

The Broadband Services Router 64000 (BSR 64000) from Motorola provides broadband carriers with a competitive edge in defining, deploying and managing broadband services. The carrier-class,

CMTS/intelligent edge router allows broadband operators to rapidly introduce differentiated data, voice and multimedia services for both corporate and residential subscribers and to deliver Quality of Service (QoS) levels end-to-end across broadband access, metropolitan and core networks.

Broadband providers can deliver per-flow QoS to offer guaranteed Service Level Agreements (SLAs). The SmartFlow™ features of the BSR 64000 perform content-aware packet classification through Layer 4

to provide unprecedented QoS

flexibility. Since all the processing-intensive

filtering,

forwarding,

accounting

and QoS/SLA functions

are performed in hardware at

wire-speed, the BSR 64000 reduces latency

to a fraction of that commonly found

in mainstream, software-based routers.



## ► Features

- Resilient carrier-class system architected for 99.999 percent availability
- Based on open systems standards, the BSR 64000 is DOCSIS 1.0-qualified, EuroDOCSIS 1.0-qualified and compatible with DOCSIS 1.1, EuroDOCSIS 1.1 and PacketCable 1.0 specifications
- Advanced Spectrum Management to ensure reliable and high-quality service delivery
- Wire-speed forwarding with broadcast, unicast and multicast protocol support
- Carrier-class intradomain, interdomain and multicast routing with OSPF v2, RIP v1 and v2, BGP4, IS-IS, VRRP, IGMP, DVMRP and PIM-SM/DM
- SmartFlow QoS classification for thousands of flows at wire-speed with guaranteed SLAs
- Open Access support with Policy-Based Routing and full-featured MPLS
- The Advanced Provisioning Manager from Motorola allows operators to automatically create value-added services and manage BSR platforms
- Per-flow QoS guarantees across access and metropolitan networks as well as the core networks of multiple providers



## PLATFORM

### ► A Next-Generation Multi-Service Platform

The BSR 64000 is Data Over Cable Service Interface Specification (DOCSIS) 1.0-qualified, EuroDOCSIS 1.0-qualified and compatible with DOCSIS 1.1, EuroDOCSIS 1.1 and PacketCable 1.0 specifications. It is a highly-integrated, carrier-class, intelligent edge router with an integrated, high-density Cable Modem Termination System (CMTS) for Hybrid Fiber Coax (HFC) connectivity. The BSR 64000 can support up to 26 downstream transmitters and up to 104 upstream receivers in a single, space-saving chassis. It can also be deployed to integrate and extend QoS and routing functionality to legacy, first-generation DOCSIS or proprietary CMTS equipment.

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 Diff-Serv and/or MultiProtocol Label Switching (MPLS). High-density interfaces to locally-attached Web or video caches reduce the uplink traffic and allow broadband providers to bring applications closer to their subscribers. The BSR 64000 can aggregate traffic flows from multiple space-saving BSR 1000 platforms as operators extend the access infrastructure.

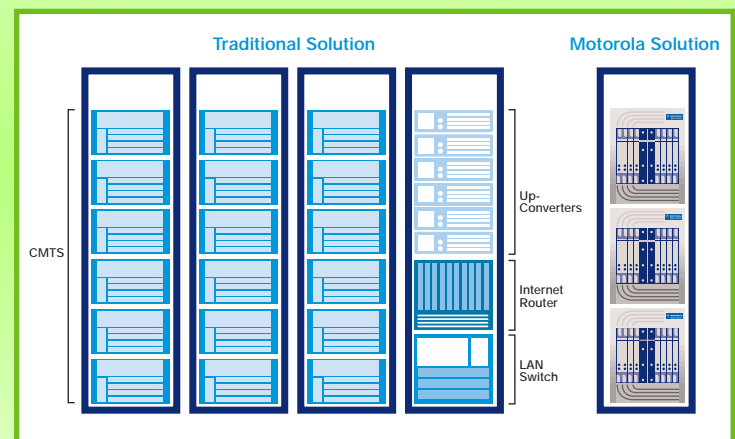
Motorola allows increased intelligence to the edge of the optical metro and core networks. To simplify and scale the delivery of multiple services and to cope with constantly-increasing traffic volume, the intelligence in the network must shift from the core to the edge. The BSR 64000 is a high-performance, intelligent optical 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 is a  
high-performance, intelligent  
optical edge router.

