RS 38000 Switch Router Getting Started Guide

Release 9.4

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REGULATORY COMPLIANCE INFORMATION

This product complies with the following:

SAFETY

UL 1950; CSA C22.2, No. 950; 73/23/EEC; EN 60950; IEC 950

ELECTROMAGNETIC

FCC Part 15, Canada ICES-003, EN 55022, VCCI and EN 55024

COMPATIBILITY (EMC)

EN 61000-3-3; EN 50082-1, AS/NZS 3548; VCCI V-3

REGULATORY COMPLIANCE STATEMENTS

Note Complies with Part 68, FCC rules.
FCC Registration Number 6TGUSA-46505-DE-N
Riverstone Networks, Inc.
Model WICT1-12
Made in U.S.A.

FCC COMPLIANCE STATEMENT

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Note This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment uses, generates, and can radiate radio frequency energy and if not installed in accordance with the operator's manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause interference in which case the user will be required to correct the interference at his own expense.

Warning Changes or modifications made to this device that are not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

INDUSTRY CANADA COMPLIANCE STATEMENT

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la class A prescrites dans le Règlement sur le brouillage radioélectrique édicté par le ministère des Communications du Canada.

NOTICE: The Industry Canada label identifies certified equipment. This certification means that the equipment meets telecommunications network protective, operational, and safety requirements as prescribed in the appropriate Terminal Equipment Technical Requirements document(s). The department does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be coordinated by a representative designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines, and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

CAUTION: Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.

NOTICE: The Ringer Equivalence Number (REN) assigned to each terminal device provides an indication of the maximum number of terminals allowed to be connected to a telephone interface. The termination on an interface may consist of any combination of devices subject only to the requirement that the sum of the Ringer Equivalence Numbers of all the devices does not exceed 5.

VCCI COMPLIANCE STATEMENT

This is a Class A product based on the standard of the Voluntary Control Council for Interference by Information Technology Equipment (VCCI). If this equipment is used in a domestic environment, radio disturbance may arise. When such trouble occurs, the user may be required to take corrective actions.

この装置は，情報処理装置等電波障害自主規制協議会（ＶＣＣＩ）の基準に基づくクラスＡ情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。

BSMI (TAIWAN BUREAU OF STANDARDS, METROLOGY AND INSPECTION, MINISTRY OF ECONOMIC AFFAIR)WARNING:

Warning: This is a Class A product. In a domestic environment this product may cause radio interference..

警告使用者：
這是甲類的資訊產品，在居住的環境中使用時，可能會造成
干擾，在這種情況下，使用者會被要求採取某些適當的對

SAFETY INFORMATION: CLASS 1 LASER TRANSCEIVERS

This product may use Class 1 laser transceivers. Read the following safety information before installing or operating this product.

The Class 1 laser transceivers use an optical feedback loop to maintain Class 1 operation limits. This control loop eliminates the need for maintenance checks or adjustments. The output is factory set and does not allow any user adjustment. Class 1 laser transceivers comply with the following safety standards:

- 21 CFR 1040.10 and 1040.11, U.S. Department of Health and Human Services (FDA)
- IEC Publication 825 (International Electrotechnical Commission)
- CENELEC EN 60825 (European Committee for Electrotechnical Standardization)

When operating within their performance limitations, laser transceiver output meets the Class 1 accessible emission limit of all three standards. Class 1 levels of laser radiation are not considered hazardous.

INFORMACIÓN SOBRE LA SEGURIDAD: TRANSMISOR/RECEPTOR LASER DE CLASE 1

Este producto puede utilizar transmisores/receptores láser de Clase 1. Lea la siguiente información de seguridad antes de instalar u operar este producto.

Los transmisores / receptores láser de Clase 1 utilizan un circuito óptico de control de retroalimentación para mantenerse dentro de los límites operativos de la Clase 1. Debido al uso del circuito de control, no es necesario llevar a cabo ajustes o revisiones de mantenimiento. La potencia ha sido configurada en la

fábrica y no puede ser ajustada por el usuario. Los transmisores / receptores láser de Clase 1 cumplen con las siguientes normas de seguridad:

- 21 CFR 1040.10 y 1040.11, Departamento de Salud y Servicios Humanos de los Estados Unidos (Administración de Alimentos y Fármacos)
- Publicación 825 de la IEC (Comisión Internacional Electrotécnica)
- CENELEC EN 60825 (Comité Europeo para la Estandarización Electrotécnica)

Al operar el equipo dentro de sus limitaciones de rendimiento, la potencia del transmisor / receptor láser cumple con los límites de emisión de las tres normas anteriores para los equipos de Clase 1. Los niveles de radiación permitidos por la Clase 1 no se consideran peligrosos.

LASER RADIATION AND CONNECTORS

When the connector is in place, all laser radiation remains within the fiber. The maximum amount of radiant power exiting the fiber (under normal conditions) is –12.6 dBm or 55 x 10^{-6} watts.

Removing the optical connector from the transceiver allows laser radiation to emit directly from the optical port. The maximum radiance from the optical port (under worst case conditions) is 0.8 W cm^{-2} or 8 x 10^{3} W m^{2} sr–1.

Do not use optical instruments to view the laser output. The use of optical instruments to view laser output increases eye hazard. When viewing the output optical port, power must be removed from the network adapter.

RADIACIÓN LÁSER Y CONECTORES

Una vez que el conector se encuentra en su sitio, toda la radiación láser permanece dentro de la fibra. La cantidad máxima de poder radiante que emana de la fibra (bajo condiciones normales) es de –12.6 dBm ó 55 x 10^{-6} vatios.

La remoción del conector óptico del transmisor / receptor permite que la radiación láser sea emitida directamente desde el puerto óptico. La radiación máxima emitida por el puerto óptico (en el peor de los casos) es de 0.8 W cm^{-2} ó 8 x 10^{3} W m^{2} sr–1.

No utilice instrumentos ópticos para visualizar la potencia del láser. El uso de instrumentos ópticos para visualizar la potencia del láser aumenta el riesgo de presentar lesiones en los ojos. Al visualizar la potencia del puerto óptico, es necesario cortar la corriente del adaptador de la red.

SAFETY INFORMATION: WICT1-12 T1 CARD

Warning To reduce the risk of fire, use only No. 26 AWG or larger telecommunication line cord.

Warning Para reducir el riesgo de un incendio, únicamente utilice un conductor del número 26 AWG o mayor para la línea de telecomunicaciones.

CONSUMER INFORMATION AND FCC REQUIREMENTS

1. This equipment complies with Part 68 of the FCC rules, FCC Registration Number 6TGUSA-46505-DE-N Riverstone Networks Inc. Model WICT1-12 Made in the USA. On the DS1/E1 WAN Module of this equipment is a label that contains, among other information, the FCC registration number and Ringer Equivalence Number (REN) for this equipment. If requested, provide this information to your telephone company.
2. The REN is useful to determine the quantity of devices you may connect to your telephone and still have all those devices ring when your number is called. In most, but not all areas, the sum of the REN's of all devices should not exceed five (5.0). To be certain of the number of devices you may connect to your line, as determined by the REN, you should call your local telephone company to determine the maximum REN for your calling area.
3. If your DS1/E1 WAN Module causes harm to the telephone network, the Telephone Company may discontinue your service temporarily. If possible, they will notify you in advance. But if advance notice isn't practical, you will be notified as soon as possible. You will be advised of your right to file a complaint with the FCC.
4. Your telephone company may make changes in its facilities, equipment, operations, or procedures that could affect the proper operation of your equipment. If they do, you will be given advance notice so as to give you an opportunity to maintain uninterrupted service.
5. If you experience trouble with this equipment DS1/E1 WAN Module, please contact Riverstone Networks Inc., 5200 Great America Parkway, Santa Clara, CA 95054, 408 878-6500, for repair/warranty information. The Telephone Company may ask you to disconnect this equipment from the network until the problem has been corrected or you are sure that the equipment is not malfunctioning.
6. There are no repairs that can be made by the customer to the DS1/E1 WAN Module.
7. This equipment may not be used on coin service provided by the Telephone Company. Connection to party lines is subject to state tariffs. (Contact your state public utility commission or corporation commission for information).

EQUIPMENT ATTACHMENT LIMITATIONS NOTICE

The Industry Canada label identifies certified equipment. This certification means that the equipment meets the telecommunications network protective, operational and safety requirements as prescribed in the appropriate Terminal Equipment Technical Requirements document(s). The Department does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. The customer should be aware that the compliance with the above conditions may not prevent degradation of service in some situations.

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Caution: Users should not attempt to make connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.

NOTICE: The Ringer Equivalence Number (REN) assigned to each terminal device provides an indication of maximum number of terminals allowed to be connected to a telephone interface. The termination on an interface may consist of any combination of devices subject only to the requirement that the sum of the Ringer Equivalence Numbers of all the devices does not exceed 5.

