

BROCADE CARRIER ETHERNET SWITCH/ROUTER COMPETITIVE POSITIONING



A Frost & Sullivan White Paper

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INTRODUCTION TO THE CARRIER ETHERNET SWITCH/ROUTER MARKET

Carrier Ethernet equipment is one of the fastest growing markets in the Communications Service Provider (CSP) infrastructure equipment market. Frost & Sullivan estimates the total carrier Ethernet switch/router market, defined as the sum of carrier Ethernet Demarc, Access, Aggregation, and Service Edge, revenue in 2008 was 5.3 billion USD. We estimate its growth to 17 billion USD, exhibiting a CAGR of 18.1 percent. Although this is a thriving market and provides an extremely viable solution for CSPs, there are still inherent challenges that need addressing to be successful in the market.

The carrier Ethernet switch and router market offers challenges to network equipment providers (NEPs) and CSPs implementing solutions in their networks. These challenges include complex and varied migration strategies and hybrid requirements utilizing legacy infrastructure, not to mention that it is a competitive and crowded market. NEPs that successfully address these challenges provide a valuable product for the market and for their CSP clients. In this white paper, we analyze Brocade's carrier Ethernet offering and ability to address and solve the challenges posed by CSP migration strategies and network infrastructure requirements. We also provide a comparative analysis of Brocade's product positioning in relationship to its key competitors, namely Cisco, Alcatel-Lucent, and Juniper. We will discuss drivers and challenges in the market and the competitive nature of the market.

FACTORS DRIVING MARKET GROWTH

There are key drivers that have led to the tremendous growth in the carrier Ethernet market on a global level. Some of these significant market drivers include:

- The continuing maturity of carrier Ethernet technology supported by standards bodies' efforts in important areas such as synchronization
- The consistent increase in bandwidth usage, convergence of infrastructure to carry residential, business, and mobile traffic, and a rapidly emerging application in mobile backhaul
- The requirement for CSPs to remain competitive and offer differentiated services
- Tier 2 and 3 CSP new network infrastructure build-outs opening up more opportunities for end-to-end carrier Ethernet deployment.

The vendor community has responded aggressively to these market trends, which is reflective in the product announcements that have been continuous in the past couple of years. Implementation of synchronization features, common operating and management systems, and expansion of products portfolios, including network elements' enabling more speed and features in more compact form factors, are just a few examples of NEP product-related activities.

As with all new technologies and changes in infrastructure strategy and topology, these aforementioned drivers are tempered by some challenges and restraints.

KEY INDUSTRY CHALLENGES

One of the biggest challenges is the acute competitive nature of the market and high market concentration. The top three NEPs in the market accounted for about 70 percent of the market share in 2008. These challenges include market conditions on a regional and global basis, as well as challenges addressing the varied requirements of CSPs. Some of the key challenges NEP solutions and business models must address are:

- **Strong Presence of Regional NEPs, such as in Asia, has Created a Competitive Disadvantage for North American Vendors**

The strong relationship between local NEPs and local CSPs represents a key challenge to foreign NEPs that want to expand their presence in high-growth markets. APAC is a rapidly growing market and an important region for expansion. The presence of local, strong NEPs in markets such as China and Japan is a real constraint to other NEPs.

- **The Opportunity to Offer End-to-End Solutions is Limited by Incomplete End-to-End Management Systems**

NEPs are already addressing this challenge and are currently in different stages of product development and delivery. Frost & Sullivan expects this to be a critical restraint in the near- to mid-term. End-to-end management solutions must not only address Layer 2, but must support products for Layer 0 and 2 due to optical packet convergence.

- **Unpredictability in the Migration Strategies that CSPs, Especially the Incumbents, May Adopt for Mobile Backhaul**

This has emerged to be the greatest challenge for NEPs, especially those that lack insight into or incumbency with CSPs. Key migration decisions have been delayed and migration strategies changed or decreased due to the macro-economic factors. It is expected that this challenge will remain on top.

- **Keeping up with Customer Support, Product Upgrades, and New Product Introduction Due to New Requirements and/or Faster than Anticipated Growth**

For a number of Tier 2 NEPs, keeping up with the pace of growth and the increasing requirements has been challenging. At the core is the underlying issue that deployments are very complex, and CSPs may be addressing multiple network build-outs, varied technologies, and enhancements simultaneously. This situation is aggravated by the requirement to expand the portfolio breadth and depth. This is more critical at this stage of the market growth due to CSP decision-making processes that may include Tier 1 NEPs that have existing products in CSP networks. For example, support for increasing capacity and interfaces to 10 gig, 40 gig, and 100 gig without visibility into CSP expansion plans makes it tricky for Tier 2 and 3 NEPs to plan product roadmaps. Frost & Sullivan expects that NEPs will aggressively work toward overcoming this constraint, making the competition even more intense.

