

ACTIVE Interconnects

Let's have some guts!

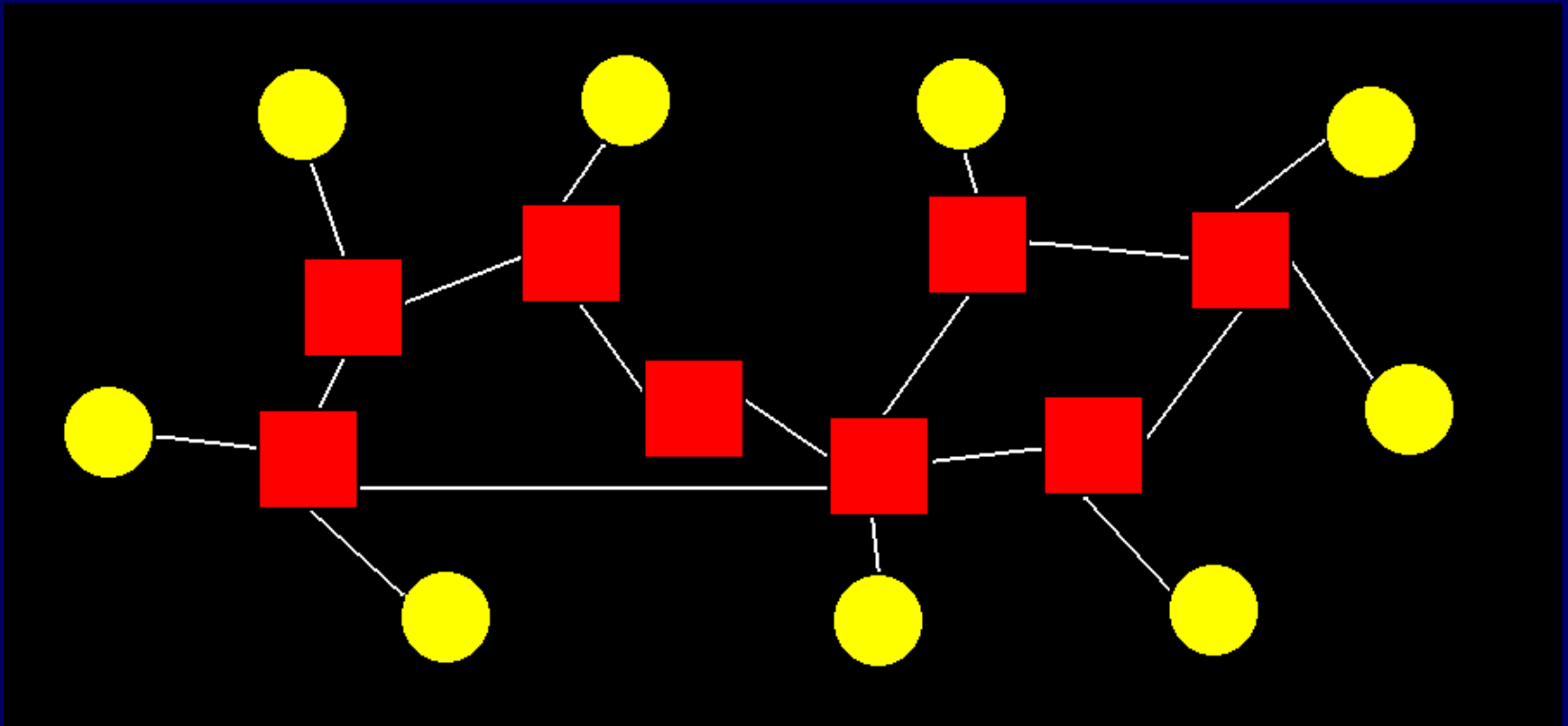
Jonathan M. Smith

(with I. Hadzic and W. Marcus)