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8. **LIMITED WARRANTY.** The sole warranty provided under this Agreement and with respect to the Licensed Materials is set forth in Riverstone's Standard Limited Warranty, which is incorporated herein by reference. THE RIVERSTONE STANDARD LIMITED WARRANTY CONTAINS IMPORTANT LIMITS ON YOUR WARRANTY RIGHTS. THE WARRANTIES AND LIABILITIES SET FORTH IN THE STANDARD LIMITED WARRANTY ARE EXCLUSIVE AND ESTABLISH RIVERSTONE'S ONLY OBLIGATIONS AND YOUR SOLE RIGHTS WITH RESPECT TO THE LICENSED MATERIALS AND THIS AGREEMENT. ALL EXPRESS OR IMPLIED CONDITIONS, REPRESENTATIONS AND WARRANTIES INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OR CONDITIONS OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, SATISFACTORY QUALITY, NONINFRINGEMENT OR ARISING FROM A COURSE OF DEALING, USAGE, OR TRADE PRACTICE, ARE HEREBY EXCLUDED TO THE EXTENT ALLOWED BY APPLICABLE LAW.

9. **LIMITATION OF LIABILITY.** Your exclusive remedy for any claim in connection with the Licensed Materials and the entire liability of Riverstone are set forth in the Riverstone Standard Limited Warranty. Except to the extent provided there, if any, IN NO EVENT WILL RIVERSTONE OR ITS AFFILIATES OR SUPPLIERS BE LIABLE FOR ANY LOSS OF USE, INTERRUPTION OF BUSINESS, LOST PROFITS OR LOST DATA, OR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OF ANY KIND, REGARDLESS OF THE FORM OF ACTION, WHETHER IN CONTRACT, TORT (INCLUDING NEGLIGENCE), STRICT LIABILITY OR OTHERWISE, EVEN IF RIVERSTONE OR ITS AFFILIATE OR SUPPLIER HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGE, AND WHETHER OR NOT ANY REMEDY PROVIDED SHOULD FAIL OF ITS ESSENTIAL PURPOSE. THE TOTAL CUMULATIVE LIABILITY TO YOU, FROM ALL CAUSES OF ACTION AND ALL THEORIES OF LIABILITY, WILL BE LIMITED TO AND WILL NOT EXCEED THE PURCHASE PRICE OF THE LICENSED MATERIALS PAID BY YOU. YOU ACKNOWLEDGE THAT THE AMOUNT PAID FOR THE LICENSED MATERIALS REFLECTS THIS ALLOCATION OF RISK.

10. **GENERAL**. The provisions of the Agreement are severable and if any one or more of the provisions hereof are illegal or otherwise unenforceable, in whole or in part, the remaining provisions of this Agreement shall nevertheless be binding on and enforceable by and between the parties hereto. Riverstone's waiver of any right shall not constitute waiver of that right in future. This Agreement (including the documents it incorporates) constitutes the entire understanding between the parties with respect to the subject matter hereof, and all prior agreements, representations, statements and undertakings, oral or written, are hereby expressly superseded and canceled. No purchase order shall supersede this Agreement. The rights and obligations of the parties to this Agreement shall be governed and construed in accordance with the laws of the State of California, excluding the UN Convention on Contracts for the International Sale of Goods and that body of law known as conflicts of laws. Any dispute in connection with the Licensed Materials will be resolved in state or federal courts located in Santa Clara County, California, U.S.A.. You consent to the personal jurisdiction of and waive any objections to venue in such courts.

RIVERSTONE STANDARD WARRANTY

A. Product Warranty

i. RIVERSTONE warrants that each unit of Hardware Products will be free from defects in material and workmanship for a period of one (1) year from the date of shipment.

ii. Breach of warranty will be enforceable against RIVERSTONE only if written notice of such breach is received by RIVERSTONE within the applicable warranty period.

iii. If a warranty claim is invalid for any reason, PURCHASER will be charged for services performed and expenses incurred by RIVERSTONE in repairing, handling and shipping the returned item.

iv. Expendable parts, such as fuses, lamps, filters, and other parts that are regularly replaced due to normal use are excluded from this warranty.

v. As to replacement parts supplied for a Product or repairs performed to a Product during the original warranty period for such Product, the warranty period on the replacement part or the repaired part shall terminate thirty (30) days after shipment or upon the termination of the warranty period applicable to the original item, whichever is longer.

vi. As to any out-of-warranty parts repaired, modified or replaced by RIVERSTONE at RIVERSTONE's regular charges, the warranty period with respect to the material and workmanship hereunder shall expire thirty (30) days after the date of shipment of said part.

B. Software Warranty. The only warranty RIVERSTONE makes to PURCHASER in connection with the Licensed Materials is that the media upon which the Licensed Materials are recorded will be replaced without charge, if RIVERSTONE in good faith determines that the media was defective and not subject to misuse.

C. Return to Factory.

i. If Parts, Products or Licensed Materials under warranty are claimed to be defective, RIVERSTONE must be notified by PURCHASER prior to the return of said Part, Product, or Licensed Materials. Within ten (10) days of the date of said notification RIVERSTONE will provide PURCHASER with a valid Return Material Authorization number, the location to which PURCHASER must return the shipment claimed to be defective, and the method of transportation. In no event will RIVERSTONE accept any returned part or Product which does not have a valid Return Material Authorization number.

ii. Within ten (10) days of receipt of notice from RIVERSTONE requiring return, PURCHASER shall deliver said shipment to a carrier at PURCHASER's facilities as aforesaid.

iii. Within thirty (30) days of receipt of same, RIVERSTONE shall use reasonable efforts to fix or replace, at its option, any defective Product or Licensed Material which RIVERSTONE has determined to be under warranty.

iv. Transportation costs relating to warranty claims will be borne by RIVERSTONE only in cases where repair or replacement is made and authorized pursuant hereto, but any applicable duties will be paid by PURCHASER. If no warranty repair or replacement was required, all transportation costs will be borne by PURCHASER. "Emergency" transportation costs shall be borne by PURCHASER or its Customer.

D. Installation Warranty: RIVERSTONE warrants that all Installation Services rendered pursuant hereto shall be accomplished in a good and workmanlike manner and shall be free of defects in workmanship for a period of ninety (90) days from the date that such services were rendered.

E. General

i. The above warranties are for the benefit of and shall apply only to PURCHASER.

ii. RIVERSTONE's warranties shall not apply to any Product or Licensed Material which has been subjected to accident, neglect, misuse, abuse, vandalism, negligence in transportation or handling, failure of electric power, air conditioning, humidity control, causes other than ordinary use, or causes beyond RIVERSTONE's control, or if the Product or Licensed Material was not properly maintained by PURCHASER during the warranty period.

iii. There shall be no warranty or liability for any Product or Licensed Materials which have been modified by PURCHASER without RIVERSTONE's prior written approval.

iv. Parts or Replacement Products or Licensed Materials outside the scope of these warranties or with respect to Product(s) or Licensed Material out-of-warranty will be furnished at the established charges of RIVERSTONE then

in effect.

v. RIVERSTONE shall have full and free access to the Products and Licensed Materials at PURCHASER's Customer's site, if required.

vi. RIVERSTONE shall not be responsible for failure to furnish Parts due to causes beyond its control. RIVERSTONE shall not be required to replace any Part if it would be impractical for RIVERSTONE personnel to do so because of unauthorized alterations to the Products or its unauthorized connection by mechanical or electrical means to another system or device.

F. Limitation of Liability

i. THESE WARRANTIES AND RIVERSTONE'S AND ITS AFFILIATES LIABILITY AND PURCHASER'S REMEDIES WITH RESPECT THERETO, AS SET FORTH HEREIN, ARE EXCLUSIVE AND EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, LIABILITIES, REMEDIES, EXPRESS OR IMPLIED, INCLUDING ANY OBLIGATION, LIABILITY, RIGHT, CLAIM, OR REMEDY IN TORT, WHETHER OR NOT ARISING FROM NEGLIGENCE OF RIVERSTONE OR ITS AFFILIATES, ACTUAL OR IMPUTED, AND NO WARRANTIES, EXPRESS OR IMPLIED REPRESENTATIONS, PROMISES OR STATEMENTS HAVE BEEN MADE BY RIVERSTONE OR ITS AFFILIATES UNLESS CONTAINED IN THIS AGREEMENT. NO WARRANTY, EXPRESS OR IMPLIED, IS MADE HEREIN THAT THE LICENSED MATERIALS, PRODUCTS OR ANY PARTS ARE MERCHANTABLE, OR FIT OR SUITABLE FOR THE PARTICULAR PURPOSES FOR WHICH THE LICENSED MATERIALS, PRODUCTS OR PARTS MAY BE ACQUIRED BY PURCHASER. IN NO EVENT SHALL RIVERSTONE OR ITS AFFILIATES BE LIABLE TO PURCHASER FOR ANY INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES INCLUDING WITHOUT LIMITATION, LOSS OF DATA, OR PROFITS, WHETHER CLAIMED BY REASON OF BREACH OF WARRANTY OR OTHERWISE, AND WITHOUT REGARD TO THE FORM OF ACTION IN WHICH SUCH CLAIM IS MADE.