BROCADE'S COMPETITIVE POSITIONING

Frost & Sullivan believes that Brocade has a competitive product portfolio and has addressed most of the aforementioned challenges. Brocade provides a product portfolio that addresses key CSP requirements with extremely competitive price points and provides its solution in a compact form-factor. It has a comprehensive, future-proof, end-to-end product portfolio that offers high-scalability, flexibility, extensive product breadth and depth that deal with various services, applications and deployment scenarios that address the global market. Brocade has introduced its products in a timely manner, keeping up with deployment requirements, and continues to enhance its products to meet broadband and mobile application trends with an optimal set of Layer 2 and Layer 3 features. Brocade has launched a variety of both fixed- and chassis-based products in the CESR market. Figure 1, Interface Density Comparison Brocade and Key Competitors, shows maximum 10 GigE and GigE port density for the shown competing products.

Figure 1

Carrier Ethernet Switch and Router Market: Interface Density Comparison - Brocade and Key Competitors (World), 2009

	Brocade MLX16/MLX32	Cisco ASR 9010	Juniper MX960	Alcatel-Lucent 7750 SR-12
Per Chassis				
10 GigE	128/256	64 8-port SFP line cards	176 16x10 Gigabit Ethernet MPC-3D-16XGE-SFPP	80 4 port XFP line card
1 GigE	768/1536	320 40-port 100/1000Mbps SFP line card	480 40x1 Gigabit Ethernet DPCE-R-Q-4XGE-XFP	400 20 port SFP line card
Chassis Height	24.5 in/ 57.7 in	36.8 in.	27.8 in	24.5 in.

Source: Brocade and Frost & Sullivan

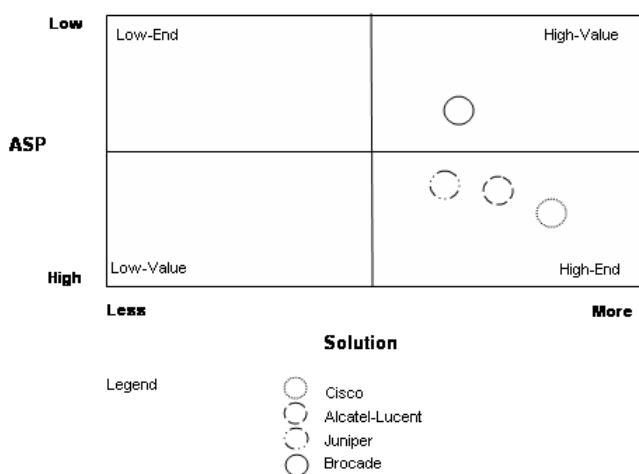
This is, of course, just one of the several metrics on which products can be compared. The point is that the real difference is with regards to the ability of vendors such as Cisco, Alcatel-Lucent, and Juniper to offer additional features that extend the scope of the platform. In the case of Cisco, examples are the availability of DPI (Deep Packet Inspection) and Session Border Controller (SBC), Gateway GPRS Support Node, Packet Data Serving Node, and Access Service Network Gateway features on its 7600 platform. Additional features such as Visual Quality Experience (VQE) technology, which provides Video Error Repair, Rapid Channel Change; Video Connection Admission Control (CAC), and Video Quality-Monitoring Module; and the Advanced Video Services Module (AVSM) blade that offers content streaming, caching, ad insertion, fast channel change, and error correction on a single blade offer enhancements for specific services. Alcatel-Lucent too offers Multiservice Integrated Service Adapter (MS-ISA) resource blades that enable services such as Application Assurance (DPI), IPSec, and Video (Fast channel Change, Retransmission, Ad Insertion). Juniper's MX Series supports subscriber management and advanced features such as session border controller, dynamic application awareness and intrusion prevention system.

Chart I, Competitive Landscape – Brocade and Key Competitors, shows the competitive positioning of Brocade and its key competitor products.