<http://www.cis.upenn.edu/~jms>

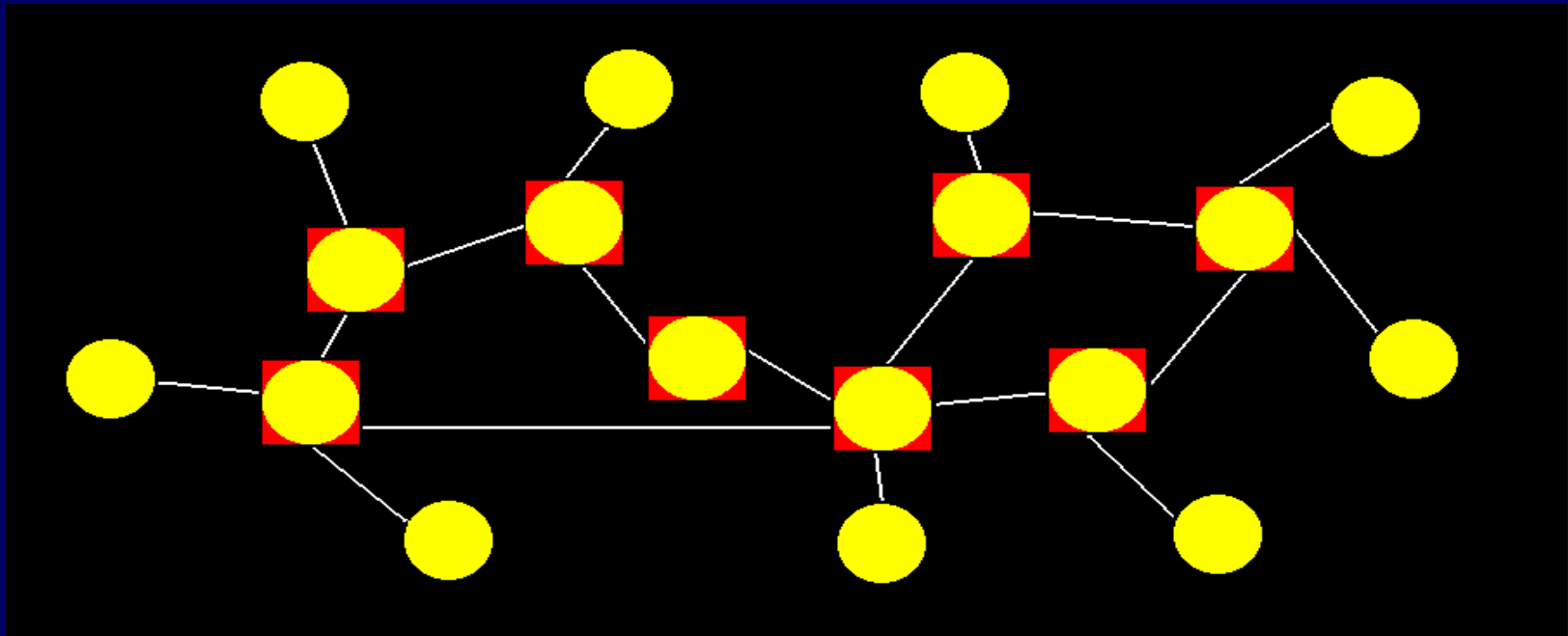
Current IP Networking Religion:

