BROCADE NETIRON CER 2000 SERIES

CARRIER-CLASS ROUTING

Compact Multi-Service Carrier Ethernet Router Series

HIGHLIGHTS

- Compact 1U, IP/MPLS NEBS Level 3-certified, Software-Defined Networking (SDN)-enabled router purpose-built for high-performance Ethernet edge routing applications

- Scalable edge router designed to support a full Internet routing table and MPLS for advanced business and residential services, service provider data center interconnect, and Internet peering

- Available in 24-port and 48-port 1 GbE versions with four or two 10 GbE uplink ports

- Powered by the field-proven Brocade Multi-Service IronWare OS that also runs on the Brocade MLXe Series of high-performance core routers

- Up to 136 Gbps of non-blocking wire-speed performance and a complete suite of IPv4/IPv6 unicast and multicast routing with fast convergence times

- Integrated support for OpenFlow 1.3 in true hybrid mode, enabling SDN for programmatic control of the network while simultaneously supporting traditional forwarding to protect existing investments

- Advanced QoS features to enforce strict SLAs at the edge of the network

Service providers, more than ever, are looking for ways to reduce network operational costs while increasing new revenue streams through over-the-top services. Brocade® NetIron® CER 2000 Series routers are purpose-built to help these providers save on space, power, and cooling while extending wire-speed IP and Multi-Protocol Label Switching (MPLS) services to the network edge without compromising performance.

The NetIron CER 2000 is available in 24- and 48-port 1 Gigabit Ethernet (GbE) copper and hybrid fiber configurations with four or two optional 10 GbE uplink ports. To help ensure high performance,

all the ports are capable of forwarding IP and MPLS packets at wire speed without oversubscription. With less than 5 watts/Gbps of power consumption, service providers can push up to 136 Gbps of business or residential Carrier Ethernet services through the NetIron CER 2000 while reducing their carbon footprint.

A broad set of highly scalable IP unicast and multicast routing features, combined with a low total cost of ownership, makes the NetIron CER 2000 an ideal choice for service providers that want to deliver Layer 2 and Layer 3 business services through a single, easy-to-manage platform.

BROCADE

SCALABLE CARRIER-CLASS ROUTING

The NetIron CER 2000 features best-in-class interior and exterior gateway protocols that are commonly deployed in provider networks. The routers support standard IPv4 and IPv6 routing protocols—including Routing Information Protocol (RIP/RIPng), Open Shortest Path First (OSPF/OSPFv3), Intermediate System-to-Intermediate System (IS-IS/IS-IS for IPv6), and Border Gateway Protocol (BGP/BGP-MP for IPv6)—with the same performance and reliability typically associated with larger chassis systems. To complement these routing features, the NetIron CER 2000 can store the full Internet routing table in hardware and achieve wire-speed forwarding performance. As a result, it is ideally suited for service provider edge routing applications as well as for enterprise border routing applications.

Compact and Scalable Routing

The NetIron CER 2000 can store up to 1,500,000 IPv4 and 256,000 IPv6 unicast routes, enough to accommodate the full IPv4 Internet routing table today and provide a smooth migration path to IPv6. In addition, the Brocade Multi-Service IronWare® operating system provides highly scalable BGP functionality and can support up to 256 BGP peers. Combined with advanced and scalable BGP route filtering mechanisms, the NetIron CER 2000 can be a route reflector in small to midsized networks.

Video Delivery

As more and more service providers include digital entertainment (using MPEG2/4-quality video) in their offerings, they require enormous amounts of bandwidth per subscriber and efficient multicast delivery.

Providing up to 136 Gbps of capacity, the NetIron CER 2000 is ideally suited for the high-bandwidth, low-latency requirements of video traffic. Today, service providers deliver triple-play and IPTV services using both Layer 2 and Layer 3 models. The NetIron CER 2000 gives them the flexibility of choosing between traditional IP multicast and Virtual Private LAN Services (VPLS) to deliver high-quality video.

The NetIron CER 2000 provides comprehensive support for multicast routing and switching through a variety of protocols—including PIM-SM, PIM-DM, PIM-SSM, IGMP v2/v3—and through other platform-independent capabilities. Egress interface-based replication optimizes performance and buffer usage to help maximize network performance for multicast traffic. In addition, the NetIron CER 2000 supports static IGMP "Joins" and efficient processing of IGMP Join/Leave requests to help ensure a fast channel-zapping experience.

Carrier-Class Reliability

Routing stability and non-stop forwarding are key attributes in maintaining high Service Level Agreements (SLAs) in provider networks. To facilitate higher SLAs, the NetIron CER 2000 supports graceful restart helper mode for both OSPF and BGP. In addition, it supports Bidirectional Forwarding Detection (BFD) for OSPF, IS-IS, and BGP, streamlining the detection of network failures and enabling sub-second convergence. The NetIron CER 2000 supports up to 8 Equal-Cost Multi-Paths (ECMPs), which can help increase redundancy. Moreover, redundant, load-sharing power supplies help ensure complete carrier-class uptime.

MPLS TO THE EDGE

Triple-play services and business Virtual Private Network (VPN) solutions are increasingly based on MPLS infrastructure. Given the enormous space constraints and the need to deliver Layer 2 and Layer 3 services in a single device, many service providers are looking for a device that can deliver maximum performance in the smallest footprint. The NetIron CER 2000 meets this objective with advanced MPLS edge features—making it an ideal platform for delivering converged voice, video, and data over MPLS in small to midsized Metro Ethernet networks.