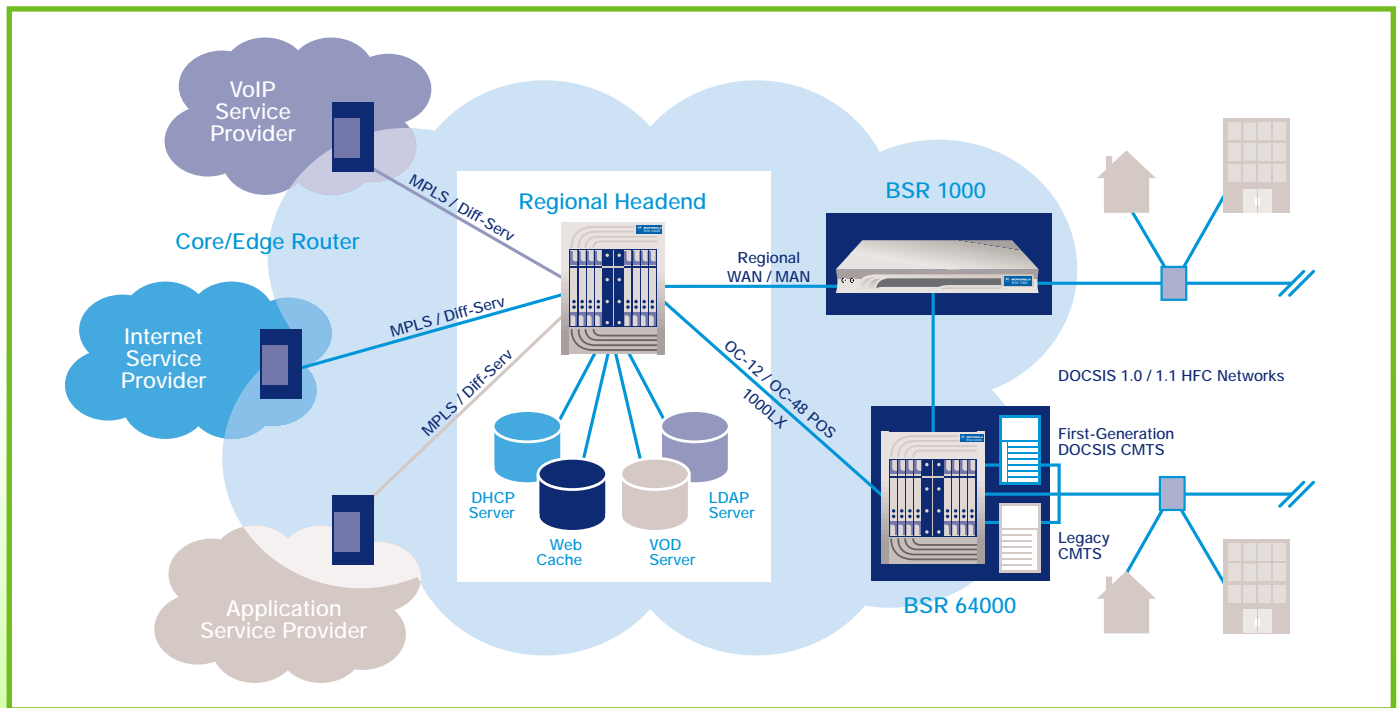
### ► Higher-Performance, Space-Saving and Cost-Effective Edge Routing

This high-density platform streamlines operations and management. The cost-effective BSR 64000 provides higher levels of performance than traditional solutions but takes up much less space. Up to three systems can be installed in a standard 7-foot rack, with each system configurable to support up to 26 downstream transmitters, with integrated up-converters and 104 upstream receivers – thereby delivering one of the highest CMTS port-densities in the industry.