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iii. Notwithstanding anything contained herein to the contrary, the total maximum liability of RIVERSTONE and it's Affiliates under this warranty is limited, at the option of RIVERSTONE, to either

(a) RIVERSTONE's use of reasonable efforts to repair any item, or part thereof; or

(b) RIVERSTONE's use of reasonable efforts to replace any item, or part thereof, or any shipment as to which any defect is claimed by PURCHASER and duly verified by RIVERSTONE; or

(c) The refund of the purchase price.

DECLARATION OF CONFORMITY ADDENDUM

Application of Council Directive(s)	89/336/EEC 73/23/EEC
Manufacturer's Name	Riverstone Networks, Inc.
Manufacturer's Address	5200 Great America Parkway Santa Clara, CA 95054
Conformance to Directive(s)/Product Standards	EC Directive 89/336/EEC EC Directive 73/23/EEC EN 55022 EN 50082-1 EN 60950
Equipment Type/Environment	Networking equipment for use in a commercial or light-industrial environment

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1 ABOUT THIS GUIDE

This guide provides a general overview of the hardware and software features, and provides procedures for initial installation and set up of the RS 38000.

1.1 HOW TO USE THIS GUIDE

If You Want To...	See...
Get an overview of the RS 38000 software and hardware features and specifications	Chapter 2, *"Introduction"*
Install the RS 38000 hardware	Chapter 3, *"Hardware Installation"*
Install the RS 38000 software, boot the software, and set up the unit	Chapter 4, *"Initial Configuration"*
Upgrade system software	Chapter 5, *"Managing Software"*
Troubleshoot installation problems	Appendix A, *"Troubleshooting"*

1.2 RELATED DOCUMENTATION

The Riverstone documentation set includes the following items. Refer to these other documents to learn more about this product.

For Information About...	See the...
How to configure and manage the RS 38000	*Riverstone RS Switch Router User Guide*
The complete syntax for all Command Line Interface (CLI) commands	*Riverstone RS Switch Router Command Line Interface Reference Manual*
Console and SYSLOG messages	*Riverstone RS Switch Router Message Reference Manual*

2 INTRODUCTION

The RS 38000 performs non-blocking, wire-speed layer-2 switching, layer-3 routing, and layer-4 application switching. This chapter provides a basic overview of the RS 38000 software and hardware feature set.

- If you want to skip this information and install the RS 38000, see Chapter 3, *"Hardware Installation."*
- If you want to boot the RS 38000 software and perform basic configuration tasks, see Chapter 4, *"Initial Configuration."*

Note For the latest operating software and user documentation, check the Riverstone Networks web site at www.riverstonenet.com.

2.1 FUNCTIONAL LAYER TERMINOLOGY

This guide and other RS documentation refers to layer-2 (L2), layer-3 (L3), and layer-4 (L4) switching and routing. These layers are based on the International Standards Organization (ISO) 7-layer reference model. Here is an example of that model. The RS operates within the layers that are not shaded. Notice that layer 2 is divided into a MAC layer, an LLC layer, and an LLC2 layer. The RS 38000 operates at the MAC and LLC layers.

Table 2-1 ISO 7-layer model and RS 38000 capabilities

Layer 7	Application	
Layer 6	Presentation	
Layer 5	Session	
Layer 4	Transport	TCP/UDP - application
Layer 3	Network	IP/IPX - routing
	LLC2	
Layer 2	LLC	
	MAC	Bridging
Layer 1	Physical	Physical Interfaces

2.2 SYSTEM OVERVIEW

The RS 38000 hardware provides wire-speed performance regardless of the performance monitoring, filtering, and Quality of Service (QoS) features enabled by the software. You do not need to accept performance compromises to run QoS or access control lists (ACLs).

The following table lists the basic hardware and software specifications for the RS 38000.

Table 2-2 Hardware and software capabilities

Feature	Specification
Throughput	• Up to 170-Gbps non-blocking Switch Fabric • Up to 90 million packets-per-second routing throughput
Capacity	• Up to 250,000 layer-3 routes • Up to 7,500,000 layer-4 application flows • 1,600,000 layer-2 MAC addresses • 4,096 virtual LANs (VLANs) • 20,000 layer-2 security and access-control filters
Routing protocols	• IP: RIP v1/v2, OSPF, BGP 2, 3, 4, IS-IS • IPX: RIP, SAP • Multicast: IGMP, DVMRP, GARP/GVRP
Bridging and VLAN protocols	• 802.1d Spanning Tree • 802.1Q (VLAN trunking) • Rapid Spanning Tree Protocol (RSTP) • Per-VLAN Spanning Tree (PVST)
MPLS	• LER and LSR complete functionality • RSVP-TE and LDP for label distribution and dynamic LSP creation • OSPF-TE and ISIS-TE traffic engineering extensions with support for online CSPF
Media interface protocols	• 802.3 (10Base-T) • 802.3u (100Base-TX) • 802.3x (1000Base-SX, 1000Base-LX) • 802.3z (1000Base-SX, 1000Base-LX) • WDM (4 x 1000Base-SX) • ATM over PoS OC-3c MMF and SMF • ATM over DS-3/E3 • PoS OC-12c SMF
RMON	• RMON v1/v2 for each port

Table 2-2 Hardware and software capabilities (Continued)

Feature	Specification
Management	• SNMP v1/v2 • Emacs-like Command Line Interface (CLI)
Port mirroring	• Traffic from specific ports • Traffic to specific expansion slots (line cards)
Hot swapping	• Line cards • Control Module (when redundant Control Module is installed and online) • Switch Fabric Modules • Power Supply (when redundant supply is installed and online)
Redundancy	• Redundant power supplies • Redundant Control Modules • Redundant Switch Fabric Modules • Virtual Router Redundancy Protocol (VRRP)

2.3 SOFTWARE OVERVIEW

This section describes the features and capabilities of the RS 38000 in greater detail.

2.3.1 Bridging

The RS provides the following types of wire-speed bridging:

Address-based bridging – The RS 38000 performs this type of bridging by looking up a packet's destination address in an L2 lookup table on the line card that received the packet from the network. The L2 lookup table indicates the exit port(s) for the bridged packet. If the packet is addressed to the router's own MAC address, the packet is routed rather than bridged.

Flow-based bridging – The RS 38000 performs this type of bridging by looking up a packet's source and destination address in an L2 lookup table on the line card that received the packet from the network.

Your choice of bridging method does not affect RS 38000 performance. However, address-based bridging requires fewer table entries. Alternately, while flow-based bridging uses more table entries, it provides tighter management and control over bridged traffic, and greater resolution to RMON I statistics.

The RS ports perform address-based bridging by default, but can be configured to perform flow-based bridging on a per-port basis. A port cannot be configured to perform both types of bridging at the same time.

2.3.2 Port and Protocol VLANs

The RS supports the following types of Virtual LANs (VLANs):

Port-based VLANs – A port-based VLAN is a set of ports that comprises a layer-2 broadcast domain. The RS confines MAC-layer broadcasts to the ports in the VLAN on which the broadcast originates. RS ports outside the VLAN do not receive the broadcast.

Protocol-based VLANs – A protocol-based VLAN is a named set of ports that comprises an IP, IPX, AppleTalk, DECNet, SNA, IPv6, or L2 broadcast domain. The RS confines protocol-specific broadcasts to the ports within the protocol-based VLAN. Protocol-based VLANs sometimes are called subnet VLANs or layer-3 VLANs.

You can include the same port in more than one VLAN, even in both port-based and protocol-based VLANs. Moreover, you can define VLANs that span across multiple routers. To simplify VLAN administration, the RS supports 802.1Q trunk ports, which allow you to use a single port to “trunk” traffic from multiple VLANs to another RS or to a switch that supports 802.1Q.

2.3.3 Routing

The RS 38000 provides wire-speed routing for the following protocols:

IP – protocol that switching and routing devices use for moving traffic within the Internet and within many corporate intranets

IPX – protocol by Novell used in NetWare products

Note All other protocols that require routing must be tunneled using IP.

By default, the RS 38000 uses one MAC address for all interfaces. The RS 38000 can be configured to have a separate MAC address for each IP interface and a separate MAC address for each IPX interface. When the RS receives a packet whose destination MAC address is one of the router’s IP or IPX interface MAC addresses, the line card that received the packet from the network uses information in the line card’s L3 lookup tables (or information supplied by the Control Module) to route the packet to its IP destination(s). (See Section 2.4.7, *"Control Module"* for information about the Control Module.)

You can add secondary IP addresses to the same IP interface, however, you can create only one IP and IPX interface on a single port or VLAN. When you add an interface to a set of ports, you are adding a VLAN to those ports. Ports that contain IP and IPX interfaces can still perform layer-2 bridging.

IP Routing

The RS 38000 supports the following IP unicast routing protocols:

- RIP v1 and RIP v2
- OSPF v2
- BGP 2,3,4
- IS-IS

IP interfaces do not use a specific routing protocol by default. When you configure an interface for routing, you also specify the routing protocol that the interface will use.

