
SONY
DEVELOPER
RAMBUS®
FORUM

# We Never Stop Innovating

**Dave Mooring**
**President**
**Rambus Inc.**

RAMBUS® DEVELOPER FORUM

# Agenda

- **Welcome**
- **Making the right connections**
  - Computers
  - Communications
  - Consumer electronics
- **Introducing Yellowstone**

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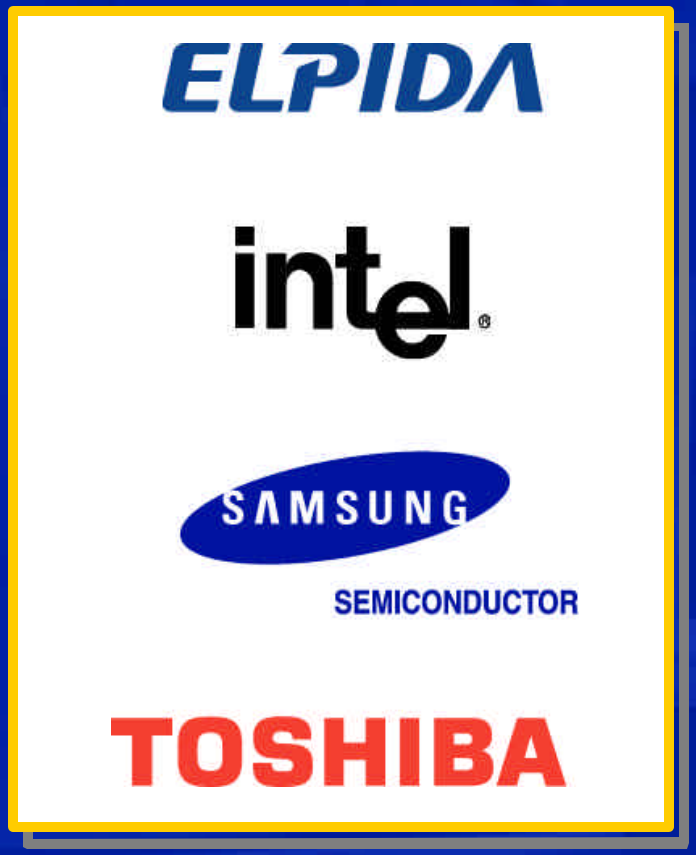
# Gold Sponsors



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SONY
Over 300 Products
Use RDRAM

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# Bandwidth Needed Everywhere

# Making the Right Connections

- Delivering complete solutions
- Providing evolutionary roadmaps
- Driving new technologies

# Agenda

- Welcome to RDF
- Making the right connections
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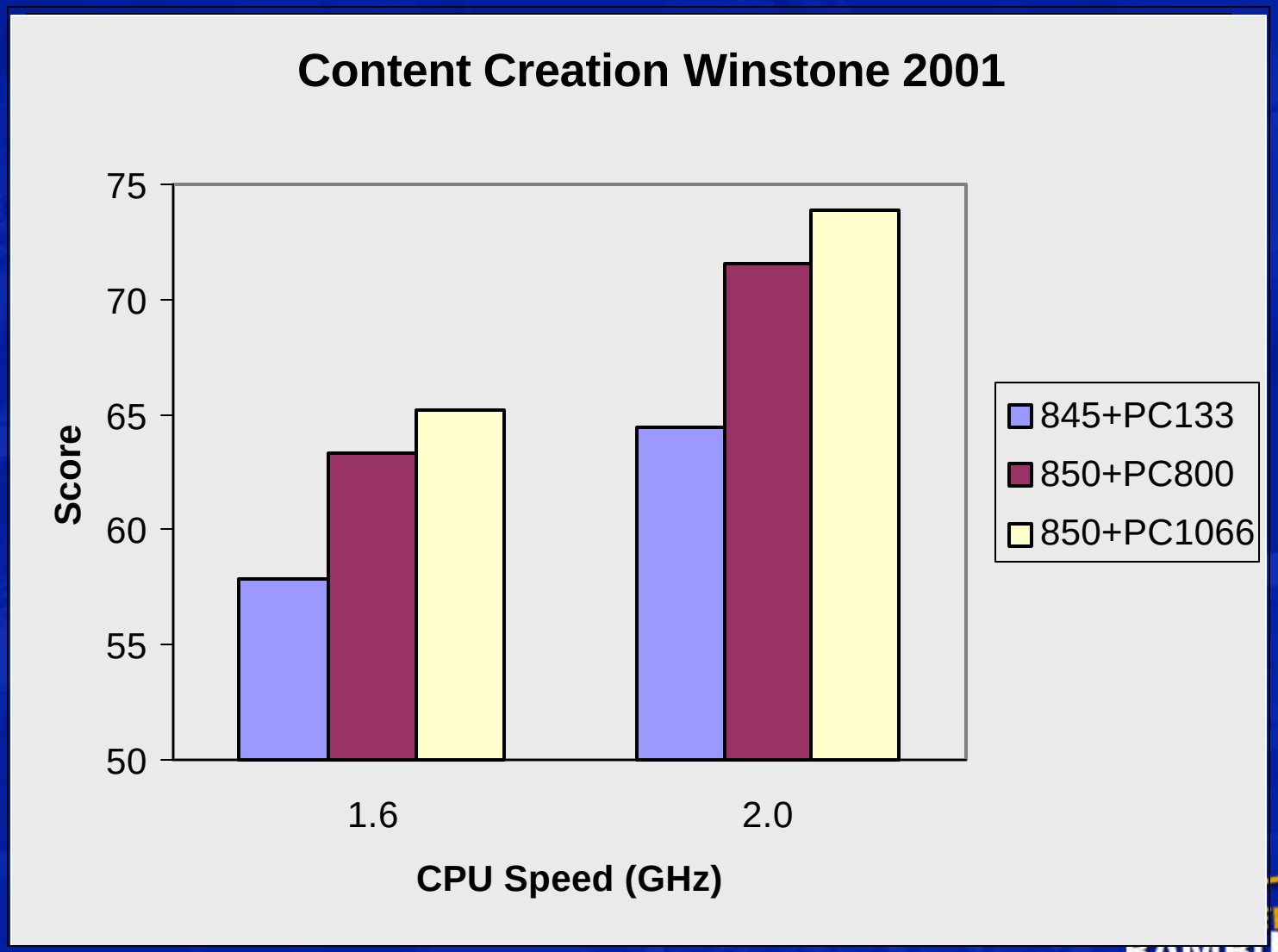
# RDRAM Sweeps SDRAM

| Benchmark Class | Benchmark Program | Perf. Ratio (850/845) | RDRAM Performance Advantage |
|---|---|---|---|
| Office Apps (light stress) | Biz Winstone 2001 | 1.13 | 8-13% |
| | CC Winstone 2001 | 1.10 | |
| | SYSMark 2001 | 1.08 | |
| IT/Corporate (heavy stress) | Office Bench 2001 (base) | 1.43 | 36 - 69% |
| | Office Bench 2001 (lev 1) | 1.36 | |
| | Office Bench 2001 (lev 2) | 1.69 | |
| Games | Quake III (high qual) | 1.61 | 20 - 61% |
| | DroneZ | 1.25 | |
| | AquaMark | 1.20 | |

