

# Broadband Services Router 64000

## Cable Modem Termination System (CMTS)/Router

FACT SHEET



### FEATURES

Fully redundant, carrier-class system architected for "five-nines" (99.999 percent) availability

Based on open systems standards, the BSR 64000 is Data Over Cable Service Interface Specification (DOCSIS®) and EuroDOCSIS 2.0 qualified, PacketCable™ 1.1 qualified, and PacketCable Multimedia (PCMM) qualified

Advanced Spectrum Management features RFSentry™, an integrated ninth receiver on each CMTS card that monitors RF performance

Wire-speed forwarding

Carrier-class intradomain, interdomain, and multi-cast routing with OSPF v2, RIP v1 and v2, BGP4, VRRP, IGMP, IP Tunneling, and PIM-SM

SmartFlow™ Quality of Service (QoS) classification for thousands of flows at wire-speed with guaranteed Service Level Agreements (SLAs)

Virtual Private Network (VPN) support with policy-based routing and full-featured MPLS

Virtual LAN (VLAN) support

Carrier-class reliability and robust QoS control enables support for real-time VoIP services

DOCSIS 2.0 logical channel support allows operators to define up to four logical channels within each physical channel

Pre-DOCSIS 3.0 support for channel bonding allows operators to bond multiple physical channels into a single, virtual, high-bandwidth channel\*

Investment protection with migration path for DOCSIS 3.0 and M-CMTS support

Dynamic Load Balancing allows cable operators to balance cable modem traffic across multiple upstream or downstream ports



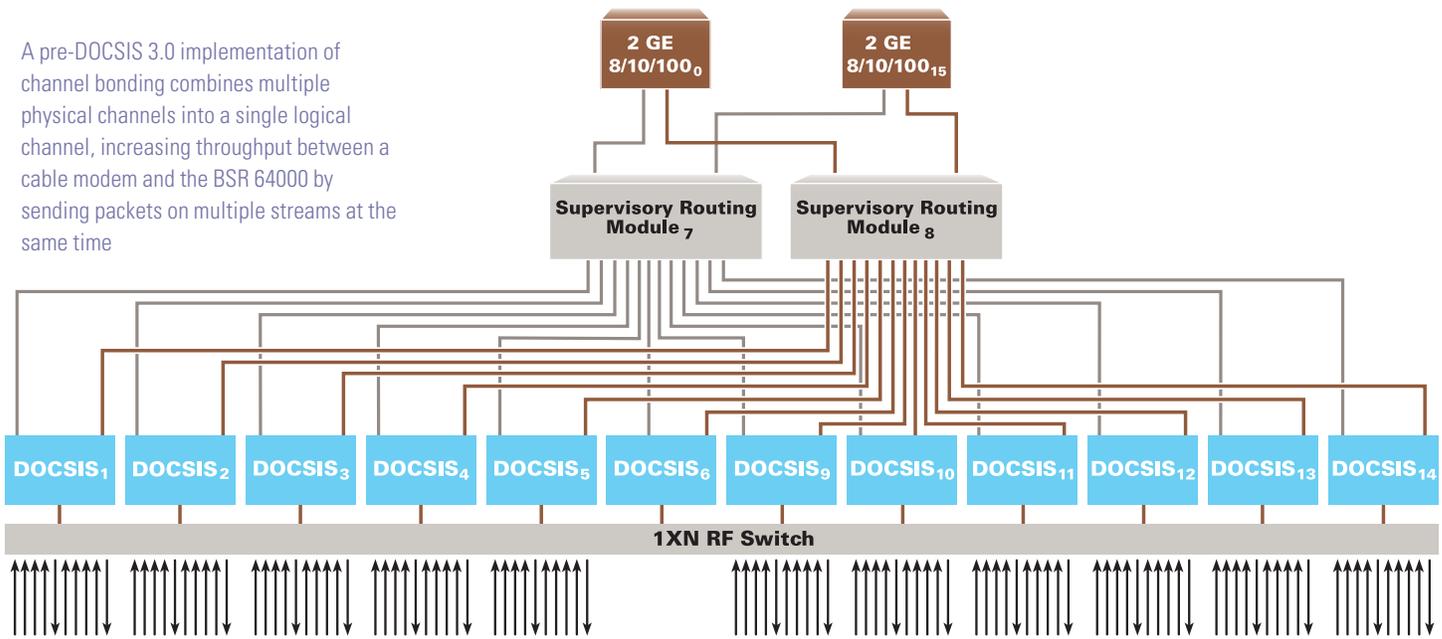
## A Next-Generation Multi-Service Platform

