IBM GLOBAL SERVICES

Session V10

Converged Network Interface Controllers (CNIC) – The Enabler for Multi-Function Ethernet Networks

Allen Light – Broadcom Corp.

IBM @server xSeries Technical Conference

Aug. 9 - 13, 2004

Chicago, IL

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Agenda

- About Broadcom
  - Who we are, what we do in the communications industry
- Convergence on Ethernet
  - Multiple heterogeneous networks are expensive and in-efficient
  - Ethernet must evolve in order to take on new roles
    - Block Level Storage Networking
    - Clustering
- Enter Converged Network Interface Controllers (CNIC)
  - TCP/IP Protocol Offload
  - iSCSI Protocol Offload
  - RDMA Technology

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About Broadcom

- Broadcom Corporation was founded in 1991 with an initial public offering in April 1998 (NASDAQ-BRCM)
- Largest company focused exclusively on semiconductors for communications applications

- 2003 revenue of $1.61 billion with currently 2,774 employees worldwide
  - 11 consecutive quarters of revenue growth
- Proven leadership expertise in mixed-signal and CMOS RF technologies, full-custom processor and DSP design and state-of-the-art system-on-a-chip (SoC) implementation
- Industry's broadest broadband product portfolio addressing every major communications market

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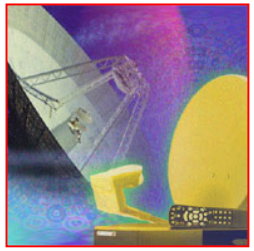
Our Mission:

Global Leadership in Delivering Silicon Solutions for Broadband Communications to the Home, Enterprise, and Mobile Markets



Cable & Satellite Set-Top Boxes

Cable Modems

DSL

Wireless Networks

Mobile Communications

Server/Storage Networks

Enterprise Switching

Gigabit Ethernet

Network Infrastructure/ Voice over IP

Broadband Processors

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Strategic Business Groups

Broadband Communications

Enterprise Computing

Mobile & Wireless

Networking Infrastructure

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Enterprise Computing Overview

Complete Network Interface Card and LAN on Motherboard Solutions

Fast Ethernet Controllers

Gigabit Ethernet Controllers

NAS and RAID Storage Solutions

Software/Firmware Drivers

Server I/O Chipsets

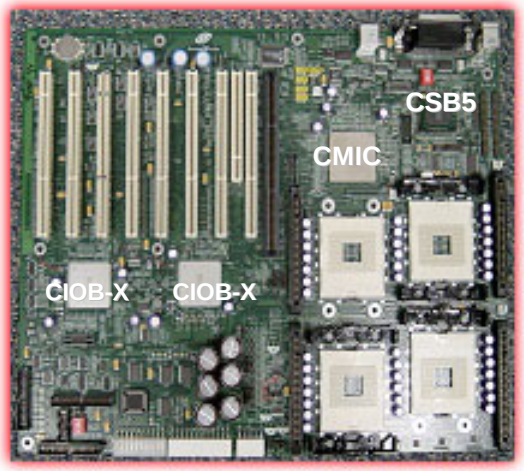
For Notebooks, Desktops, Servers, Workstations and Storage Applications

Leading Customers

IBM DELL hp invent AMD SAMSUNG BROADCOM Connecting everything

Server I/O Products

- Leading supplier of System I/O integrated circuits
- Field-proven and deployed with over 10 million chips shipped
- ServerWorks Grand Champion™ HE SystemI/O
- Champion™ HE, LE, CIOB and CIOB-E SystemI/O
  - First core logic to integrate Gigabit Ethernet (CIOB-E)
- Penetration of all major Taiwanese motherboard manufacturers of servers and workstations



4-Way Server Reference Design

Leading Customers

IBM · FUJITSU SIEMENS COMPUTERS · hp invent · DELL · intel · BROADCOM Connecting everything

Ethernet Controller Products

- **Seven generations of industry leading Gigabit Ethernet solutions**
- **First controllers to support the PCI Express™ spec**

Gibabit Ethernet NIC Card

- **Proven software driver platform qualified at all Tier 1 OEMs**
- **Design wins at all leading Tier 1 OEMs with over 100 programs announced and in production**
  - Leading provider of both NIC and LOM designs Expanding Gigabit Ethernet leadership across all segments
- **Over 30 million Gigabit Ethernet ports shipped**

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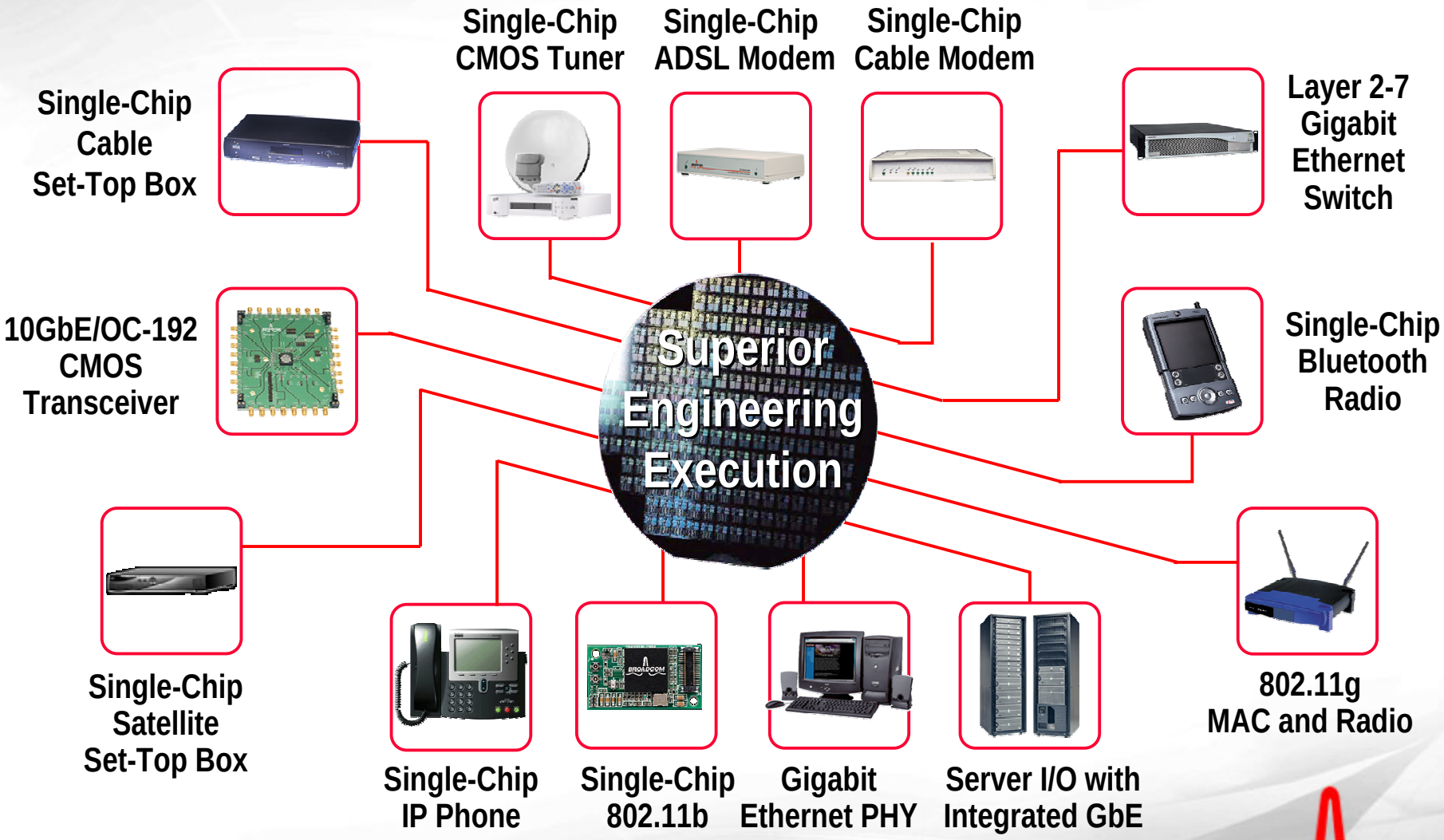
Track Record of Technology Firsts