Business VPNs

With the NetIron CER 2000 Series, service providers can offer distributed enterprise connectivity services through a transparent service such as Layer 2 VPNs, or provide more control through Layer 3 VPN services. The transparent services are delivered as point-to-point or point-to-multipoint services. To facilitate both options, the NetIron CER 2000 Series supports VPLS and Virtual Leased Line (VLL) implementations using widely accepted LDP signaling. The routers also support Border Gateway Protocol (BGP)-based MPLS VPNs and provide per-customer routing instances with a choice of BGP, Open Shortest Path First (OSPF), Routing Information Protocol (RIP), or static routing options. In addition, each virtual forwarding interface supports inbound and outbound Access Control Lists (ACLs) and rate-limiting features for accounting and Service Level Agreement (SLA) enforcement. Figure 1 shows how the NetIron CER 2000, in conjunction with the Brocade MLX® Series, provides a scalable Layer 2/3 VPN solution.

Service Management

Delivering effective MPLS services on Carrier Ethernet infrastructure requires fast fault identification and isolation. The NetIron CER 2000 supports MPLS Labeled Switch Path (LSP) pings and traceroute features to isolate any MPLS-related connectivity issues. In addition, it supports all the capabilities of IEEE 802.1ag (Connectivity Fault Management), including Connectivity Check Messages, Loopback Message/Response, and LinkTrace Message/Response. IEEE 802.1ag, in conjunction with the MPLS OAM features, provides the capabilities to monitor, isolate, and identify connectivity problems and reduce the time to repair business VPN services. To diagnose link layer connectivity issues, the NetIron CER 2000 also supports the IEEE 802.3ah Link OAM feature. In addition, the NetIron CER 2000 is certified
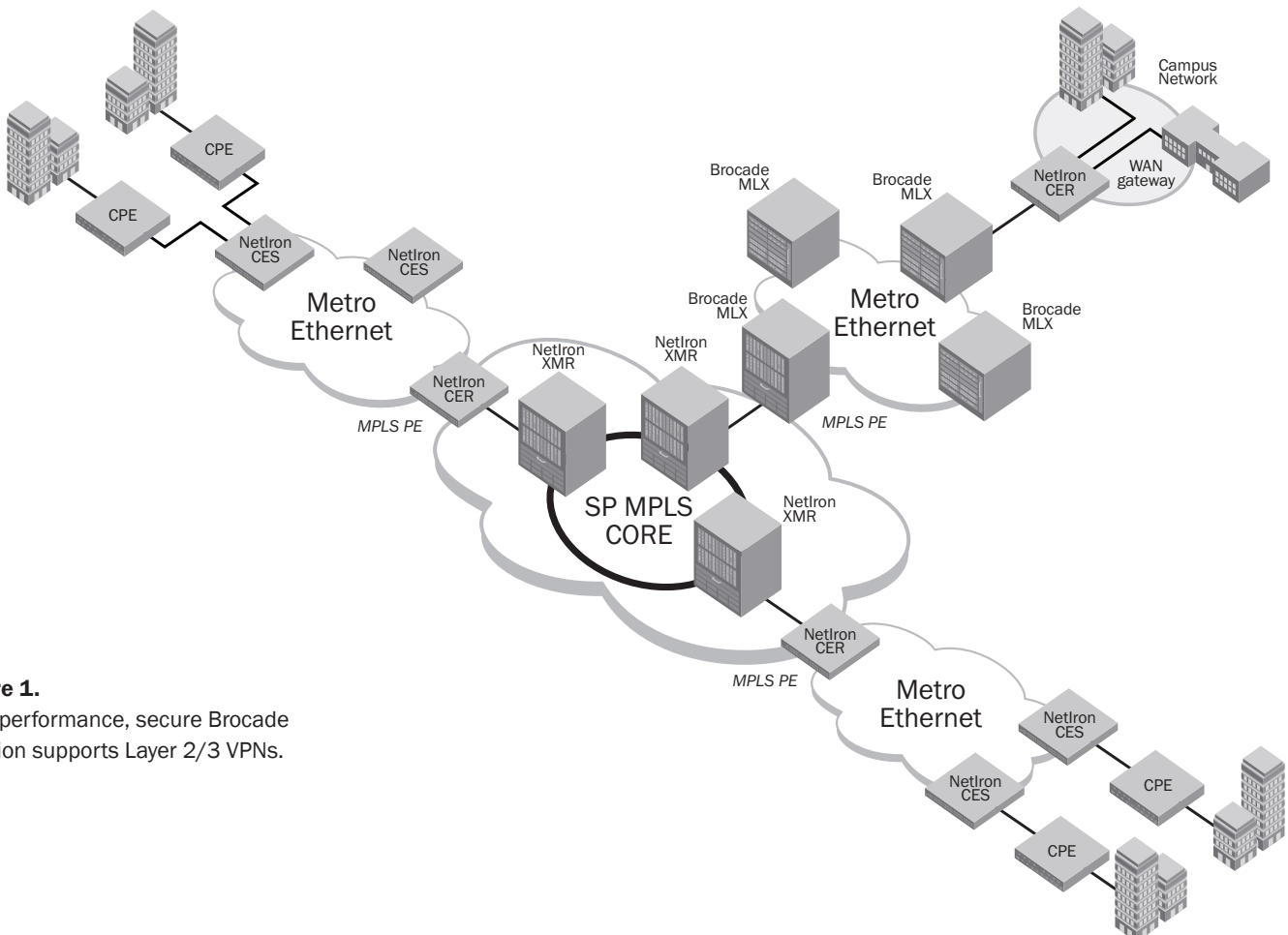

Figure 1.
High-performance, secure Brocade solution supports Layer 2/3 VPNs.

to comply with MEF 17 Service OAM and MEF 21 Link OAM specifications.