Brocade has a competitive offering in terms of scale and other important metrics such as switch capacity, forwarding capacity, power usage, etc. Chart I.0 depicts that based on an extensive analysis of features, solution offering and average selling price; Brocade offers a compelling price-performance advantage over its competition.

Chart I

Competitive Landscape: Brocade and Key Competitors - Shows the competitive positioning of Brocade and its key competitors (World), 2009.



BROCADE PRODUCT PORTFOLIO

Brocade’s carrier Ethernet products run on the Multi-Service IronWare operating system that offers advanced capabilities for rapid detection and bypass of link/node failures. An important product of its portfolio is the NetIron MLX product series featuring some key differentiating features. The MLX routers employ an advanced Virtual Output Queuing (VOQ) architecture, and innovative packet buffering and scheduling, and are hence, able to offer non-blocking packet forwarding and capable of handling severe congestion conditions. In addition, the NetIron MLX product series features Multi-VRF Routing. This allows for virtual routing in cases, in deployments where the complexity of MPLS may not be required. CSPs can create multiple routing protocol instances that peer with each other in completely virtualized domains while sharing the same physical routers and links. An important CSP requirement is to ensure high availability of networks, especially since one network may be supporting multiple services and running business and residential traffic simultaneously with different QoS requirements and traffic patterns. The NetIron MLX ensures high availability through a combination of highly resilient hardware and software design, and advanced failure detection and traffic protection/restoration schemes. The NetIron MLX includes N+1 redundant switch fabric architecture, through which Brocade is able to offer very high availability and resiliency. Even in the case of multiple fabric card failures, the system continues to operate in a graceful degradation mode, where the system tunes its performance to the remaining fabric capacity.

The latest addition to Brocade product portfolio is Brocade CER 2000 series in the carrier Ethernet Demarc segment. In its class, this is a leading product in terms of scalability, speeds and feeds, features, form factor and price point. Figure 2, Brocade Product Portfolio and Key Features - highlights the important features of Brocade's products in the carrier Ethernet switch router market.

Figure 2

Carrier Ethernet Switch and Router Market: Brocade Product Positioning and Key Features (World), 2009

Category	Sub-category	Demarc Customer premise, service provider owned	Access Central Office/Remote Terminal	Aggregation & Edge Metro Aggregation and Ethernet Service Edge
Hardware Scalability		CES	CER	MLX
	Wire speed 10 GE ports per chassis	0 or 2	0 or 2	256
	Wire speed GE ports per chassis	24 or 48	24 or 48	1536
	40GE/100 GE Ready (Yes/No)	No	No	Yes (chassis-ready with line card upgrades)
	Current switch capacity	48-136Gbps	48-136Gbps	7.68 Tbps
	Future switch capacity	48-136Gbps	48-136Gbps	15.36 Tbps
	Forwarding Capacity	48-136Gbps	48-136Gbps	5.12 Tbps
	Forwarding Rate	36-101Mpps	36-101Mpps	3.8 bpps (full duplex)
Logical Scalability				
	MAC address table	128K	128K	1M
	Routing table (RIB)	256K	4 Million	2M
	Number of Virtual LANs (VLAN)	4K	4K	4K
	Logical separation of VLANs	Yes using VPLS	Yes using VPLS	Yes using VPLS
	IPv4/IPv6 (FIB)	32K/	512K/	512K/120K
	Virtual Private LAN Service (VPLS) instances	128	1,000	4000
	Multi-Virtual Routing and Forwarding (Multi-VRF)	16	128	400
	Layer 2/3 Virtual Private Network (VPN)	Hardware support	Hardware support	400
Form Factor		IRU	IRU	4RU-33RU
Power				
	Power Usage	120-295W	135-350W	1313-10781W
	Power Per GE (wire speed ports)	4.25W	4.56W	8.4W
	Space Requirements	IRU, 19" rack	IRU, 19" rack	4RU-33RU, 19" rack
Certifications				
	MEF (9, 14, 21)	MEF 9,14,21	MEF 9,14,21	MEF 9,14
	NEBS	Compliant	Compliant	Compliant
	Others			
Redundancy/Availability	Product: Hitless Management Failover (Layer 2 and Layer 3) ISSU	N/A (single management plane)	N/A (single management plane)	Yes, Yes
End-to-End MPLS support (Access to Edge)		Yes (Full VPLS, VLL)	Yes (Full VPLS, VLL)	Yes (Full VPLS, VLL)