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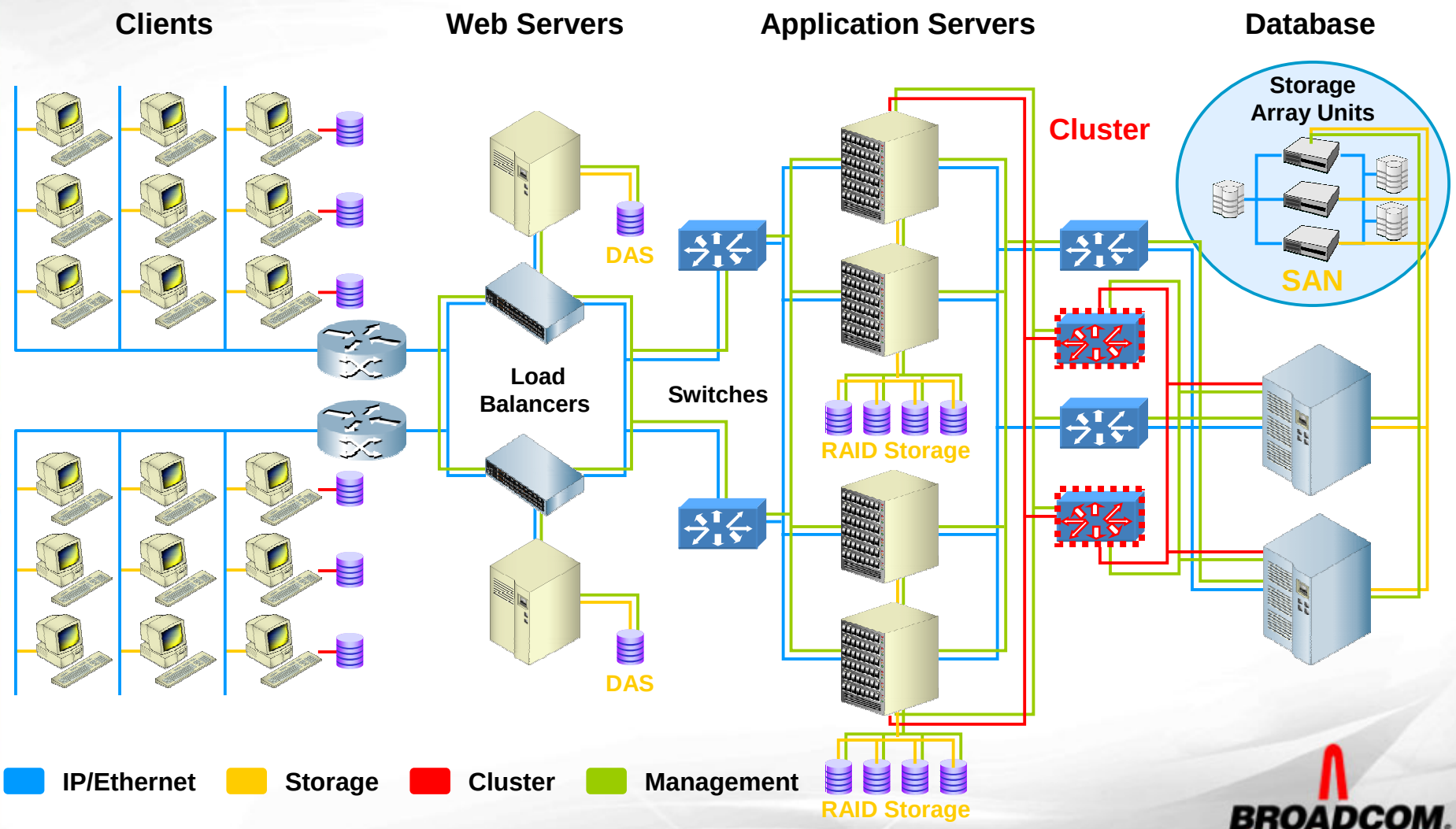
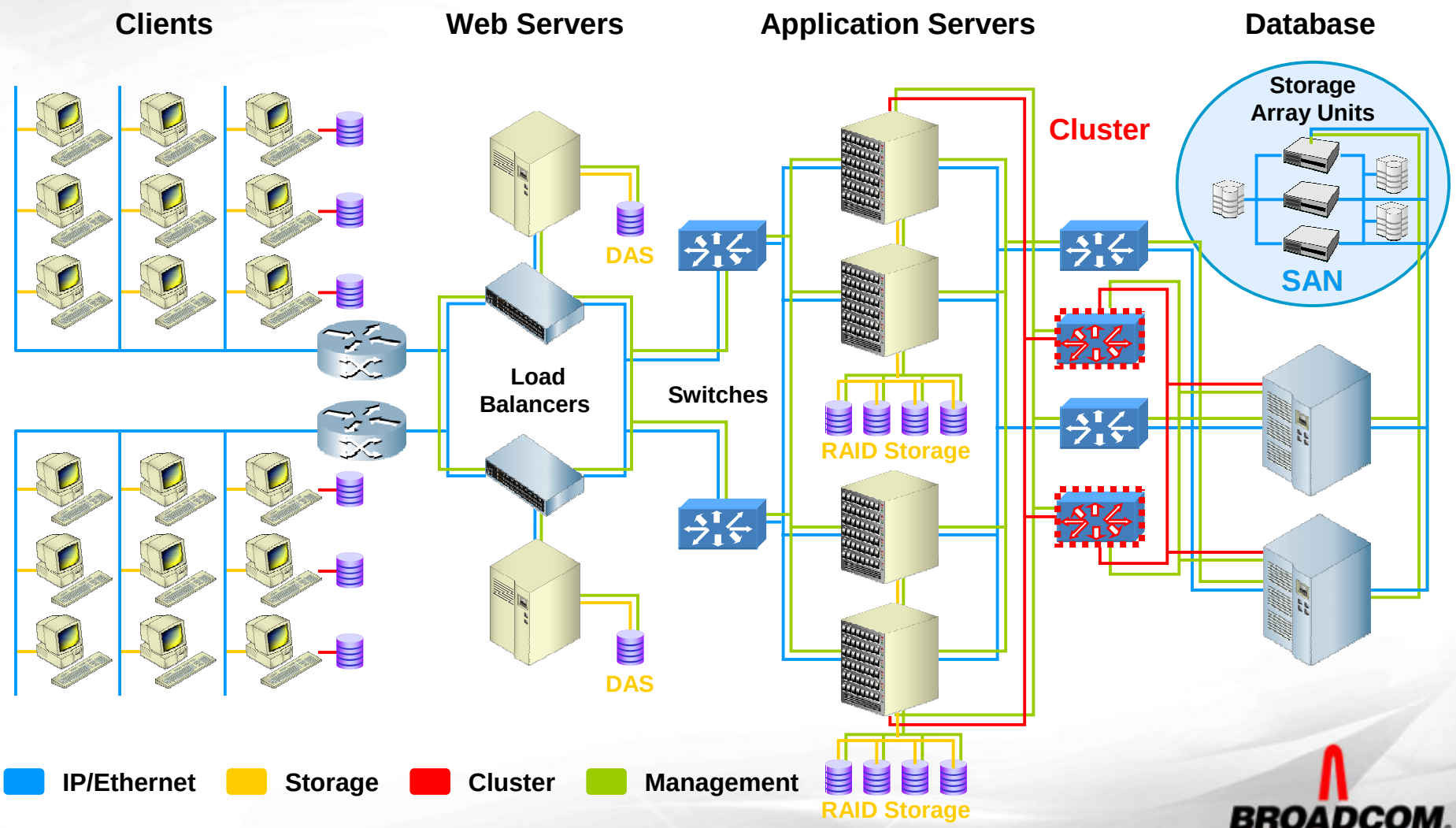
Convergence on Ethernet