To simplify the manageability of MPLS services, Brocade IronView® Network Manager (INM) features the MPLS Manager, which can manage VPLS and VLL services across networks that are based on NetIron switches and routers.

DELIVERING HIGH SERVICE LEVELS WITH ADVANCED QOS CAPABILITIES

Service provider business services are often tiered under different service levels, ranging from premium to "best-effort" services. At each level of service, providers must meet or exceed customer agreements—and failing to do so can lead to strict financial penalties and loss of business. As a result, Quality of Service (QoS) is a critical factor in creating selective services and meeting SLAs.

The NetIron CER 2000 supports up to eight queues per port, each with a distinct priority level—enabling service providers to sell multi-tiered business VPN services. By applying advanced QoS capabilities (such as the use of two-rate, three-color traffic policers, egress shaping, and priority remarking), service providers can offer guaranteed service levels to customers. In addition, the NetIron CER 2000 supports ingress and egress bandwidth profiles per User Network Interface (UNI) that comply with the rigid traffic management specifications of MEF 10/MEF 14.

VIRTUALIZED DOMAINS WITH MULTI-VRF

Just as VLANs segment a Layer 2 domain into multiple broadcast domains, Multi-Virtual Routing and Forwarding (Multi-VRF) enables a single Layer 3 domain to be segmented into multiple virtual IP domains. This enables enterprise or service provider networks to support two or more VPNs with overlapping IP address spaces on the same router or physical interface—rather than deploying multiple physical routers. Each VPN can be dedicated to traffic from a specific application or from a specific group of users for greater security and manageability.

The NetIron CER 2000 supports up to 128 VRFs and can hold a full Internet routing table inside a VRF. It also has the capability to dynamically exchange routing information within each VRF using multiple routing protocols, such as BGP, OSPF, or RIP. In addition, the NetIron CER 2000 enables route exchanges between VRFs, which helps service providers or large enterprises use a single VRF as a gateway to the Internet while running confidential mission-critical traffic in other VRFs.

ENFORCING SECURITY AT THE EDGE

Edge routers are usually the first line of defense for service providers, either protecting their own cores or their business customers from Denial of Service (DoS) attacks. The NetIron CER 2000 has a comprehensive set of hardware-based security features to monitor and block unwanted traffic.

Both inbound and outbound Access Control Lists (ACLs) are supported on any kind of interface—physical, trunk groups, or virtual interfaces. In addition, the NetIron CER 2000 supports sFlow- and ACL-based mirroring to help monitor malicious traffic and take preventive actions. To increase the reliability of service delivery, the NetIron CER 2000 (with the help of Receive ACLs) can defend itself against unwanted traffic targeted toward its control plane.

SOFTWARE-DEFINED NETWORKING

Software-Defined Networking (SDN) is a powerful new network paradigm that provides increased agility and programmatic control of network infrastructure, enabling a new class of IT applications to meet critical business needs. The NetIron CER 2000 enables SDN by supporting the OpenFlow protocol, which allows communication between an OpenFlow controller and the OpenFlow-enabled NetIron CER 2000 router. The NetIron CER 2000 delivers OpenFlow 1.3 in hybrid switch mode, meaning organizations can simultaneously deploy traditional Layer 2 and Layer 3 forwarding with OpenFlow on the same system. This unique capability enables network operators to integrate OpenFlow into existing networks, giving them the benefits offered by SDN for specific flows while the remaining traffic is handled the same way as before. OpenFlow 1.3 delivers a richer feature set required for commercial and enterprise networks to address complex network behavior and optimize performance for dynamic SDN applications. These features include Quality of Service (QoS), Q-in-Q, Group Tables, Active-Standby Controller, and IPv6. The NetIron CER 2000 delivers OpenFlow at scale by supporting up to 32,000 flows in a single device.

SIMPLIFIED SERVICE MANAGEMENT

To simplify the manageability and provisioning of Ethernet services, the Brocade NetIron CER 2000 Series leverages Brocade Network Advisor, an application that unifies network management for all Brocade products. Brocade Network Advisor provides the easy-to-use MPLS Manager, which can help configure, monitor, and manage VPLS and Virtual Leased Line (VLL) services across networks that are based on Brocade routers. In addition, the sFlow-based technology utilized by Brocade Network Advisor reduces network downtime with proactive monitoring, traffic analysis, and reporting.

INVESTMENT PROTECTION

To help protect technology investments, the NetIron CER 2000 supports both 1 GbE and 10 GbE ports in a compact 1U device. The 24-port models are field-upgradable to 10 GbE, enabling a scalable growth strategy and migration to 10 GbE services whenever the time is right. In addition, the NetIron CER 2000 is IPv6-ready, which enables providers to offer IPv6 services at a later stage with minimal service disruption.

The NetIron CER 2000 leverages the same Brocade Multi-Service IronWare operating system that runs on field-proven Brocade MLX routers as well as NetIron CES switches. As a result, Brocade delivers similar software functionality across the NetIron family, enabling accelerated feature delivery and greater overall stability.

BROCADE GLOBAL SERVICES

Brocade Global Services has the expertise to help organizations build scalable, efficient cloud infrastructures. Leveraging 15 years of expertise in storage, networking, and virtualization, Brocade Global Services delivers world-class professional services, technical support, network monitoring services, and education, enabling organizations to maximize their Brocade investments, accelerate new technology deployments, and optimize the performance of networking infrastructures.