The system includes flexible interfaces for SONET/SDH and Ethernet connectivity, and it eliminates the need for discrete CMTS equipment, up-converters, aggregation switches and routers. The BSR 64000 offers unified management of routing, QoS and CMTS functions, and 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 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 to provide access to metropolitan networks and the core networks of one or more providers. High-speed interfaces allow connectivity to local servers to allow operators to efficiently distribute content, services and applications over the access network.



## ► Unprecedented SmartFlow QoS and Multi-Service Support

Broadband access networks deliver the capacity required for converged data, voice and multimedia services, and the BSR 64000 is a flexible platform for enabling these next-generation IP services. It provides broad, multi-service support and allows operators to swiftly generate incremental revenue streams from innovative new services.

Broadband access networks are the foundation for new classes of entertainment and business services, including: IP telephony; interactive, multiplayer gaming; on-demand music, audio and video; tiered-data services; Virtual Private Networks (VPNs); and application hosting. Provisioning these services over a shared media requires robust QoS control to deliver the fine levels of service granularity required for real-time applications.

Traditional solutions lack the wire-speed QoS capabilities, density and scalability required for large-scale deployment and often use proprietary protocols or proprietary protocol extensions. The BSR 64000 with SmartFlow allows per-flow policing and traffic shaping at wire-speed, thus enabling broadband operators to provide SLAs to business, residential and service provider customers on either a short-term or long-term basis. High-performance, content-aware packet classification and forwarding at wire-speed

provides unmatched abilities to offer customized QoS levels and guaranteed SLAs.

Among the QoS parameters that can be included in SLAs are Constant Bit Rate (CBR), maximum bandwidth allocation for sustained traffic flows or bursts, minimum bandwidth guarantees with measurable Committed Information Rates (CIRs), bounded delays and minimal packet loss guarantees.

The BSR 64000 allows broadband operators to support multiple services from a single provider or to allow multiple providers to deliver multiple services. Operators can deliver measurable and guaranteed QoS from the subscriber to the core backbone networks of multiple providers of services, applications and content. SmartFlow allows operators to classify packets into flows based on packet content and provide the appropriate QoS treatment for each flow using DOCSIS 1.1 or EuroDOCSIS 1.1 for the upstream HFC network, hierarchical per-flow queuing for the downstream HFC network and Diff-Serv or MPLS for the metropolitan and core networks. The system provides the customized statistics collection and per-provider provisioning needed to ensure and document the flexible delivery of services over a common cable network infrastructure.

