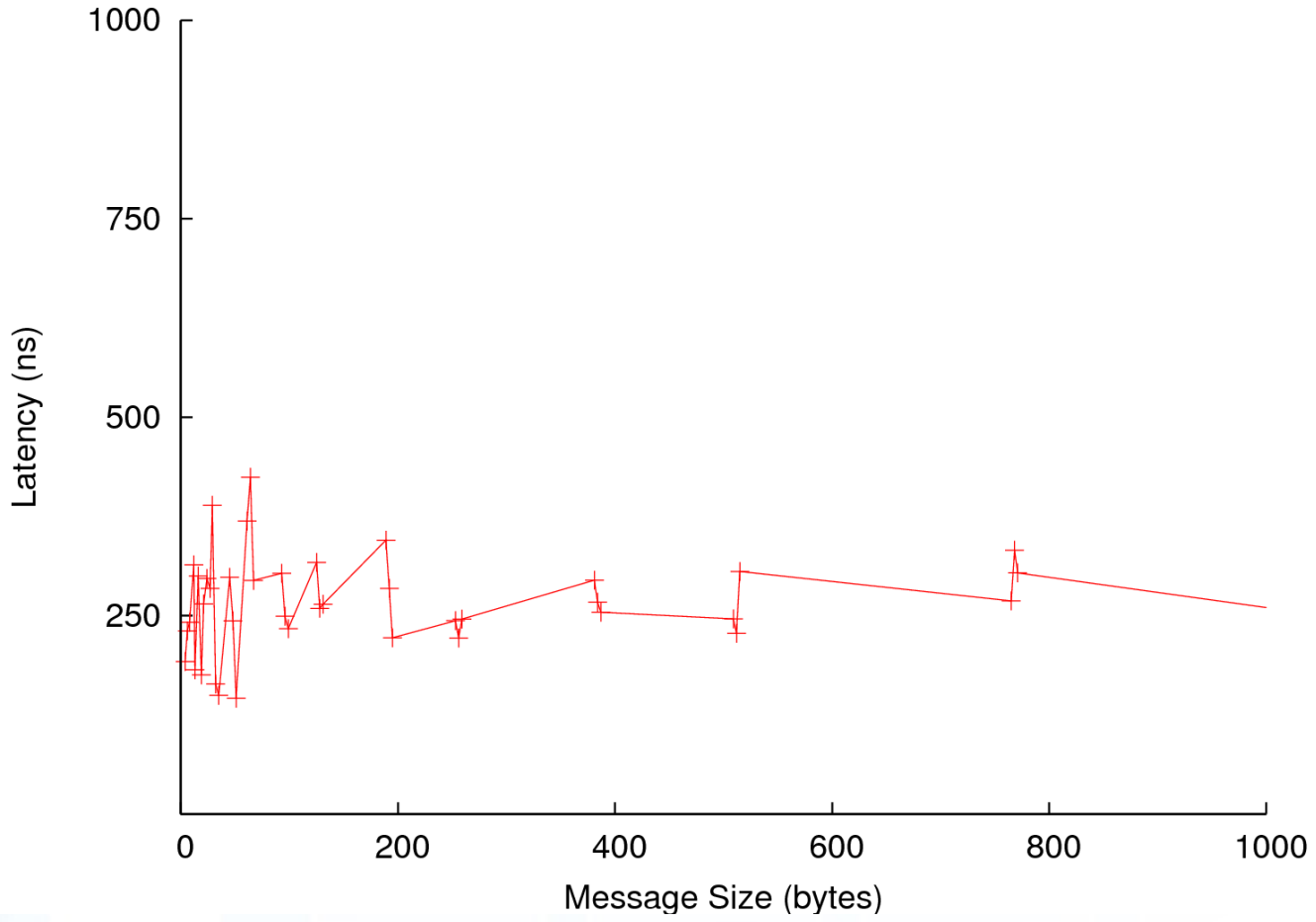
Throughput

NetEffect performance cont...



Latency

Switch overhead



*Fulcrum Micro Test Platform

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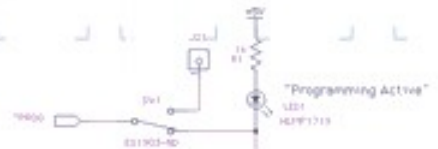
10 Gig iWARP

- Comparable (better?) in performance to IB
  - Higher throughput than standard 4X IB
  - Switch latency is comparable
  - A bit higher latency at small message sizes
  - Appropriate for cluster interconnect
  - Appropriate for high-end servers
  - Appropriate for storage (iSCSI)
- Just getting started with it
  - WAN tests
  - Interoperability with other iWARP HW



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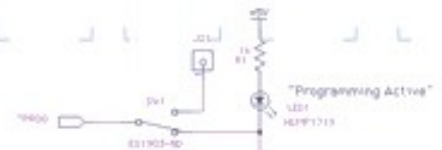
Current iWARP work

- iWARP in the WAN
  - Main point of this talk
- Interoperability of iWARP devices
  - Ammasso, NetEffect, Software iWARP
- RDMA enabled web server
  - Apache *mod_rdma* and proxy server
- RDMA enabled FTP client/server
- Real applications with NetEffect device