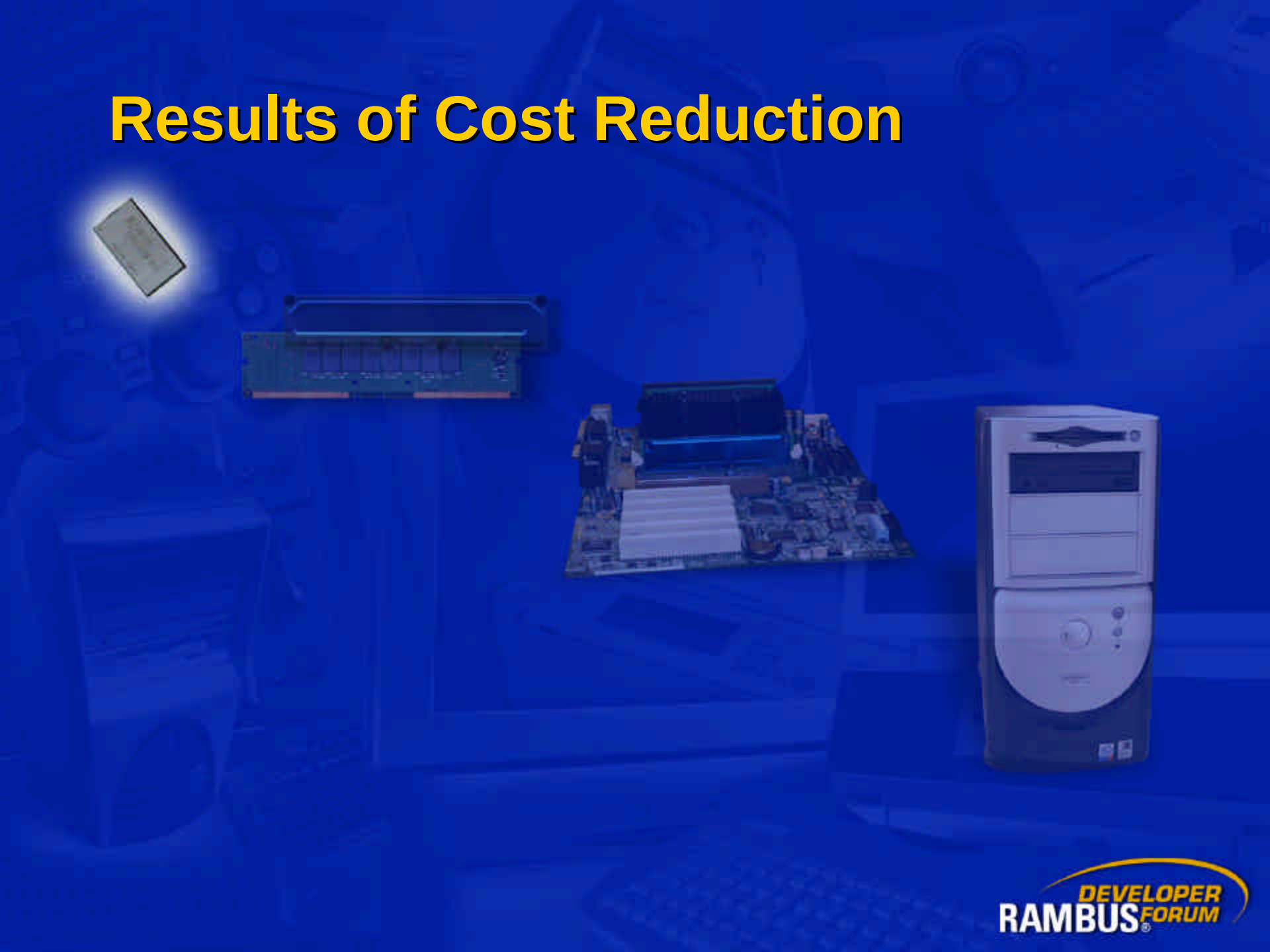
Source: www.anandtech.com 1.5GHz P4

# RDRAM Scales Best




Source: Rambus Inc., 2001

# Results of Cost Reduction



# Results of Cost Reduction

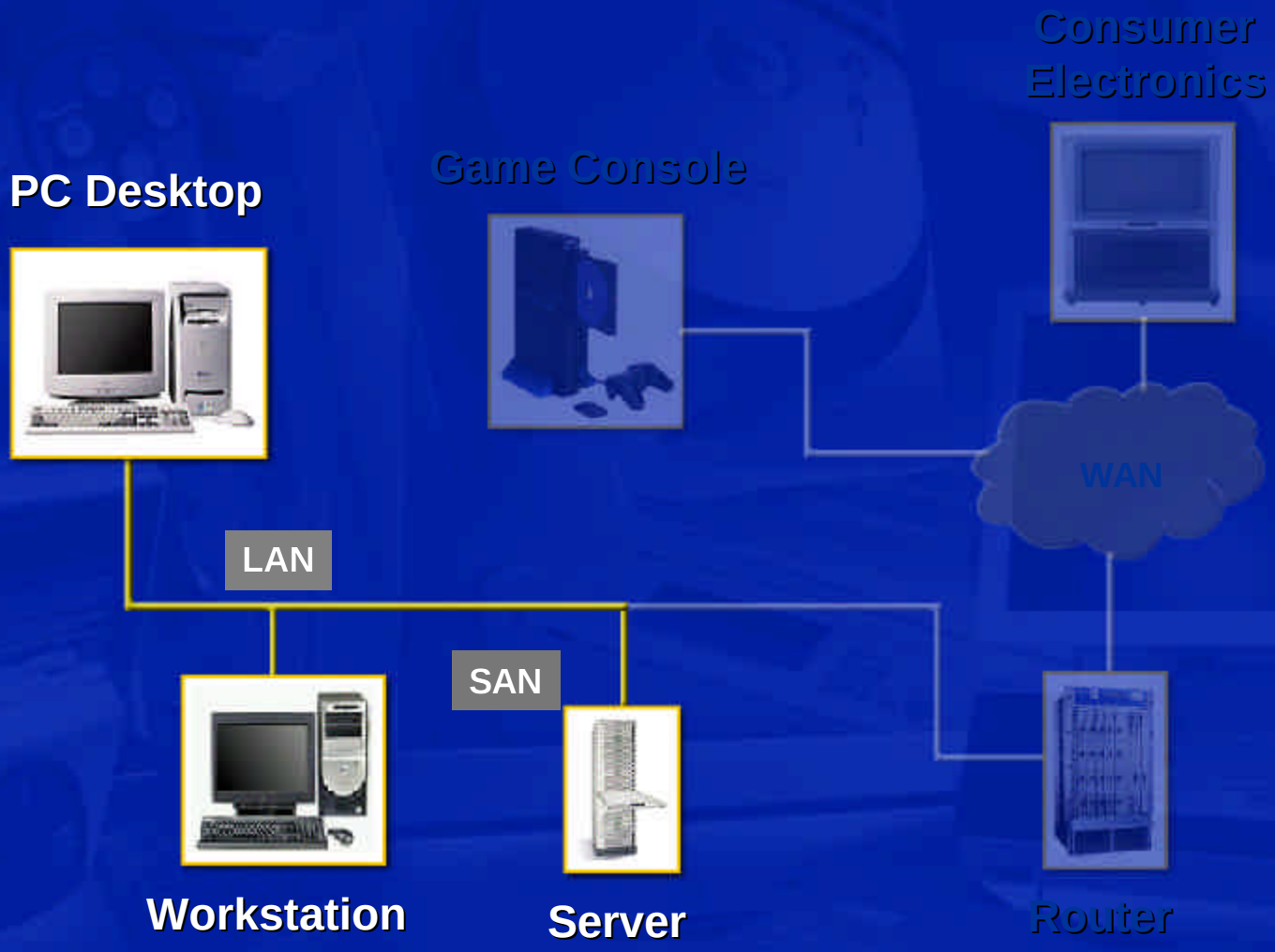
8 → 6 → 4 layers

# Results of Cost Reduction

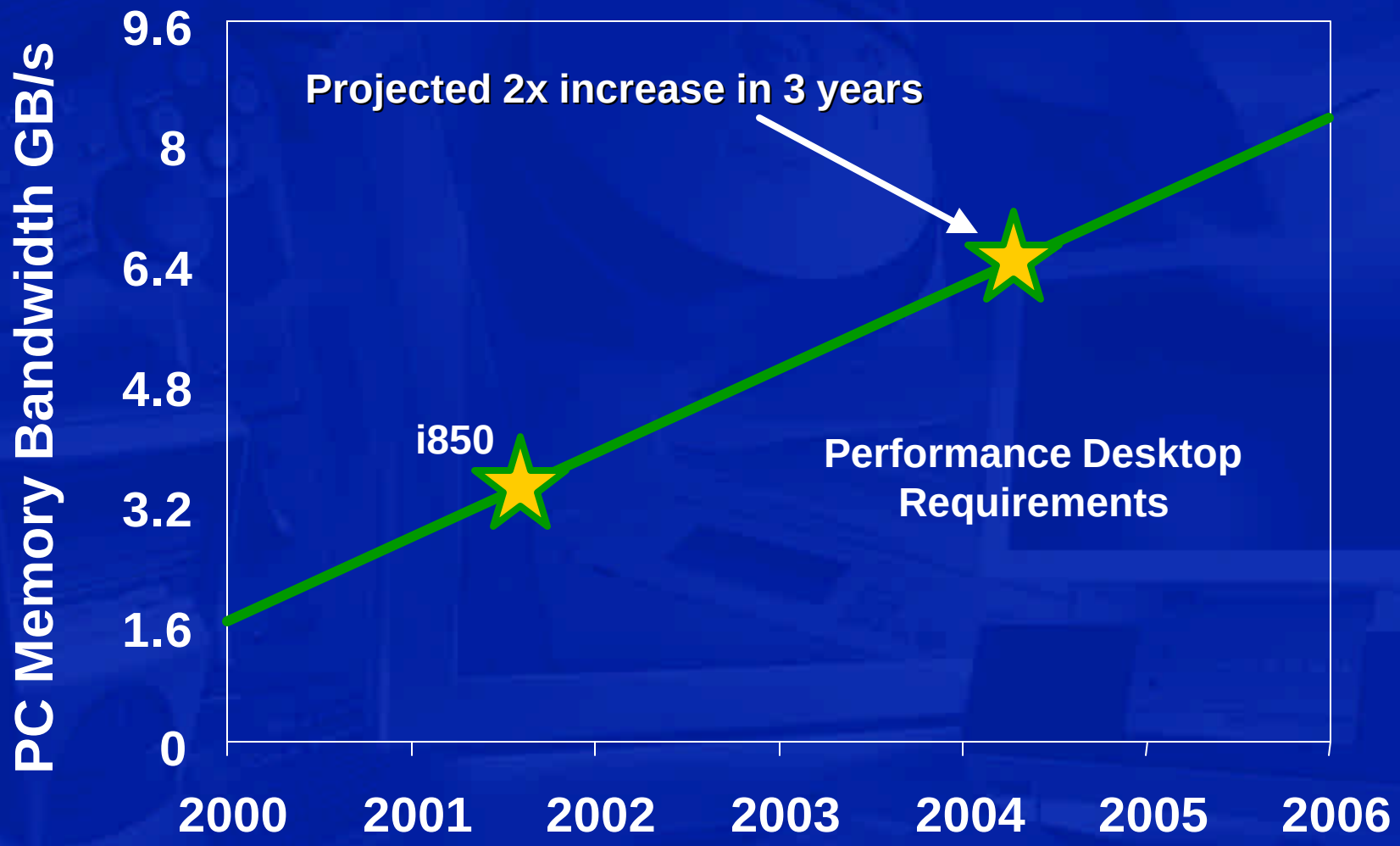
4 layer motherboards shipping

# Results of Cost Reduction

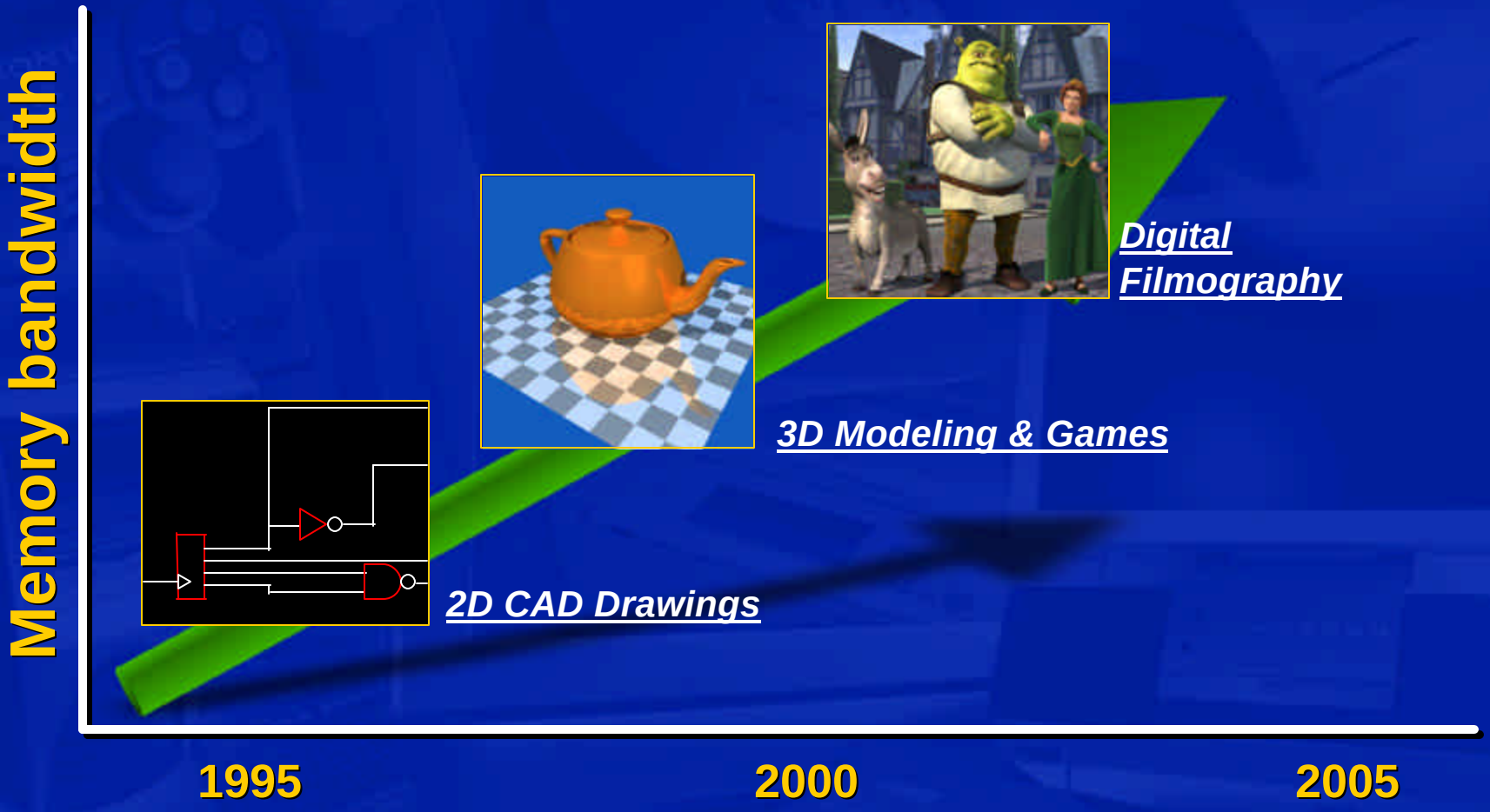