IP Multicast Routing

The RS 38000 supports the following IP multicast routing protocols:

- IGMP
- DVMRP
- GARP/GVRP

The RS 38000 does not use a specific IP multicast routing protocol by default. When you configure an interface for IP multicast, you also specify the routing protocol you want the interface to use.

IPX Routing

The RS 38000 supports the following IPX routing protocols:

IPX RIP – a version of the Routing Information Protocol (RIP) tailored for IPX

IPX SAP – the Service Advertisement Protocol, which allows hosts attached to an IPX network to reach printers, file servers, and other services

By default, IPX routing is enabled on the RS when an IPX interface is created.

2.3.4 Layer-4 Switching

In addition to layer-2 bridging and layer-3 routing, the RS 38000 performs layer-4 switching. Layer-4 switching is based on applications and flows.

Layer-4 Applications – The RS 38000 understands the application for which an IP or IPX packet contains data and therefore enables you to manage and control traffic on an application basis. For IP traffic, the RS 38000 looks at the packet's TCP or UDP port number to determine the application. For IPX packets, the RS 38000 looks at the destination socket to determine the application.

Layer-4 Flows – The RS 38000 can store layer-4 flows on each line card. A layer-4 flow consists of the source and destination addresses in the IP or IPX packet combined with the TCP or UDP source and destination port number (for IP) or the source and destination socket (for IPX). You can therefore manage and control individual flows between hosts on an individual application basis.

A single host can have many individual layer-4 entries in the RS 38000. For example, an IP host might have separate layer-4 application entries for email, FTP, HTTP, and so on, or separate layer-4 flow entries for specific email destinations and for specific FTP and Web connections.

2.3.5 MPLS Support

Multi Protocol Label Switching (MPLS) is supported on the RS 38000 through software and through hardware on the R28-GBCMM-04 Gigabit Ethernet line cards. The following MPLS capabilities are supported on the RS 38000:

- Complete Label Edge Router (LER) and Label Switching Router (LSR) functionality with no impact on performance
- Label generation and swapping, along with push and pop operations for supporting multiple levels of label stacking
- Tunneling of layer-2 Ethernet over MPLS

- Support for thousands of label switched paths
- Support for static and dynamic creation of LSPs
- Label Distribution Protocol (LDP) and Resource Reservation Protocol with Traffic Engineering (RSVP-TE) for label distribution and dynamic Label Switched Path (LSP) creation with support for LDP over LDP and LDP over RSVP, allowing different tunneling schemes
- Standby LSPs and fail over
- Traffic engineering extensions to OSPF and IS-IS, along with Constrained Shortest Path First (CSPF)

Multi Protocol Label Switching (MPLS) is supported on the RS 8000/8600 through software and through hardware on the G8M-GBCMM-02 Gigabit Ethernet line card, G8M-PO3MM-02 2-port OC-3 linecard, and G8M-PO3MM-02 2-port OC-12 linecard. The following MPLS capabilities are supported on the RS 8000/8600:

- Complete Label Edge Router (LER) and Label Switching Router (LSR) functionality with no impact on performance
- Label generation and swapping, along with push and pop operations for supporting multiple levels of label stacking
- Tunneling of layer-2 Ethernet over MPLS (for Gigabit Ethernet card)
- Tunneling of layer-2 bridged PPP traffic over MPLS (for OC-3/OC-12 modules)
- Support for thousands of label switched paths
- Support for static and dynamic creation of LSPs
- Label Distribution Protocol (LDP) and Resource Reservation Protocol with Traffic Engineering (RSVP-TE) for label distribution and dynamic Label Switched Path (LSP) creation with support for LDP over LDP and LDP over RSVP, allowing different tunneling schemes
- Standby LSPs and fail over
- Traffic engineering extensions to OSPF and IS-IS, along with Constrained Shortest Path First (CSPF)
- MPLS VPNs over BGP

2.3.6 Security

The bridging, routing, and application (layer-2, layer-3, and layer-4) support described in previous sections enables you to implement security strategies that meet specific needs. For layer-2, a wide range of bridging filters are available. Additionally, all layers can be protected using Access Control List (ACL) filtering. You can implement the following types of filters and ACLs to secure traffic on the RS 38000:

- Layer-2 source filters (block bridge traffic based on source MAC address)
- Layer-2 destination filters (block bridge traffic based on destination MAC address)
- Layer-2 flow filters (block bridge traffic based on specific source-destination pairs)
- Layer-3 source ACLs (block IP or IPX traffic based on source IP or IPX address)
- Layer-3 destination ACLs (block IP or IPX traffic based on destination IP or IPX address)
- Layer-3 flow ACLs (block IP or IPX traffic based on specific source-destination address pairs)
- Layer-4 flow ACLs (block traffic based on application flows)
- Layer-4 application ACLs (block traffic based on UDP or TCP source and destination ports for IP or source and destination sockets for IPX)

In addition to filtering and ACL, the RS also provides login security in the form of TACACS, TACACS+, RADIUS, and Secure Session Shells (SSH) version 1.5.

2.3.7 Quality of Service

Although the RS 38000 supplies non-blocking, wire-speed throughput, you can configure the RS to apply Quality of Service (QoS) policies during peak periods to guarantee service to specific hosts, applications, and flows (source-destination pairs). This is especially useful in networks where the traffic level can exceed the network medium's capacity.

QoS policies can be configured for the following types of traffic:

- Layer-2 prioritization (802.1p)
- Layer-3 source-destination flows
- Layer-4 source-destination flows
- Layer-4 application flows

QoS mechanisms supported on the RS 38000 include the following:

- Traffic control queuing
- Weighted random early detection
- Weighted fair queuing
- Strict priority queuing
- QoS traffic control queues
- ToS octet rewrites
- Multi-Protocol Label Switching (MPLS) and the creation of LSPs for traffic engineering

Note Traffic control queuing is based on assigning traffic to one of four queues: control, high, medium, and low. Control traffic (routing protocols, and so on) has the highest priority, high the second highest, and so on. The default priority for all traffic is low.

2.3.8 Statistics

The RS 38000 can provide extensive statistical data on demand. You can access the following types of statistics:

Layer-2 RMON and MIB II Statistics – Port statistics for normal packets and for errors (packets in, packets out, CRC errors, and so on)

Layer-3 RMON v2 Statistics – Statistics for ICMP, IP, IP-interface, IP routing, IP multicast, VLAN

Layer-4 RMON v2 Statistics – Statistics for TCP and UDP

LFAP – Light-weight File Accounting Protocol

Open APIs – Slate and FAS Lite.

2.3.9 Web Hosting Features

The RS 38000 provides features that support and improve performance for high-capacity web access:

Load balancing – allows incoming HTTP requests to a company's web site to be distributed across several physical servers. If one server should fail, other servers can pick up the workload.

Web caching – allows HTTP requests from internal users to Internet sites to be redirected to cached web objects on local servers. Not only is response time faster, since requests can be handled locally, but overall WAN bandwidth usage is reduced.

Session persistence – In certain situations where load balancing is being used, it may be critical that all traffic for the client be directed to the same physical server for the duration of the session; this is the concept of *session persistence*.

TCP persistence – a binding is determined by the matching the source IP/port address as well as the virtual destination IP/port address.

SSL persistence – a binding is determined by matching the source IP address and the virtual destination IP/port address. Note that requests from *any* source socket with the client IP address are considered part of the same session.

Sticky persistence – a binding is determined by matching the source and destination IP addresses only. This allows all requests from a client to the same virtual address to be directed to the same load balancing server.

Virtual private network (VPN) persistence – for VPN traffic using Encapsulated Security Payload (ESP) mode of IPSec, a binding is determined by matching the source and destination IP addresses in the secure key transfer request to subsequent client requests.

IP persistence – Used for L3 persistence of load balancing sessions.