Motorola's Broadband Services Router 64000 (BSR 64000) is DOCSIS® and EuroDOCSIS 2.0 qualified, PacketCable™ 1.1 qualified, and PacketCable Multimedia (PCMM) qualified. It is a fully redundant, carrier-class, intelligent edge router with an integrated, high-density CMTS for Hybrid Fiber Coax (HFC) connectivity. It includes an internal RF matrix switch to provide the CMTS redundancy and resilience necessary for demanding, mission-critical applications delivered over cable infrastructure. The BSR 64000 is a high-performance, intelligent edge router that performs sophisticated traffic grooming and forwarding in a distributed fashion at the periphery of the broadband access network to enable end-to-end service delivery across access, metropolitan, and core networks.

The BSR 64000 delivers the per-flow packet treatment needed to enable end-to-end SLAs across broadband access networks—including handoffs to metropolitan or core networks using DiffServ and/or Multiprotocol Label Switching (MPLS). It supports important standards for packetized voice services, including Dynamic QoS (DQoS), Common Open Policy Service (COPS), IPsec, and the Communications Law Enforcement Act (CALEA) for legal intercept.

It allows operators to efficiently manage impairments on the HFC network so they can continuously optimize performance, create bandwidth, and efficiently migrate to DOCSIS 2.0 while leveraging investments in deployed DOCSIS 1.0 and 1.1 cable modems. Advanced Spectrum Management features allow operators to optimize throughput and cancel out or avoid impairments. It includes ingress noise cancellation, post-equalization, sophisticated noise measurement, and noise avoidance capabilities. Advanced Spectrum Management features RFSentry™, an integrated ninth receiver on each CMTS card that monitors RF performance.

A pre-DOCSIS 3.0 implementation of channel bonding combines multiple physical channels into a single logical channel, increasing throughput between a cable modem and the BSR 64000 by sending packets on multiple streams at the same time



The BSR 64000 supports a full implementation of DOCSIS 2.0, including ATDMA and SCDMA. It supports the ability to define up to four DOCSIS 2.0 logical channels within each physical channel, allowing cable operators to optimize the throughput of upstream bandwidth. It also offers investment protection opportunities with a migration path to support pre-DOCSIS 3.0 channel bonding and future support for DOCSIS 3.0 on the same chassis.\*

### High-Performance, Redundant, and Cost-Effective Routing

This high-density platform streamlines operations and management. The BSR 64000 can support up to 24 downstream transmitters and up to 96 upstream receivers in a single, space-saving chassis. The system includes flexible interfaces for Gigabit Ethernet, 10/100 Ethernet, and SONET/SDH connectivity and it eliminates the need for discrete CMTS equipment, upconverters, aggregation switches, and routers. The BSR 64000 offers unified management of routing, Quality of Service (QoS), and CMTS functions and it scales economically to meet ever-increasing subscriber demands and the introduction of new services.

The BSR 64000 design is based on centralized routing table calculations and distributed forwarding, and it provides the benefits of simple configuration (single router appearance), scalable performance (each additional line card brings an associated forwarding engine), and low cost-of-entry (operators only purchase the forwarding power required). It can be deployed to consolidate traffic flows on the broadband access network and provide access to metropolitan and

core networks. High-speed interfaces allow connectivity to local servers so operators can efficiently distribute content, services, and applications over the access network.

### DOCSIS 3.0 Channel Bonding

The BSR 64000 platform provides cable operators with a versatile architecture capable of supporting next-generation DOCSIS 3.0 technology to enable high-speed residential and commercial data services in excess of 100 Mbps. Multiple downstream channels are combined or bonded together to dramatically increase the downstream data rate, allowing for a significant increase in downstream capacity and offering cable operators a cost-effective solution to compete with next-generation xDSL and fiber-based telco services.