AFFORDABLE ACQUISITION OPTIONS

Brocade Capital Solutions helps organizations easily address their IT requirements by offering flexible network acquisition and support alternatives. Organizations can select from purchase, lease, Brocade Network Subscription, and Brocade Subscription Plus options to align network acquisition with their unique capital requirements and risk profiles. To learn more, visit www.Brocade.com/CapitalSolutions.

MAXIMIZING INVESTMENTS

To help optimize technology investments, Brocade and its partners offer complete solutions that include professional services, technical support, and education. For more information, contact a Brocade sales partner or visit www.brocade.com.

KEY FEATURES

Comprehensive IPv4/IPv6 routing support based on the Brocade Multi-Service IronWare OS

- High-performance, robust routing using Forwarding Information Base (FIB) programming in hardware
- RIP/RIPng, OSPF/OSPFv3, IS-IS/IS-IS for IPv6, and BGP-4/BGP-MP for IPv6
- Secure Multi-VRF routing for supporting virtual routing applications over non-MPLS backbones
- VRRP and VRRP-E
- 8-path Equal Cost Multi-Path (ECMP)
- Up to 1,500,000 IPv4 unicast routes in FIB
- Up to 256,000 IPv6 unicast routes in FIB
- Connecting IPv6 islands over IPv4 MPLS using IPv6 Provider Edge (6PE) routers
- 6VPE enabling IPv6 multitenancy to the edge of the cloud
- BFD Holdover for OSPFv2/3 and IS-IS
- BFD for Static Routes
- BFD for OSPFv3
- ND6 IPv6 Prefix Suppress
- IS-IS Graceful Restart Helper Mode
- 127-bit IPv6 interface addresses

Software-Defined Networking (SDN)

- OpenFlow 1.3: QoS (for metering and enqueue), Group Table (select and fast failover), Q-in-Q (TAG type auto-recognition), Active-Standby Controller, IPv6, Transport Layer Security (TLS) 1.2 (controller interface)
- Brocade OpenFlow hybrid switch mode for OpenFlow capabilities on the same system as traditional routing or switching features
- Supports up to 32,000 OpenFlow flows

Rich multicast support

- IPv4 multicast protocols, including PIM-DM, PIM-SM, and PIM-SSM
- IPv6 multicast support, including PIM-SM/SSM and MLD
- IGMP v2/v3 routing and snooping support
- IGMP static group support
- Multicast boundaries to facilitate admission control
- Up to 6000 multicast groups in hardware
- Multicast traffic distribution over Link Aggregation Groups (LAGs)
- Efficient egress interface-based replication to maximize performance and conserve buffers
- Multicast for MPLS
- Multicast ECMP

Advanced MPLS features

- Comprehensive MPLS signaling and path calculation algorithms for both traffic-engineered and non-traffic-engineered applications: OSPF-TE, IS-IS-TE, RSVP-TE, and CSPF
- MPLS Fast ReRoute (FRR) and hot standby paths for traffic protection
- Label Distribution Protocol (LDP)
- Advanced MPLS services: IP over MPLS, VLL, VPLS, Layer 3 VPN, and routing over VPLS
- BFD for RSVP-TE LSPs
- LDP Inbound and Outbound FEC Filtering
- RSVP Liberal Bypass LSP Selection
- Link Protection Request for RSVP Fast Reroute
- RSVP Hello Messages for Neighbor Failure Detection
- RSVP TE Link Metric for CSPF Computation
- Static Route over RSVP LSP

Advanced Carrier-grade Ethernet services

- Up to 128,000 MAC addresses
- 4000 VLANs/S-VLANs/B-VLANs
- Ability to reuse VLAN-ID on each port using the Brocade Ethernet Service Instance (ESI) framework
- MPLS Layer 2 VPN services
- IEEE 802.1ad Provider Bridges
- IEEE 802.1ah Provider Backbone Bridges
- IEEE 802.1ag Connectivity Fault Management
- ITU Y.1731 OAM functions and mechanisms for Ethernet-based networks
- Comprehensive set of Layer 2 control protocols: Brocade MRP/MRP-II, VSRP, RSTP, MSTP, and ITU G.8032 Ethernet Ring Protection (ERP version 1 and 2)
- Multi-Chassis Trunking (MCT) with support for up to 256 clients (Active/Active mode or Active/Standby mode for Active/Passive access for client ports)
- E-LINE (EPL and EVPL), E-LAN, and E-TREE support
- Protocol tunneling of Bridge Protocol Data Units (BPDUs)
- MEF 9, MEF 14, and MEF 21 certification

Support for link aggregation using either IEEE 802.3ad LACP or static trunks

- Up to 12 ports per LAG
- Support for single-link Link Aggregation Control Protocol (LACP)

Deep egress buffering for transient bursts in traffic

- 64 to 192 MB of buffering, based on configuration

Advanced QoS

- Inbound and outbound two-rate, three-color traffic policers with accounting
- Eight queues per port, each with a distinct priority level
- Multiple queue servicing disciplines: Strict Priority, Weighted Fair Queuing, and hybrid
- Advanced remarking capabilities based on port, VLAN, PCP, DSCP, or IPv4 flow
- Egress port and priority-based shaping
- QoS for management protocols (SSH and Telnet)