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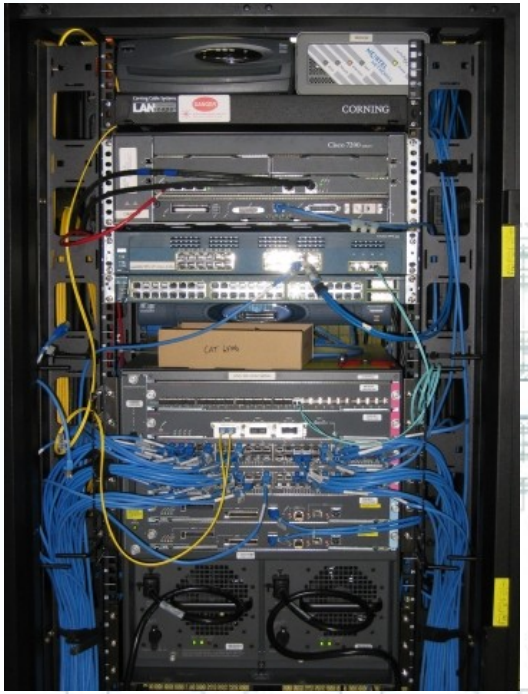
OSC iWARP resources

- NetRes Cluster
  - Up to 41 Ammasso
  - On TFN
- P4 Cluster
  - 17 Ammasso
  - On TFN
- NetEffect
  - 2 Servers
  - On TFN



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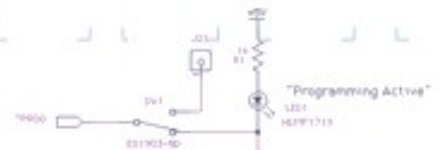
Basic performance

- At 1 Gbps TCP about same as iWARP
  - Today's processors capable of 1Gbps
    - At high CPU utilization
- 10 Gbps will be a different story
- Things do not work the same in WAN
  - Tunable network parameters a must
    - Window Size
    - MTU?



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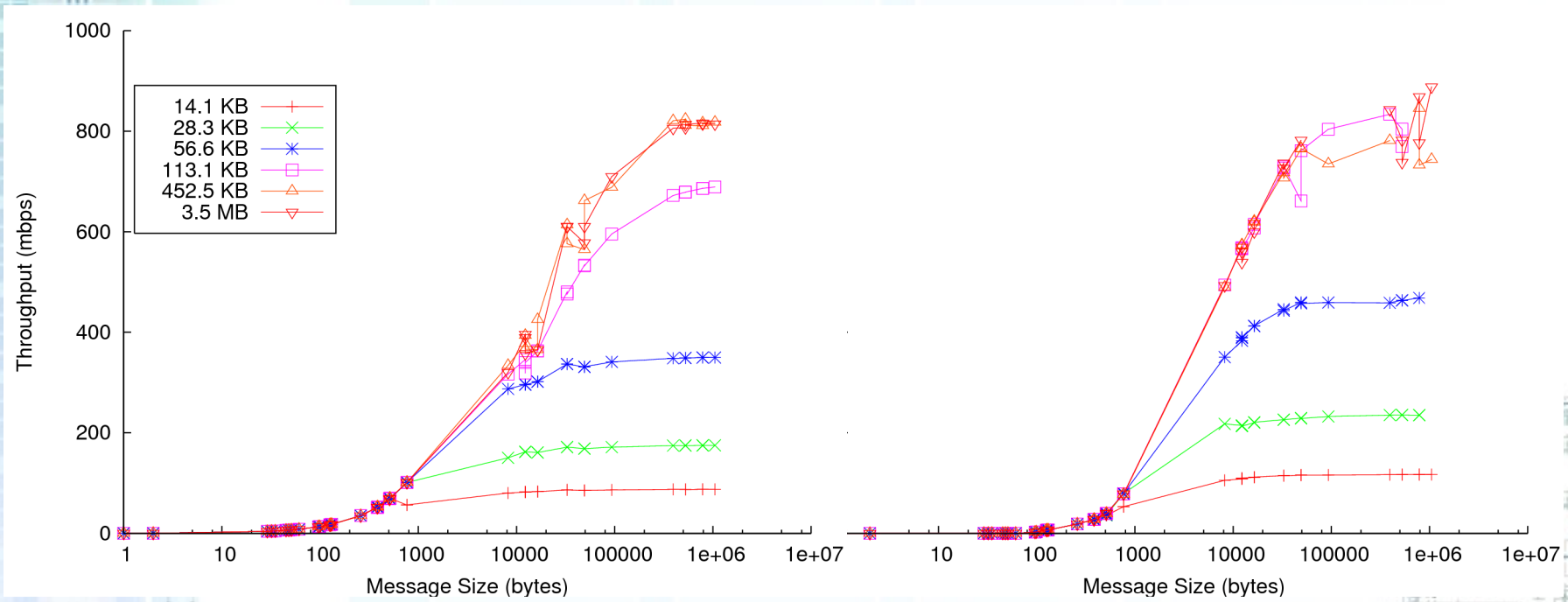
Window size effect in WAN



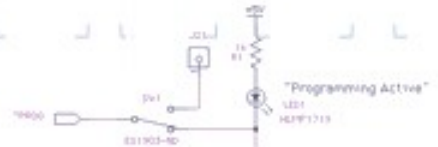
iWARP

TCP

*Note 113.1 KB not full BW for iWARP

iWARP FTP

- Demo at SC 2005
- Work in progress to create production version
- Written in OpenFabrics verbs API
  - Will work on iWARP or InfiniBand
- Intended use: Move large data sets in WAN