2.3.10 Management Platforms

You can manage the RS using the following management platforms:

Command Line Interface (CLI) – An Emacs editor-like interface that accepts typed commands and responds when applicable with messages or tables. Use the CLI to perform the basic setup procedures described in Chapter 4, *"Initial Configuration."*

SNMP MIBs and traps – The RS supports SNMP v1/v2 and many standard networking MIBs. The RS 38000's SNMP agent is accessed using integration software such as HP OpenView 5.x on Windows NT or Solaris 2.x, or Aprisma SPECTRUM on Windows NT or Solaris 2.x. Setting up SNMP on the RS 38000 is described in Chapter 4, *"Initial Configuration."*

2.4 HARDWARE OVERVIEW

This section describes the RS 38000 hardware components with which you will be working. Installing the hardware is described in Chapter 3, *"Hardware Installation."* The following hardware components are described:

- Chassis, backplane, and fan assembly
- Switch Fabric module
- Power supplies
- Control Module
- Line cards

2.4.1 Chassis

Figure 2-1 and Figure 2-2 shows the various components of the RS 38000 chassis

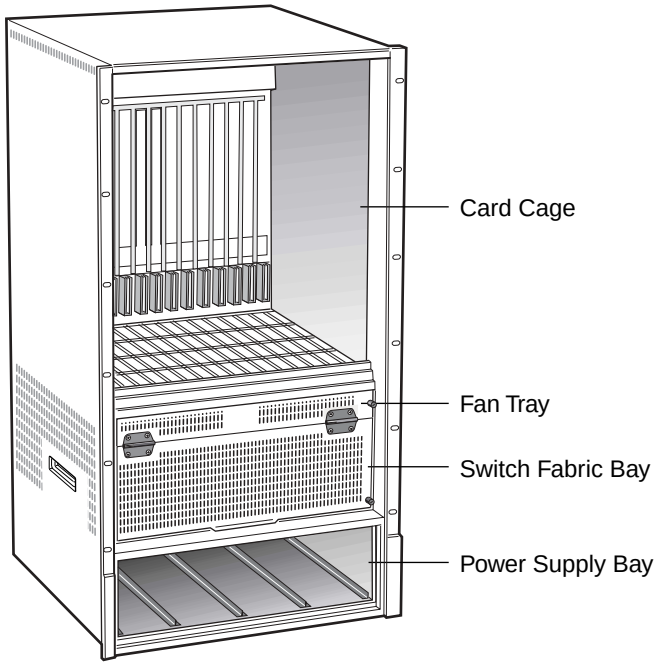

Figure 2-1 Components of RS 38000 chassis

The RS 38000 chassis contains 16 vertical slots for line cards, numbered from 1 to 16. Slot 1 is on the left side of the chassis and slot 16 is on the right side. Slot 8 must be occupied by a Control Module (see Section 2.4.7, *"Control Module"*), with slot 9 available for a redundant Control Module or a line card. The RS 38000 chassis also contains two horizontal slots for at least one Switch Fabric module; the second slot can contain a redundant Switch Fabric module. Power supplies are installed in the bottom portion of the chassis. In an AC environment, two AC power supplies are required; four AC power supplies are supported for redundant operation. In a DC environment, one DC power supply is required; two DC power supplies are supported for redundant operation. AC and DC power supplies cannot be intermixed in the system.

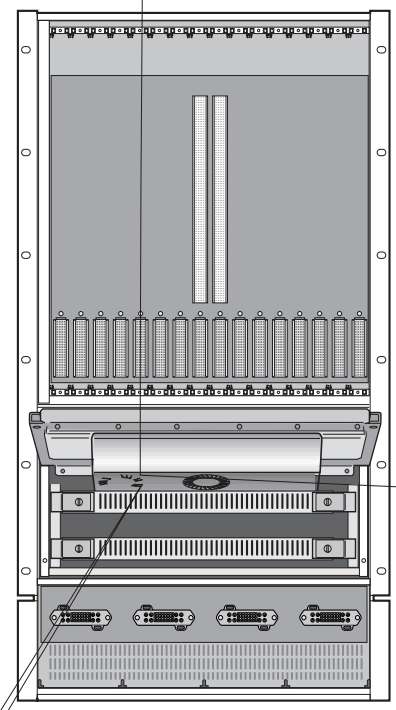

Figure 2-2 Front view with fabric bay open

Figure 2-3 shows an RS 38000 fully loaded with redundant AC power supplies, redundant Control Modules, and line cards. Notice that the Control Modules reside in slot 8 and 9.

Figure 2-3 Front view of loaded RS 38000 chassis

You can install line cards in any order in the slots. For example, you could install line cards in slots 2 and 5 and leave the other line card slots empty. The RS provides non-blocking throughput regardless of the software features you are using. Therefore, you do not need to “load balance” line cards by placing them in certain physical relationships to balance the load on the backplane. Regardless of where you install the line cards, the backplane can provide full, non-blocking throughput.

2.4.2 Backplane

The backplane occupies the rear of the chassis and connects the power supplies, Control Modules, and line cards together. The power supplies use the backplane to provide power to the system. The line cards and Control Modules use the backplane to exchange control information and packets. The backplane is installed at the factory.

2.4.3 Fan Assembly

The RS 38000 contains a fan assembly to provide a cooling air flow across the Control Module(s) and line cards. The fan assembly is located below the vertical slots. The RS 38000 fan assembly contains six fans.

Note To ensure that the fan assembly can provide adequate cooling, always provide a minimum of 3 inches of clearance above and behind the chassis.

2.4.4 Switch Fabric Module

On the RS 38000, the Switch Fabric is contained on a separate plug-in module. The RS 38000 has slots for two of these modules. When two Switch Fabric modules are installed, the module in the slot labeled “Fabric 1” serves as the primary Switch Fabric module, the module in the slot labeled “Fabric 2” serves as a redundant Switch Fabric module. The front panel of the Control Module contains LEDs that indicate the status of the Switch Fabric—see Section 2.4.7, *"Control Module."*

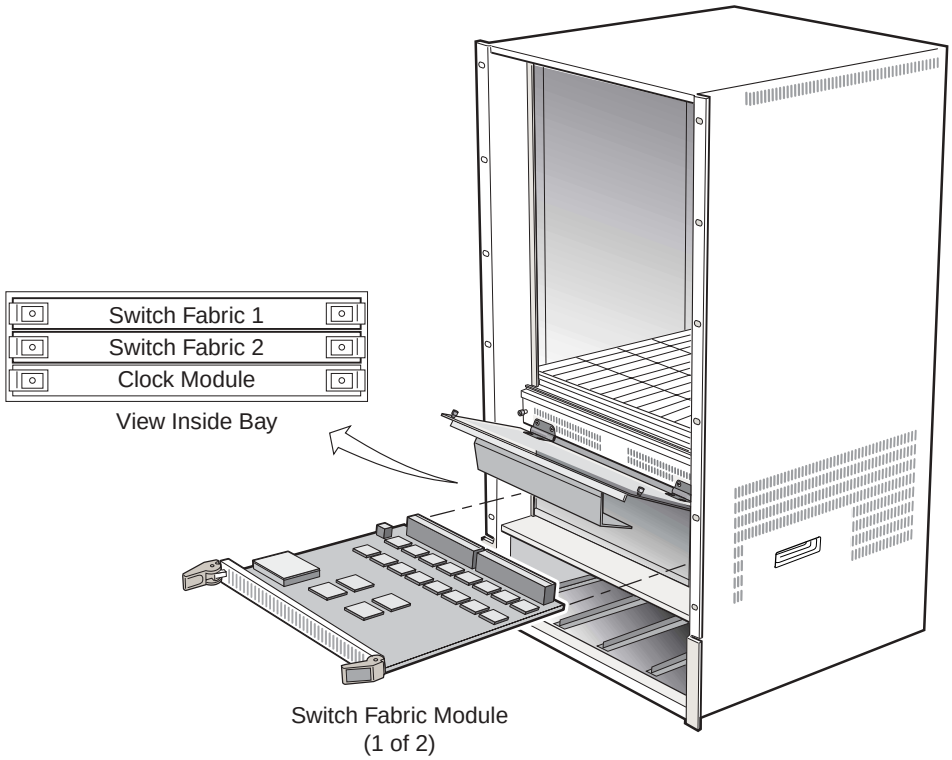

Figure 2-4 Switch Fabric module

2.4.5 AC Power Supply

The AC power supply are powered by 100-120V (16A) or 200-240V (8A). Each component (Control Module, line card, and so on) regulates its power needs. Two power supplies provide enough current to operate a fully-populated chassis; one or two additional power supplies provide redundant power. The power supply has its own internal cooling fan. The vent on the front of the power supply is the inlet vent for the cooling fan.

Figure 2-5 shows the front view of an RS 38000 AC power supply.

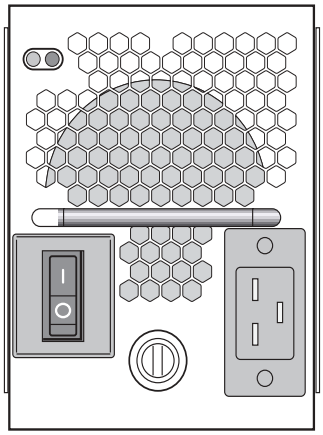

Figure 2-5 Front view of an RS 38000 AC power supply

To ensure against equipment failure, install one or two redundant power supplies. Each power supply provides 1200W for a total power output of 2400W. When three or more power supplies are active in the RS 38000, they load share with each supply delivering a prorated percentage of the current needed. Moreover, if one power supply fails, the other power supplies immediately assume the entire load, preventing any system outage.

The AC power supply has a green status LED. When the status LED is lit, the power supply is connected to an appropriate power source and is active. The status LED is lit when the power supply is switched on, not when the power supply is plugged into a power source.

Table 2-3 AC power supply physical specifications

Specification	Measurement
Dimensions	16.25" (L) x 4.0" (W) x 4.625" (H)
Weight	12.0 lbs. (5.45 kg)
Power Output	1200 W
Voltage Range	100-120V, 16A 200-240V, 8A
Frequency	50-60 Hz

2.4.6 DC Power Supply

The DC power supply are powered by 48 volts DC. Each component regulates its power needs. A single DC power supply provides enough current to operate a fully-populated chassis.