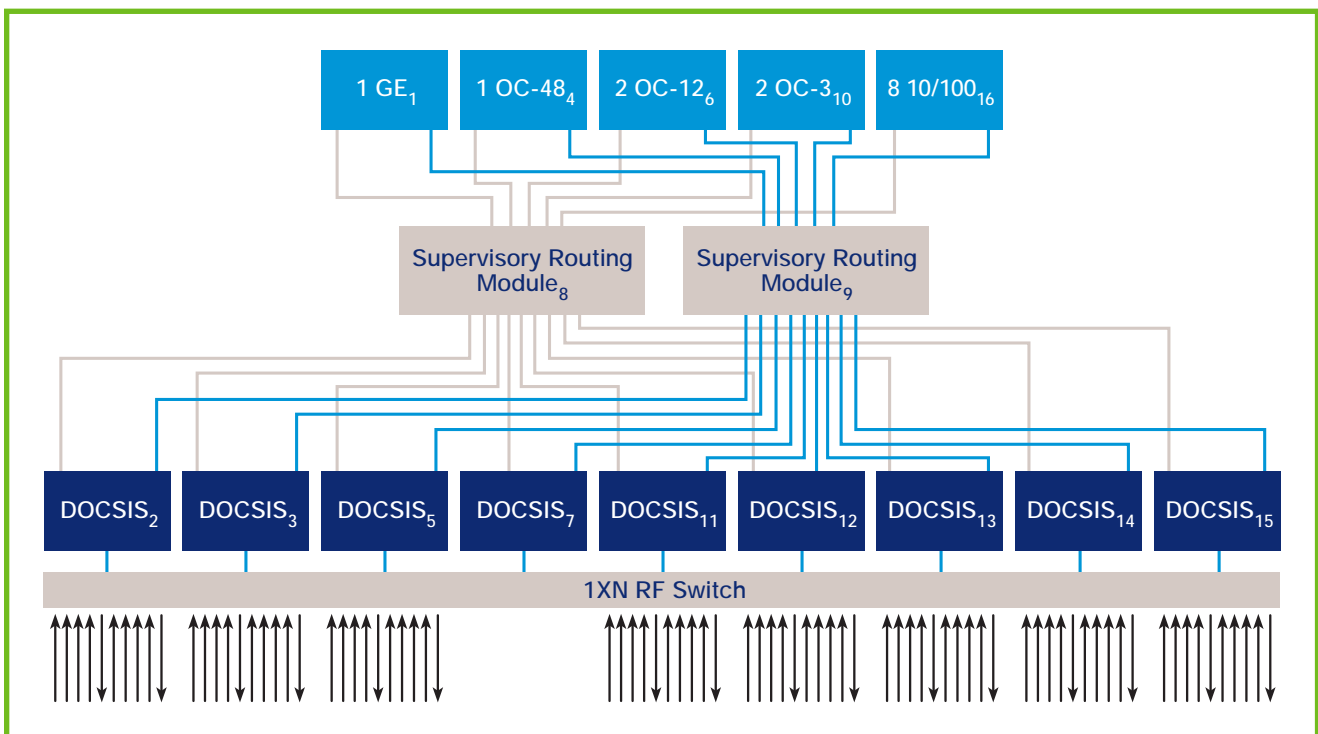
# ARCHITECTURE

## Innovative System Architecture

The BSR 64000 architecture optimizes performance and reliability by centralizing routing table calculations while distributing packet-forwarding functions. The system offers high levels of resiliency and redundancy, and the 16-slot, NEBS-compliant chassis has a midplane architecture that enhances serviceability by decoupling functional hardware modules from the physical I/O and connectivity. The platform has redundant power and fans, and offers the highest-density DOCSIS and EuroDOCSIS interface capacity in the industry.

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 by separating the front logic cards from the passive rear I/O cards, thus eliminating the need to change cable connections. The chassis provides interfaces for -48V DC power and allows hot-insertion and removal capabilities. The slots can be populated with three types of hardware modules: the Supervisory Routing Modules (SRMs), the Network Interface Modules and the DOCSIS or EuroDOCSIS Modules.

**The Supervisory Routing Modules (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 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. The SRMs can process up to 750,000 route entries and support Open Shortest Path First (OSPF) v2, Border Gateway Protocol (BGP) 4, Intermediate System-Intermediate System (IS-IS), Routing Information Protocol (RIP) v1, RIP v2, Internet Group Management Protocol (IGMP), Distance Vector Multicast Routing Protocol (DVMRP), Virtual Router Redundancy Protocol (VRRP) and Protocol-Independent Multicast/Sparse Mode and Dense Mode (PIM-SM/DM).



## The BSR 64000 can support up to 26 downstream transmitters and up to 104 upstream receivers in a single, space-saving chassis.