Enterprise Network Today



Converged Network



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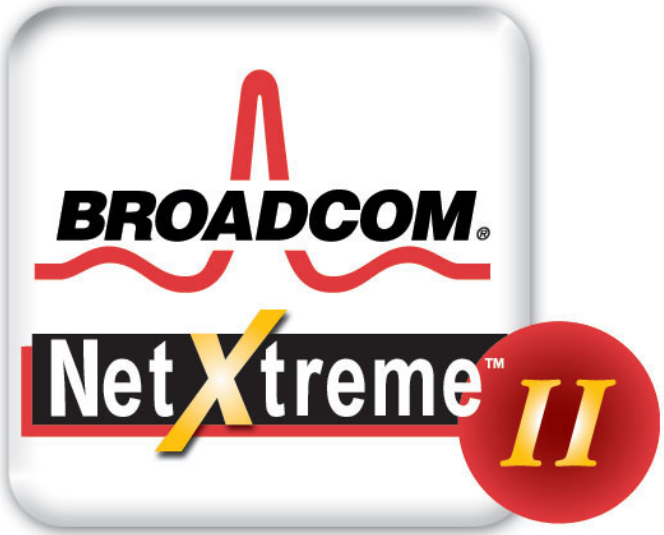
Slide 12

Solution — Convergence on Ethernet

- Networking - TCP/IP offload engine (TOE)
- Storage Networking - SCSI over IP networks (iSCSI)
- Clustering - Remote Direct Memory Access (RDMA) over TCP/IP
- Management – Utilize your existing Ethernet Infrastructure for “in band” Management transport



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Broadcom's BCM5706 Controller

- Industry's First C-NIC Gigabit Ethernet Controller
- Features
  - TOE Chimney Engine
  - RDMA,
  - iSCSI
- Sampling: Now, Channel Availability: 2nd half '04