- ☐ Smart hosts on the edges
- ☐ Dumb switches in the center



Active Networking

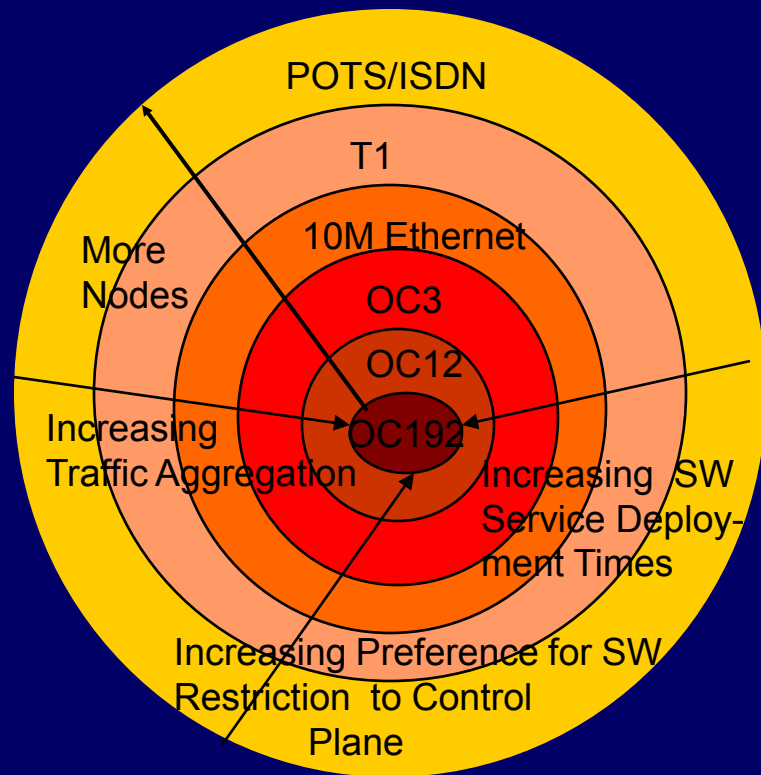
- Can change network behavior on-the-fly
 - In-band capsules
 - Out-of-band loadable modules
 - Details? See <http://www.cis.upenn.edu/~switchware>



Applications and Challenges

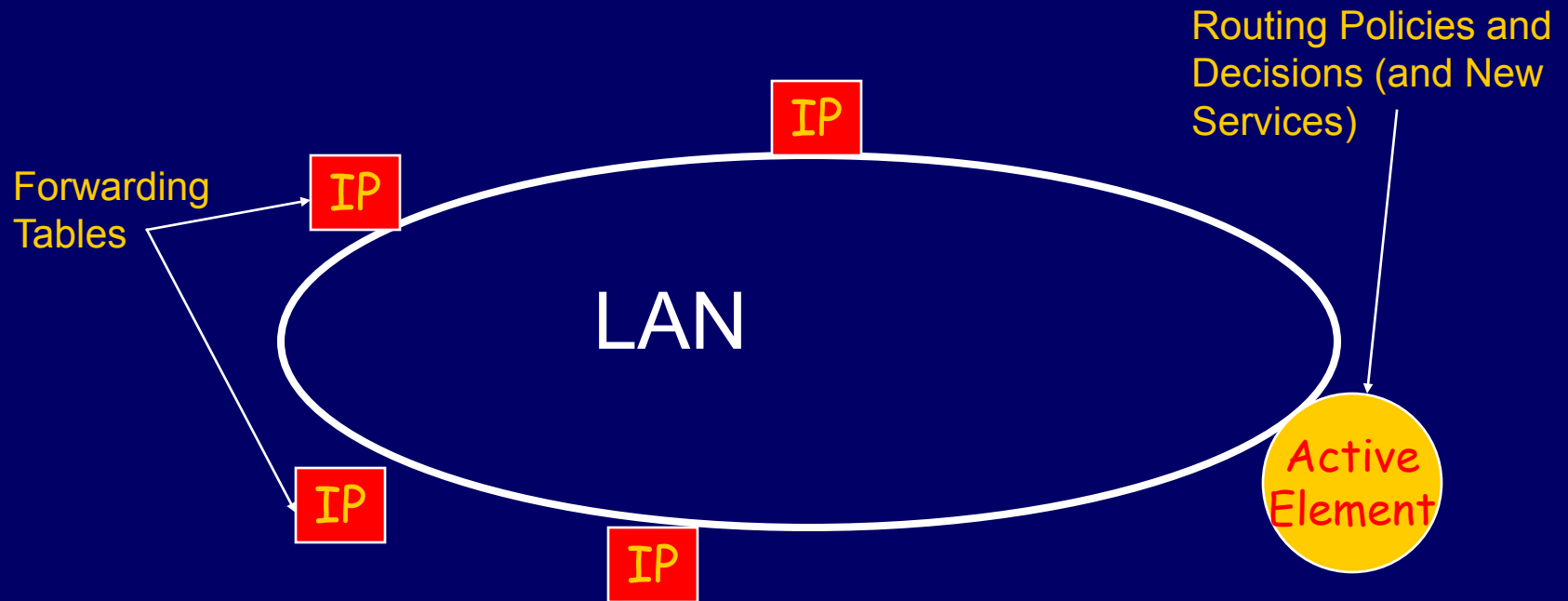
- ☐ Allow user customization of network
- ☐ E.g., caching, routing, transcoding, etc.
- ☐ Concerns: Flexibility, Usability,
Security and PERFORMANCE
- ☐ For example, is Active Networking even
relevant in an all-optical network?