# Bandwidth Needed Everywhere



# PC Bandwidth Needs Increasing



# Bandwidth Brings Software to Life

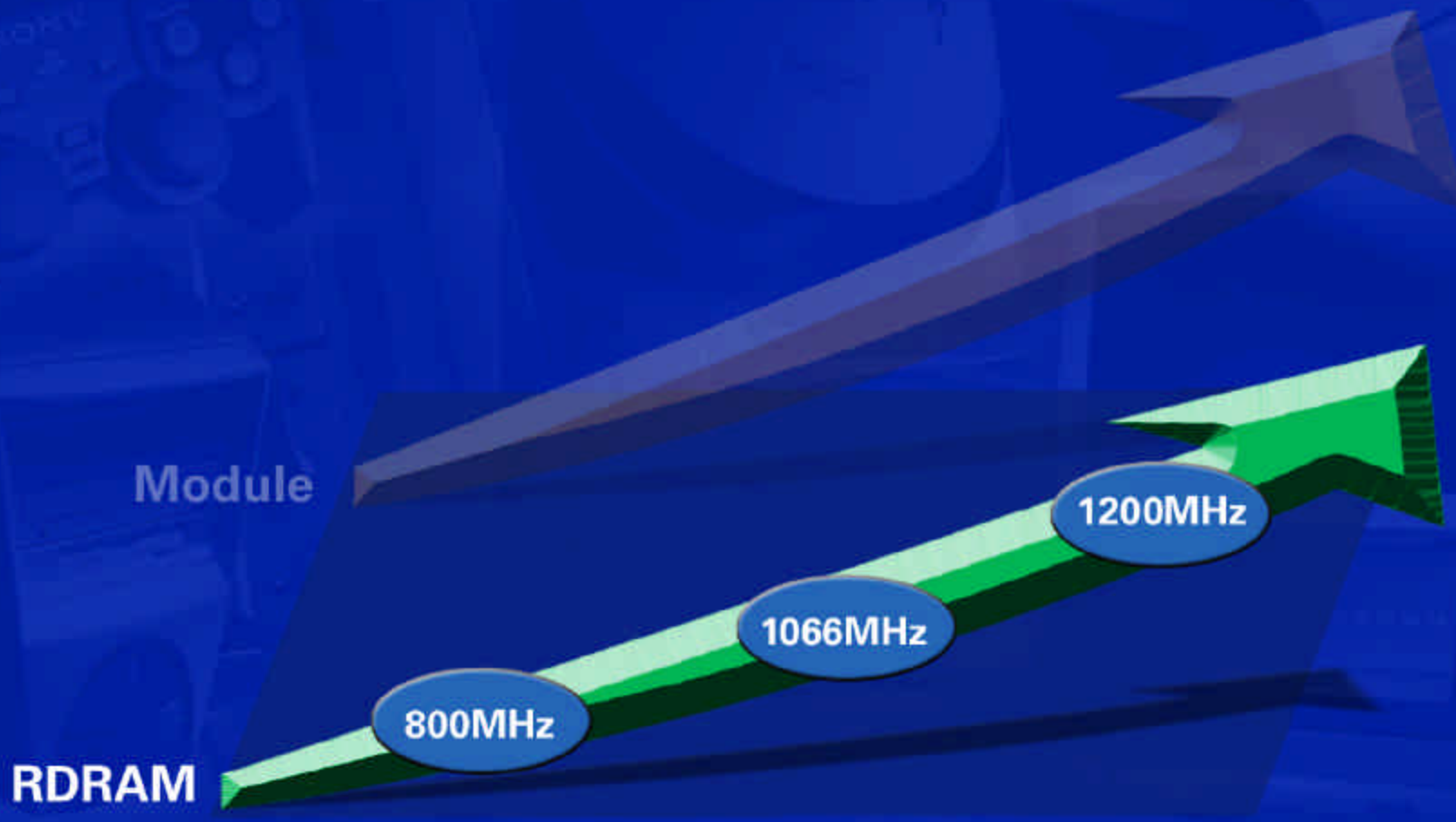


# Server Trends

**x86 High Density Blade Servers**


**High Performance Servers**

# Evolutionary Roadmap



# Evolutionary Roadmap

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# Speeding-up Communications