Solution Features	
Category	Key Features
Operating System	<ul style="list-style-type: none"> Common Multi-Service IronWare OS across all SP products
Management System	<ul style="list-style-type: none"> Integration with many NMS/OSS vendors including IBM Tivoli Netcool, HP OpenView, EMC Smarts, etc.
OAM	<ul style="list-style-type: none"> Supports 802.1ag, Y.1731 and 802.3ah The feature uses hardware support for milli-second timers In addition, supports 1-hop BFD for routing protocols and BFD for RSVP-TE LSPs
Security	<p>Policy enforcement and monitoring for enforcing SLAs and implementing security policies:</p> <ul style="list-style-type: none"> Two rate three color traffic policers Traffic policer accounting Layer 3 and Layer 2 Access Control Lists (ACL) Granular ACL accounting Hardware-based packet filtering Hardware-based policy based routing (PBR) Unicast Reverse Path Forwarding (uRPF) Receive ACLs Extensive sFlow Layer 2-7 traffic monitoring for IPv4, IPv6 and MPLS services
Quality of Service	<ul style="list-style-type: none"> Inbound and outbound two rate three color traffic policers with accounting 8 distinct priority levels Weighted Random Early Detection (WRED) support for congestion management and precedence dropping (tunable via configuration) Hybrid queue servicing disciplines: mixed Strict Priority and Weighted Fair Queuing
Advanced Layer 2 Features	<ul style="list-style-type: none"> Supports E-LINE, E-LAN and E-TREE services using MPLS and Provider Bridging/Provider Backbone Bridging Provides ability to extend full VPLS towards the edge and access nodes, and also supports VPLS-PBB for scaling VPLS networks
Layer 3 Features	<ul style="list-style-type: none"> Full suite of unicast and multicast IPv4 and IPv6 routing protocols MPLS services providing several service choices: IP over MPLS, Virtual Leased Line (VLL), Virtual Private LAN Service (VPLS), BGP/MPLS VPN, and Multi-VRF High scalability up to: <ul style="list-style-type: none"> 10 million BGP routes 1 million IPv4 routes in hardware (FIB) 240,000 IPv6 routes in hardware (FIB) 2000 BGP peers per system 2,000 BGP/MPLS VPNs and up to 1 million VPN routes 32,000 VLLs per system 16,000 VPLS and up to 1 million VPLS MAC addresses 4,094 VLANs and up to 2 million MAC addresses
Value Added Services (DPI, SBC etc.)	<ul style="list-style-type: none"> sFlow support for proactive network monitoring across all products Offers offline traffic analysis and network control without impacting forwarding performance
Resiliency	<ul style="list-style-type: none"> Comprehensive set of Layer 2 control protocols: MRP, VSRP, RSTP, MSTP, MPLS sub-50ms failover using FRR, hot-standby paths
Migration/Upgrade Process (Software, Hardware, Both)	<ul style="list-style-type: none"> Ability to upgrade the packet processor capability using flexible packet processor technology

CONCLUSIONS

The carrier Ethernet switch and router market is in a very high-growth phase driven by many key factors. That said, the features demanded by CSPs have become extensive and are very complex. Some of the newer key requirements are future-proof and highly scalable solutions, effortless and seamless upgrade, leveraging of existing deployments, and the flexibility to support multiple applications, markets and innovative services in the future.

Frost & Sullivan believes that Brocade offers a compelling solution based on price-performance and meets the increasingly stringent CSP requirements. It has a comprehensive solution and offers a variety of products in each carrier Ethernet switch/router product segment. For example, NetIron MLX is available in 4, 8, 16 and 32 slot versions. The 10 Gig-E capable NetIron CES series for customer premise and multi-tenant unit is available in six models featuring MPLS, PBB, and advanced L2/3 features in IRU form factor devices. From a common operating and management system across its entire portfolio to support for VPLS-PBB for scaling VPLS networks and an optimal set of advanced Layer 2 and Layer 3 features, Brocade has been able to provide CSPs extensive features on hardware and software levels. With the launch of NetIron CER 2000, Brocade has brought extremely cost-effective scalable routing and MPLS to the edge of the network enabling CSPs to deliver advanced, converged IP voice, video, and data services in a compact IRU form factor. With attributes like redundant switch fabric, terabit-scale architecture, wire-speed dual stack IPv4/IPv6 routing, and high scalability, Brocade has ensured that CSPs are able to receive the best performance, and a broad and comprehensive set of features that will enable future-proofing deployments, and all this in a cost-effective and compact form factor.

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