Network D:



Solution: Active Router Control (stay out of forwarding path)

□ IP Router/Forwarders co-located with
Active Elements:

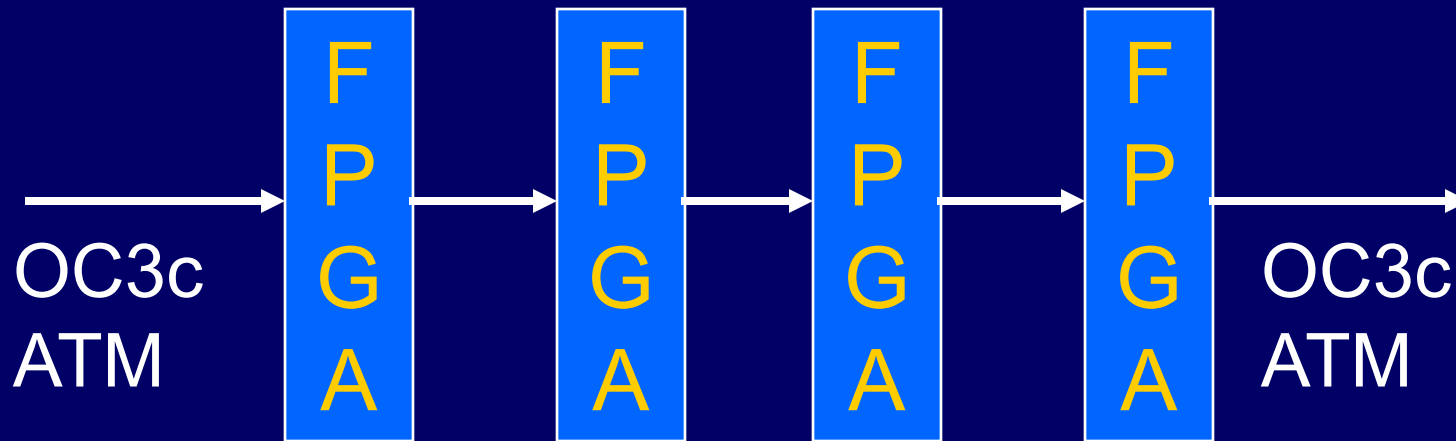


Can we do more? Or do optics invalidate Active Nets vision?

☐ Approach:

- ☐ look at the other exponential technologies
- ☐ processor clock rates track bandwidths
- ☐ exotic technologies, e.g., mediaprocessors
- ☐ general-purpose CPUs? Maybe.....

Protocol Processing Pipeline (P4)