*Quality of Service*

*Network Processors*

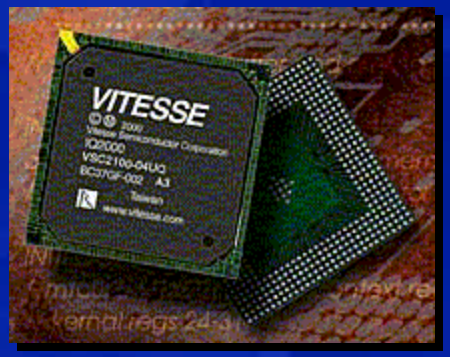
*Gigabit Ethernet*

*Serial Links*

*OC192*

*RaSer*

*OC48*


*RDRAM*

*Look up Tables*

*Gigabit Switch/Routers*

*OC768*

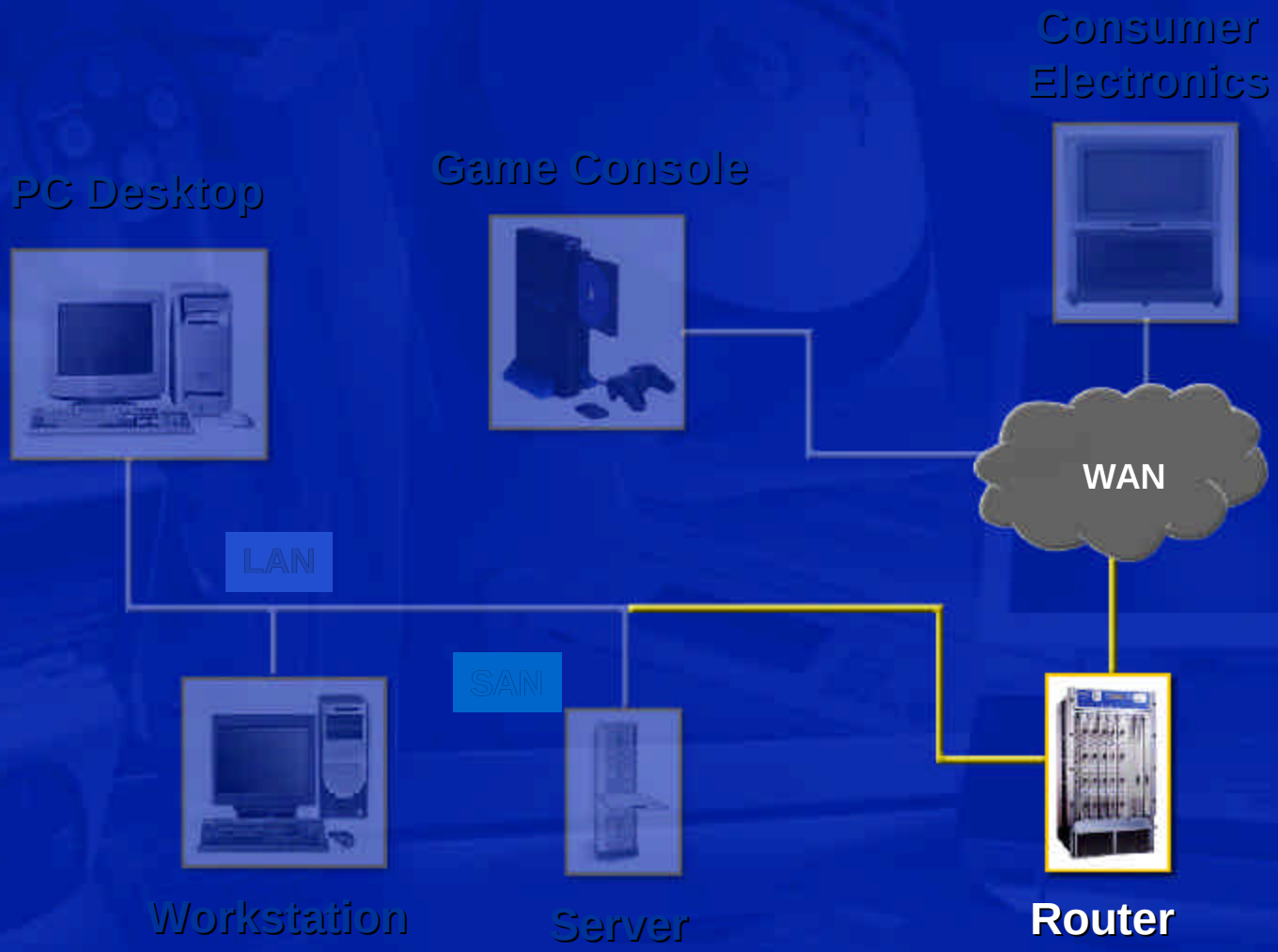
*Line Cards*

*Wire-speed routing*

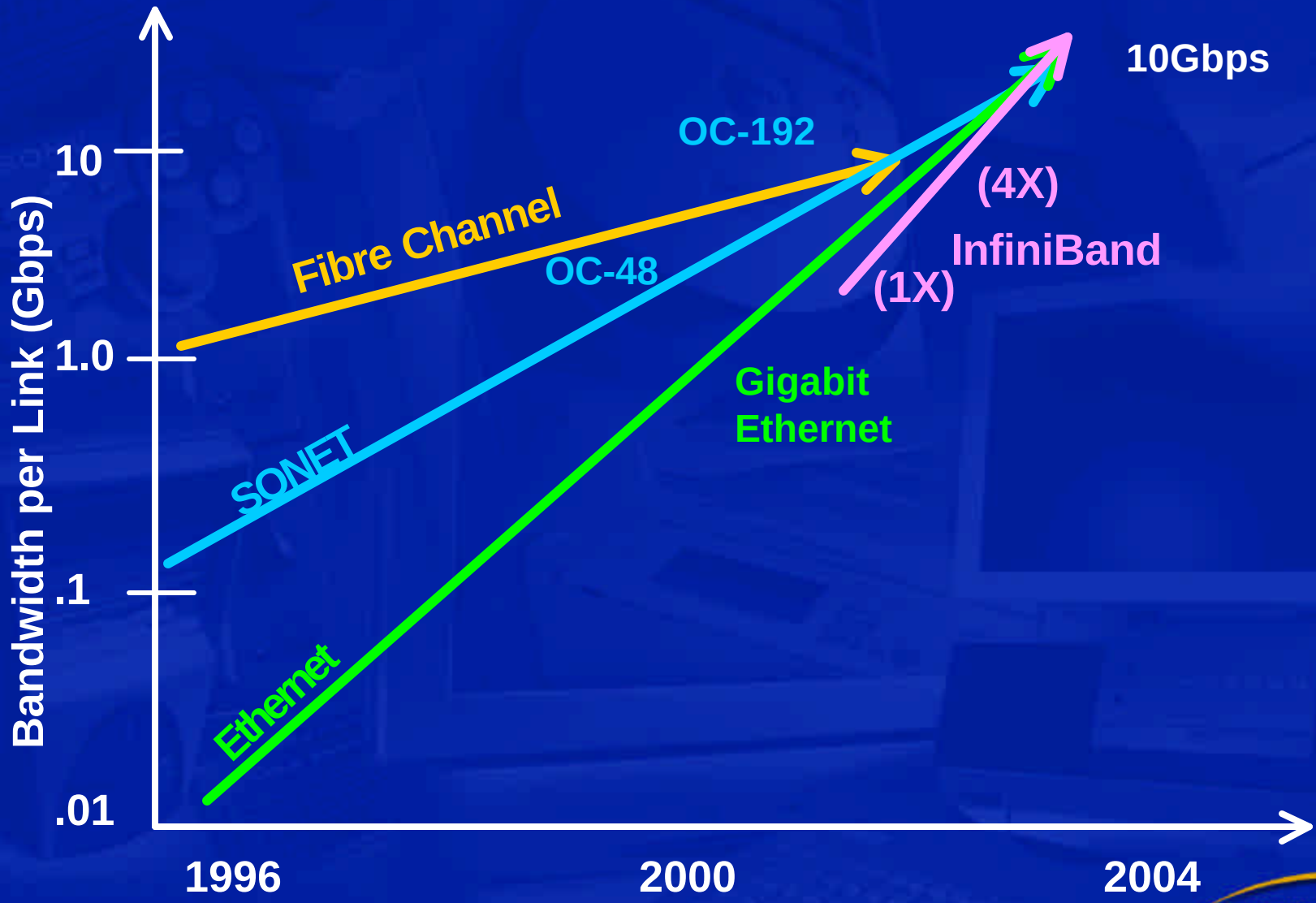
*Packet Buffers*

NEC tsmc IBM UMC LSI LOGIC TOSHIBA

# Bandwidth Needed Everywhere

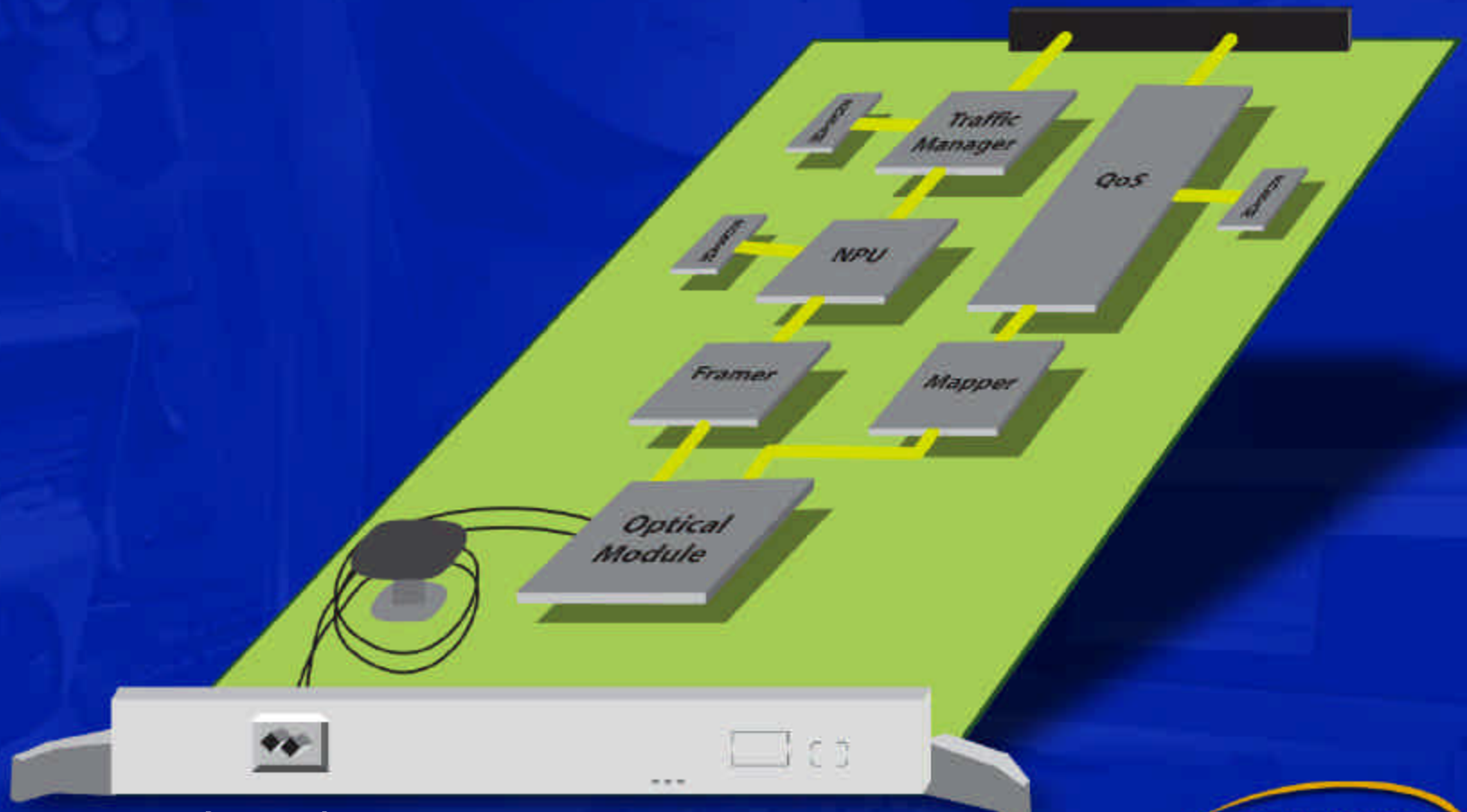


# Line Rate Speeds Increasing



# Serial Links Need High Bandwidth

Serial link bandwidth =
2-4x line rate




Line I/O

# Serial Links Need High Bandwidth

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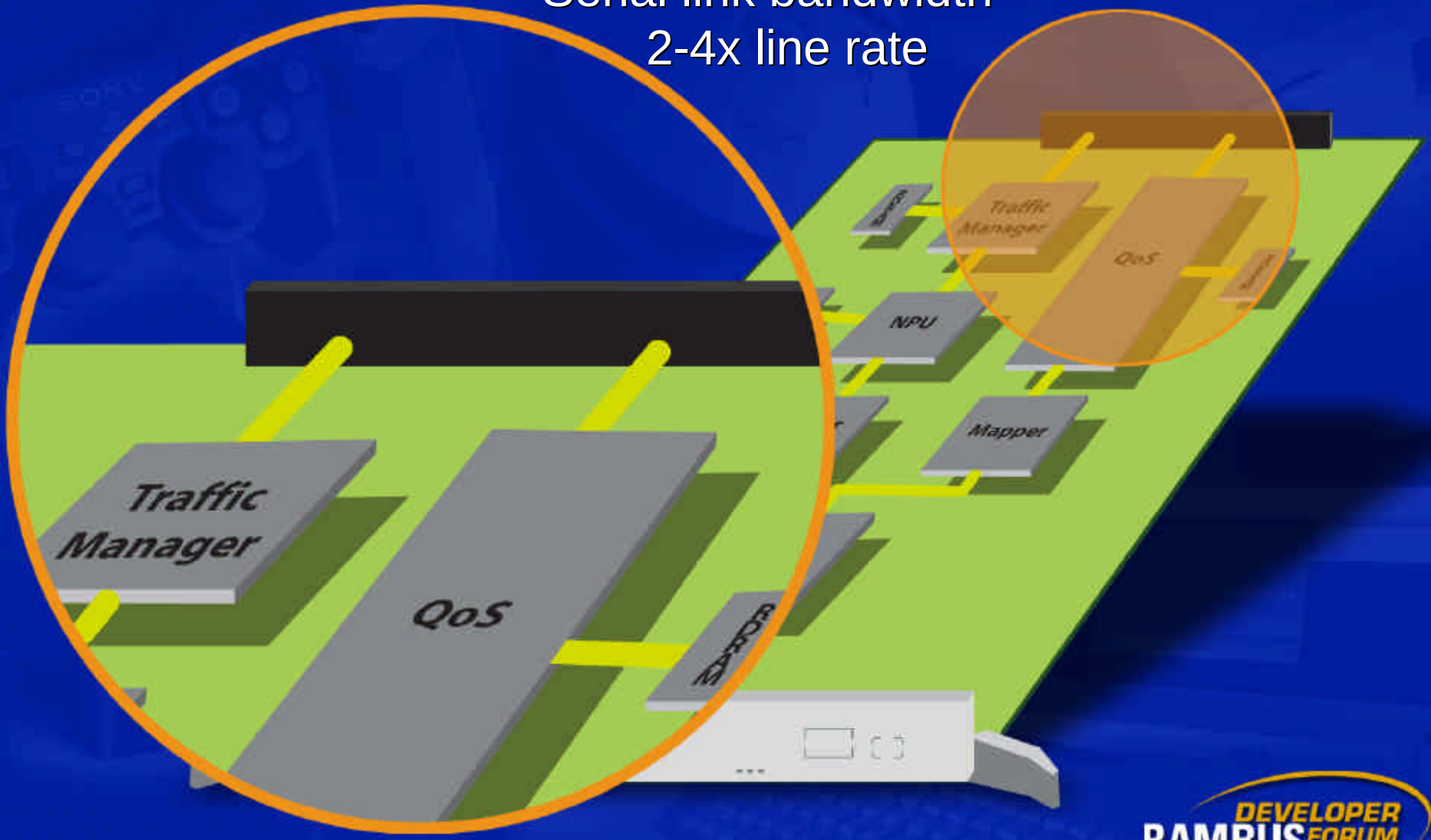
2-4x line rate