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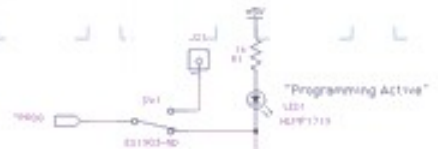
Basic FTP Performance

- Server: Springfield
- Client: Columbus
- Link: 10Gbps (TFN)
- About same perf

	iWARP	TCP/IP
200K	.010 s	.015 s
1M	.021 s	.031 s
10M	.117 s	.247 s
100M	1.05 s	2.59 s



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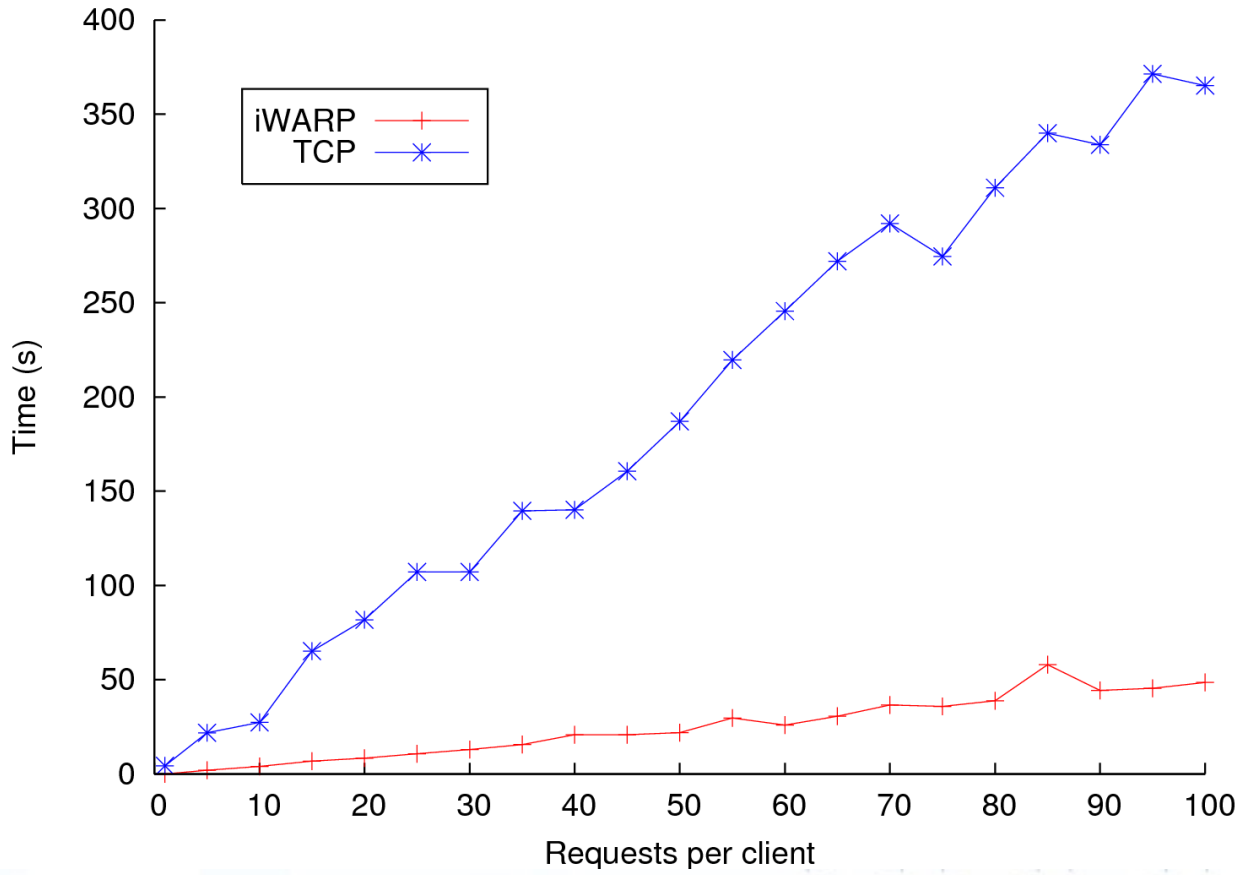
The iWARP Benefit



*16 clients each time

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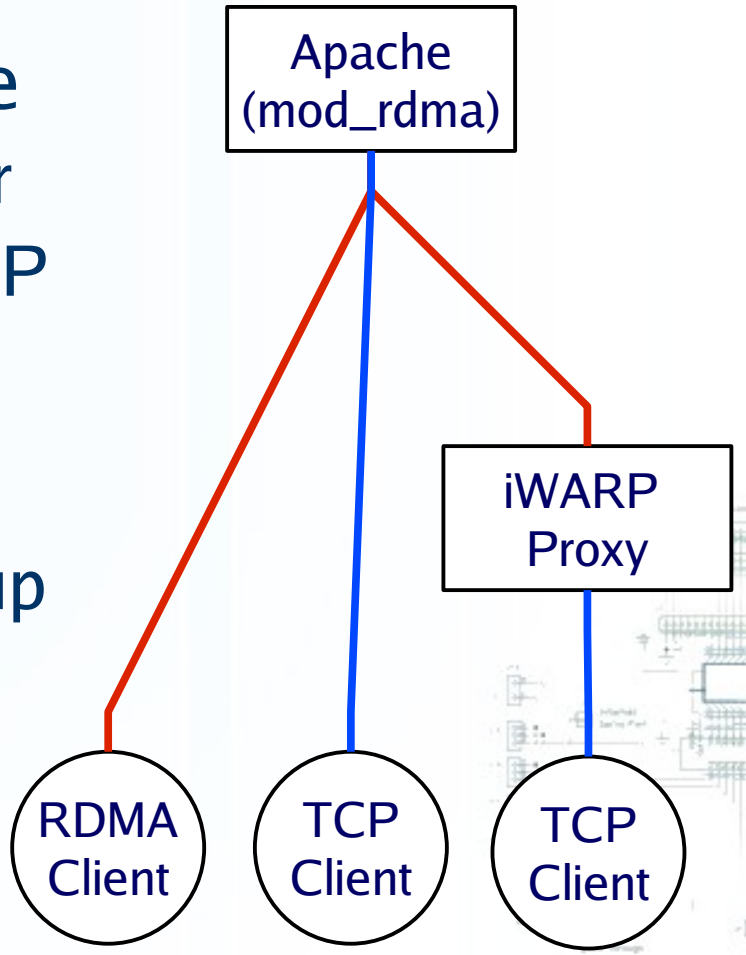
iWARP in the WWW