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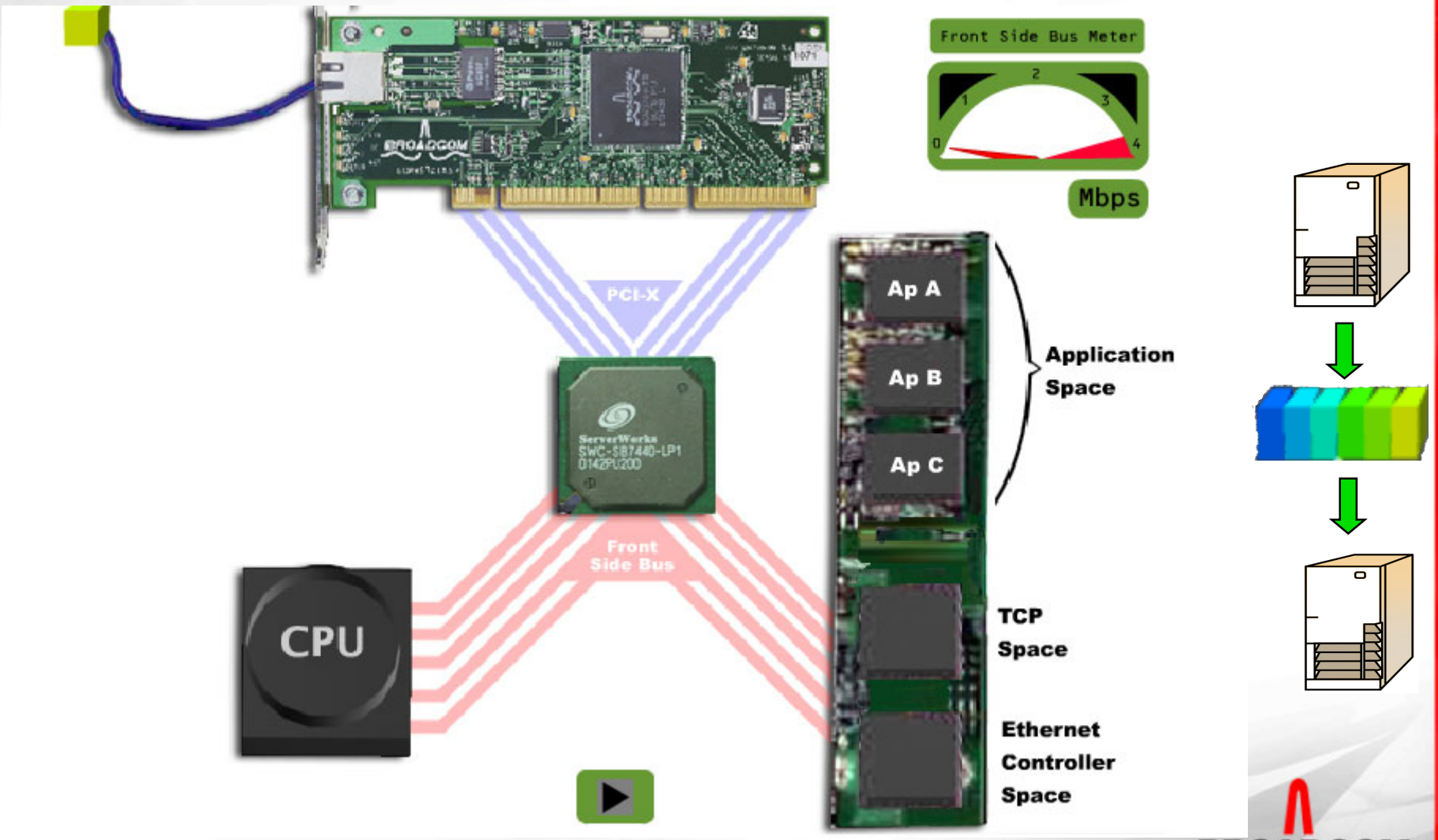
TCP/IP Receive Illustrated