### Carrier-Class VoIP

The BSR 64000 is a carrier-class platform architected for the 99.999 percent availability and wire-rate performance required for real-time voice services. It supports continuous operation in a mission-critical, service-oriented environment. The BSR 64000's architecture integrates Central Office features that lower operational and maintenance cost. These features include: a Stratum 3 clock; a mid-plane chassis design with field replaceable modules; "cable once" rear cabling; simple front access; fully redundant control; sophisticated route calculations; and an internal 64 Gbps switching fabric.

The BSR 64000 supports continuous operation regardless of internal and external failures, and it supports hitless software upgrades. SmartFlow provides the QoS control necessary for prioritiz-

ing voice calls to enable real-time service delivery. It offers proven interoperability with Motorola's families of multimedia terminal adapters and voice-enabled cable modems. With the BSR 64000, operators can deliver converged voice and data services over the HFC network using a scalable, cost-effective system that provides carrier-class availability. They can also begin a migration path toward offering seamless mobility of voice services that can be delivered over cellular networks and broadband-based Wi-Fi® networks.

### Advanced Multimedia Services

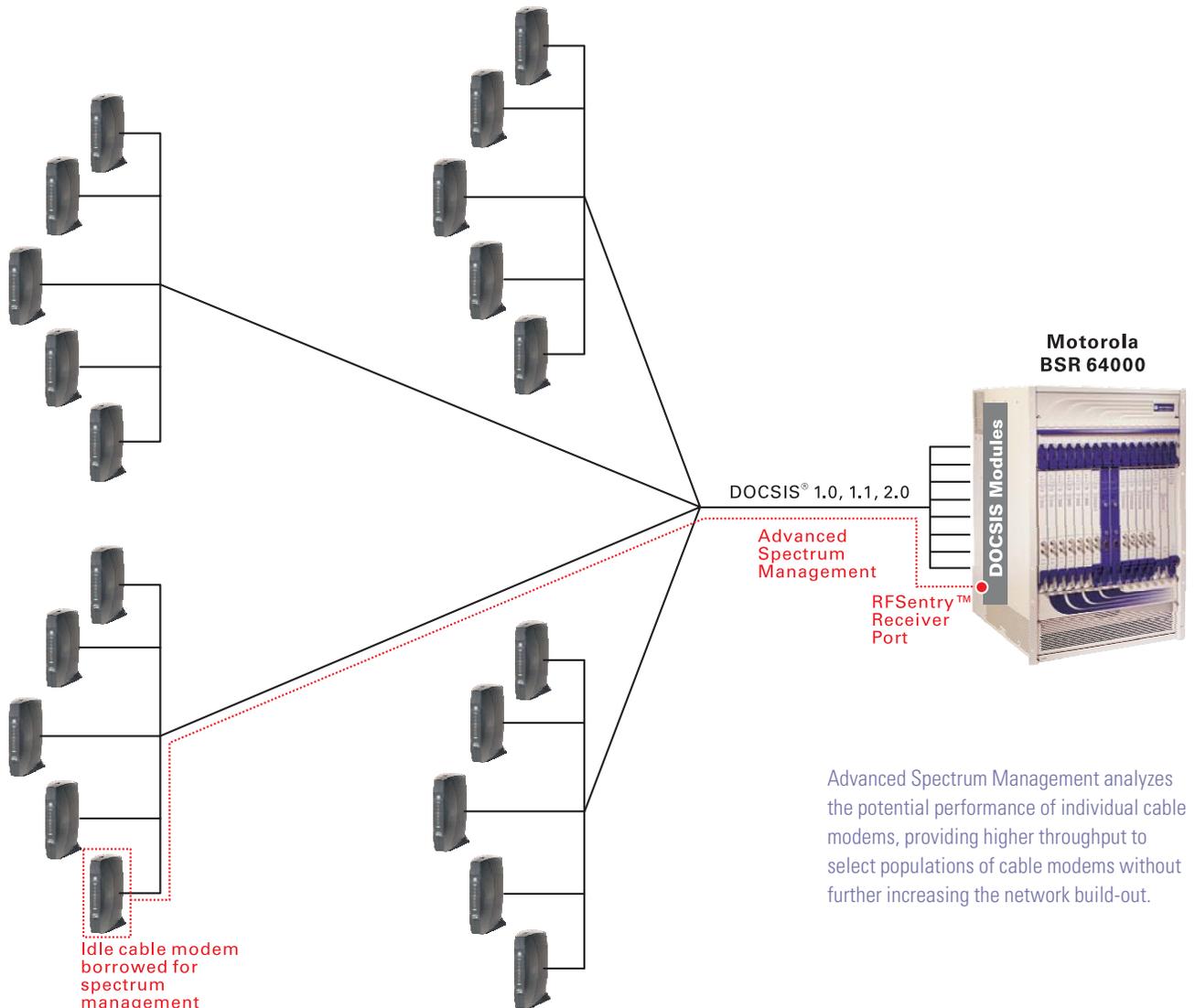
The BSR 64000 provides support for the PacketCable Multimedia (PCMM) architecture, which allows cable operators to offer a variety of QoS IP-based revenue generating services such as VoIP, online gaming, and other multimedia services. The PCMM architecture is comprised of an Application Manager, Policy Server, CMTS, Recorded Keeping Server, and Clients. It defines the requirements needed to support QoS-based multimedia applications, leveraging the existing