- RDMA module for Apache
  - Add RDMA info in header
  - Request/Response in TCP
  - Data transfer with RDMA
- Downside
  - RDMA connection build up
- Why not full iWARP port?
  - Extensive changes to Apache code base
  - New feature not new web server



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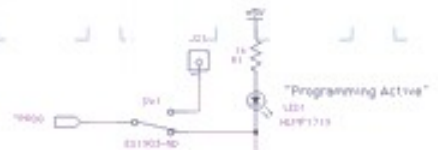
RDMA enabled Apache web server

- mod_rdma
  - Apache module to handle RDMA transfers
  - “Grab” out going data and ship it with RDMA
  - Manipulate headers for minor changes
    - Simple changes, nothing fundamental
  - All the benefits of Apache
    - No rewrite of Apache code needed
    - Utilizes Apache *hooks*



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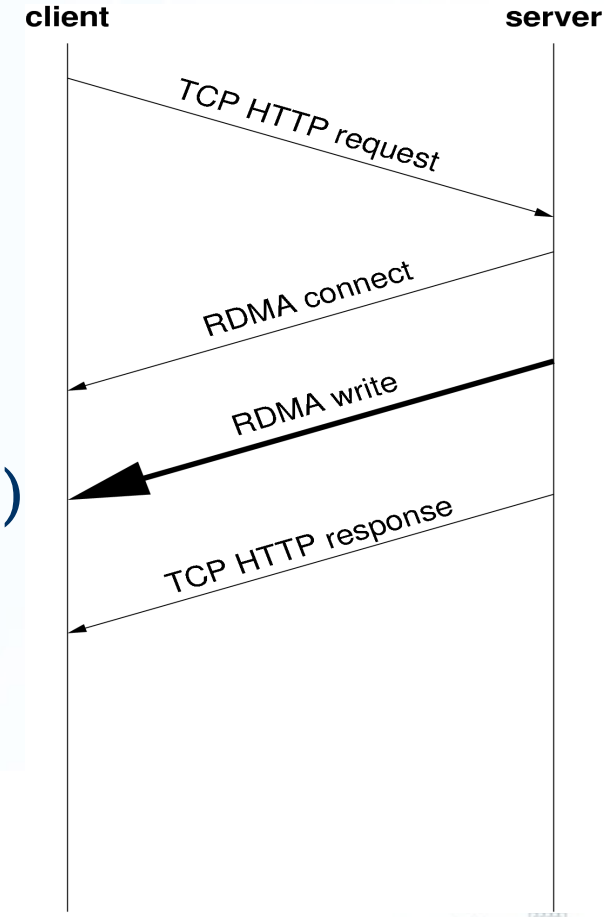
mod_rdma cont.

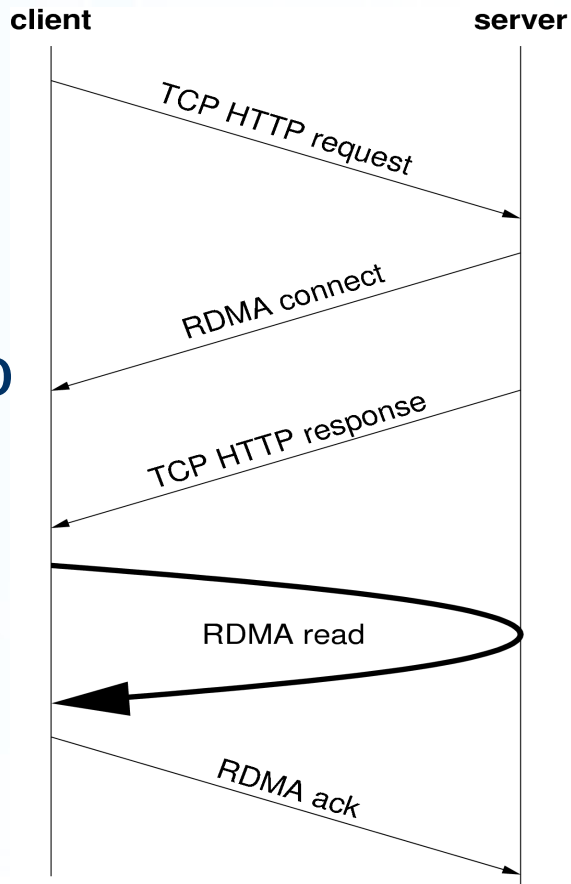
- Server Writes
  - Client has to guess size of file
  - RDMA connect takes time
    - Same as TCP connection (it is)




```
GET /index.html HTTP/1.1
Host: www.osc.edu
User-Agent: Mozilla/5.0
Connection: Keep-Alive
RDMA: server-writes, ip=10.0.0.15, port=3242, stag=642, to=0, maxlen=1048576
```

mod_rdma cont...