Figure 2-6 shows the front view of an RS 38000 DC power supply

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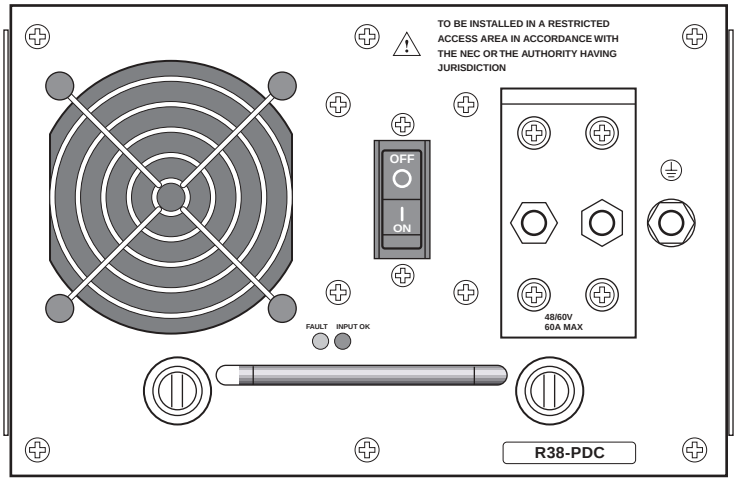


Figure 2-6 Front view of an RS 38000 DC power supply

The RS 38000 DC power supply has three power terminals on the front panel, consisting of one positive (+) terminal, one negative (-) terminal, and a safety ground. The DC supply is designed to be powered by a 48 volt DC source.

Table 2-4 DC power supply physical specifications

Specification	Measurement
Dimensions	16.25" (L) x 8.125" (W) x 4.625" (H)
Weight	12.0 lbs. (5.45 kg)
Power Output	2400 W
Voltage Range	36-72V, 50 A @ 48 V nominal

2.4.7 Control Module

The Control Module is the central processing unit of the RS 38000. It contains system-wide bridging and routing tables. Traffic that does not yet have an entry in the L2 and L3/L4 lookup tables on individual line cards is sent to the Control Module. After processing traffic, the Control Module updates the L2 and L3/L4 tables on the line cards that received the traffic. The line cards thus "learn" about how to forward traffic.

Note If you plan to install a redundant Control Module, see Section 4.9, *"Using Redundant Control Modules."*

Figure 2-7 shows the front panel of the Control Module.

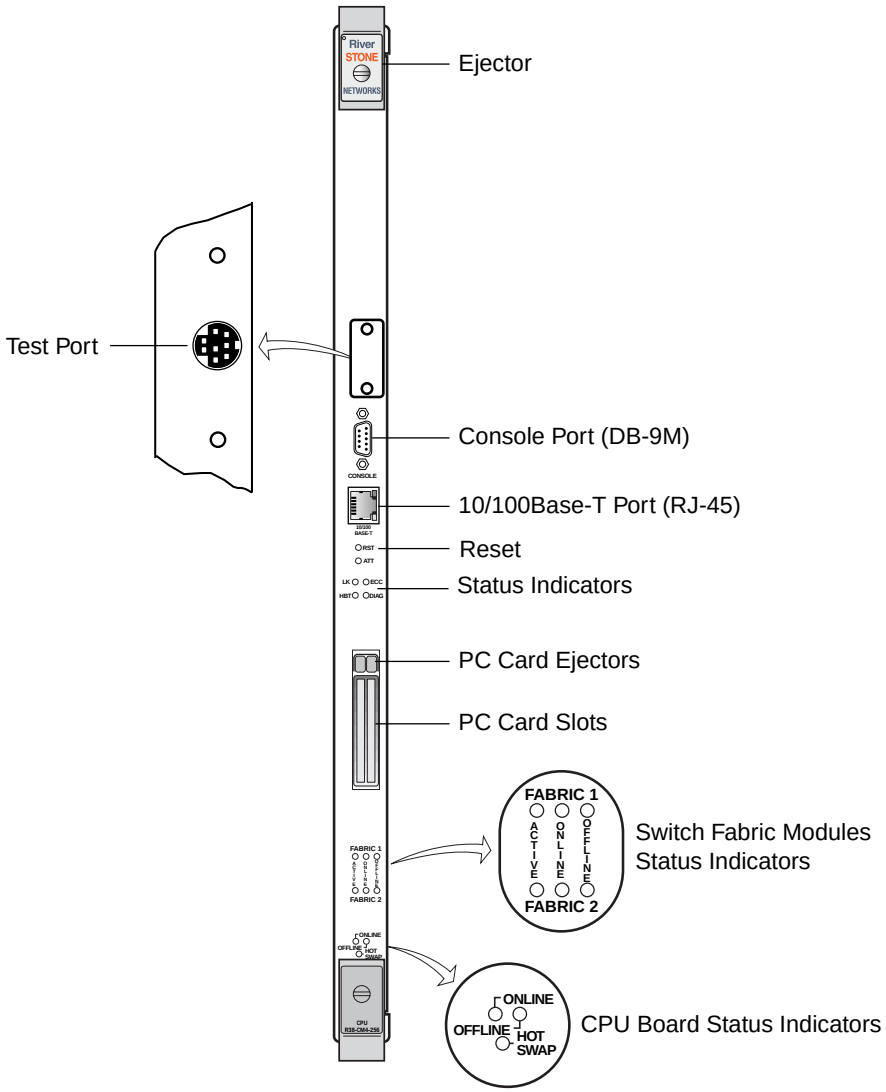


Figure 2-7 Front panel of the Control Module

Caution The Test Port is for use by Riverstone Networks, Inc. support personnel only.

Boot Flash

The Control Module has a boot flash containing the boot software and configuration files. The system software image file typically resides on a 32 megabyte PC card, but can also reside on a TFTP server or BootP/TFTP server.

Memory Module

The Control Module uses memory to hold routing tables, bridging tables, and other tables. The minimum factory configuration for the Control Module includes 256MB of memory (in a 256MB DIMM). You can obtain an RS 38000 memory upgrade kits from Riverstone Networks, Inc. to increase memory to 512MB (in one 256MB DIMM).

External Controls and Connections

The Control Module has the following external controls and connections.

- Male DB-9 Data Communications Equipment (DCE) port for serial connection to a management terminal or PC running terminal emulation software. Use this port and the supplied serial cable to establish a direct CLI connection to the RS 38000.
- 10/100Base-TX Data Terminal Equipment (DTE) port for network (“in-band”) connection from a management terminal. The port is configured as a Media Data Interface (MDI).
- Reset switch (RST). Use this switch to reboot the CPU.
- Hot Swap switch. Use this switch to deactivate the module for hot swapping. See the *Riverstone RS Switch Router User Guide* for information on how to hot swap the Control Module.
- Status LEDs
- PC card flash memory slots. These slots hold the PC flash memory cards that contain the shipped system image software.

Control Module DB-9 Connector Pin Assignment

Table 2-5 DB-9 pin assignments

Control Module DB-9 connector (DCE)	Pin number	Management console DB-9 connector (DTE)
Unused	1	Unused
TXD (transmit data)	2	RXD (receive data)
RXD (receive data)	3	TXD (transmit data)
Unused	4	Unused

Table 2-5 DB-9 pin assignments (Continued)

Control Module DB-9 connector (DCE)	Pin number	Management console DB-9 connector (DTE)
GND (ground)	5	GND (ground)
DTR (data terminal ready)	6	DSR (data set ready)
CTS (clear to send)	7	RTS (request to send)
RTS (request to send)	8	CTS (clear to send)
Unused	9	Unused

Control Module RJ-45 Connector Pin Assignment

Table 2-6 RJ-45 console connector pin assignments

Control Module RJ-45 connector	Pin Number	Management console RJ-45 connector
TXD (transmit data)	1	RXD (receive data)
TXD (transmit data)	2	RXD (receive data)
RXD (receive data)	3	TXD (transmit data)
Unused	4	Unused
Unused	5	Unused
RXD (receive data)	6	TXD (transmit data)
Unused	7	Unused
Unused	8	Unused

Control Module LEDs

Table 2-7 Control Module LEDs

LED	Description
OK	When this LED is on, the RS 38000 and all ports are functioning correctly.
ERR	When this LED is on, a fatal system error has occurred. Activate the RS 38000's boot PROM to reboot the system.
HBT	This LED flashes when the RS 38000's boot PROM is active.
DIAG	When this LED is on, the RS 38000 is in diagnostic mode. While in diagnostic mode, several other LEDs on the RS 38000 are active, as well.