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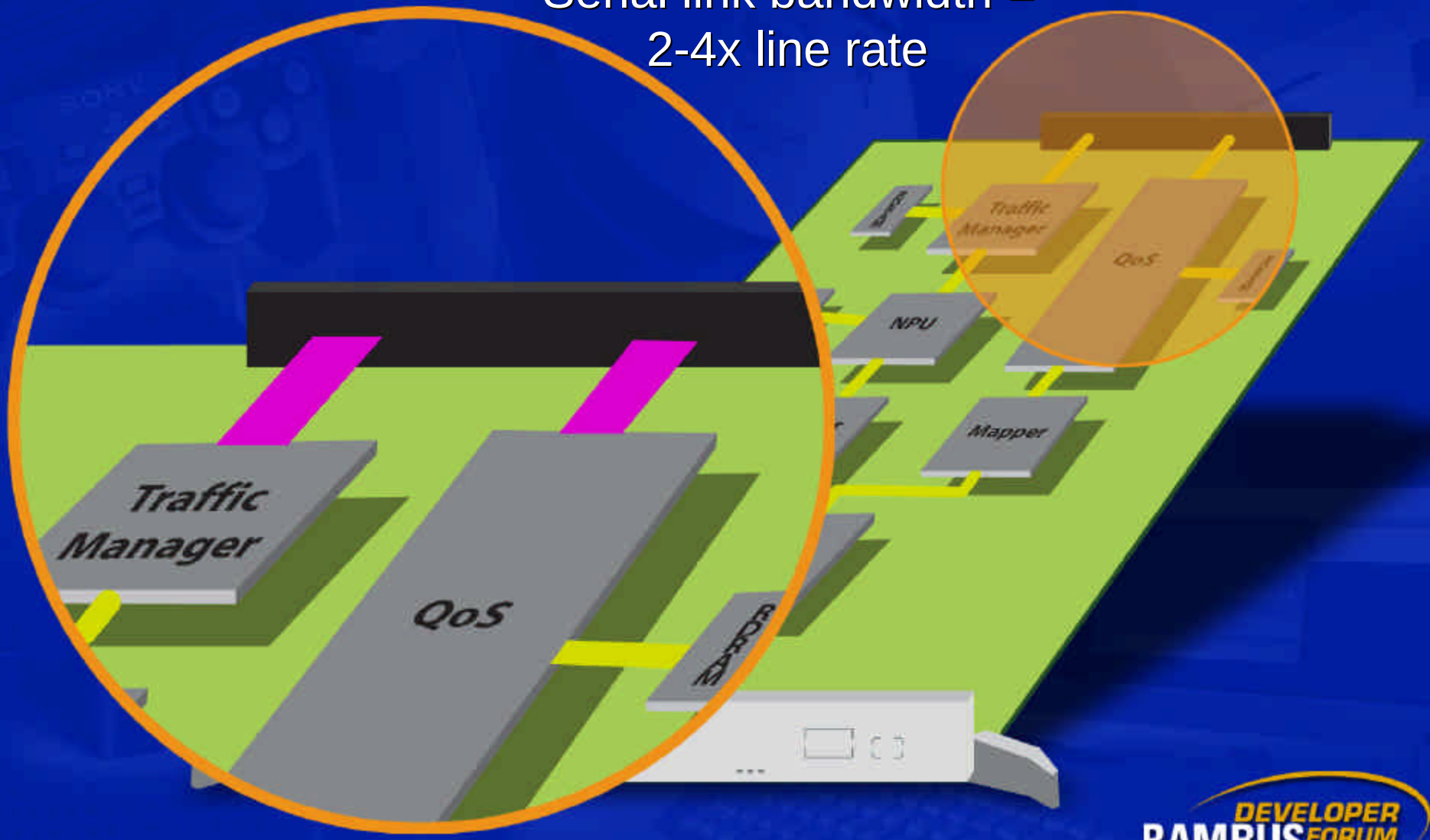
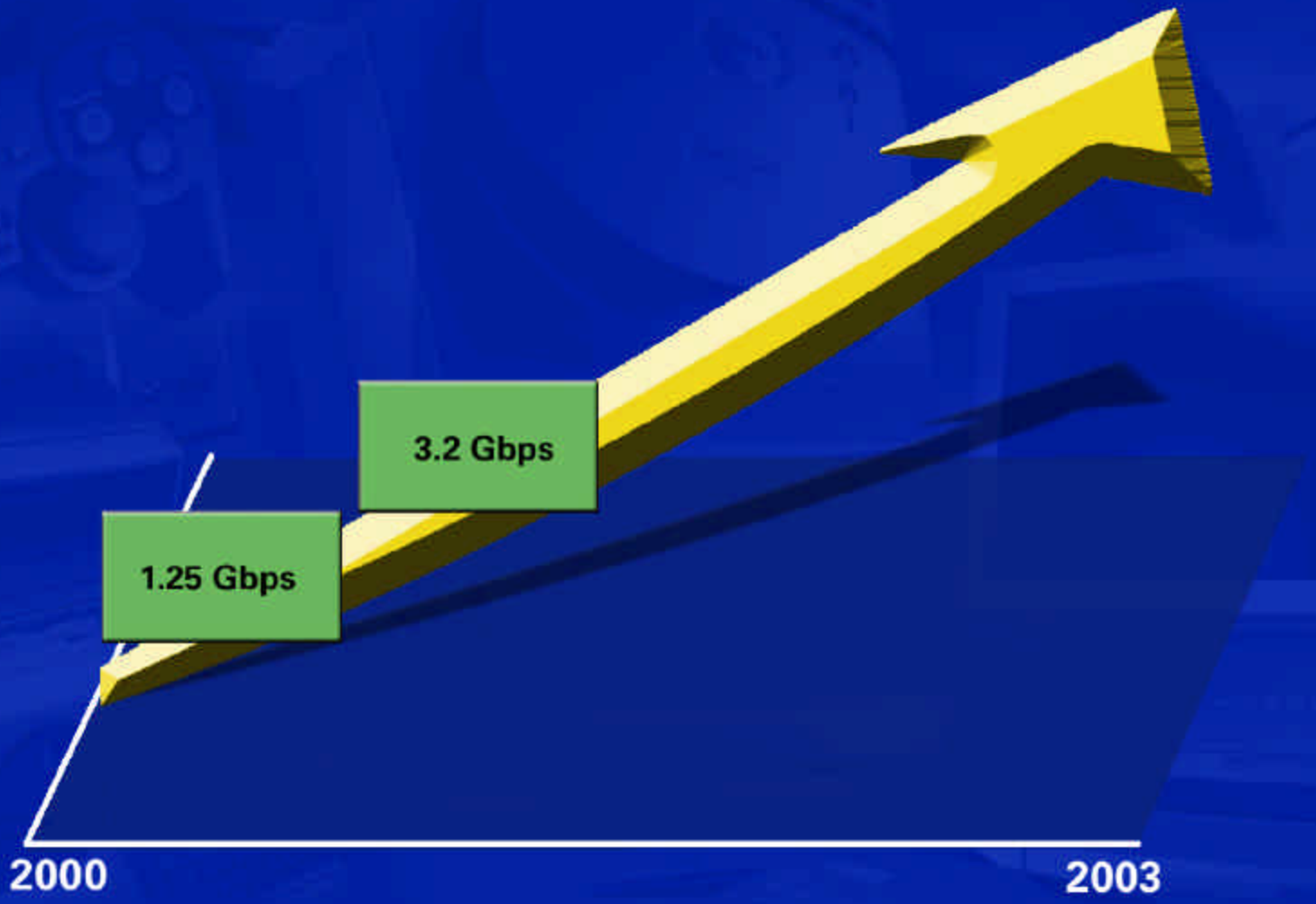
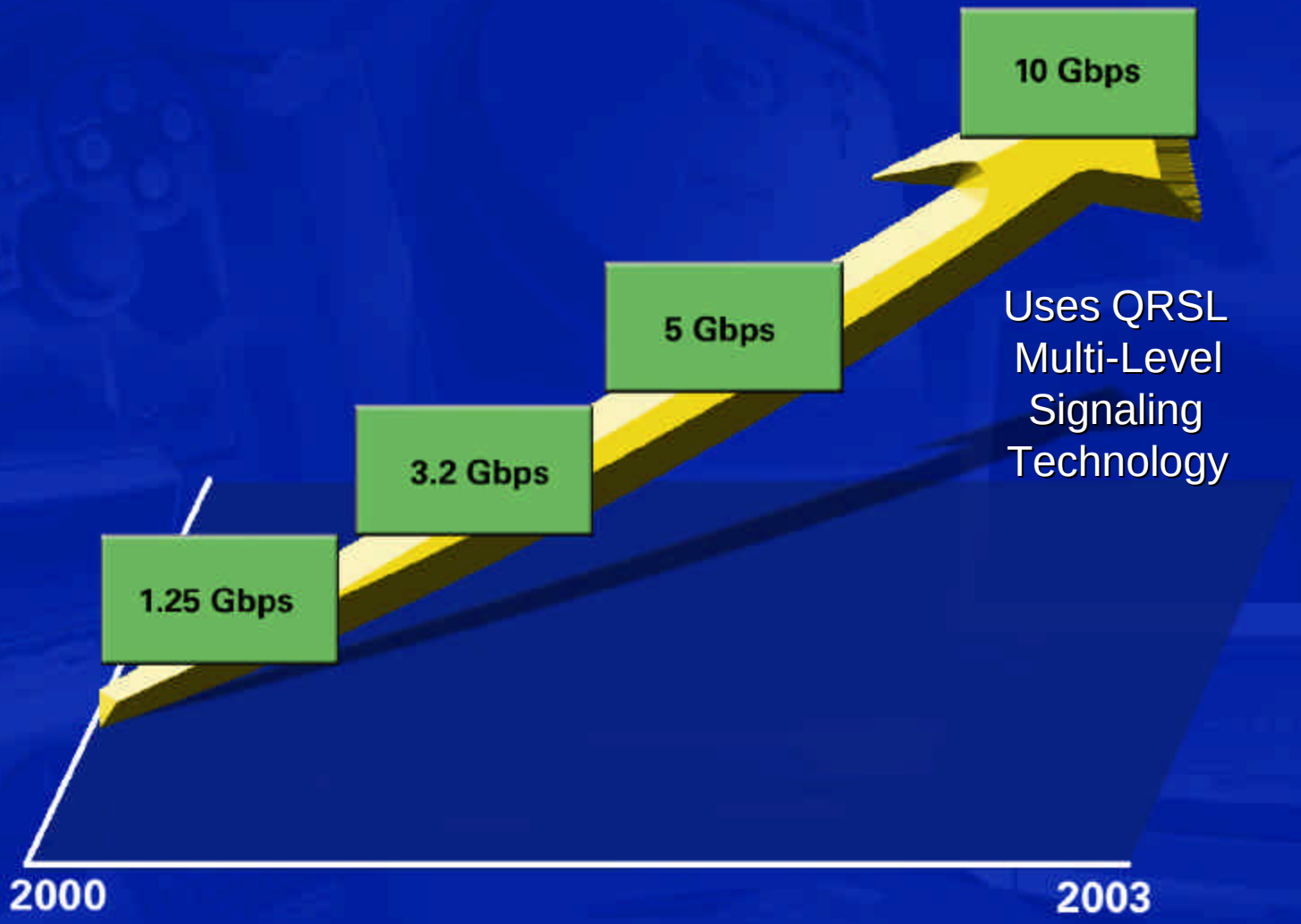