- Client Reads
  - Still have RDMA connect
  - Server replies with RDMA info
  - Client has to send an extra ACK to tell server RDMA read done

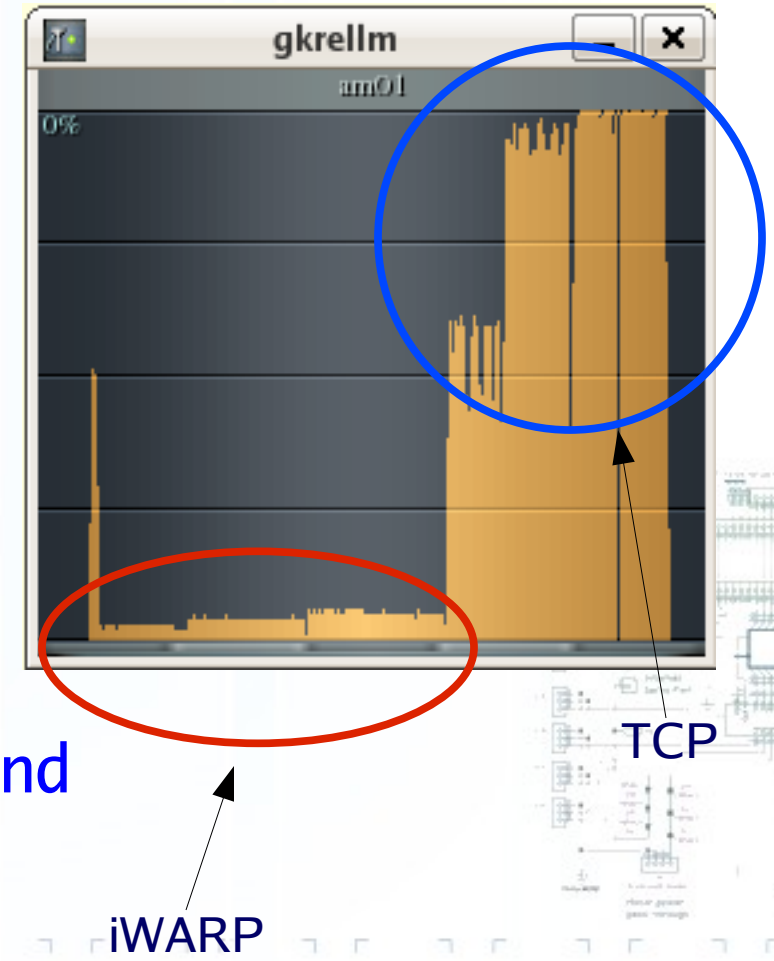


GET /index.html HTTP/1.1
Host: www.osc.edu
User-Agent: Mozilla/5.0
Connection: Keep-Alive
RDMA: clinet-reads, ip=10.0.0.14, port=3242 maxlen=1048576

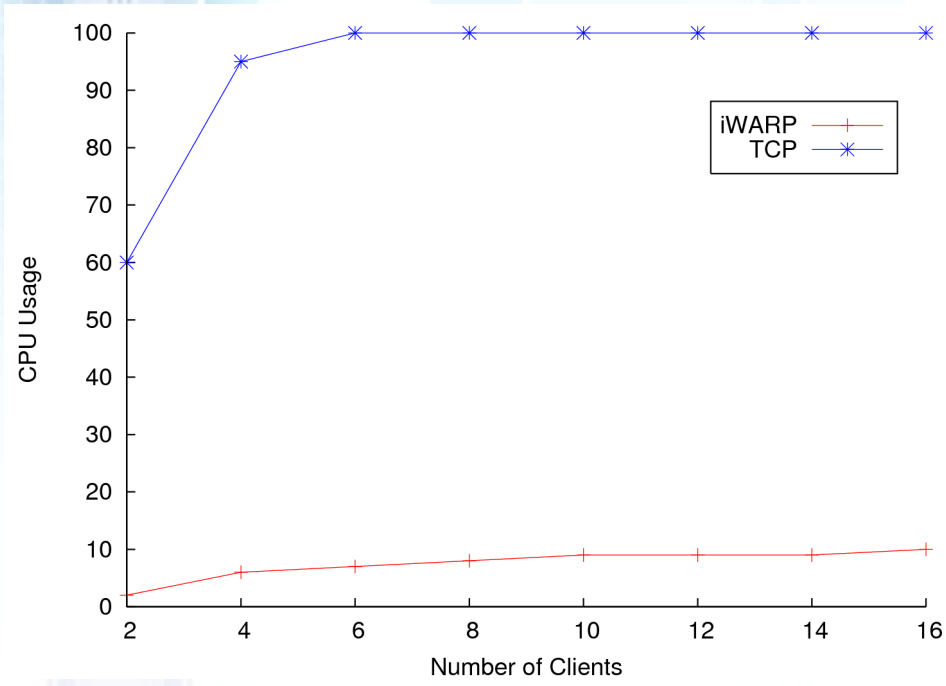
HTTP/1.1 200 OK
Host: www.osc.edu
Content-Length: 1327
Connection: Keep-Alive
RDMA: client-reads, stag=642, to=0