**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 and enable SmartFlow wire-speed flow classification and forwarding in hardware – thus optimizing throughput. Network Interface Module configurations include:

- 2-port OC-3/STM-1 or 2-port OC-12/STM-3 Packet over SONET/SDH (POS)
- 1-port Gigabit Ethernet
- 8-port 100BaseT Fast Ethernet
- 1-port OC-48/STM POS with an integrated Add/Drop Multiplexer

**The DOCSIS and EuroDOCSIS Modules** contain the broadband HFC network interfaces for the system. Each module includes either one downstream transmitter and four upstream receivers or two downstream transmitters and eight upstream receivers. The DOCSIS Module supports all DOCSIS modulation modes, and the EuroDOCSIS Module supports all EuroDOCSIS modulation modes. These modules also implement per-flow packet classification, apply QoS policies and perform distributed forwarding. Each module supports Advanced Spectrum Management functionality, with integrated upstream spectrum management and configurable intelligent frequency, modulation and bandwidth agility. Each module also offers tunable Radio Frequency (RF) output that simplifies operation and eliminates the costs and management overhead of external up-converters.

An integrated RF switch connects the input and output of each DOCSIS Module or EuroDOCSIS Module to the RF plant to allow 1:N redundancy. These modules support automatic RF line switchover

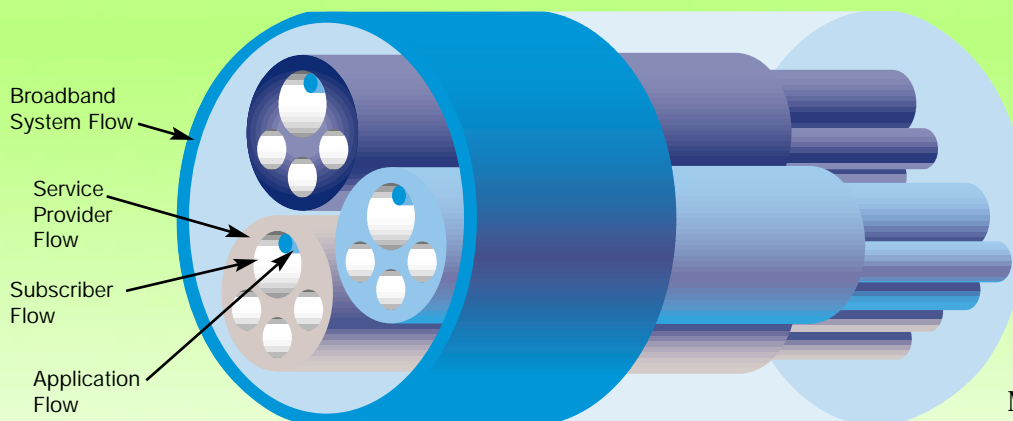
with a single spare serving as a backup to all other DOCSIS Modules or EuroDOCSIS Modules in the chassis. This allows broadband operators to offer carrier-grade availability for services such as IP telephony, which are intolerant of the extended cable modem re-registration times that typically occur following CMTS card failures.

All modules connect to the primary and secondary SRMs via redundant control buses that allow the flow of control and management information from the SRM to the resource modules. 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 a Network Interface Module for upstream metropolitan or wide-area connectivity and another Network Interface Module for high-speed LAN connectivity to server applications and caches, and up to 13 DOCSIS Modules or EuroDOCSIS Modules. The system provides 2.1 Gbps, bi-directional, nonblocking data packet transport between the modules in a cross-connect manner, thus offering a redundant, 64 Gbps fabric. This distributed architecture provides the density and performance required to accelerate the mass deployment of new, revenue-generating services over HFC infrastructure.

### ► Policy-Based Routing and MPLS

The BSR 64000 can be deployed as an MPLS Label Edge Router (LER) to provide support for dynamic Label Switched Path (LSP) creation. Because of the BSR 64000's hardware-based distributed forwarding architecture, MPLS traffic flows can be routed at wire-speed. Treatments for QoS are based on the policies defined by-and-for each service provider 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 to allow broadband providers to enable third-party, revenue-sharing partners to deliver content, applications and services over the access network. The BSR 64000 looks at multiple fields within packets to determine the appropriate routing and QoS. Because the BSR 64000 can look at the individual application flows, it can extend the capabilities of DOCSIS 1.1. This intelligent edge router can inspect multiple fields within packets to determine the appropriate routing and packet classification requirements. Packet routing is partially determined by looking at the source IP address, understanding to which service provider partner the IP address belongs, applying the appropriate MPLS label and then routing the traffic on the appropriate LSP to that partner for handling. This examination allows the BSR 64000 to implement more sophisticated QoS policies than are possible by simply looking at the data's destination address. The BSR 64000 can assign QoS and routing policies based on parameters such as service provider, subscriber and application.