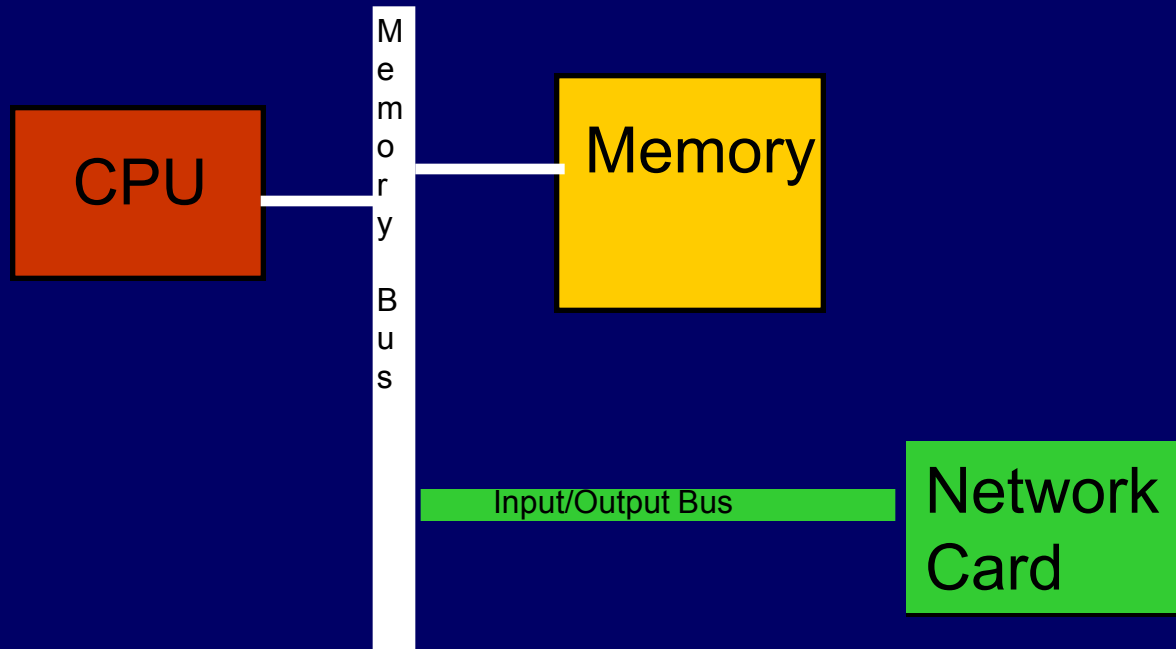
<http://www.cis.upenn.edu/~boosters>

Some rough arithmetic...

- OC192c SONET is 9.6 Gb/s
- For 64 bit CPU, 150 MW/s
- Clock rates of 500-750 MHz mean:
 - RR moves: 2-3 W/instruction
 - Register file writes likely bottleneck
 - So about 5 instructions/word
 - Can't afford any delays

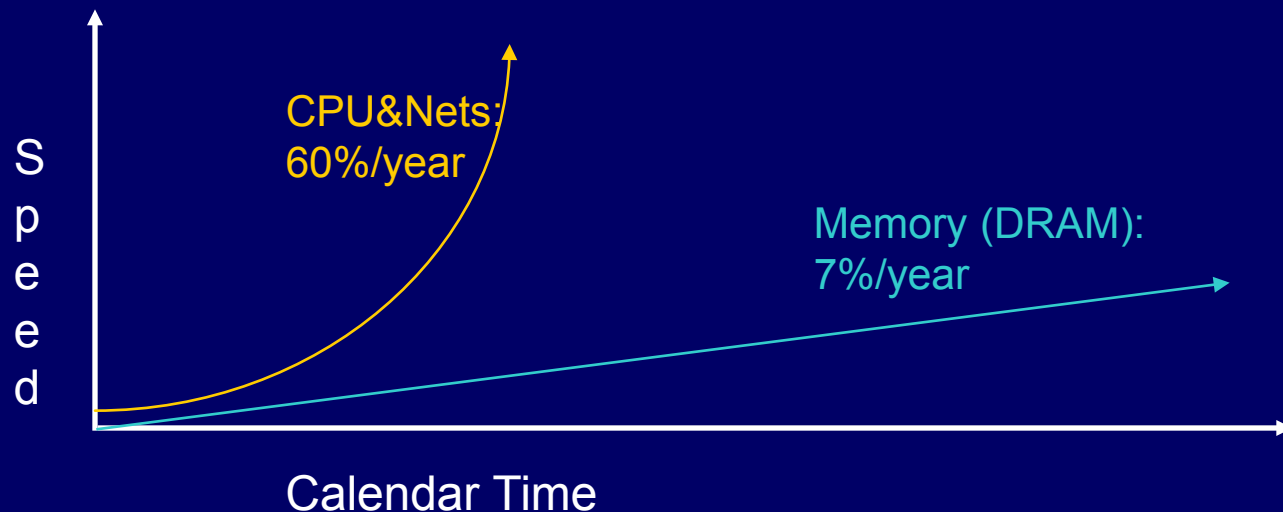
Typical Computing, Memory & Network Attachment