Comprehensive hardware-based security and policies

- Hardware-based Layer 3 and Layer 2 ACLs (both inbound and outbound) with logging
- Ability to bind multiple ACLs to the same port
- Hardware-based receive ACLs
- Hardware-based Policy-Based Routing (PBR)

Additional security capabilities

- Port-based network access control using 802.1x or MAC port security
- Root guard and BPDU guard
- Broadcast, multicast, and unknown unicast rate limits
- ARP inspection for static entries
- Multi-port static ARP and static MAC

Advanced monitoring capabilities

- Port- and ACL-based mirroring that enables traffic mirroring based on incoming port, VLAN-ID, or IPv4/TCP/UDP flow
- Hardware-based sFlow sampling that allows extensive Layer 2-7 traffic monitoring for IPv4 and Carrier Ethernet services
- ACL-based sFlow support
- sFlow support for MPLS LSR and LER interfaces

Interface capabilities

- Jumbo frame support up to 9216 bytes
- Optical monitoring of SFP and XFP optics for fast detection of fiber faults
- UDLD and LFS/RFN support

Intuitive, comprehensive status indication via LEDs

- Per-port UP/DOWN/ACTIVITY indicators
- FAN tray status
- Power supply status

Redundancy

- Redundant, hot-swappable AC/DC power supplies at the rear
- Removable fan tray with fan redundancy

Software-Defined Networking (SDN)

- Support for OpenFlow v1.0

BROCADE NETIRON CER 2000 SERIES BY THE NUMBERS

Features	NetIron 2024C-RT	NetIron 2024F-RT	NetIron 2048CX-RT	NetIron 2048FX-RT	NetIron 2024C-4X-RT	NetIron CER 2024F-4X-RT
Port density	24 10/100/1000 RJ45 ports with optional slot for 2×10 GbE XFP uplinks	24 100/1000 Hybrid Fiber SFP ports with optional slot for 2×10 GbE XFP uplinks	48 10/100/1000 RJ45 ports with 2×10 GbE XFP uplinks	48 100/1000 Hybrid Fiber SFP ports with 2×10 GbE XFP uplinks	24 0/100/1000 RJ45 ports with 4×10 GbE ports	24 100/1000 Hybrid Fiber SFP ports with 4×10 GbE ports
10 G uplinks	Yes (optional slot for 2×10 GbE XFP uplinks)	Yes (optional slot for 2×10 GbE XFP uplinks)	Yes (built in)	Yes (built in)	Yes (built in)	Yes (built in)
Combination ports	Yes (4 100/1000 SFP ports)	Yes (4 10/100/1000 RJ45 ports)	No	No	Yes (4 100/1000 SFP ports)	Yes (4 10/100/1000 RJ45 ports)
Forwarding performance	48 Gbps 88 Gbps (with 2×10 GbE module installed)	48 Gbps 88 Gbps (with 2×10 GbE module installed)	136 Gbps	136 Gbps	128 Gbps	128 Gbps
Packet forwarding performance	36 Mpps 65 Mpps (with 2×10 GbE module installed)	36 Mpps 65 Mpps (with 2×10 GbE module installed)	101 Mpps	101 Mpps	101 Mpps	101 Mpps
Buffering	64 MB 128 MB (with 2×10 GbE uplinks)	64 MB 128 MB (with 2×10 GbE uplinks)	192 MB	192 MB	192 MB	192 MB
Power supply options	Internal AC or DC	Internal AC or DC	Internal AC or DC	Internal AC or DC	Internal AC or DC	Internal AC or DC
Power supply redundancy	1+1	1+1	1+1	1+1	1+1	1+1
Fan redundancy	M+N	M+N	M+N	M+N	M+N	M+N
Airflow	Front to back	Front to back	Front to back	Front to back	Front to back	Front to back

BROCADE NETIRON CER 2000 SERIES SOFTWARE OPTIONS

License	Content
BASE	Advanced Layer 2 and 3 functions: • IPv4 routing: RIP, OSPF, IS-IS, and BGP • IPv6 routing: RIPng, OSPFv3, IS-IS for IPv6, and BGP-MP for IPv6 • Virtual routing in non-MPLS environments via Multi-VRF • All classic Layer 2 capabilities • QoS and ACLs • Management via SNMP/CLI • Bundled with base hardware • Connectivity Fault Management (IEEE 802.1ag) and Y.1731 Service OAM
ADV_SVCS_PREM (Advanced Services Premium)	All functions in BASE plus: • Multi-Protocol Label Switching (MPLS) • MPLS-based Layer 2 (VLL and VPLS) and Layer 3 (BGP VPNs) VPNs • Provider Bridges (IEEE 802.1ad) and Provider Backbone Bridges (IEEE 802.1ah) • Ethernet Service Instance (ESI) framework • OpenFlow scalability and operational enhancements

Note: To optimize deployment, software functionality is available in different licensed packages.