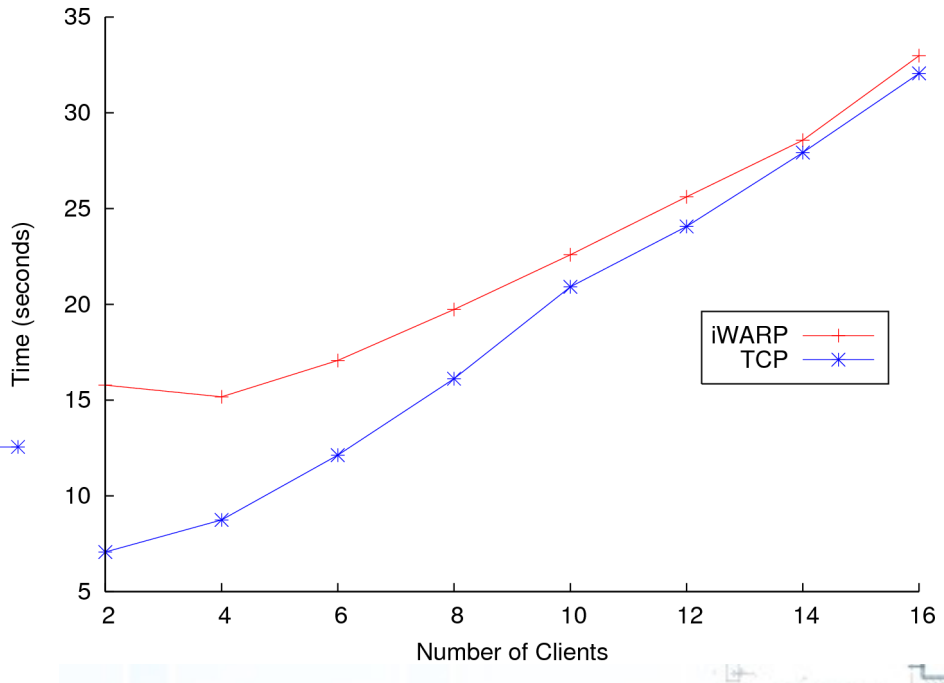
RDMA enabled Apache performance

- 1 page with 20 images
  - Stock wget
  - RDMA enabled wget
- CPU usage for 2,4,6 clients
  - RDMA
    - starts out low, stays low
  - TCP
    - starts out in middle goes and stays high



mod_rdma perf cont..





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Example web based app

- Database of all US cities
  - Includes zip code, latitude, longitude, etc.
  - One fake person from each city
  - A little over 42,000 entries
- User: “give me all people within X miles of Zip”
- Server: responds with a variable number of results w/pictures per page
  - lots of trig for PHP to crunch on
  - lots of querying for MySQL database
  - pictures ensure lots of data to transfer
- Developed by Manu Mukerji

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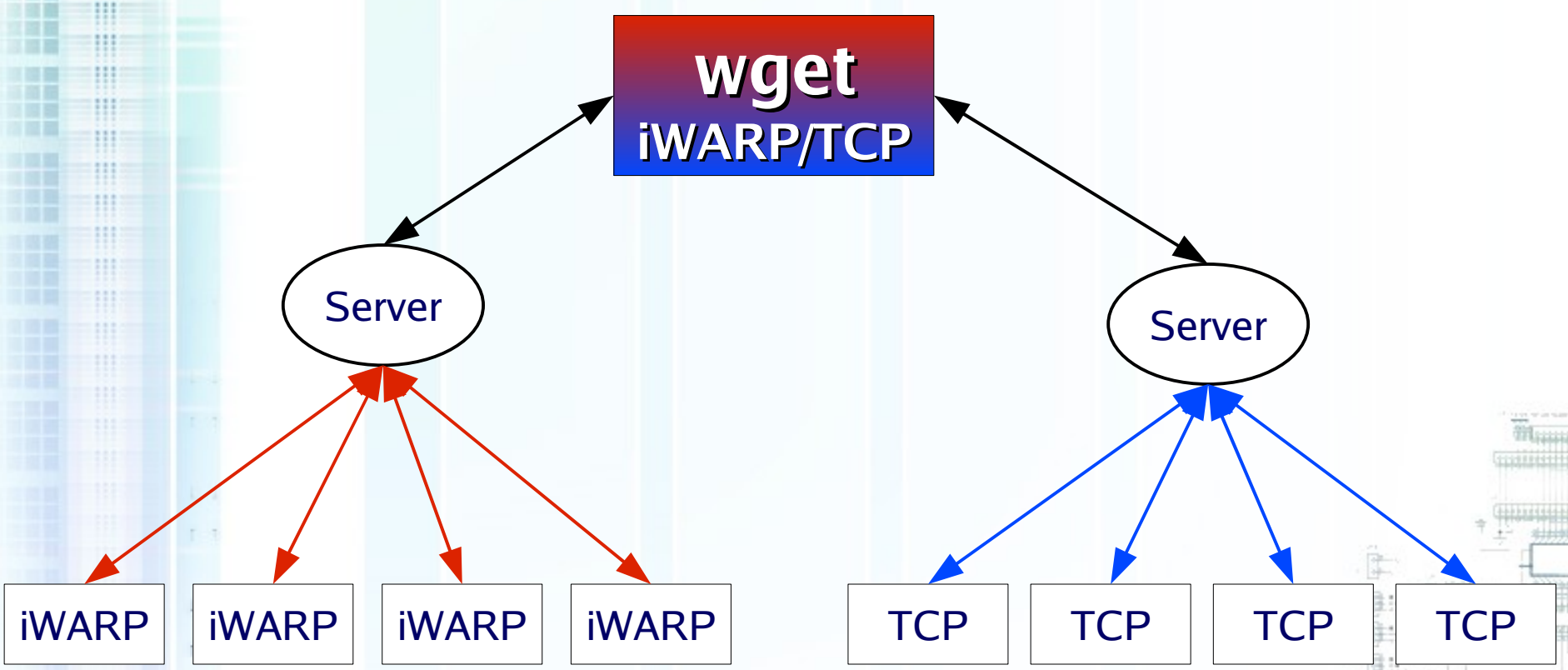
Two scenarios