# RaSer™ Serial Link Roadmap

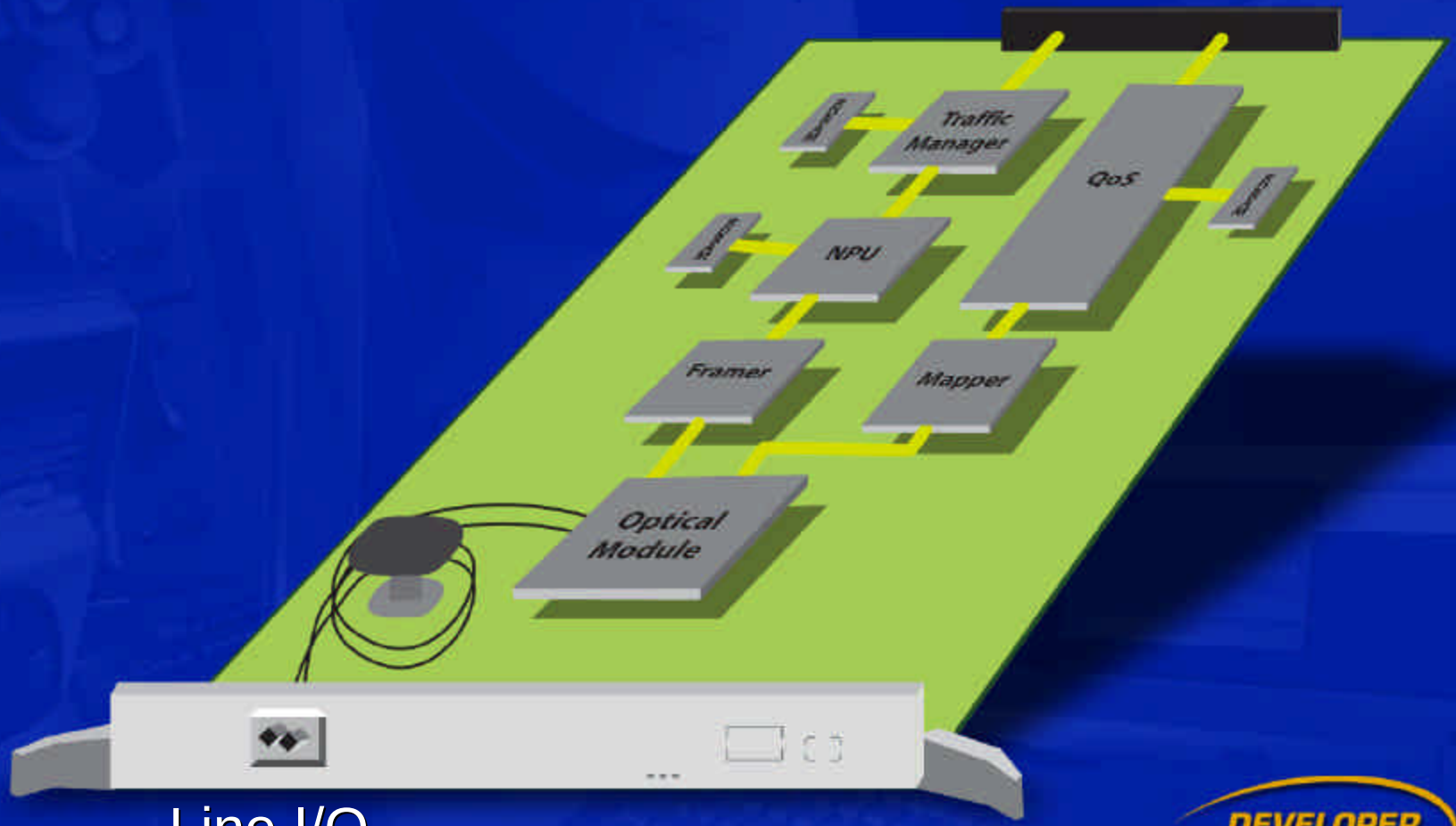


# RaSer Serial Link Roadmap



# High Bandwidth RDRAM Needed

Memory bandwidth =
2-4x line rate



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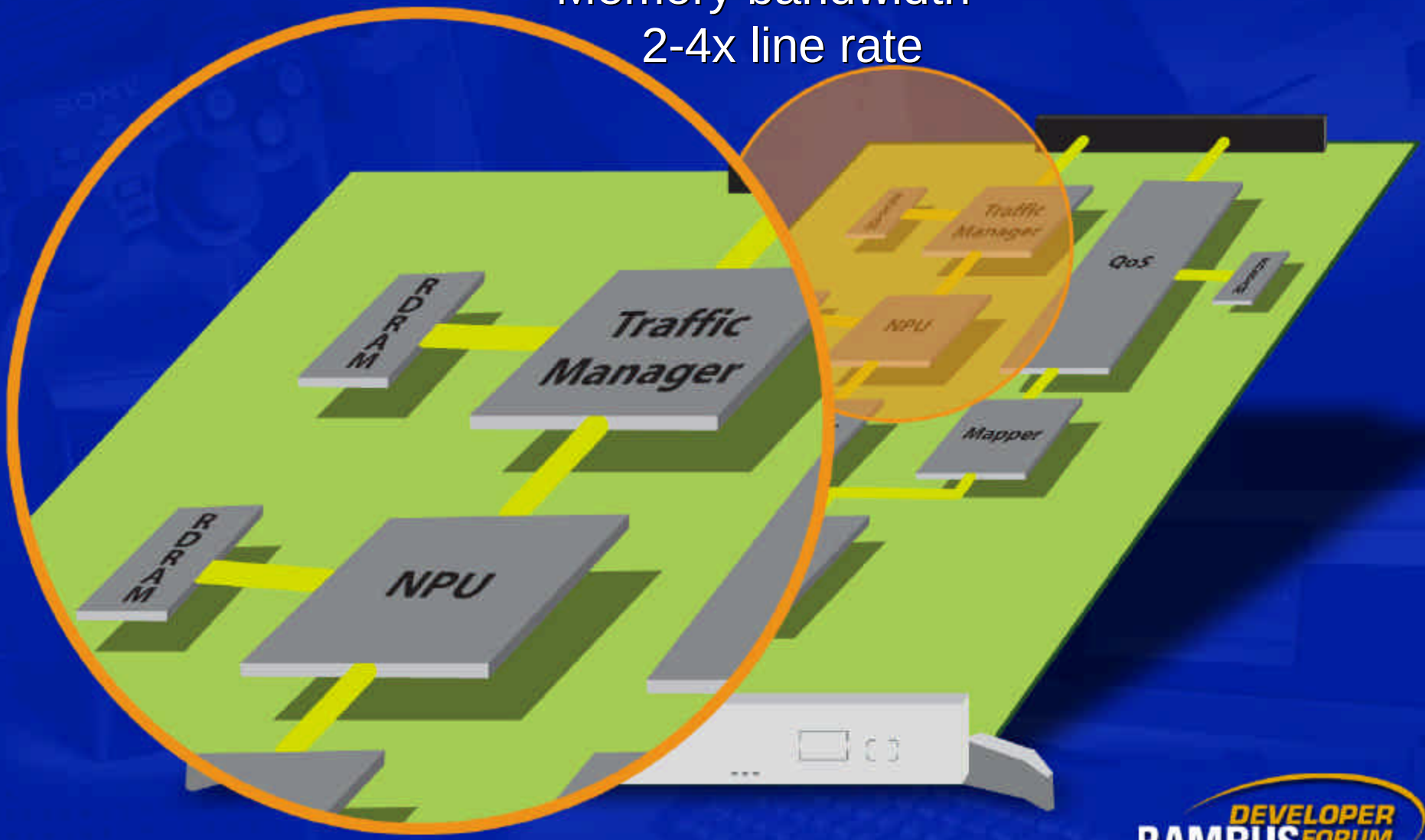

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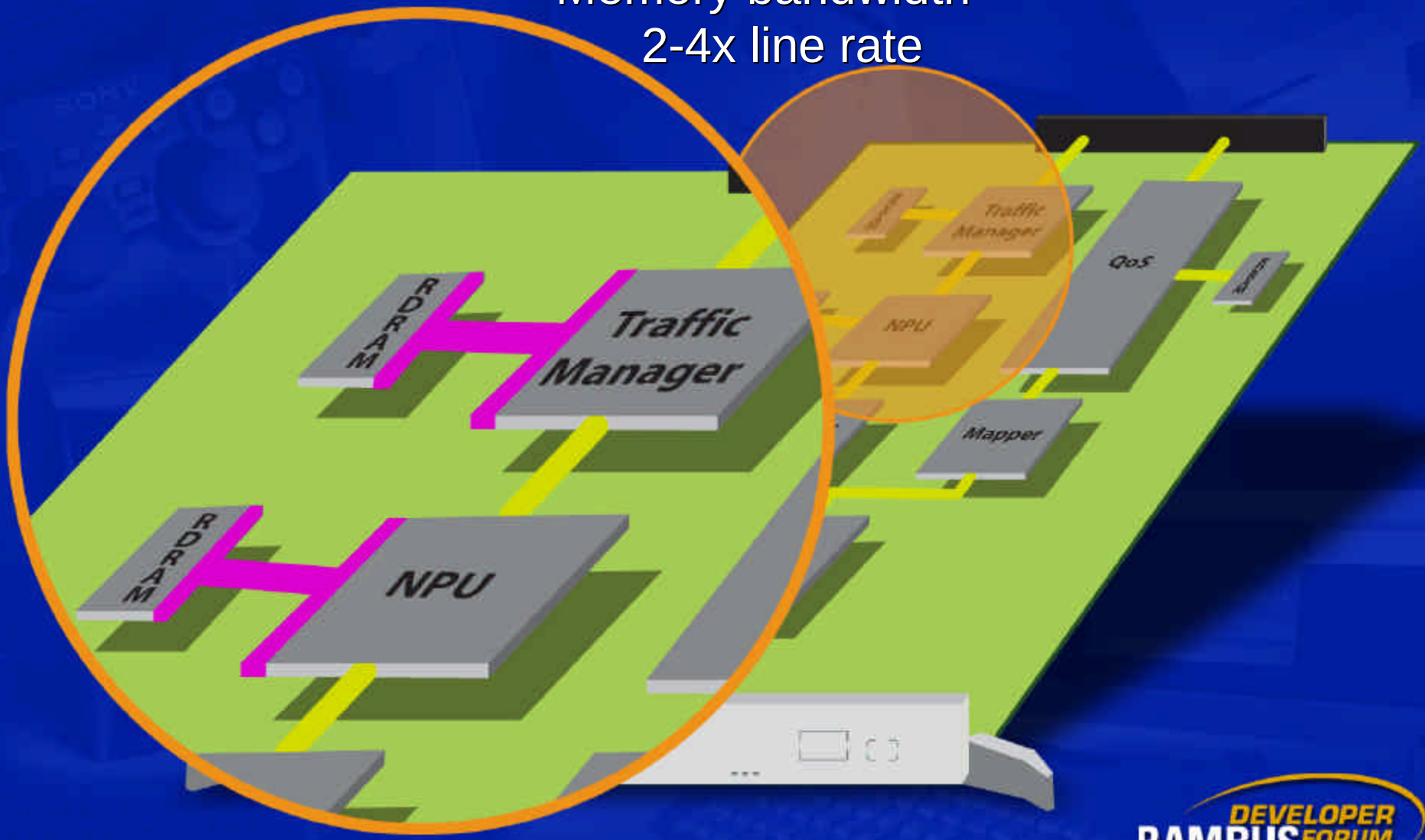
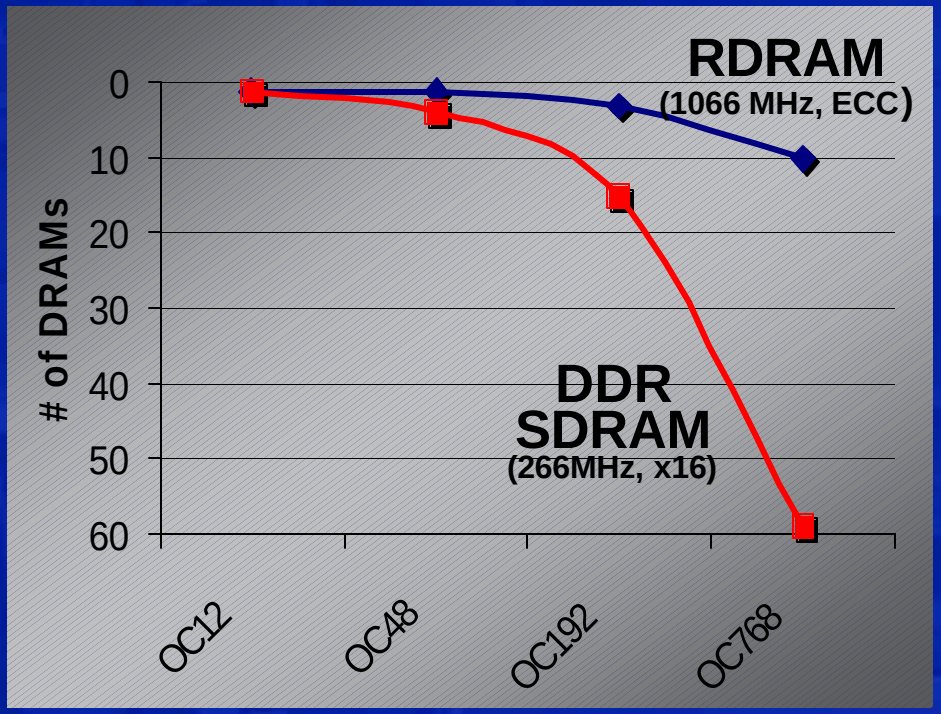
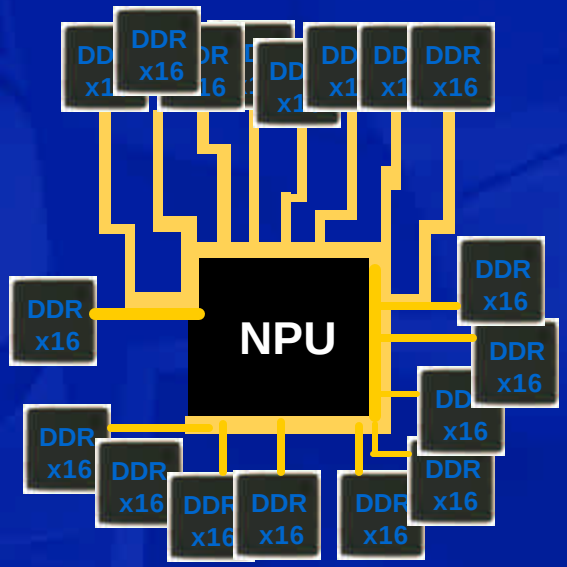
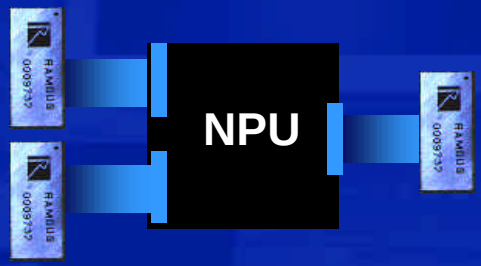