BROCADE NETIRON CER 2000 SERIES POWER SPECIFICATIONS

Configuration	Maximum AC Power Consumption (Watts) (100 to 240 V AC)	Maximum DC Power Consumption (Watts)	Maximum Thermal Output (BTU/hour)
NetIron 2024C-RT	135	135	461
NetIron CER 2024C-RT with 4×10 GbE uplink	266	225	907
NetIron CER 2024F-RT	160	160	546
NetIron CER 2024F-RT with 4×10 GbE uplink	315	239	1076
NetIron CER 2048CX-RT	305	305	1041
NetIron CER 2048FX-RT	350	350	1195

BROCADE NETIRON CER 2000 SERIES PHYSICAL SPECIFICATIONS

Model	Dimensions
• NetIron CER 2024C-RT • NetIron CER 2024C-RT with 4×10 GbE uplink installed • NetIron CER 2024F-RT • NetIron CER 2024F-RT with 4×10 GbE uplink installed • NetIron CER 2048CX-RT • NetIron CER 2048FX-RT	17.4 in. W × 1.7 in. H × 17.6 in. D (44.3 cm × 4.4 cm × 44.8 cm)

BROCADE NETIRON CER 2000 SERIES SPECIFICATIONS

IEEE Compliance

- IEEE 802.3 10Base-T
- IEEE 802.3u 100Base-TX, 100Base-FX, 100Base-LX
- IEEE 802.3z 1000Base-SX/LX
- IEEE 802.3ab 1000Base-T
- 802.3 CSMA/CD AcCERs Method and Physical Layer Specifications
- 802.3ae 10 Gigabit Ethernet
- 802.3x Flow Control
- 802.3ad Link Aggregation
- 802.1Q Virtual Bridged LANs
- 802.1D MAC Bridges
- 802.1w Rapid STP
- 802.1s Multiple Spanning Trees
- 802.1x Port-based Network Access Control
- 802.1ad Provider Bridges
- 802.1ah Provider Backbone Bridges
- 802.1ag Connectivity Fault Management (CFM)
- 802.1ab Link Layer Discovery Protocol
- 802.1ah Provider Backbone Bridging

ITU Compliance

- Y.1731 OAM functions and mechanisms for Ethernet
- ITU-T G.8032 Ethernet Ring Protection (ERP version 1 and 2)

MEF Specifications

- MEF 2 Requirements and Framework for Ethernet Service Protection
- MEF 4 Metro Ethernet Network Architecture Framework Part 1: Generic Framework
- MEF 6.1 Metro Ethernet Services Definitions Phase 2
- MEF 9 Abstract Test Suite for Ethernet ServiCER at the UNI
- MEF 10.1 Ethernet Services Attributes Phase 2
- MEF 11 User Network Interface (UNI) Requirements and Framework
- MEF 12 Metro Ethernet Network Architecture Framework Part 2: Ethernet Services Layer
- MEF 13 User Network Interface (UNI) Type 1 Implementation Agreement
- MEF 14 Abstract Test Suite for Traffic Management Phase 1
- MEF 15 Requirements for Management of Metro Ethernet Phase 1 Network Elements
- MEF 17 Service OAM Framework and Requirements (partial)
- MEF 19 Abstract Test Suite for UNI Type 1
- MEF 21 Abstract Test Suite for UNI Type 2 Part 1 Link OAM

RFC Compliance

BGPv4	• RFC 4271 BGPv4 • RFC 1745 OSPF Interactions • RFC 1997 Communities and Attributes • RFC 2439 Route Flap Dampening • RFC 2796 Route Reflection • RFC 1965 BGP4 Confederations • RFC 2842 Capability Advertisement • RFC 2918 Route Refresh Capability • RFC 1269 Managed Objects for BGP • RFC 2385 BGP Session Protection via TCP MD5 • RFC 3682 Generalized TTL Security Mechanism, for eBGP Session Protection • RFC 4273 BGP-4 MIB • RFC 4893 BGP Support for Four-octet AS Number Space • RFC 5396 Textual Representation of Autonomous System (AS) Numbers • RFC 4724 Graceful Restart Mechanism for BGP (helper mode)
OSPF	• RFC 2328 OSPF v2 • RFC 3101 OSPF NSSA • RFC 1745 OSPF Interactions • RFC 1765 OSPF Database Overflow • RFC 1850 OSPF v2 MIB • RFC 2370 OSPF Opaque LSA Option • RFC 3630 TE Extensions to OSPF v2 • RFC 3623 Graceful OSPF Restart (helper mode)
IS-IS	• RFC 1195 Routing in TCP/IP and Dual Environments • RFC 1142 OSI IS-IS Intra-domain Routing Protocol • RFC 2763 Dynamic Host Name Exchange • RFC 2966 Domain-wide Prefix Distribution • RFC 5120 IS-IS Multi-Topology Support • RFC 5306 Restart Signaling for IS-IS
RIP	• RFC 1058 RIP v1 • RFC 2453 RIP v2 • RFC 1812 RIP Requirements
IPv4 multicast	• RFC 1122 Host Extensions • RFC 1112 IGMP • RFC 2236 IGMP v2 • RFC 3376 IGMP v3 • RFC 3973 PIM-DM • RFC 2362 PIM-SM • RFC 4610 Anycast RP using PIM
IPv6 core	• RFC 2460 IPv6 Specification • RFC 2461 IPv6 Neighbor Discovery • RFC 2462 IPv6 Stateless Address—Auto-Configuration • RFC 4443 ICMPv6 • RFC 4291 IPv6 Addressing Architecture • RFC 3587 IPv6 Global Unicast—Address Format • RFC 2375 IPv6 Multicast Address Assignments • RFC 2464 Transmission of IPv6 over Ethernet Networks • RFC 2711 IPv6 Router Alert Option • RFC 3315 Dynamic Host Configuration Protocol (DHCP) for IPv6
IPv6 routing	• RFC 2080 RIPng for IPv6 • RFC 2740 OSPFv3 for IPv6 • draft-ietf-isis-ipv6 Routing IPv6 with IS-IS • RFC 2545 Use of BGP-MP for IPv6 • RFC 6106 Support for IPv6 Router Advertisements with DNS Attributes • RFC 4659 BGP-MPLS IP Virtual Private Network (VPN) Extension for IPv6 • RFC 6164 Using 127-Bit IPv6 Prefixes on Inter-Router Links
IPv6 transitioning	• RFC 4798 Connecting IPv6 Islands over IPv4 MPLS Using IPv6 Provider Edge Routers • RFC 4659 Transporting IPv6 Layer 3 VRFs across IPv4/MPLS backbones (6VPE)
MPLS	• RFC 3031 MPLS Architecture • RFC 3032 MPLS Label Stack Encoding • RFC 3036 LDP Specification • RFC 2205 RSVP v1 Functional Specification • RFC 2209 RSVP v1 Message Processing Rules • RFC 3209 RSVP-TE • RFC 3270 MPLS Support of Differentiated Services • RFC 3812 MPLS MIB • RFC 4090 Fast Reroute Extensions to RSVP-TE for LSP Tunnels; partial support • RFC 4875 Extensions to RSVP-TE for P2MP TE LSPs • RFC 5443 LDP IGP Synchronization • RFC 5712 MPLS Traffic Engineering Soft Preemption
Layer 2 VPN and PWE3	• RFC 4664 Framework for Layer 2 Virtual Private Networks • RFC 4665 Service Requirements for Layer 2 Provider-Provisioned Virtual Private Networks • RFC 4762 VPLS using LDP Signaling • draft-ietf-pwe3-arch PWE3 Architecture • RFC 4447 Pseudowire Setup and Maintenance using LDP • RFC 4448 Encapsulation Methods for Transport of Ethernet over MPLS Networks • RFC 5542 Definitions of Textual Conventions for Pseudowire (PW) Management • RFC 5601 Pseudowire (PW) Management Information Base
Layer 3 VPN	• RFC 2858 Multiprotocol Extensions for BGP-4 • RFC 3107 Carrying Label Information in BGP-4 • RFC 4364 BGP/MPLS IP VPNs • draft-ietf-idr-bgp-ext-communities BGP Extended Communities Attribute • RFC 4576 Using LSA Options Bit to Prevent Looping in BGP/MPLS IP VPNs (DN Bit) • RFC 4577 OSPF as the PE/CE Protocol in BGP/MPLS IP VPNs • draft-ietf-idr-route-filter Cooperative Route Filtering Capability for BGP-4 • RFC 4382 MPLS/BGP Layer 3 VPN MIB