1. Back end RDMA clients

2. Back end TCP clients

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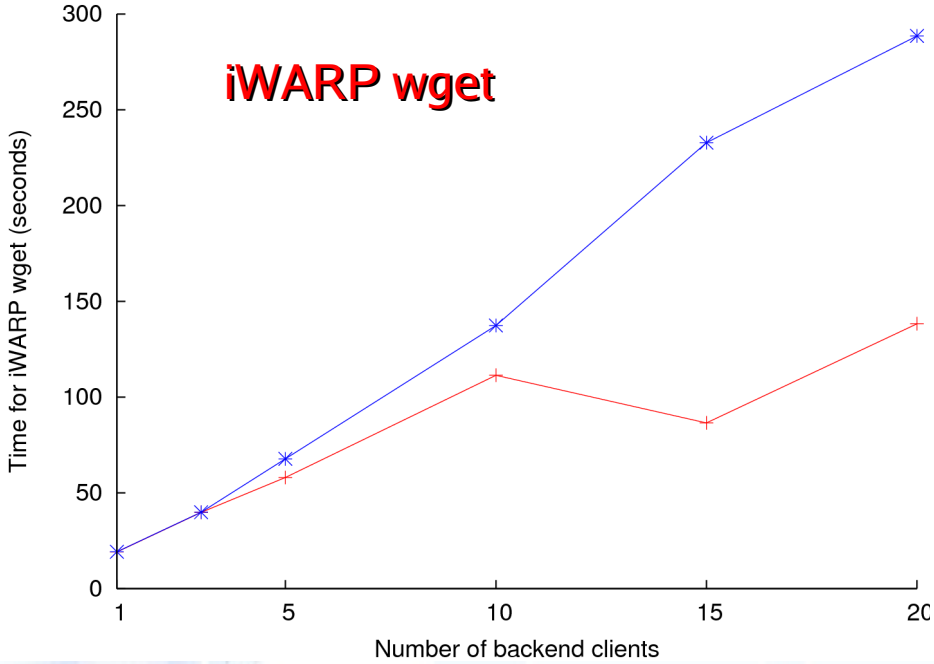
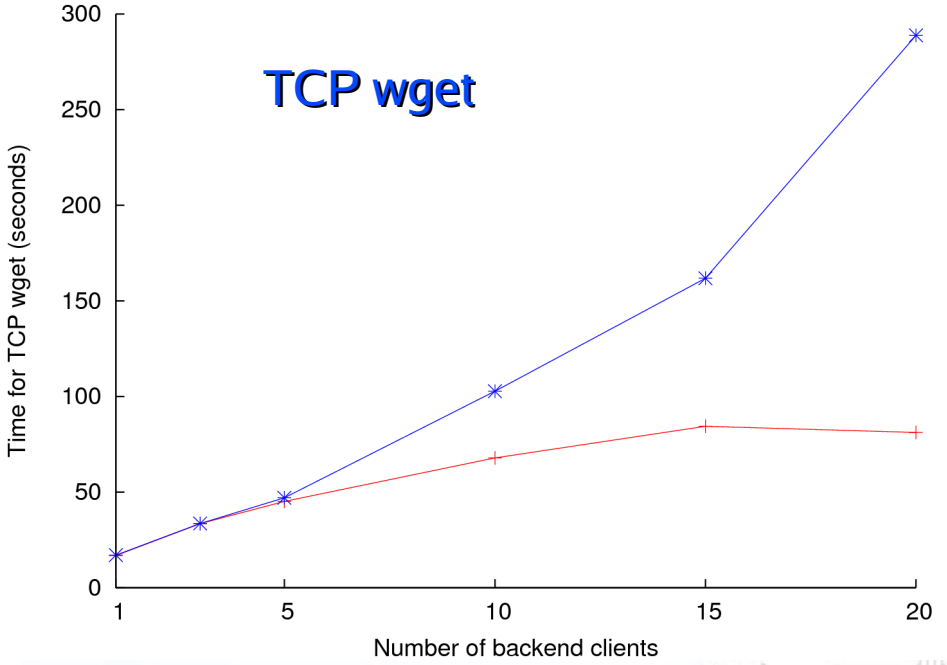
Sample app performance