□ Architecture:



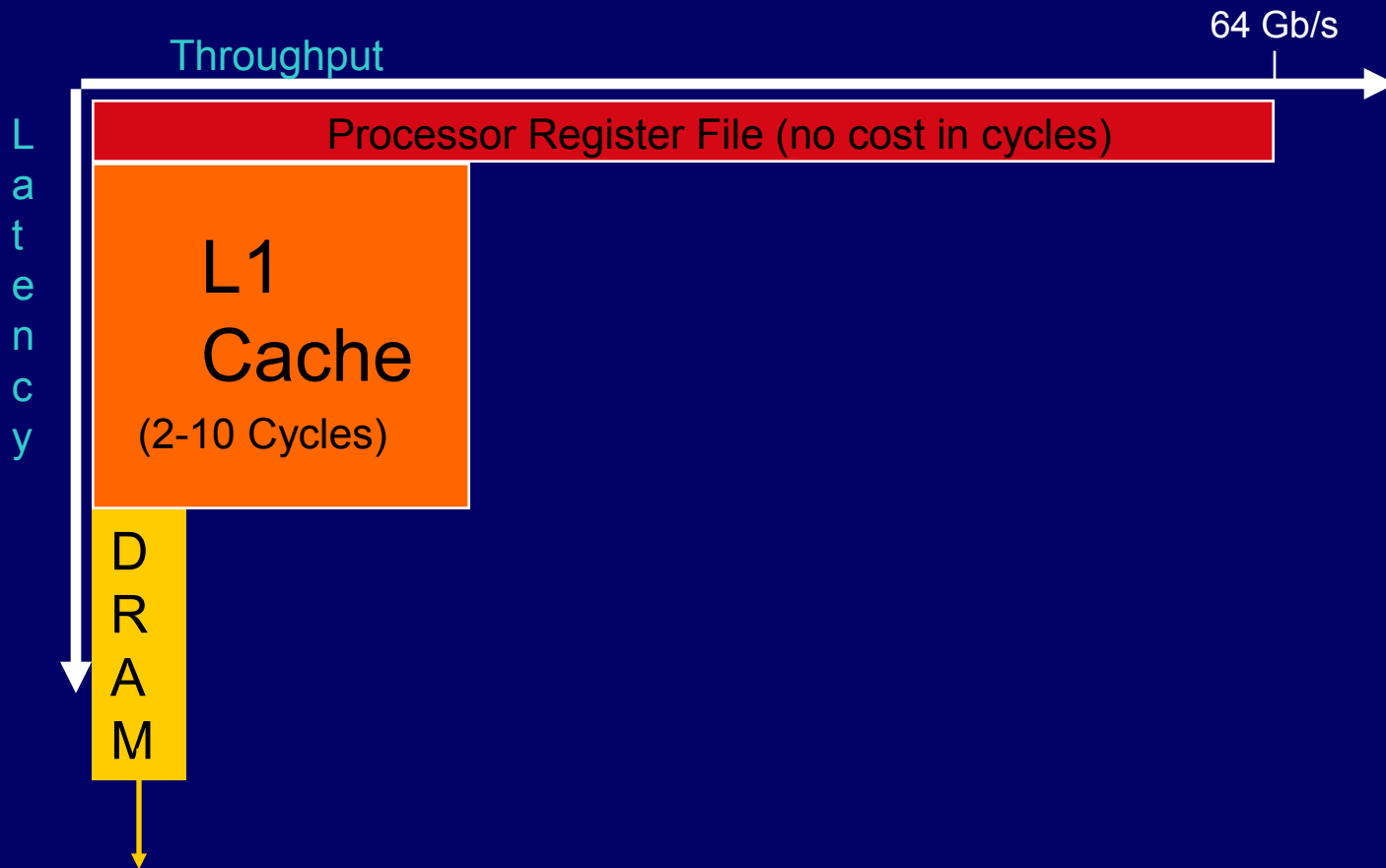
Why this won't work: mismatched exponentials