Table 2-7 Control Module LEDs (Continued)

LED	Description
FABRIC 1/FABRIC 2	These LEDs indicate the status of the switching fabric(s): **ACTIVE** – When lit, this LED indicates that the switching fabric is actively receiving, processing, and sending packets. **ONLINE** – When lit, this green LED indicates that the switching fabric is online and is ready to receive, process, and send packets if configured to do so. **OFFLINE** – When lit, this amber LED indicates that the switching fabric is offline (powered off) and is ready for hot swap. This LED is also lit briefly during a reboot or reset of the RS 38000 and goes out as soon as the Control Module discovers and properly initializes the switching fabric module.
Online	When lit, this green LED indicates that the module is online and is ready to receive, process, and send packets if configured to do so.
Offline	When lit, this amber LED indicates that the module is offline (powered off) and is ready for hot swap. The Offline LED also is lit briefly during a reboot or reset of the RS.

2.4.8 24-Port 10/100Base-TX Line Card

The 24-port 10/100Base-TX line card contains 24 independent Ethernet ports. Each port senses whether it is connected to a 10-Mbps segment or a 100-Mbps segment and automatically configures itself as a 10Base-T or 100Base-TX port. Figure 2-8 shows the front panel of the 24-port 10/100Base-TX line card.

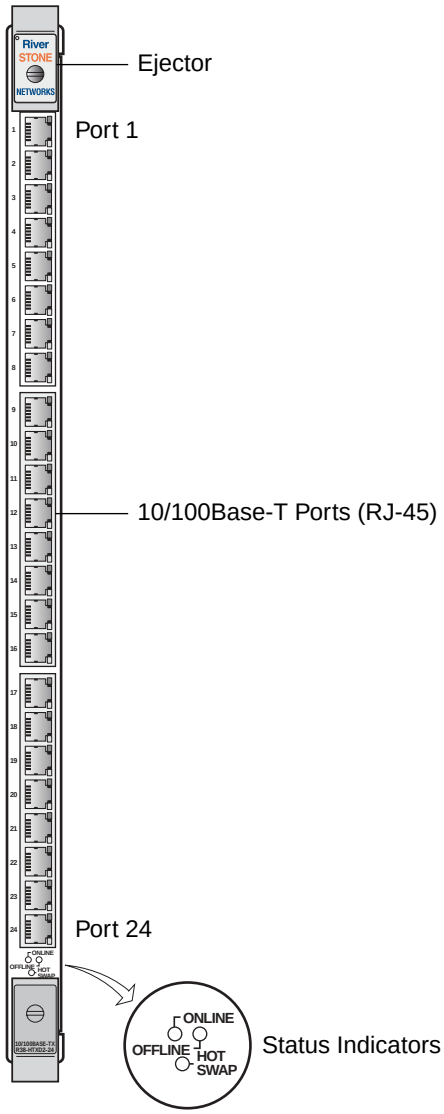


Figure 2-8 Front panel of 24-port 10/100Base-TX line card

RJ-45 Connectors

The following table lists the pin assignments for the RJ-45 connectors on the 10/100Base-TX and for the RJ-45 connectors on the device at the other end of the network segment cables.

Table 2-8 RJ-45 10/100Base-TX connector pin assignments

Line card RJ-45 connector	Pin number	RJ-45 connector at other end of segment
RXD (receive data)	1	TXD (transmit data)
RXD (receive data)	2	TXD (transmit data)
TXD (transmit data)	3	RXD (receive data)
Unused	4	Unused
Unused	5	Unused
TXD (transmit data)	6	RXD (receive data)
Unused	7	Unused
Unused	8	Unused

Figure 2-9 shows the pin positions in the 10/100Base-TX connectors:

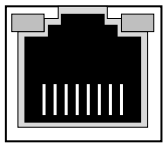


Figure 2-9 10/100Base-TX RJ-45 connector showing pin numbering

Table 2-9 24-port 10/100Base-TX line card media specifications

Port type	Specification
10Base-T	• 802.3 standard • RJ-45 connector wired as Media Data Interface Crossed (MDIX); see Table 2-8 for pin assignments • EIA Category 3, 4, or 5 unshielded twisted pair cabling • Maximum 100 meters (328 feet) segment length
100Base-TX	• 802.3u standard • RJ-45 connector wired as Media Data Interface Crossed (MDIX); see Table 2-8 for pin assignments • EIA Category 5 unshielded twisted pair cabling • Maximum 100 meters (328 feet) segment length

Table 2-10 24-port 10/100Base-TX line card LEDs

LED	Description
Online	When lit, this green LED indicates that the line card is online and is ready to receive, process, and send packets if configured to do so.
Offline	When lit, this amber LED indicates that the line card is offline (powered off) and is ready for hot swap. The Offline LED also is lit briefly during a reboot or reset of the RS 38000 and goes out as soon as the Control Module discovers and properly initializes the line card.
Per-Port Link Defect	When lit, this LED indicates a link problem.
Per-Port Traffic	This LED flashes when data is being sent or received.

2.4.9 32-Port 10/100Base-TX Line Card

The 32-port 10/100Base-TX line card contains 32 independent Ethernet ports. Each port senses whether it is connected to a 10-Mbps segment or a 100-Mbps segment and automatically configures itself as a 10Base-T or 100Base-TX port. Figure 2-10 shows the front panel of the 32-port 10/100Base-TX line card.

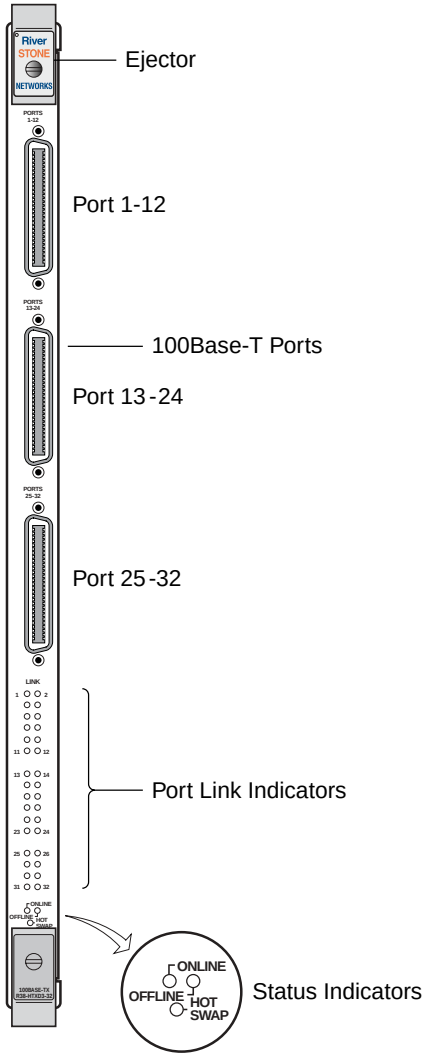


Figure 2-10 Front panel of 32-port 10/100Base-TX line card

The ports are fanned out from the 50-pin RJ-21 connector using industry-standard pin assignments.

Note The third RJ-21 connector has only 8 active ports that use 32 out of the 50 connector pins.

Table 2-11 RJ-21 10/100Base-TX connector pin assignment

Port number	Connector pin number	Signal	Connector pin number	Signal
1	1 2	RxD (-) TxD (-)	26 27	RxD (+) TxD (+)
2	3 4	RxD (-) TxD (-)	28 29	RxD (+) TxD (+)
3	5 6	RxD (-) TxD (-)	30 31	RxD (+) TxD (+)
4	7 8	RxD (-) TxD (-)	32 33	RxD (+) TxD (+)
5	9 10	RxD (-) TxD (-)	34 35	RxD (+) TxD (+)
6	11 12	RxD (-) TxD (-)	36 37	RxD (+) TxD (+)
7	13 14	RxD (-) TxD (-)	38 39	RxD (+) TxD (+)
8	15 16	RxD (-) TxD (-)	40 41	RxD (+) TxD (+)
9	17 18	RxD (-) TxD (-)	42 43	RxD (+) TxD (+)
10	19 20	RxD (-) TxD (-)	44 45	RxD (+) TxD (+)
11	21 22	RxD (-) TxD (-)	46 47	RxD (+) TxD (+)
12	23 24	RxD (-) TxD (-)	48 49	RxD (+) TxD (+)
	25	Not connected	50	Not connected

Table 2-12 32-port 10/100Base-TX line card media specifications

Port type	Specification
10Base-T	• 802.3 standard • RJ-21 connector wired as Media Data Interface Crossed (MDIX); see Table 2-11 for pin assignments • EIA Category 3, 4, or 5 unshielded twisted pair cabling • Maximum 100 meters (328 feet) segment length
100Base-TX	• 802.3u standard • RJ-21 connector wired as Media Data Interface Crossed (MDIX); see Table 2-11 for pin assignments • EIA Category 5 unshielded twisted pair cabling • Maximum 100 meters (328 feet) segment length

