BROCADE DATA CENTER NETWORKS UPDATE

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Brocade Background

- Founded 1995, ~4100 employees worldwide, operating in more than 160 countries
- Customers in all major industries, in 90% of Global 1000 Datacenters
- Annual revenues of ~$2 Billion
- HQ: San Jose, California
- Best of Breed SAN: Brocade, McDATA, CNT, Inrange
- Storage Area Network (SAN) Pioneer and Leader (75% market share)
- Foundry Networks acquisition completed in December 2008
- Going Beyond SAN with IP/Ethernet, Server Attachment (HBA), and DCB/FCoE
Brocade Products for the HPC Interconnect & Storage Market

Low Latency, Scalable & Converged
## Brocade HPC Products Summary

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Standard Ethernet</th>
<th>DCB / CEE and FCoE</th>
<th>FC Storage Networks</th>
<th>Product Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FCX Data Center</strong></td>
<td>1 GbE</td>
<td>--</td>
<td>--</td>
<td>Compact 1U, high performance, low-latency 24/48 10/100/1000 RJ45 ports, ToR, up to 4x10 GbE uplinks</td>
</tr>
<tr>
<td><strong>Turbolron 24X</strong></td>
<td>10/1 GbE</td>
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<td>Compact 1U, low-latency, cut-through, high-performance, 24 10/1 GbE dual-speed plus 4 10/100/1000 ports, ideal as ToR and aggregation switch</td>
</tr>
<tr>
<td><strong>NetIron MLX</strong></td>
<td>100/10/1 GbE</td>
<td>Yes</td>
<td>--</td>
<td>Advanced routers with industry-leading 10 GbE (up to 256 ports) and 1 GbE (up to 1,536 ports), wire-speed performance. 4, 8, 16 or 32 slot chassis</td>
</tr>
<tr>
<td><strong>BigIron RX</strong></td>
<td>10/1 GbE</td>
<td>--</td>
<td>--</td>
<td>Advanced switches with high port density of 10 GbE (256 ports, 4:1 oversubscribed or 64 ports 1:1 non-oversubscribed) and 1 GbE (768 ports 1:1 nonoversubscribed). 4, 8 or 16 slot chassis</td>
</tr>
<tr>
<td><strong>DCX and DCX-4S Backbones</strong></td>
<td>10 GbE (w/ 10-24 blades)</td>
<td>Yes</td>
<td>Yes</td>
<td>DCX: up to 512 8 Gbps FC ports; DCX-4S: up to 256 8 Gbps FC ports, up to 3 per rack; FC and DCB/CEE/FCoE blades</td>
</tr>
<tr>
<td><strong>FCoE 8000 switches and 10-24 blades</strong></td>
<td>10 GbE</td>
<td>Yes</td>
<td>Yes</td>
<td>Compact 1U, 24 ports low-latency 10 GbE and 8 port 8 Gbps FC, cut-through, non-blocking, ToR and blade switch</td>
</tr>
<tr>
<td><strong>CNA adapters</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>--</td>
<td>Dual mode, NIC &amp; CNA, high-performance adapters, 1 or 2 port SFP+ configurations.</td>
</tr>
<tr>
<td><strong>VCS Enabled Switches</strong></td>
<td>10/1 GbE</td>
<td>Yes</td>
<td>(Future)</td>
<td>Low-latency, cut-through 1U, 24 ports, and 2U, 60 ports, 10/1 GbE converged switch, supports DCB- and TRILL-based plug-and-play Ethernet fabric</td>
</tr>
<tr>
<td><strong>Network Management INM and DCFM</strong></td>
<td>Management Products for all of the above</td>
<td></td>
<td></td>
<td>For additional information on Brocade products, solution briefs, white papers and news please visit us at <a href="http://www.brocade.com/hpc">www.brocade.com/hpc</a> or write us at <a href="mailto:hpc_info@brocade.com">hpc_info@brocade.com</a></td>
</tr>
</tbody>
</table>
Brocade Virtual Cluster Switching (VCS)

VCS brings data center-proven Brocade fabric technology to Ethernet

Revolutionizes Layer 2 networking

Increases scalability of virtual server environments and sphere of mobility

Maximizes network performance—reduces network complexity
Virtual Cluster Switching - Components

Ethernet Fabric

- No Spanning Tree Protocol
- Multi-path, deterministic
- Auto-healing, non-disruptive
- Lossless, low latency
- Convergence-ready

Distributed Intelligence

- Self-forming
- Arbitrary topology
- Fabric is aware of all members, devices, VMs
- Masterless control, no reconfiguration

Logical Chassis

- Logically flattens and collapses network layers
- Scale edge and manage as if single switch
- Auto-configuration
- Centralized or distributed mgmt; end-to-end