□ Memory exponential has been capacity

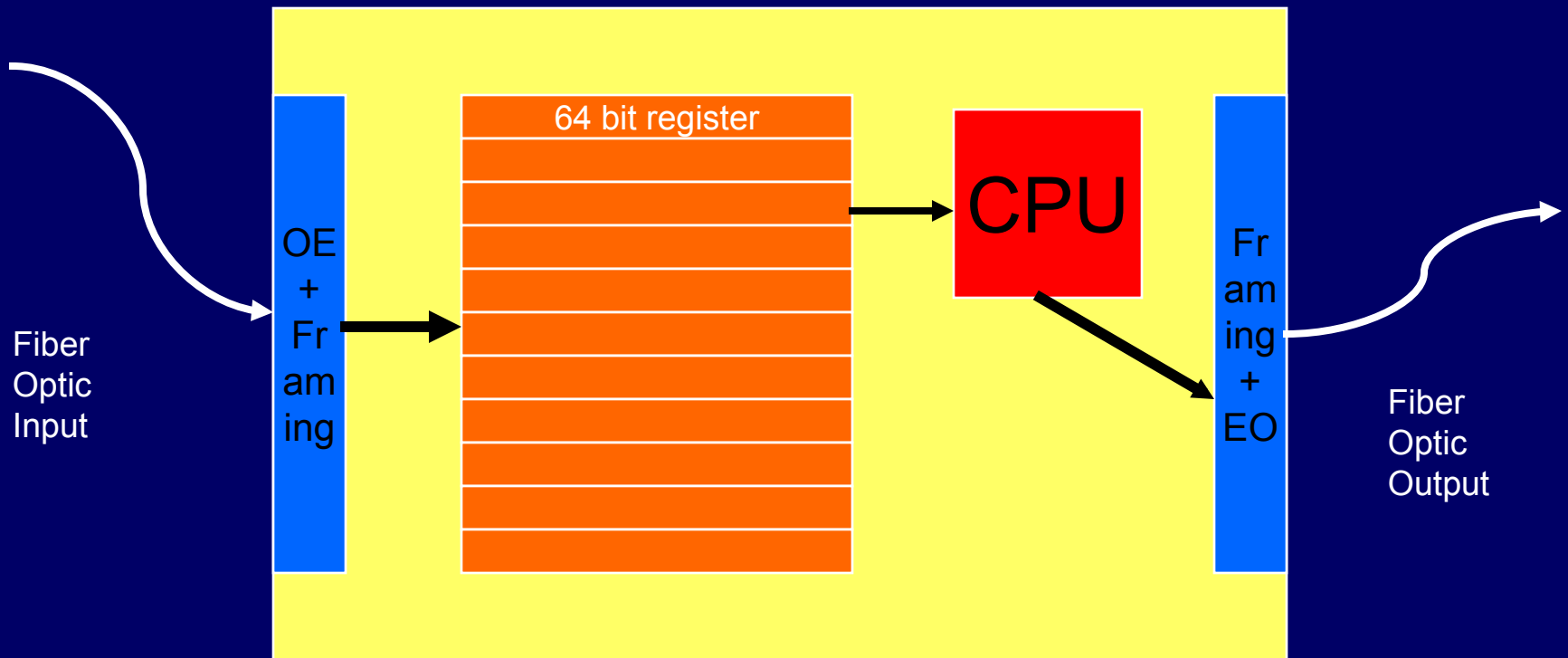


Not throughput!

□ Unattractive tradeoffs for networks:



Fiber-coupled processing?



Register-Only Media Processor (ROMP)

Summary

- ☐ *Many attractions of active networking*
- ☐ *Can trade away flexibility for performance*
- ☐ *Can get out of the fast path (ARC), or*
- ☐ *Specialized HW in fast path: The P4, or*
- ☐ *Glue a CPU in the fast path (ROMP)*

<http://www.cis.upenn.edu/~switchware>