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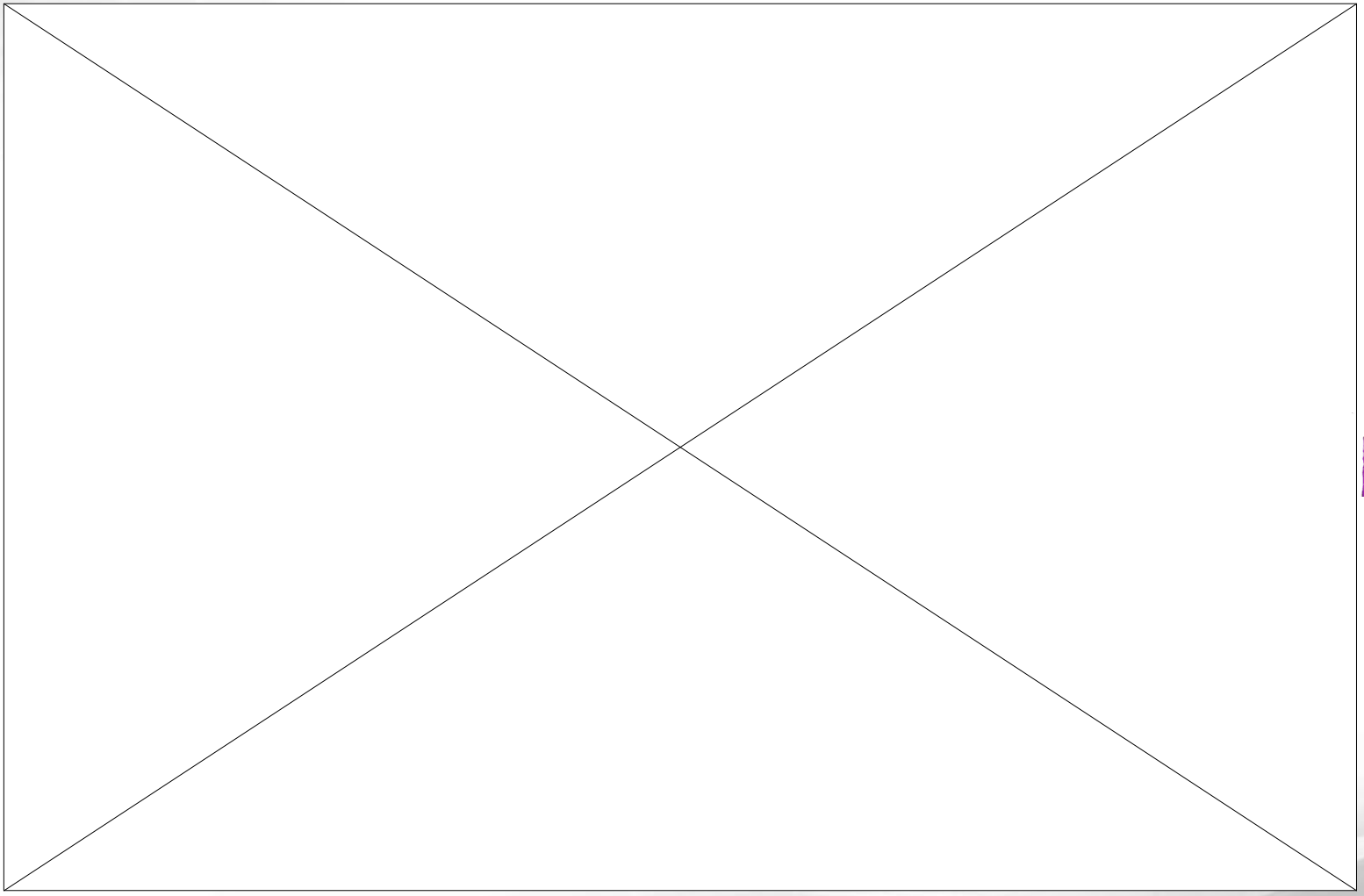
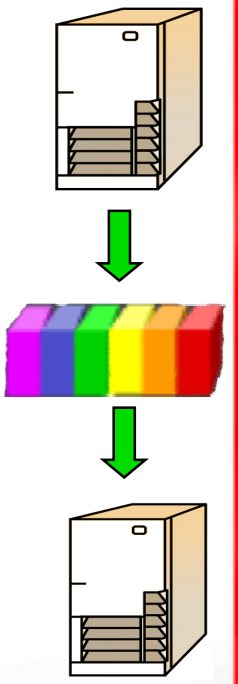
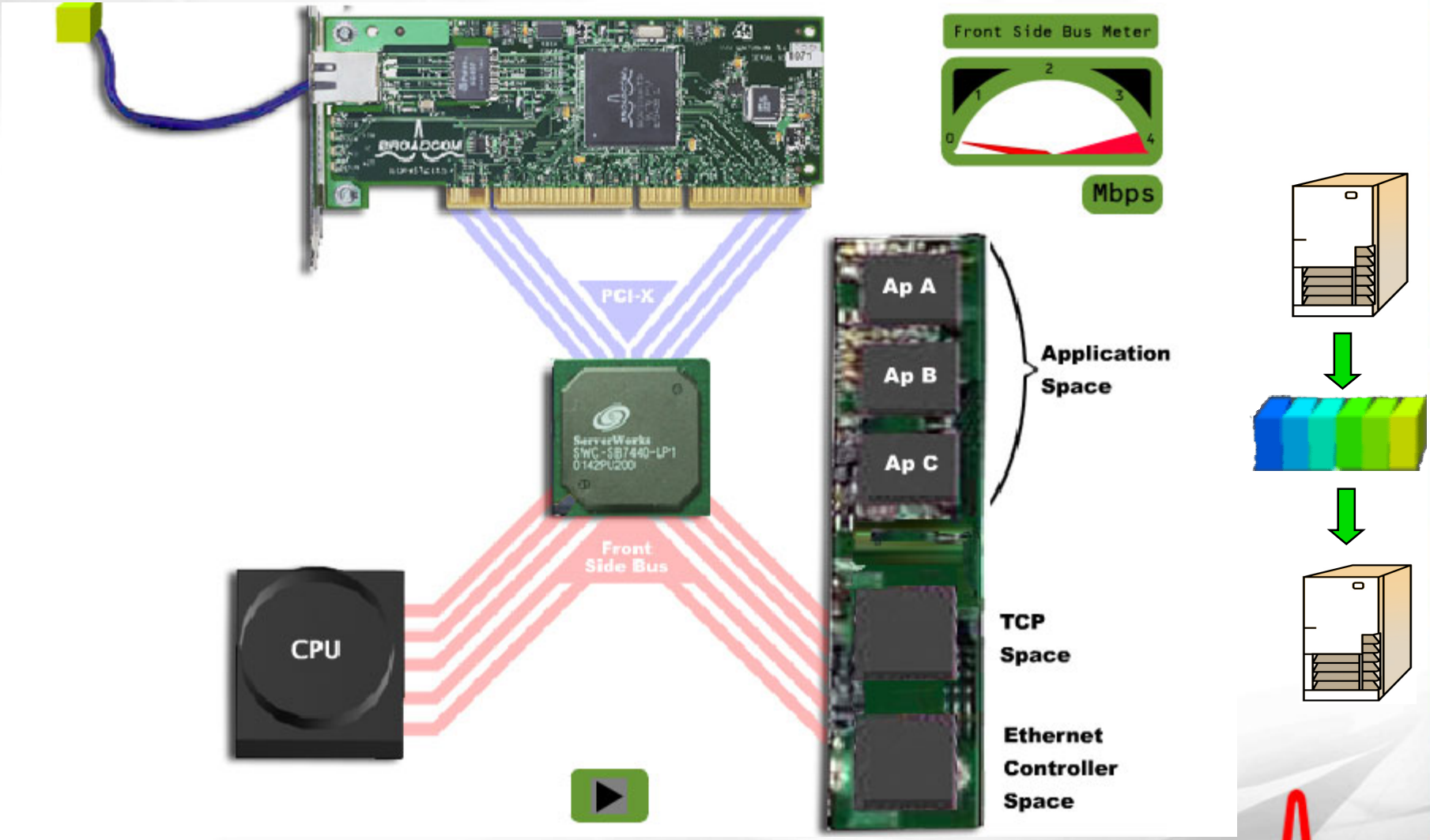
Host TCP/IP Processing