**SmartFlow Granular QoS**

► **Carrier-Class Availability**

The BSR 64000 is architected for 99.999 percent availability and provides the fault detection and switchover required for high-availability services. It includes Automatic Protection Switching (APS), redundant controller and routing modules, and Layer 3 redundancy features. The carrier-class BSR 64000 supports all of the traditional Central Office (CO)

operational requirements – such as minimal disruptive software upgrades in redundant pairs, live insertion, version roll-back, integration into the alarming scheme and full NEBS compliance. Extensive fault detection and reporting features let operators optimize system performance and deliver primary-line IP telephony reliability. The system is designed for cost-effective reliability and offers 1:1 redundancy for the switch fabric, SRM and Network Interface Modules. The DOCSIS and EuroDOCSIS Modules can be configured for 1:N redundancy so that a single spare can efficiently provide backup for up to 12 live modules.

► **Automated Service Creation**

The Advanced Provisioning Manager from Motorola abstracts the creation of QoS-enabled services so they can be defined according to the business policy needs of the operator rather than the Command Line Interface (CLI) of the edge router. The Advanced Provisioning Manager allows broadband operators to offer Web-based customer self-provisioning and to integrate service creation with the existing Operations Support Systems (OSS) infrastructure.

The Advanced Provisioning Manager is based on industry standards, and Motorola provides compatibility with leading OSS applications to enable providers to deploy the Advanced Provisioning Manager as part of a complete subscriber management system.

Motorola complements the Advanced Provisioning Manager with partnerships with best-of-breed OSS vendors so operators can ensure compatibility as they deploy end-to-end services. Operators can therefore provision end-to-end services from the subscriber to the core network of multiple providers. Broadband operators can leverage hierarchical per-flow queuing features of the BSR product family to provision SLAs to residential and business subscribers as well as revenue-sharing partners, such as ISPs or ASPs.

The Advanced Provisioning Manager enables integration with provisioning, subscriber management and other OSS applications and databases using the Lightweight Directory Access Protocol (LDAP). It also offers Java™ and eXtensible Markup Language (XML) interfaces. With the Advanced Provisioning Manager, operators benefit from per-flow metering and can retrieve and export information in XML. Operators can create and manage service profiles and instantiate the service profiles into BSR 64000s and into space-saving BSR 1000s. The service profiles can then optionally be sent to a third-party service mediation system to populate customer care systems and to enable customer self-selection at self-service portals. These service mediation systems are offered by partners of Motorola, and they can also provide flow-through connectivity to back-end OSS applications. The Advanced Provisioning Manager also serves as an Element Management System (EMS) for the Broadband Services Router 64000 and the BSR 1000 platforms to enable efficient management and control.

#### ► **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 allows users with different administrative access needs customized views according to their access privileges. It also allows multiple providers to each view its own network management environment or control services to its customers over the broadband access network. 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 also offers 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.

#### ► **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 provides broadband carriers with a competitive edge in defining, deploying and managing broadband services. Operators can deploy this intelligent edge routing solution at the edge of the broadband access network to enable end-to-end service delivery across access, metropolitan and core networks. This 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 delivers the intelligence needed to offer guaranteed SLAs, and the 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.