DOCSIS 1.1 access technology. PCMM enables operators to efficiently and cost-effectively deploy these new revenue generating IP multimedia services.

### An Innovative and Redundant System Architecture

The BSR 64000 architecture optimizes performance and reliability by centralizing routing table calculations while distributing packet forwarding functions. The BSR 64000 offers a high level of reliability with complete system redundancy, including redundant 1:N CMTS modules with an integrated RF Switch Matrix, redundant 1:1 Network Interface Modules, redundant 1:1 Supervisory Routing Modules (SRMs) with a redundant switch fabric, and redundant power supplies and fan assemblies.

The next-generation, 16-slot, NEBS-compliant chassis has been designed to deliver advanced services while offering investment protection opportunities by enabling support for potentially



Advanced Spectrum Management analyzes the potential performance of individual cable modems, providing higher throughput to select populations of cable modems without further increasing the network build-out.

higher densities in the future. The BSR 64000 has a midplane architecture that enhances serviceability by decoupling functional hardware modules from the physical I/O and connectivity. The midplane provides the physical paths used for interslot communications and includes the switch fabric cross-connect paths used by the data plane and a management bus used by the control plane.

The midplane design simplifies support and reduces Mean-Time-To-Repair (MTTR) by separating the front logic cards from the passive rear I/O cards, thus eliminating the need to change cable connections. The chassis provides dual redundant power connections for –48 VDC power, and the BSR 64000 supports hot-insertion and removal capabilities. The slots can be populated with three types of hardware modules: the 2:8 DOCSIS or EuroDOCSIS modules, the SRMs, and the Network Interface Modules.

### **2:8 DOCSIS and EuroDOCSIS 2.0 CMTS Modules**

The 2:8 DOCSIS and EuroDOCSIS 2.0 CMTS modules provide high density and offer advanced functionality. Based on industry-leading DOCSIS 2.0 silicon from Broadcom Corp., these modules enable Advanced Spectrum Management, which includes ingress noise cancellation, post-equalization, sophisticated noise measurement, and noise avoidance capabilities.

Each module occupies a single slot in the BSR 64000 and has two downstream and eight upstream ports. While eight receivers per module are available for servicing subscriber traffic, Motorola has architected a ninth receiver—RFSentry™—onto each module to enable Advanced Spectrum Management. An RFSentry receiver can monitor performance on any one of the upstream ports without impacting throughput. It can non-obtrusively gain access to all of the return nodes connected to one of the receiver ports and perform tests on any available modem on any one of the receiver port's supported nodes.

The BSR 64000 supports both ATDMA and SCDMA, including upstream support for QPSK and 16, 32, 64, 128, and 256 QAM. It allows DOCSIS 2.0 cable modems to coexist with DOCSIS 1.X modems. Motorola has leveraged the DOCSIS ATDMA specification and adds value by including advanced noise cancellation techniques that work with all DOCSIS 1.X and 2.0 cable modems to help operators increase throughput. The BSR 64000 noise cancellation capabilities allow operators to optimize performance while operating in DOCSIS 1.X/2.0 mixed mode.

Motorola's post-equalization capabilities offer the operator the ability to increase the throughput of DOCSIS 1.0 cable modems by allowing them to operate in 16 QAM mode virtually anywhere that it is possible to operate in QPSK. The BSR 64000 2:8 DOCSIS and EuroDOCSIS 2.0 CMTS modules perform per-burst equalization that enables the receiver to equalize—and thus correct for—the effects of micro-reflections, amplitude distortion, and group delay distortion.