RDMA Step by Step



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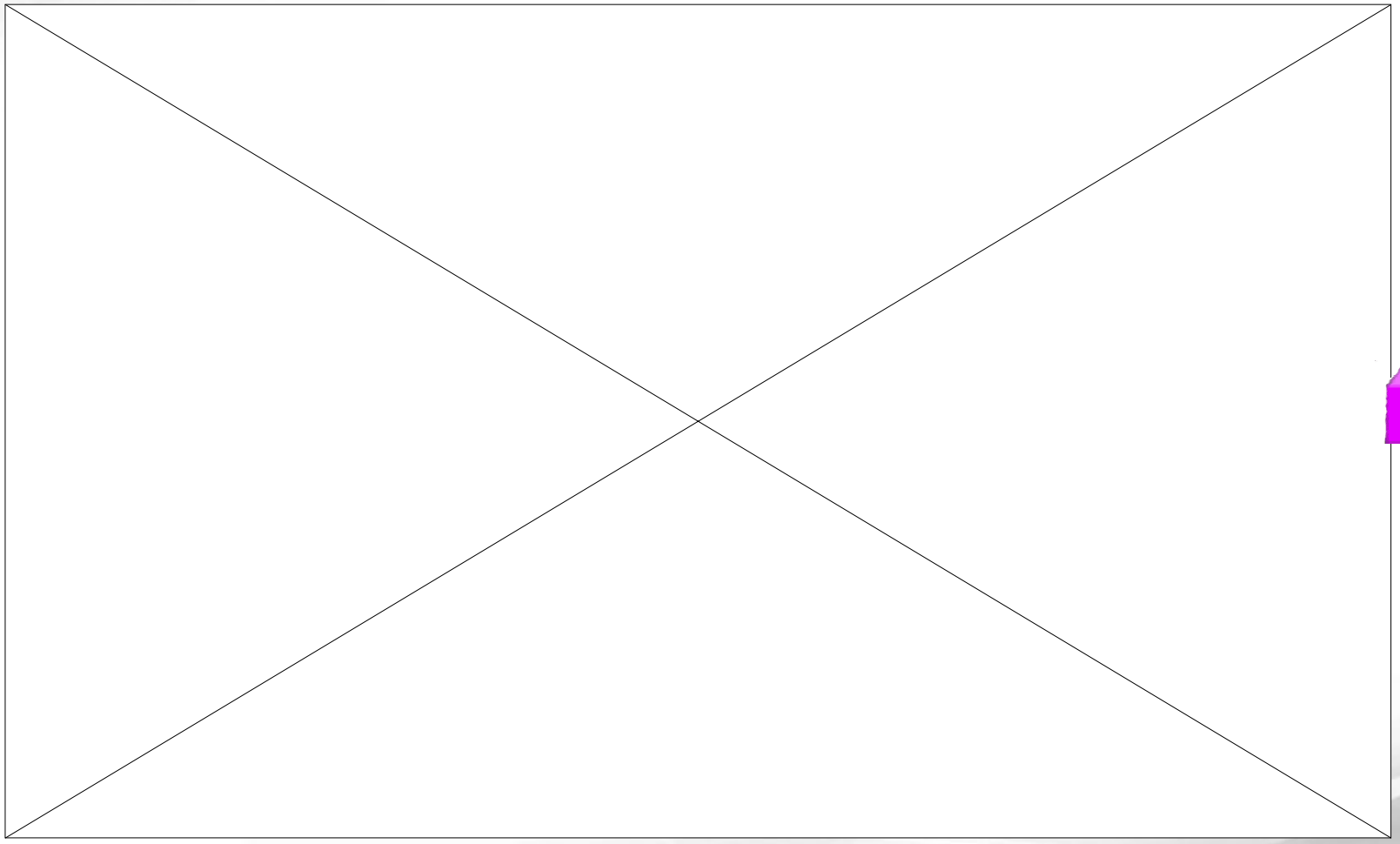
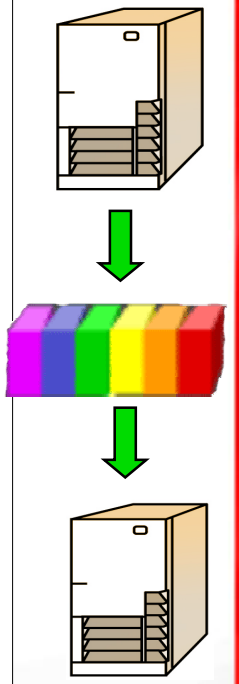
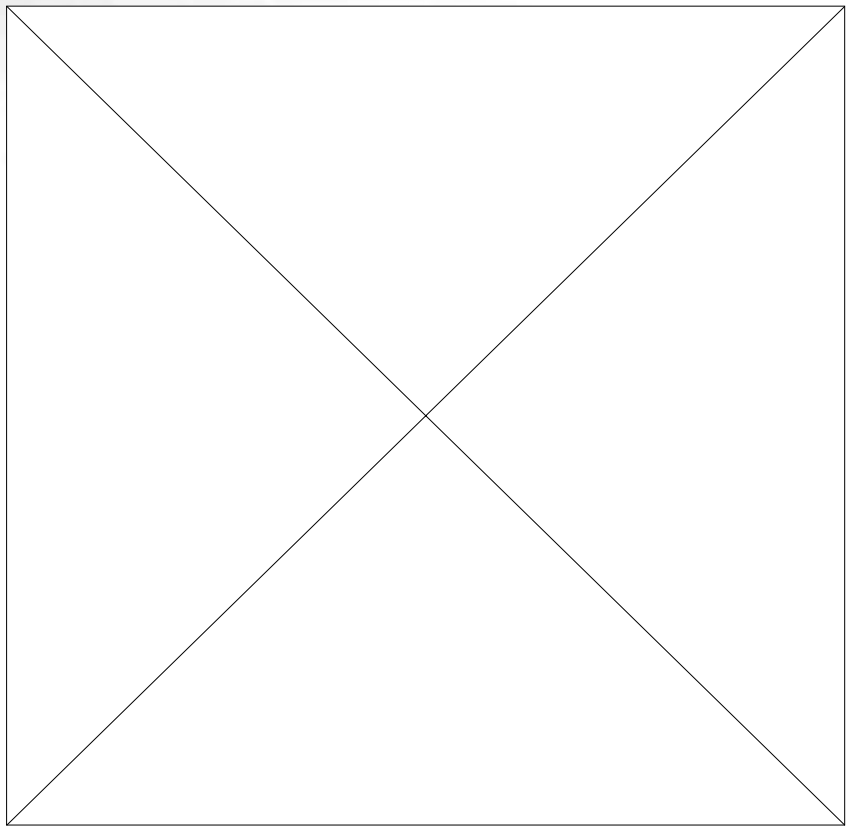
RDMA Missing Packet