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# BSR 64000 SPECIFICATIONS

## HIGH-PERFORMANCE IP ROUTING

SmartFlow Wire-speed Forwarding and Flow Classification  
More than 3 Million Packets-per-Second for Each Network Interface Module  
More than 42 Million Packets-per-Second for Each Chassis  
Wire-speed QoS  
Routing Policy Support  
750,000 Routes  
50 Route Updates/Second

## STANDARDS-BASED INTEROPERABILITY

DOCSIS 1.0-qualified  
EuroDOCSIS 1.0-qualified  
DOCSIS 1.1-compatible  
EuroDOCSIS 1.1-compatible  
PacketCable 1.0-compatible

## INTRADOMAIN/ INTERDOMAIN ROUTING

RIP v1      RIP v2      OSPF v2  
BGP4      IS-IS      VRRP

## MULTICAST ROUTING SUPPORT

DVMRP      PIM-SM/DM      IGMP v2  
MBGP

## ADVANCED QoS

IP Diff-Serv  
MPLS  
Per-SID Queuing on the DOCSIS Module and EuroDOCSIS Module  
MPLS-based VPN Support

## NETWORK MANAGEMENT AND PROVISIONING

Cisco CLI  
SNMP v1 and v3  
Motorola MIBS  
LDAP v3  
COPS Client  
RADIUS Interoperability  
Open Interfaces to Provisioning, Accounting and Billing Applications  
HTTP/Java/XML Integration  
DHCP Relay  
Multiple Levels of Account/Password Authentication  
Telnet with Security Extensions  
Multiple Community Strings

## FLEXIBLE CONFIGURATIONS

2-port OC-3/STM-1 or 2-port OC-12/STM-3 POS  
1-port Gigabit Ethernet  
8-port 10/100Base-T Ethernet  
1-port OC-48/STM16 with an Integrated Add/Drop Multiplexer

## FULL RF SPECTRUM SUPPORT

DOCSIS and EuroDOCSIS  
Up to 26 Downstream Transmitters  
Up to 104 Upstream Receivers  
Integrated Up-converter for RF Output  
Advanced Spectrum Management Functionality  
Upstream Modulation . . . QPSK and 16 QAM  
Upstream Per-channel  
Bit Rate . . . . . 0.320 - 10.24 Mbps  
Upstream Input  
Frequency Range . . . . . 5 - 42 MHz DOCSIS  
5 - 65 MHz  
EuroDOCSIS  
Downstream  
Modulation . . . . . 64 QAM and  
256 QAM  
Downstream Output  
Frequency Range . . . . . 88 - 857 MHz  
(Channel Center)  
Output Frequency  
Step Size . . . . . 32.0 kHz  
Downstream Per-channel  
Bit Rate . . . . . 27 Mbps  
(64 QAM DOCSIS)  
36 Mbps  
(64 QAM  
EuroDOCSIS)  
38 Mbps  
(256 QAM DOCSIS)  
56 Mbps  
(256 QAM  
EuroDOCSIS)

## SCALABLE PLATFORM FOR GROWTH

DOCSIS 1.0- and EuroDOCSIS 1.0-qualified  
DOCSIS 1.1-, EuroDOCSIS 1.1- and PacketCable 1.0-compatible  
Hot-swappable Modules  
VxWorks Real-time Operating System  
Redundant Power and Fan Units  
1:1 SRM Redundancy  
1:N DOCSIS and EuroDOCSIS Module Redundancy  
Redundant 64 Gbps Switch Fabric  
16-slot, NEBS-compliant Chassis  
Power . . . . . -48V DC  
(Optional AC Power)  
Height . . . . . 24.47" (57.66 cm, 14U)  
Width . . . . . 19" (48.26 cm)  
Depth . . . . . 19.75" (50.17 cm)  
Fully-configured  
Weight . . . . . 140 lbs (63.5 kg)  
Operating  
Temperature . . . . . 0 - 40° C  
Non-operating  
Temperature . . . . . -20° C - 60° C  
Operating  
Humidity . . . . . 10 - 90%  
Non-operating  
Humidity . . . . . 5 - 95%



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