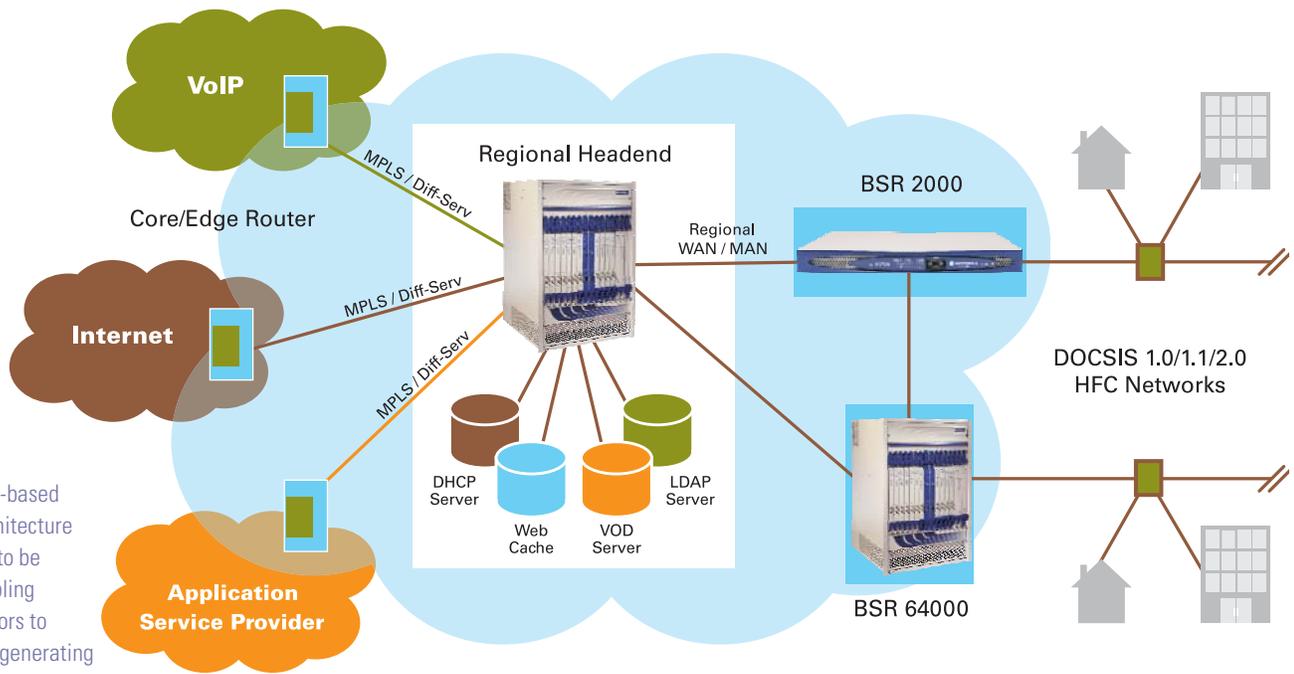
These impairments have historically been the limiting factors in achieving QAM modulation higher than 4 QAM (QPSK). The combination of post equalization and superior ingress noise cancellation capabilities results in a DOCSIS 1.X system today where 16 QAM, error-free operation is achievable virtually anywhere in the return path. Therefore, operators can effectively double the throughput of their installed base of modems.

Each module supports Advanced Spectrum Management functionality with integrated upstream spectrum analysis and management and configurable intelligent frequency, modulation, and bandwidth agility. They support the ability to define up to four DOCSIS 2.0 logical channels within each physical channel, allowing cable operators to optimize the throughput of upstream bandwidth. The BSR 64000's Advanced Spectrum Management capabilities analyze the potential performance of individual cable modems, allowing the optimal modulation profile to be assigned to each of four populations of cable modems. This allows cable operators to best utilize DOCSIS 2.0 logical channels to provide higher throughput to select populations of cable modems without further increasing the network build out.