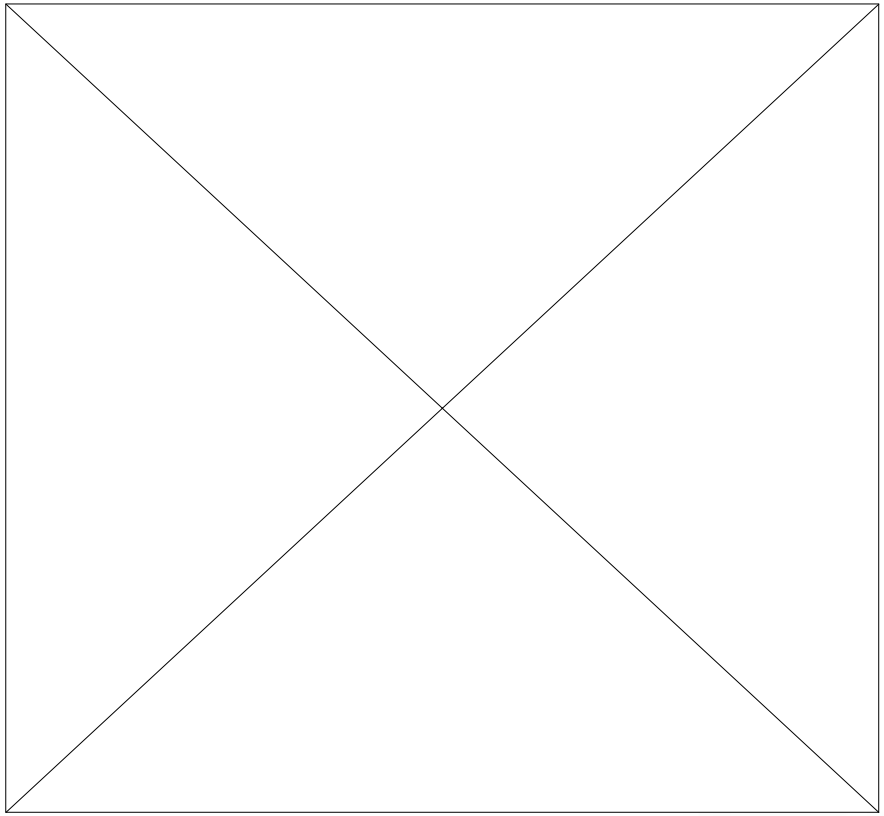




Adapter Comparison



CPU is free to work
on applications
Adapter handles
TCP/IP and RDMA



CPU is flooded
with kernel interrupts
Front side bus
becomes limiting factor

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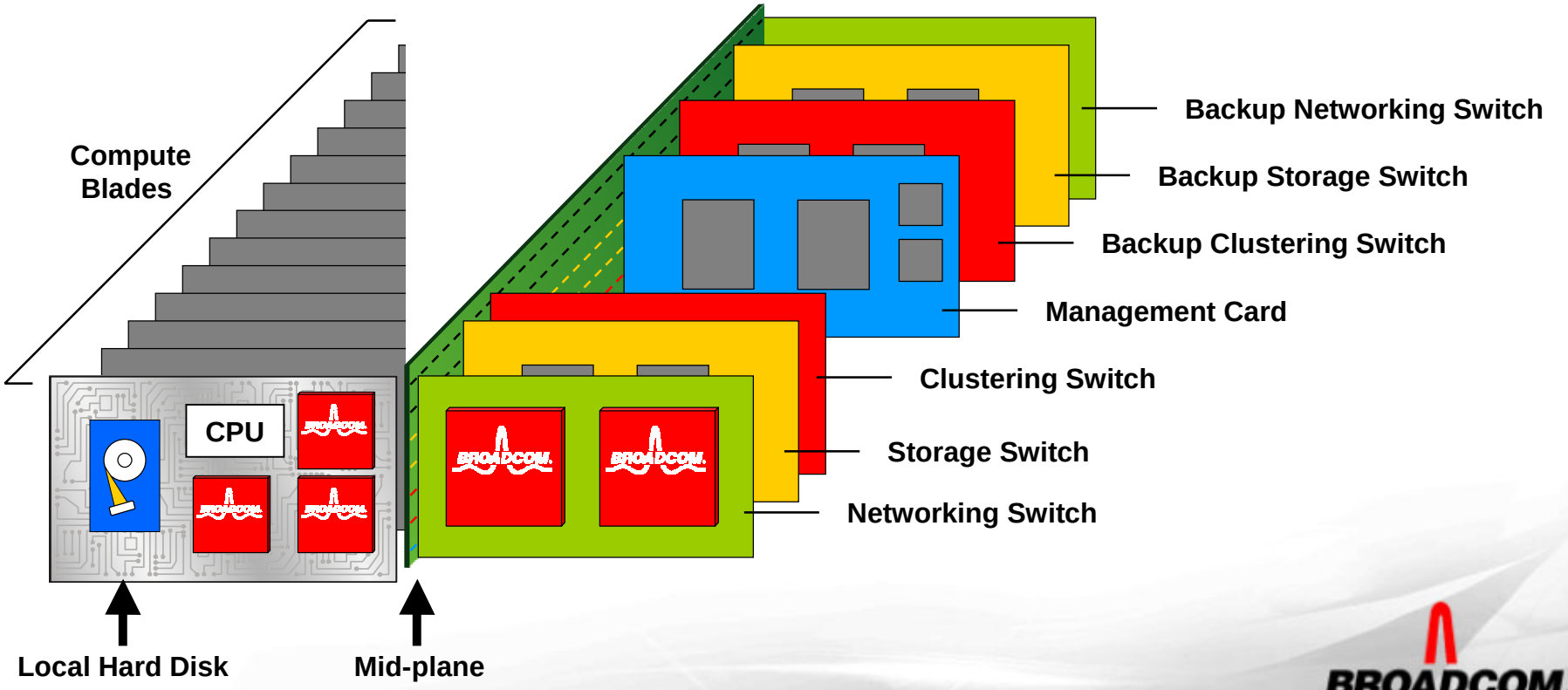
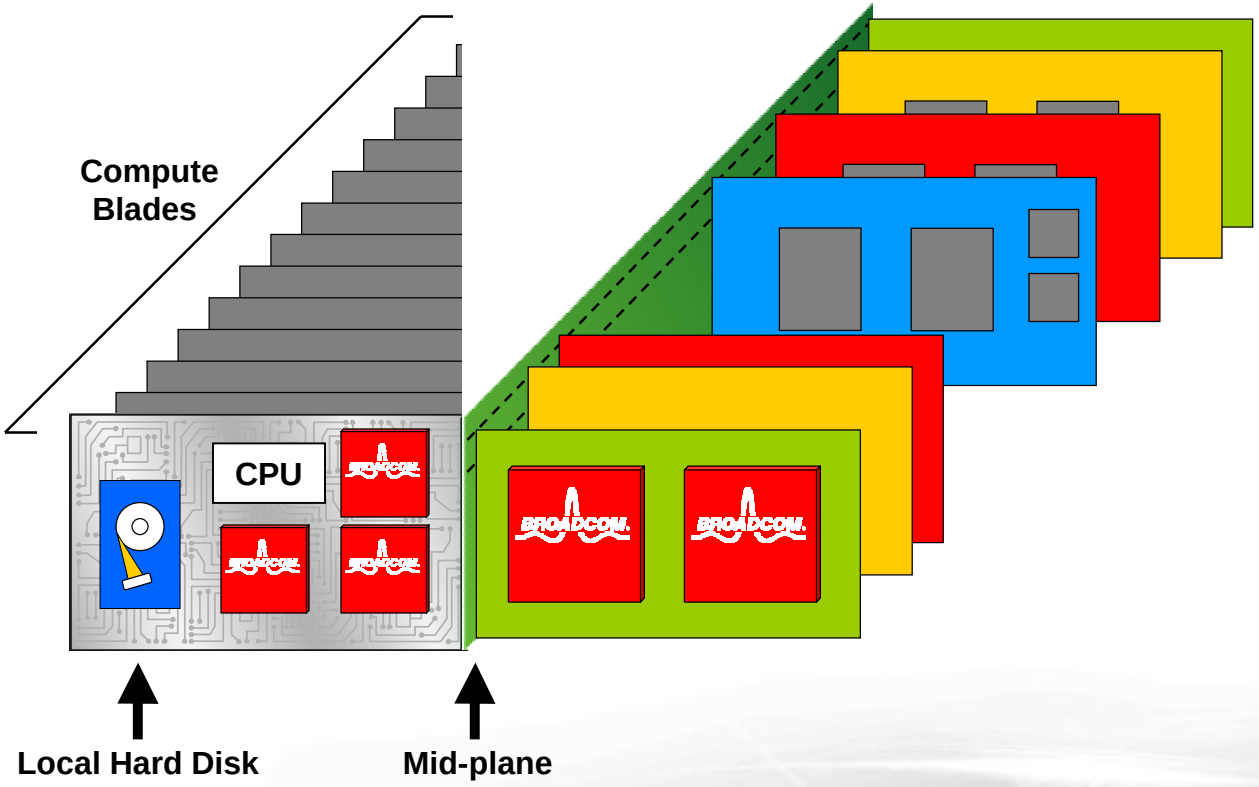
Example Application — Blades