back end iWARP

back end TCP

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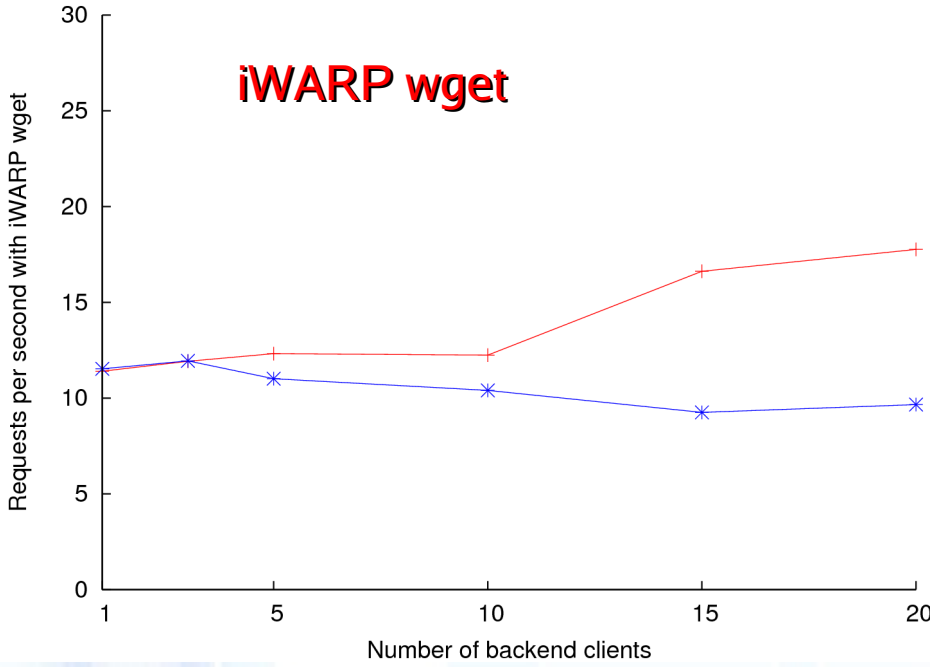
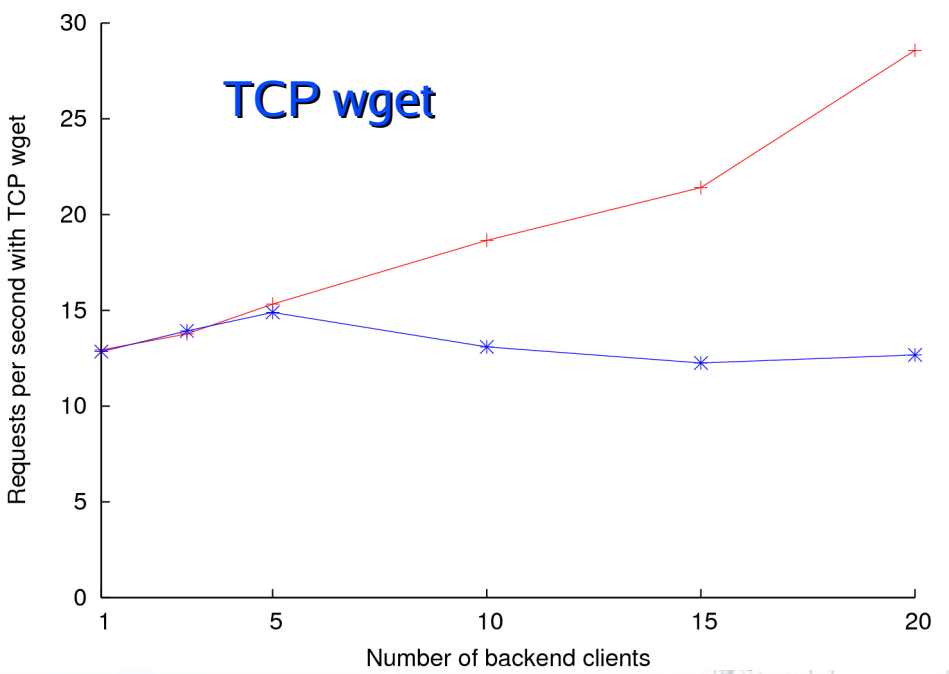
Server performance





back end iWARP

back end TCP

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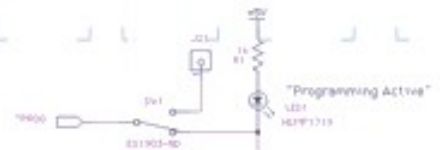
Upcoming work...

- NetEffect interoperability
  - with Ammasso cards
  - with Software iWARP
- OpenFabrics port of mod_rdma
  - Including SSL support
- OpenFabrics port of wget
- Many 1Gig clients to single 10Gig server
  - http
  - ftp



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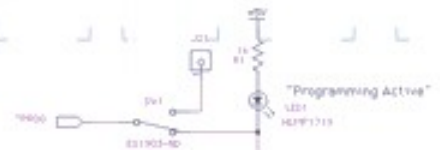
iWARP road to adoption

- Beginning
  - Hardware iWARP in most high end of servers
  - Software iWARP in clients
- ***After time....***
  - ***HW iWARP clients will begin to appear***
  - ***SW iWARP will become common***
- ***In parallel.....***
  - ***Specialty clusters of iWARP***
- Eventually
  - World will move beyond 1 Gig
  - iWARP is one of the best answers for Ethernet

Conclusion

- iWARP is WAN capable
- iWARP is a viable cluster interconnect
- HW is now available
- Will make a difference in servers today
- Benefit all computing not just HPC



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Questions?

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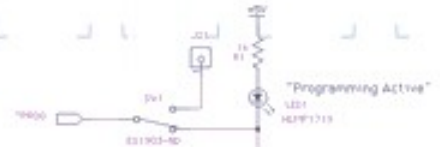
http://www.osc.edu/~dennis/iwarp



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