The 2:8 DOCSIS and EuroDOCSIS modules include a pre-DOCSIS 3.0 implementation of channel bonding that can bond multiple physical channels into a single, virtual, high-bandwidth channel. This is achieved by inverse multiplexing multiple RF channels to create a single logical channel. Channel bonding enables increased throughput between a cable modem and the BSR 64000 by sending packets on multiple streams at the same time. It uses a flexible, packet-based algorithm for combining the capacity of multiple upstream or downstream channels to achieve the equivalent throughput of a wideband channel, allowing cable operators to deliver over 100 Mbps to individual cable modems.

The modules support Dynamic Load Balancing, which allows operators to balance cable modem traffic across multiple upstream and downstream ports. This enables better bandwidth utilization, which allows cable operators to support more voice customers and higher data speeds. The modems are directed to move through the DOCSIS Dynamic Channel Change (DCC) feature.

The BSR 64000 offers an integrated, managed, tunable RF upconverter that simplifies operation, reduces rack space, and eliminates the costs and management overhead of external upconverters. These modules support 64, 256, 512, and 1,024 QAM downstream. They implement per-flow packet classification, apply QoS policies, and perform distributed forwarding.



The BSR 64000's hardware-based distributed forwarding architecture allows MPLS traffic flows to be routed at wire-speed, enabling broadband network operators to deploy additional revenue-generating services.

### Supervisory Routing Modules

The SRMs run all the routing protocols and control applications. Routing table calculations are centralized in these modules to optimize system performance and simplify configuration and management. The SRMs calculate the forwarding tables and distribute forwarding information to the Network Interface Modules and the DOCSIS or EuroDOCSIS modules, and they act as a centralized control system to manage other modules in the chassis.

They contain the redundant switch fabric that provides the connectivity between modules, and they include an I/O interface to the midplane for dedicated Ethernet and RS-232 management ports. Redundant control buses connect all modules to the primary and secondary SRMs and enable the flow of control and management information. The SRMs support leading routing protocols, including OSPF v2, BGP 4, RIP v1, RIP v2, IGMP, VRRP, and PIM-SM.

### Network Interface Modules

The Network Interface Modules classify packets, apply QoS policies, and forward traffic flows. They provide the high-speed local, wide area, and metropolitan area interfaces for the BSR 64000. They enable wire-speed flow classification and forwarding in hardware to optimize throughput. Network Interface Module configurations include:

- The EtherFlex™ card with two ports of Gigabit Ethernet and eight ports of 10/100 Ethernet built with Small Formfactor Pluggable (SFP) optics

- Two-port OC-3/STM-1 or two-port OC-12/STM-3 Packet over SONET/SDH (POS)

The Network Interface Modules support full 1:1 redundancy to enable uninterrupted service for revenue-generating applications such as voice, data, and video.

### Integrated RF Switch

The Integrated RF Switch connects the input and output of each DOCSIS or EuroDOCSIS CMTS module to the RF plant to allow 1:N redundancy. These modules support automatic CMTS module switchover with a single standby DOCSIS or EuroDOCSIS module serving as a backup to all other DOCSIS or EuroDOCSIS modules in the chassis, containing configuration information for all of the active modules. This allows broadband operators to support hitless failover and offer carrier-grade availability for services such as IP telephony, which are intolerant of the extended cable modem re-registration times that typically occur following CMTS card failures.

### Flexible Configuration

The two central slots in the chassis are reserved for the primary and secondary SRMs to enable 1:1 redundancy. Typical configurations will also include redundant Network Interface Modules for upstream metropolitan or wide area connectivity and up to 11 active DOCSIS or EuroDOCSIS CMTS modules and a spare.

Bi-directional, non-blocking 2.1 Gbps data packet transport is provided between modules in a cross-connect manner via a redundant, 64 Gbps fabric. This distributed architecture can provide the density and performance required to accelerate the mass deployment of new revenue-generating services over HFC infrastructure. It provides the capability to support even higher density interfaces and new features. In the future, operators can deploy the BSR 64000 safe in the knowledge they can evolve the platform to capitalize on new technologies and business opportunities.

## MPLS and Policy-Based Routing

You can deploy the BSR 64000 as an MPLS Label Edge Router (LER) at the edge of the network or as an MPLS Label Switch Router (LSR) to provide high-speed Layer 2 transport across the network. Operators can support commercial VPN services. Because of the BSR 64000's hardware-based distributed forwarding architecture, MPLS traffic flows can be routed at wire-speed so broadband network operators can deploy additional revenue-generating services.