General protocols	• RFC 791 IP
	• RFC 792 ICMP
	• RFC 793 TCP
	• RFC 1350 TFTP
	• RFC 826 ARP
	• RFC 768 UDP
	• RFC 894 IP over Ethernet
	• RFC 903 RARP
	• RFC 906 TFTP Bootstrap
	• RFC 1027 Proxy ARP
	• RFC 951 BootP
	• RFC 1122 Host Extensions for IP Multicasting
	• RFC 1256 IRDP
	• RFC 1519 CIDR
	• RFC 1542 BootP Extensions
	• RFC 1812 Requirements for IPv4 Routers
	• RFC 1541 and 1542 DHCP
	• RFC 2131 BootP/DHCP Helper
	• RFC 3768 VRRP
	• RFC 854 TELNET
	• RFC 1591 DNS (client)
QoS	• RFC 2475 An Architecture for Differentiated Services
	• RFC 3246 An Expedited Forwarding PHB
	• RFC 2597 Assured Forwarding PHB Group
	• RFC 2698 A Two-Rate Three-Color Marker
Other	• RFC 1354 IP Forwarding MIB
	• RFC 2665 Ethernet Interface MIB
	• RFC 1757 RMON Groups 1, 2, 3, 9
	• RFC 2068 HTTP
	• RFC 4330 SNTP
	• RFC 2865 RADIUS
	• RFC 3176 sFlow
	• RFC 2863 Interfaces Group MIB
	• Draft-ietf-tcpm-tcpsecure TCP Security
	• draft-ietf-bfd-base Bidirectional Forwarding Detection (BFD)
	• RFC 2784 Generic Routing Encapsulation (GRE)
	• RFC 4741 NETCONF (Partial)
	• RFC 4087 IP Tunnel MIB
	• RFC 4133 Entity MIB
	• RFC 5676 Definitions of Managed Objects for Mapping SYSLOG Messages to SNMP Notifications

Network Management

- Brocade Network Advisor Web-based Graphical User Interface (GUI)
- Integrated industry-standard Command Line Interface (CLI)
- sFlow (RFC 3176)
- Telnet
- SNMP v1, v2c, v3
- SNMP MIB II
- RMON
- Entity MIB (Version 3)

Element Security Options

- AAA
- RADIUS
- Secure Shell (SSH v2)
- Secure Copy (SCP v2)
- HTTPs
- TACACS/TACACS+
- Username/Password (Challenge and Response)
- Bi-level Access Mode (Standard and EXEC Level)
- Protection against Denial of Service attacks, such as TCP SYN or Smurf attacks

Environmental

Temperature	Operating: 0°C to 40°C (32°F to 104°F)
	Non-operating: –25°C to 70°C (–13°F to 158°F)
Humidity	Relative: 5% to 90% at 40°C (104°F), non-condensing
	Non-operating: 95% maximum relative humidity, non-condensing
Altitude	Operating: 10,000 ft (3048 m)
	Non-operating: 15,000 ft (4500 m) maximum