Dynamic Services

Connectivity over Distance, Native Fibre Channel, Security Services, Layer 4-7, etc.
Ethernet Fabric Details

- 1st true Ethernet fabric
  - Layer 2 technology
- Link speed agnostic
- Data Center Bridging (DCB)
  - Lossless, deterministic
  - Priority-based Flow Control (PFC)
  - Enhanced Transmission Selection (ETS)
  - Data Center Bridging Exchange (DCBX)
- Transparent Interconnection of Lots of Links (TRILL)
  - Active multi-path
  - Multi-hop routing
  - Highly available, sub-250ms link recovery
- LAN/SAN Convergence Ready
  - FCoE and iSCSI traffic
- Standards-based
  - Extends existing Ethernet infrastructure
VCS – Flexible Fabric Design

- Scalable architecture
- Consistent hop counts (max 3)
- Two Tiered Fat Tree fabric
- Multiple paths (L2 ECMP)

- Resilient architecture
- Consistent hop counts (max 2)
- Full Mesh Fabric
- Multiple path (L2 ECMP)

- Flexibility to chose any design (Clos, Mesh, Cube, etc....)
  - Each switch is fully aware of the entire network
  - Shortest path forwarding
Examples - 10GbE VCS fabrics for lowest latency and best price/performance

• Low latency, non-oversubscribed & optimal cost network fabrics using Brocade’s 24 and 60-port VCS-enabled switches:
  
• for up to 156 10GbE servers – use full Mesh fabric with the 24 ports switch. Max 2 switches for server-to-server connectivity, total 13 switches.

• for up to 930 10GbE servers – use full Mesh fabric with the 60 ports switch. Max 2 switches for server-to-server connectivity, total 31 switches.

• for up to 1800 10GbE servers – use Clos fabric with the 60 ports switch. Max 3 switches for server-to-server connectivity, total 90 switches.

• Many designs are possible function of the server connectivity (1/10GbE), desired network oversubscription level, number of servers, and target latency - please write us at hpc_info@brocade.com for more information and visit our booth at SC10.
Brocade MLX Router Series

- 480 Gbps FDX per Half-Slot
- Removable Partitions
- 960 Gbps FDX per Full-Slot
- 64 10 GbE (2006)
- 128 10 GbE (2007)
- 256 10 GbE (2010)
- > 256 10 GbE (Future)
- 32 100 GbE

- 4.8 Billion packets per second
- 6.4 Tbps forwarding capacity
- 15.36 Tbps fabric capacity

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Brocade MLXe Routers
Product Highlights

A Unified Platform That Scales From Data Center Core to Service Provider Core

Industry-leading 10GbE wire-speed density of 256 ports
Industry-leading 100GbE wire-speed density of 32 ports
Supports MLX and XMR modules
64 x 10 GbE links in a LAG

Multi-Chassis Trunking (MCT) - active/active links with instantaneous node failover
Terabit trunks, 1.6 Tb/s per trunk.
MLXe Modules
Same chassis, different scalability options

MLX scalability
- MLX management module
- 2-port 100 GbE
- 48 port 10/100/1000 Mini –RJ21
- 4-port 10 GbE
- 20-port FE/GE
- 8-port 10 GbE

Enhanced scalability
- XMR management module
- 2-port 100 GbE
- XMR 4-port 10 GbE
- XMR 20-port FE/GE
Industry’s first **2 port** 100 GbE module
Massive 100 GbE density of **32 wire-speed** ports
Multiple **full** 100 Gigabit packet processors.
**Terabit trunks** with 1.6 Tb/s per trunk.
**Ports on Demand** enabling pay as you grow strategy
Classic XMR and MLX chassis support 1-port 100 GbE
**Full featured** card with Advanced MPLS and IPv4/IPv6 capabilities
1 million IPv4 and 240 K IPv6 FIB capacity
**802.3ba** compliant and supports CFP based optics
MLX Customer Deployments Examples
Data Center and Enterprise IP Networks

High-Performance data center core/aggregation router

Network virtualization to server edge

High-Performance R&D interconnect

MPLS/ VPLS connection between data centers and campuses

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**Brocade HPC - More Information**

- **Brocade’s HPC site**: [www.brocade.com/hpc](http://www.brocade.com/hpc)

- **Visit us at SC10** to hear about our customers and see our demos
  - Brocade booth and briefings
  - SCinet (XMR 10GbE, TORs), SCinet Sandbox (100GbE)
  - Exhibitor Forum talks (100GbE and VCS - Thu afternoon)
  - Disruptive Technologies booth (VCS)

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Thank You