Treatments for QoS are based on the policies defined for each MPLS Label Switched Path (LSP) to enable end-to-end traffic treatment across access, metropolitan, and core networks. The BSR 64000 offers a carrier-class implementation of policy-based routing with MPLS. Motorola's MPLS implementation supports IETF standards and is fully interoperable with MPLS-enabled routers and switches.

Support for BGP/MPLS VPN (RFC 2547) allows cable operators to provide compelling VPN services for enterprise customers that encourage them to migrate from their incumbent carriers. Broadband operators can offer services with the same parameters for QoS, security, and performance at a fraction of the cost of traditional leased line or Frame Relay/ATM services offered by incumbent providers—and operators can provide enhanced value by allowing commercial customers to quickly and easily provision additional bandwidth.

## VLAN Services to Commercial Customers

An alternative to MPLS VPNs for connecting multiple commercial locations in a secure virtual network is to use Virtual LANs (VLANs). VLANs enable Transparent LAN Service (TLS) via DOCSIS cable modems. The BSR 64000 allows operators to bridge Layer 2 packets from TLS subscribers to and from an 802.1q VLAN on the network side of the CMTS.

## Network Management and Control

The BSR 64000 offers several options for efficient administration, management, and control to streamline deployment and operation costs. In headend locations with limited availability of trained staff, troubleshooting on the BSR 64000 is simple, with easy-to-read diagnostic LEDs as well as remote management capability to support provisioning, configuration, monitoring, and problem identification.

The BSR 64000 supports Simple Network Management Protocol (SNMP) v1 and v3. Motorola supports all appropriate standard MIBs and offers custom MIBs to monitor and control the BSR 64000's value-added features. Partitioned management provides users with different administrative access needs customized views according to their access privileges. Because of the importance of network security, the BSR 64000 supports RADIUS, TACACS+, Secure Shell (SSH) login, Syslog authentication, and other security measures. The system supports the File Transfer Protocol (FTP) for bulk data transfer, and management of the BSR 64000 can be seamlessly integrated into the existing network management infrastructure.

The BSR 64000 offers extensive diagnostic capabilities and includes a Cisco®-compatible Command Line Interface (CLI) for ease-of-use and interoperability with legacy infrastructure. The CLI supports full scripting capability and ASCII-formatted command files can be uploaded, downloaded, and executed. The BSR 64000 also offers a PC-based management application that helps operators capture, analyze, and optimize the use of upstream bandwidth. Upstream spectrum data from an RFSentry port is captured and analyzed, and the graphical user interface presents flexible reports on network performance and the potential bandwidth gains that can be realized by deploying advanced features of the BSR 64000.

With the capability to support even higher-density interfaces and new features, the BSR 64000 can be deployed today and evolve to capitalize on tomorrow's technologies and business opportunities.

## BSR 64000 SPECIFICATIONS

### SCALABLE PLATFORM FOR GROWTH

Hot-swappable modules  
 Redundant power and fan units, 1:1 SRM redundancy, 1:N DOCSIS and EuroDOCSIS module redundancy, redundant 64 Gbps switch fabric  
 Advanced real-time operating systems such as VxWorks

### PHYSICAL

**Form** 16-slot, NEBS-compliant chassis  
**Dimensions** 29.75 in H x 19 in W x 19.75 in D (75.56 cm x 48.26 cm x 50.17 cm)  
**Weight** 140 lbs (63.5 kg) (fully configured)  
**Power** -48 VDC (optional AC power)  
**Operating Temperature** 0 °C to 40 °C (32 °F to 122 °F)  
**Non-Operating Temperature** -20 °C to 60 °C (-4 °F to 140 °F)  
**Operating Humidity** 10% to 90% (non-condensing)  
**Non-Operating Humidity** 5% to 95% (non-condensing)

### STANDARDS-BASED INTEROPERABILITY

**Compliant** DOCSIS 2.0, EuroDOCSIS 2.0, PacketCable 1.1, PacketCable Multimedia 1.0  
**Qualified** EuroPacket Cable 1.0

### FLEXIBLE CONFIGURATIONS

With EtherFlex card:  
 Two Gigabit Ethernet ports with SFP optics  
 Eight 10/100 Fast Ethernet ports  
 Two-port OC-3/STM-1 or two-port OC-12/STM-3 POS