Safety Agency Approvals

- CAN/CSA-C22.2 No. 60950-1-3
- UL 60950-1
- IEC 60950-1
- EN 60950-1 Safety of Information Technology Equipment
- EN 60825-1 Safety of Laser Products—Part 1: Equipment Classification, Requirements and User's Guide
- EN 60825-2 Safety of Laser Products—Part 2: Safety of Optical Fibre Communication Systems

Electromagnetic Emission

- ICES-003 Electromagnetic Emission
- FCC Class A
- EN 55022/CISPR-22 Class A/VCCI Class A
- AS/NZS 55022
- EN 61000-3-2 Power Line Harmonics
- EN 61000-3-3 Voltage Fluctuation and Flicker
- EN 61000-6-3 Emission Standard (Supersedes: EN 50081-1)

Immunity

- EN 61000-6-1 Generic Immunity and Susceptibility; this supersedes EN 50082-1
- EN 55024 Immunity Characteristics. This supersedes:
  — EN 61000-4-2 ESD
  — EN 61000-4-3 Radiated, radio frequency, electromagnetic field
  — EN 61000-4-4 Electrical fast transient
  — EN 61000-4-5 Surge
  — EN 61000-4-6 Conducted disturbances induced by radio-frequency fields
  — EN 61000-4-8 Power frequency magnetic field
  — EN 61000-4-11 Voltage dips and sags

Telco NEBS/ETSI

- Telcordia GR-63-CORE NEBS Requirements: Physical Protection
- Telcordia GR-1089-CORE EMC and Electrical Safety
- Telcordia SR-3580 Level 3
- ETSI ETS 300-019 Physical Protection:
  — Part 1-1, Class 1.1, Partly Temperature Controlled Storage Locations
  — Part 1-2, Class 2.3, Public Transportation
  — Part 1-3, Class 3.1, Temperature Controlled Locations (Operational)
- ETSI ETS 300-386 EMI/EMC

Power and Grounding

- ETS 300 132-1 Equipment Requirements for AC Powered Equipment Derived from DC Sources
- ETS 300 132-2 Equipment Requirements for DC Powered Equipment
- ETS 300 253 Facility Requirements

Physical Design and Mounting

Rack mount	19-inch rack mount supporting racks compliant with:
	• ANSI/EIA-310-D
	• ETS 300 119
	• GR-63-CORE Seismic Zone 4

Environmental Regulatory Compliance

- EU 2002/95/EC RoHS
- EU 2002/96/EC WEEE

ORDERING INFORMATION

Product number	Description
BR-CER-2024C-4X-RT-AC	24×1 GbE copper (RJ45) with four combination RJ45/SFP ports, 4×10 GbE, one 500 W AC power supply, and base software license with enhanced routing scalability
BR-CER-2024C-4X-RT-DC	24×1 GbE copper with four combination RJ45/SFP ports, 4×10 GbE, one 500 W DC power supply, and base software license with enhanced routing scalability
BR-CER-2024F-4X-RT-AC	24×1 GbE Hybrid Fiber SFP with four combination 10/100/1000 RJ45 ports, 4×10 GbE, one 500 W AC power supply, and base software license
BR-CER-2024F-4X-RT-DC	24×1 GbE Hybrid Fiber SFP with four combination 10/100/1000 RJ45 ports, 4×10 GbE, one 500 W DC power supply, and base software license
NI-CER-2024C-RT-AC	24×1 GbE copper (RJ45) with four combination 100/1000 SFP ports, one optional 2×10 GbE slot, one 500 W AC power supply, and base software license with enhanced routing scalability
NI-CER-2024C-RT-DC	24×1 GbE copper (RJ45) with four combination 100/1000 SFP ports, one optional 2×10 GbE slot, one 500 W DC power supply, and base software license
NI-CER-2024F-RT-AC	24×1 GbE Hybrid Fiber (HF) SFP with four combination 10/100/1000 RJ45 ports, one optional 2×10 GbE slot, one 500 W AC power supply, and base software license
NI-CER-2024F-RT-DC	24×1 GbE Hybrid Fiber (HF) SFP with four combination 10/100/1000 RJ45 ports, one optional 2×10 GbE slot, one 500 W DC power supply, and base software license
NI-CER-2048C-RT-AC	48×1 GbE copper (RJ45) with four combination 100/1000 SFP ports, one 500 W AC power supply, and base software license
NI-CER-2048CX-RT-AC	48×1 GbE copper (RJ45) with 2×10 GbE XFP uplinks, one 500 W AC power supply, and base software license
NI-CER-2048CX-RT-DC	48×1 GbE copper (RJ45) with 2×10 GbE XFP uplinks, one 500 W DC power supply, and base software license
NI-CER-2048FX-RT-AC	48×1 GbE Hybrid Fiber (HF) with 2×10 GbE XFP uplinks, one 500 W AC power supply, and base software license
NI-CER-2048FX-RT-DC	48×1 GbE Hybrid Fiber (HF) with 2×10 GbE XFP uplinks, one 500 W DC power supply, and base software license
NI-CER-2024-2X10G	NetIron CER 2×10 GbE XFP uplink for 24-port models
NI-CER-2024-RT-2X10G	NetIron CER 2×10 GbE XFP uplink for 24-port models
NI-CER-2024-ADVU-SW	Advanced Services Premium software upgrade for NetIron CER 2000 24-port routers (NetIron CER 2024C, NetIron CER 2024F)
NI-CER-2048-ADVU-SW	Advanced Services Premium software upgrade for NetIron CER 2000 48-port routers (NetIron CER 2048C, NetIron CER 2048F, NetIron CER 2048CX, NetIron CER 2048FX)

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