# RDRAM is Lowest Pincount and Smallest Footprint




**RDRAM VS DDR SDRAM**
**for OC192 NPU**

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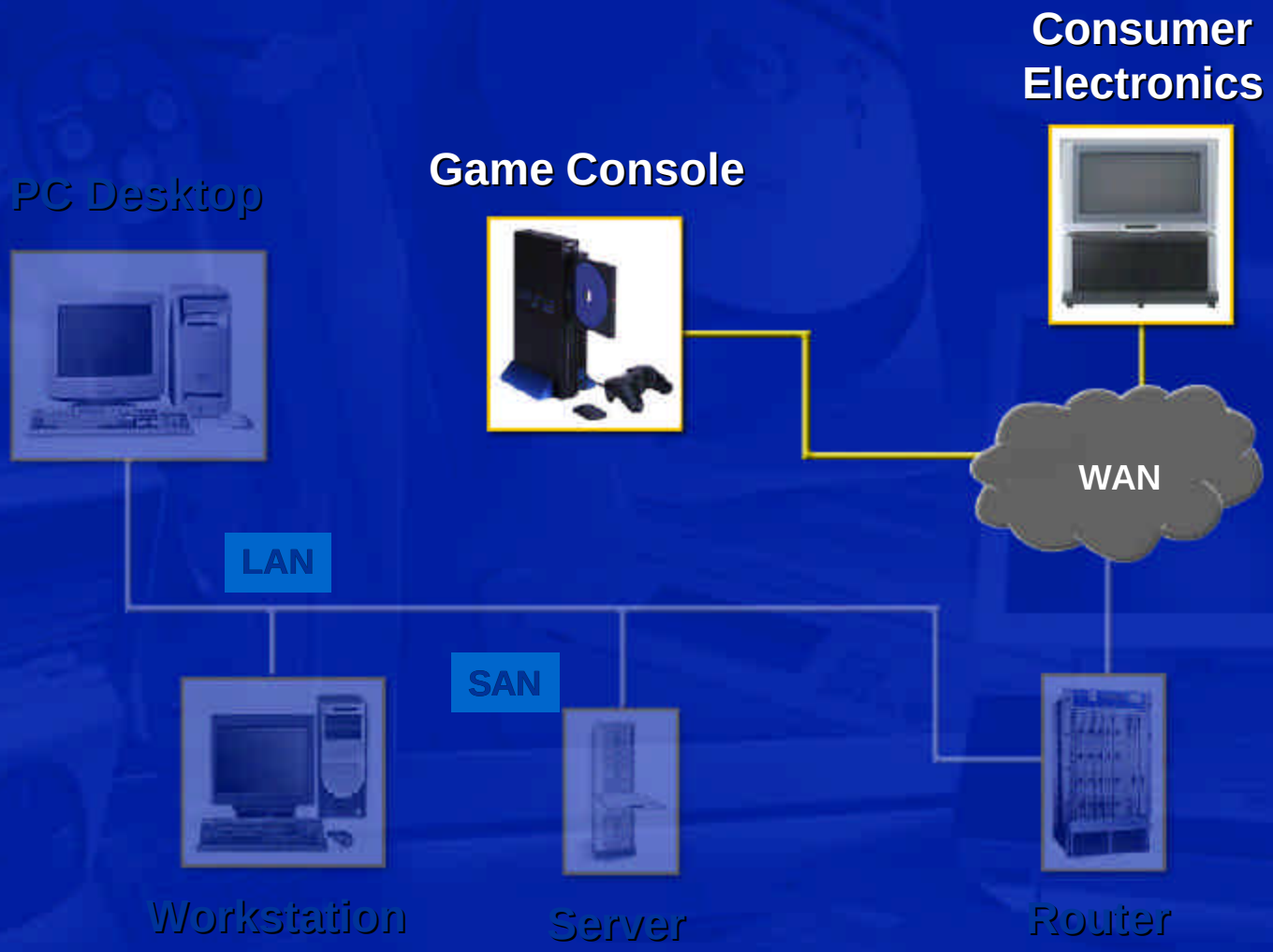
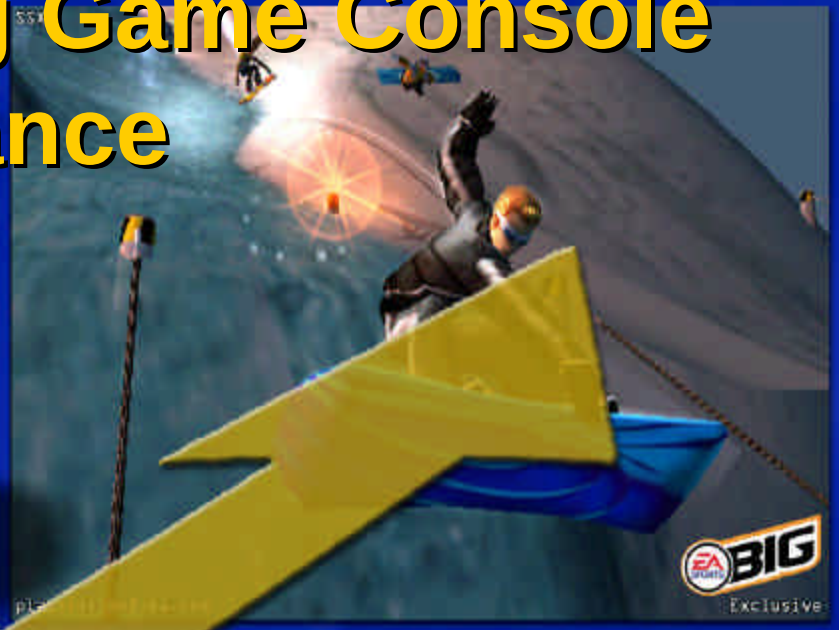
# RDRAM: At the Heart of the Digital Experience

# Bandwidth Needed Everywhere



# 3D Games Driving Game Console Memory Performance






**Game console bandwidth approaching 30 GB/sec in 2005**

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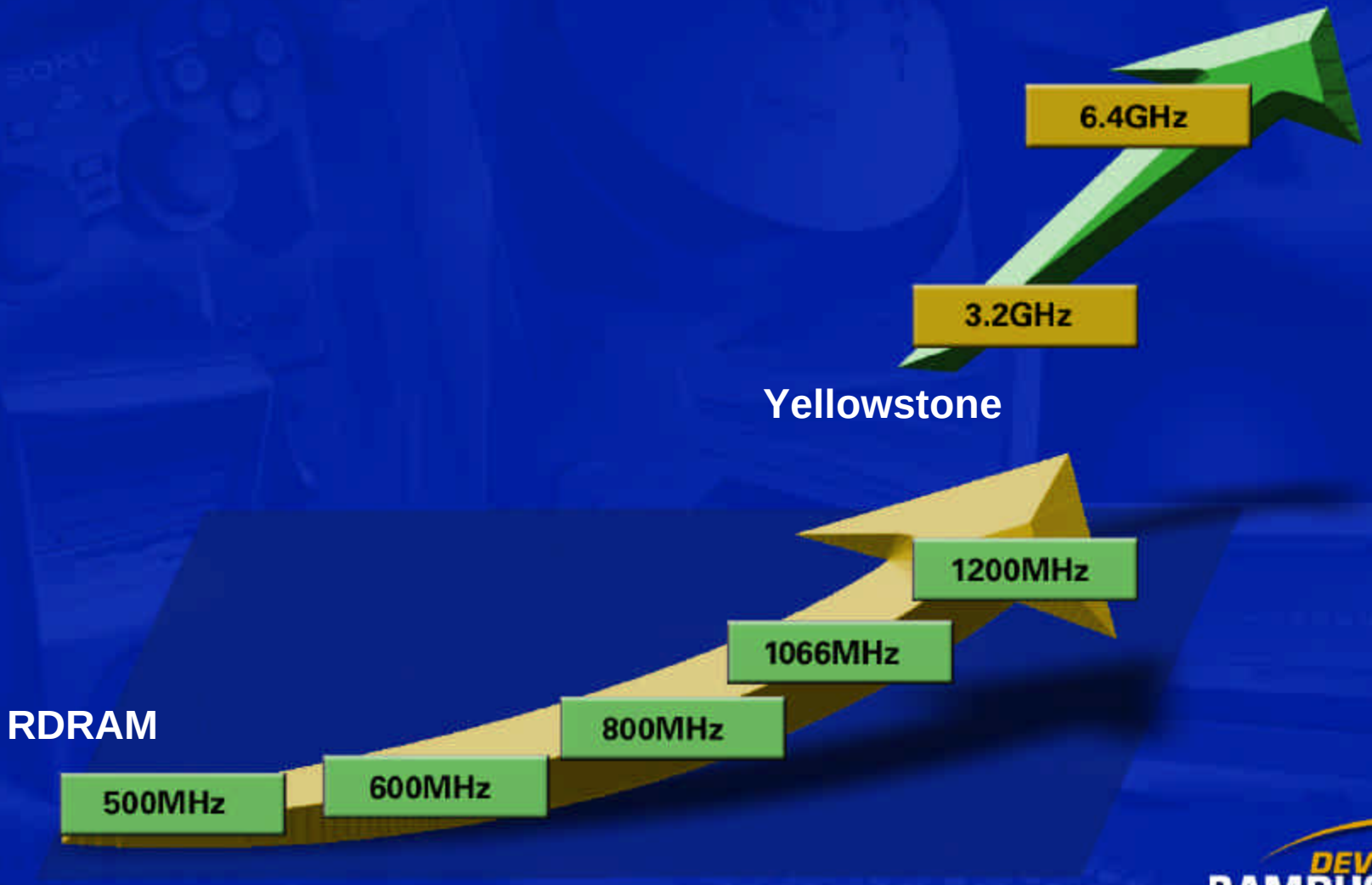
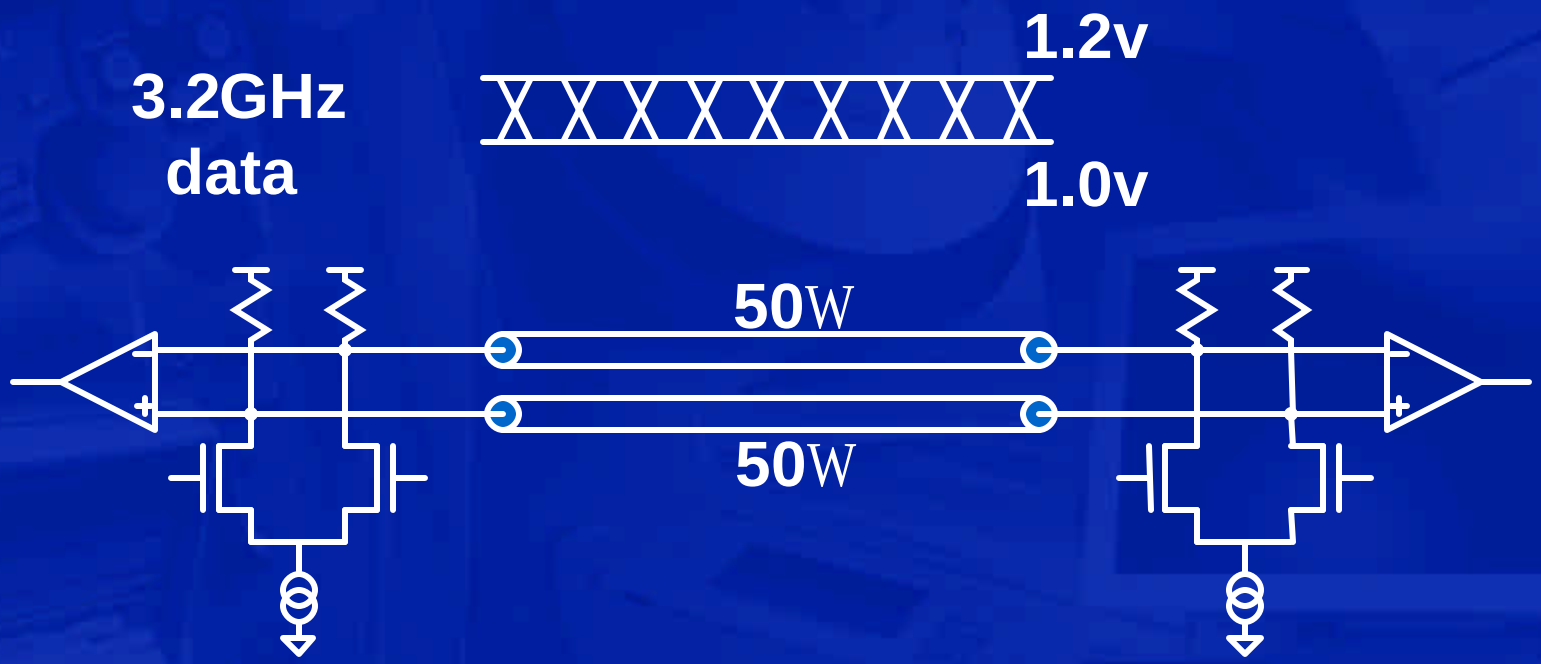
# Yellowstone: A Quantum Leap in Memory Signaling Technology