### ROUTING

**Intradomain/Interdomain** RIP v1, RIP v2, OSPF v2, BGP4, VRRP  
**Multicast** PIM-SM and PIM-SSM, IGMP v2

### ADVANCED QOS

IP DiffServ, standards-based MPLS, BGP/MPLS VPNs (RFC 2547), per-SID queuing on the 2:8 DOCSIS and EuroDOCSIS modules

### NETWORK MANAGEMENT AND PROVISIONING

Cisco-compatible CLI; SNMP v1 and v3; standard DOCSIS and IETF MIBs; Motorola MIBs; LDAP v3; DHCP relay; COPS client; RADIUS interoperability, TACACS+, SSH login, SYSLOG, multiple community strings, Telnet with security extensions, multiple levels of account/password authentication; open interfaces to provisioning, accounting, and billing applications; PC-based application for capturing, analyzing, and optimizing use of upstream bandwidth

### FULL RF SPECTRUM SUPPORT

DOCSIS 2.0 and EuroDOCSIS 2.0 (A-TDMA and S-CDMA), logical channels, pre-DOCSIS 3.0 channel bonding up to four downstream channels on dual 2:8 CMTS modules\*; up to 24 downstream transmitters; up to 96 upstream receivers; Advanced Spectrum Management functionality; downstream DOCSIS transmitter; integrated, managed tunable upconverter for RF output; upstream modulation QPSK and 16, 32, 64, 128, 256 QAM; upstream per-channel bit rate 0.320 to 40.96 Mbps

<b>Upstream Input Frequency Range</b>	
DOCSIS	5 to 42 MHz
J-DOCSIS	5 to 55 MHz
EuroDOCSIS	5 to 65 MHz
<b>Downstream Modulation</b>	
64, 256, 512, and 1024 QAM	
<b>Downstream Output Frequency Range</b>	
88 to 857 MHz (channel center)	
<b>Output Frequency Step Size</b>	
32 kHz	
<b>Downstream Per-Channel Bit Rate</b>	
64 QAM DOCSIS	27 Mbps
64 QAM EuroDOCSIS	36 Mbps
256 QAM DOCSIS	38 Mbps
256 QAM EuroDOCSIS	56 Mbps
512 QAM DOCSIS	48.28 Mbps
512 QAM EuroDOCSIS	59.20 Mbps
1024 QAM DOCSIS	53.60 Mbps
1024 QAM EuroDOCSIS	65.80 Mbps

#### **HIGH-PERFORMANCE IP ROUTING**

Wire-speed forwarding and flow classification; more than 3 million PPS for each Network Interface Module, more than 42 million PPS for each chassis;  
Wire-speed QoS; routing policy support; 50 route updates/second

Specifications are subject to change without notice.

\* Requires BSR 64000 Software Release 4.3 or later.

# Enabling Next-Generation, Multi-Service Broadband Networks

The BSR 64000 allows operators to swiftly deploy enhanced IP services to generate new revenue streams, capture market share, and accelerate return-on-investment for network infrastructure. This carrier-class switching and service-provisioning solution can provide broadband carriers with a competitive edge in defining, deploying, and managing broadband services. This fully redundant, high-density solution is architected for 99.999 percent availability so broadband providers can offer enhanced IP services as well as IP telephony. SmartFlow sophisticated flow classification and QoS treatment can deliver the intelligence needed to offer guaranteed SLAs. Tight integration of intelligent edge routing and CMTS features allows broadband providers to maximize the use of headend space and simplify management and operations while delivering robust new services.



**MOTOROLA**

Motorola, Inc. 101 Tournament Drive, Horsham, Pennsylvania 19044 U.S.A.  
[www.motorola.com](http://www.motorola.com)

MOTOROLA and the Stylized M Logo are registered in the US Patent & Trademark Office. RFSeentry, EtherFlex, and SmartFlow are trademarks of Motorola, Inc. DOCSIS is a registered trademark and PacketCable is a trademark of Cable Television Laboratories, Inc. Wi-Fi is a registered trademark of the Wi-Fi Alliance. Cisco is a registered trademark of Cisco Systems. All other product or service names are the property of their respective owners. © Motorola, Inc. 2006 All rights reserved.

533927-001-a

5704 - 0806 - 0K