Server Blade	Network Switch	Storage Switch	Cluster Blade	Management Blade



Converged Fabrics

Server Blade	Network Switch	Storage Switch	Cluster Blade	Management Blade



New Ethernet Technologies

iSCSI

Remote Direct Memory Access (RDMA)

Integrated Management

Accelerated Networking (TOE)

Slide 21

Features and Benefits of TOE Chimney

Feature	Benefit
Emphasis on application compatibility	• Simple deployment of TCP/IP offload technology • Robust solution, accelerates network stack and storage stack
Fully integrated with host stack to keep TOE simpler, easier to manage, and more secure	• Connection setup, management, control on host: Host stack processes management messages (ARP, DHCP, IPv6 ND, ICMP, RIP, OSPF, etc.) • TOE doesn't need to support IPv4 options, urgent data, or IPv4 fragments • Better security against DoS and other attacks • Clean integration with RSS • Connections can fall back to host stack
Designed for Efficiency	• Connections, in-flight data, preserved when moving between host and TNIC stacks • Multiple connections can be offloaded/uploaded at one time • Zero-copy receives for kernel applications that pre-post receive buffers

Features and Benefits of iSCSI

Feature	Benefit
Independent Host Bus Adapter Personality	• Full “look and feel” of an individual adapter to end user • No dependency on the Ethernet LAN adapter
Integrated TCP/IP and iSCSI protocol processing	• iSCSI performance that does not impose tax on the systems host CPU • iSCSI header and data digest processing on chip
iSCSI boot	• Enables new possibilities for diskless servers

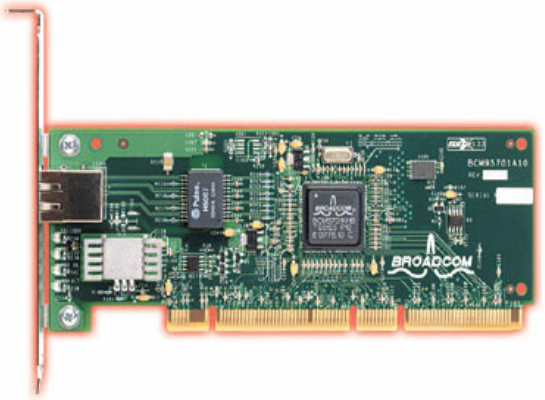
Features and Benefits of RDMA

Feature	Benefit
Independent “R-NIC” Personality	• RDMA over IP for low latency application to application transport • Full “look and feel” of an individual adapter to end user • No dependency on the Ethernet LAN adapter
User and Kernel Mode API interfaces	• User mode interface for clustering applications • Kernel mode interface for sockets and MPI type applications

Broadcom Products @ IBM

IBM xSeries eServers GbE NICs

- IBM offers Gigabit adapters to upgrade servers in both fiber and copper (Single port and Dual port) environments
  - NetXtreme 1000 SX+ Fiber Ethernet
  - NetXtreme 1000T+ Dual Port Ethernet Adapter
  - NetXtreme 1000T+ Ethernet Adapter
  - NetXtreme 1000T Express Ethernet Adapter
    - NEW support for PCI Express
- NIC Teaming increases throughput and reliability – even with heterogeneous NICs



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eServer xSeries GbE Systems

As your network requirements grow, simply continue to add Gigabit-enabled devices to maximize benefits and performance!

IBM @server xSeries

IBM eServer xSeries 440, 445, 450, 455	IBM eServer xSeries 305, 335, 365	IBM eServer xSeries 205, 225, 235, 255

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Broadcom NetXtreme™ Gigabit Ethernet Enhances Value and Performance of IBM ThinkCentre™ Desktops!

- Ease of deployment
  - Supports all major Operating Systems and Drivers
  - Compatible with existing CAT 5 cabling
  - Auto-negotiates to current Ethernet infrastructure speeds
- Proven Cable and Card Diagnostics
  - Improves manageability
  - Lowers TCO by reducing customer calls and returns
- Increases client application performance over 10/100 Fast Ethernet
  - Improves MS Outlook performance by up to 300+%
  - Performs MS SQL-Server transactions up to 100% faster
- Superior Technology
  - ASF 1.0
  - TCP/IP Large Send Offload significantly reduces CPU burden
  - VLAN Support

Now with Gigabit Ethernet!

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