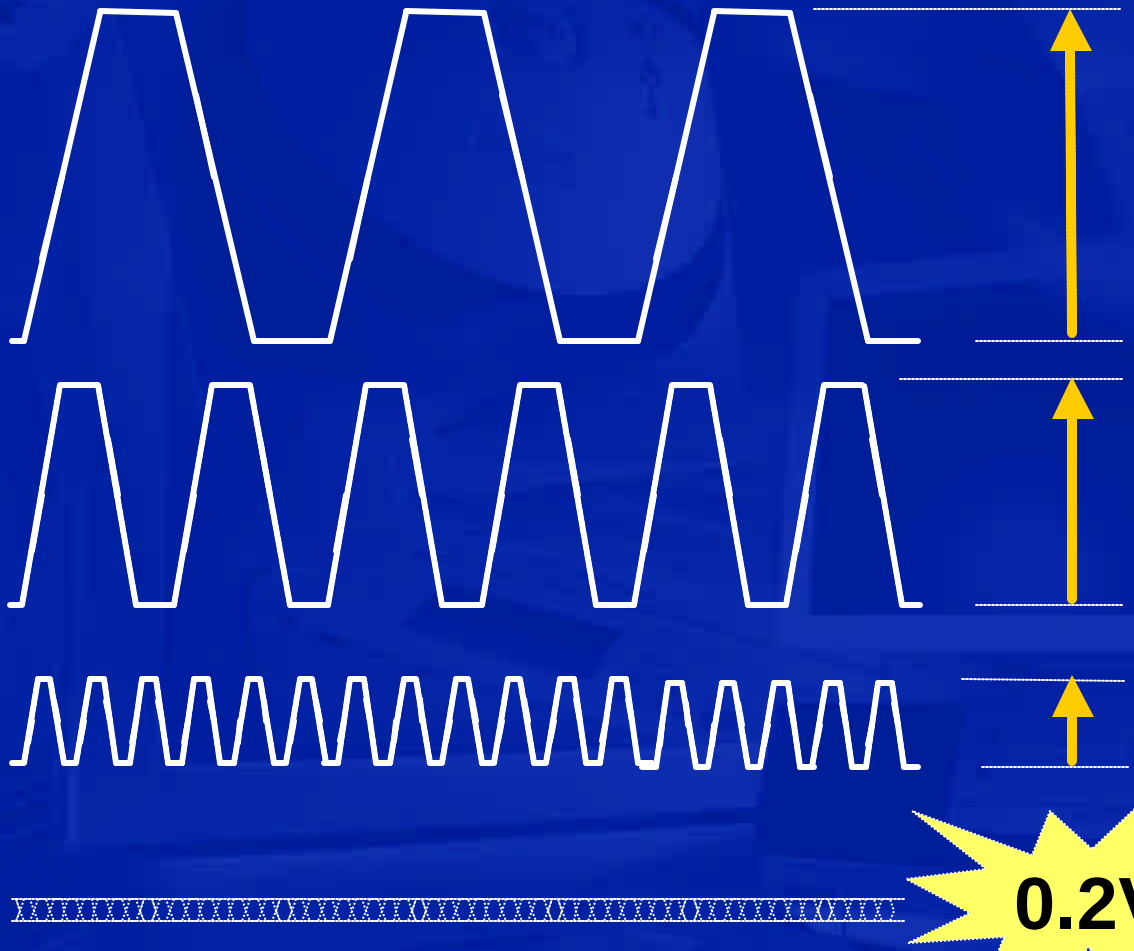


# DRSL: Differential RSL




- Bi-directional differential
- Ultra low 200mV swing
- On-chip termination

# Ultra Low Voltage Signaling



# ODR: Octal Data Rate

400MHz
system clock

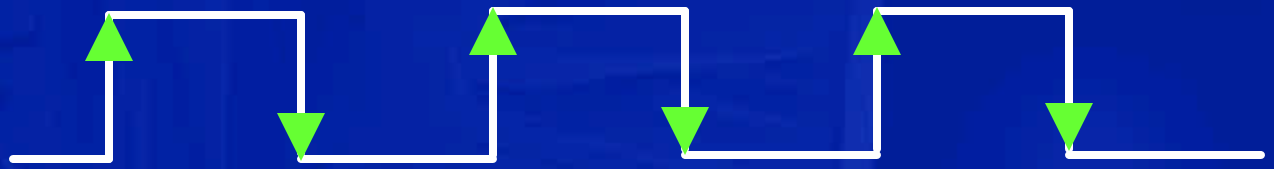
1.6GHz
on-chip clock

3.2GHz data

# Double Data Rate Signaling (DDR)

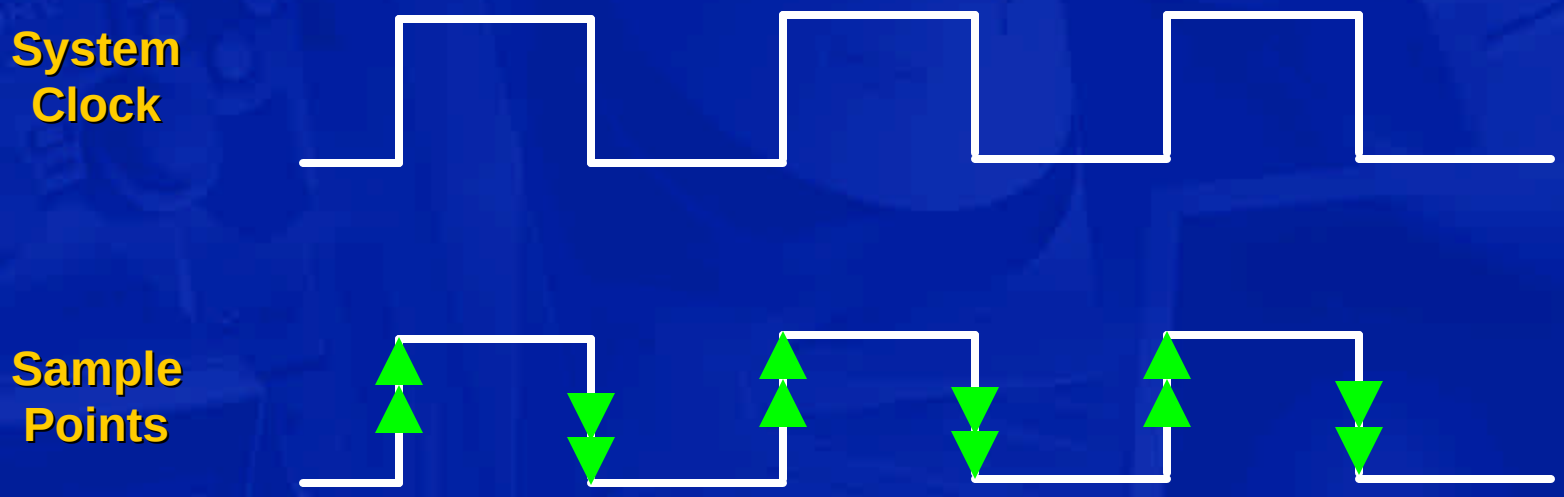
System Clock

Sample Points



## 2 bits per clock

# Quad Data Rate Signaling (QRSL)

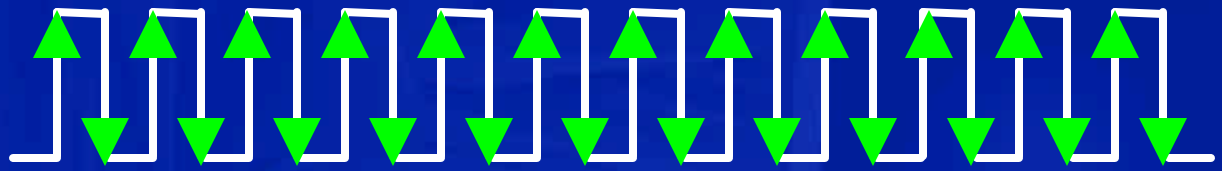



## 4 bits per clock

# Octal Data Rate Signaling (ODR)

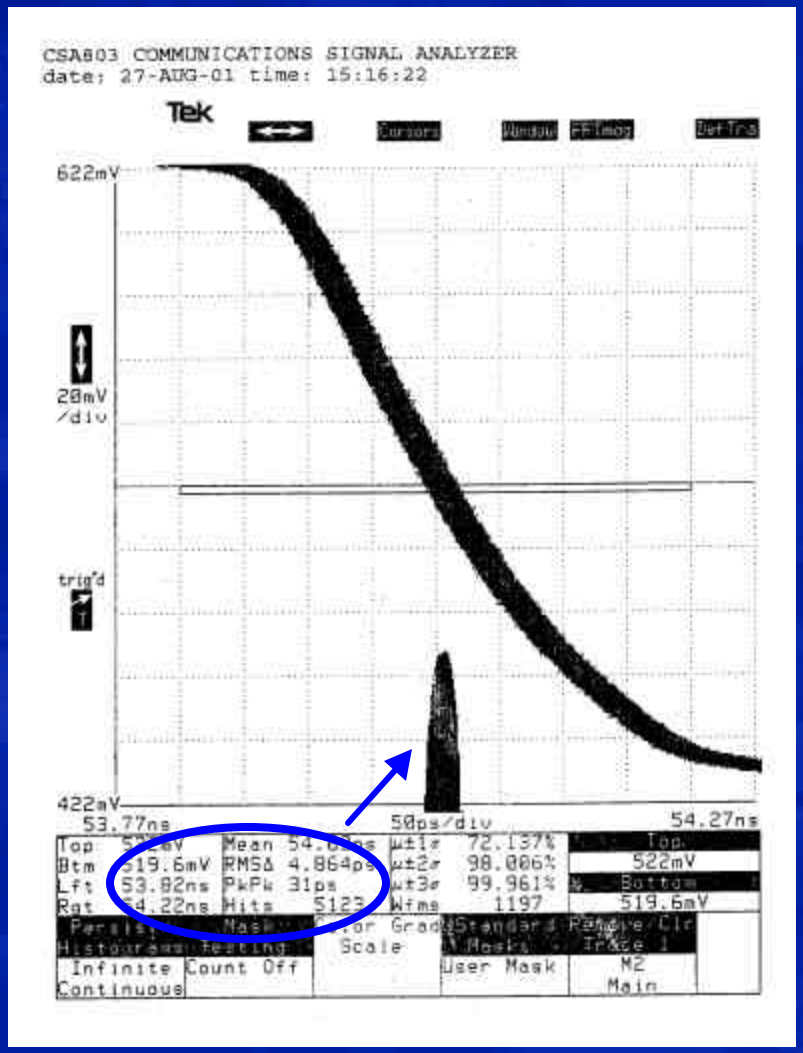
System Clock

Sample Points



**ODR is 8 bits per clock**

# 3.2GHz DRAM PLL Operation




- Yellowstone PLL fully functional
- VCO operational
- Very low jitter (~30ps) on sample clock

# Low Cost Signaling

- **Uses industry standard components**
  - Cheap 4-layer PCBs
  - Existing commodity packaging
- **Tailored for low cost systems**
  - Reduces pin-count and footprint
  - Supports commodity DRAM cores
  - Eliminates termination resistors

# Yellowstone: A Quantum Leap in Memory Signaling

- **3.2GHz data rate with roadmap to 6.4GHz**
- **Applies the latest Rambus innovations**
  - DRSL - Differential RSL signaling
  - ODR - Octal Data Rate
- **Ideal for consumer electronics and communications**
  - Applicable to computing platforms in the future

# Yellowstone Q&A Session

- Hosted by Laura Fleming, VP
- 11:00 A.M. following Sony Keynote
- San Jose Conference Room

# Summary

- RDRAM: Pure Performance
- RaSer: Serial Link Leadership
- Yellowstone: Quantum Leap

**Thank you!**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