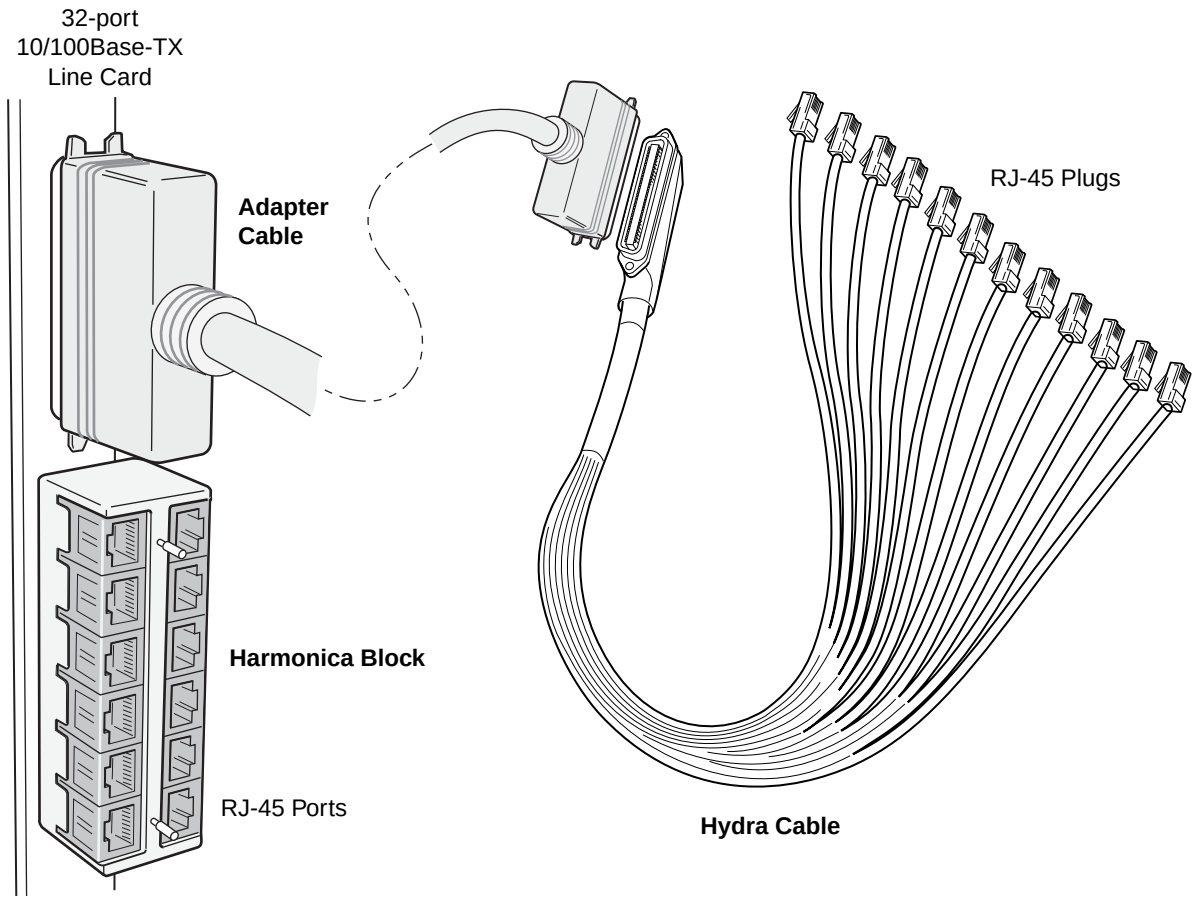


Figure 2-11 Wiring options for 32-port 10/100Base-TX line card

Note Thirty-two LEDs are grouped below the three RJ-21 connectors. Each LED indicates the link state of the associated physical port.

Table 2-13 32-port 10/100Base-TX line card LEDs

LED	Description
Online	When lit, this green LED indicates that the line card is online and is ready to receive, process, and send packets if configured to do so.
Offline	When lit, this amber LED on the left side of the line card indicates that the line card is offline (powered off) and is ready for hot swap. The Offline LED also is lit briefly during a reboot or reset of the RS and goes out as soon as the Control Module discovers and properly initializes the line card.

2.4.10 Gigabit Ethernet GBIC Line Card

Figure 2-12 shows the front panel of the 4-port and 8-port Gigabit Interface Converter (GBIC) line card.

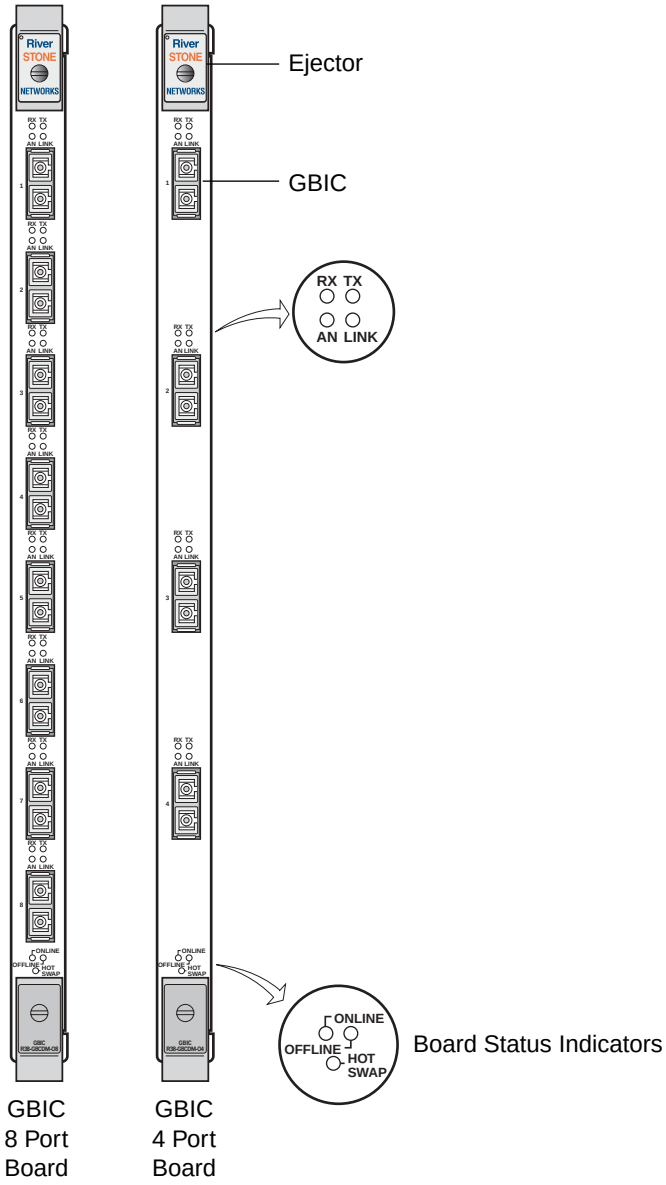


Figure 2-12 Front panel of GBIC line cards

GBIC modules provide the media-specific portion of a GBIC line-card (see Figure 2-13), which support gigabit Ethernet connectivity across multiple media types and distances. The host GBIC line card provides the power, initialization, and control for each GBIC module. Any combination of GBICs can be used on a single GBIC line card.

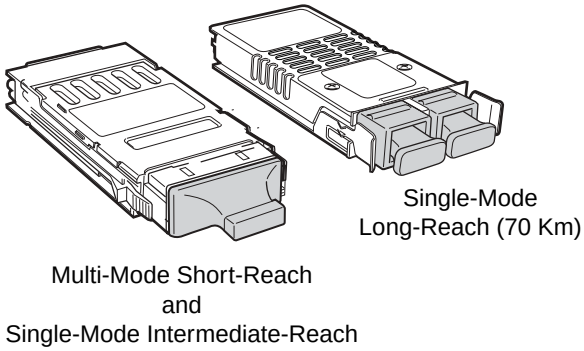


Figure 2-13 GBIC modules

The GBIC line cards accepts the following GBIC modules:

Table 2-14 GBIC modules media specification

Port type	Specification
GBIC SX (MMF)	• Multi-mode fiber interface • 50 or 62.5 125-mm multi-mode fiber cable terminated with SC connectors • Maximum of 300 m of cable
GBIC LX (SMF-IR)	• Single-mode fiber (intermediate range) interface • 8 or 9 125-mm single-mode fiber cable terminated with SC connectors • Maximum of 10 km of cable
GBIC LH (SMF-LR)	• Single-mode fiber (long range) interface • 8 or 9 125-mm single-mode fiber cable terminated with SC connectors • Maximum of 70 km of cable
GIC-12	• Twisted pair copper with RJ-45 interface • Conforms to all 1000 BaseT specifications
GIC-CWDM	• See Section 2.4.18, *"CWDM GBICs"* for details about using CWDM GBICs with this line card.

Note When the GIC-12 GBIC is plugged into a port, the link LED for the line card is lit even when there isn't a cable plugged into the GBIC.

When the GIC-12 GBIC is plugged into a port, autonegotiation should be set for that port.

Table 2-15 GBIC line card LEDs

LED	Description
Online	When lit, this green LED indicates that the line card is online and is ready to receive, process, and send packets if configured to do so.
Offline	When lit, this amber LED indicates that the line card is offline (powered off) and is ready for hot swap. The Offline LED also is lit briefly during a reboot or reset of the RS and goes out as soon as the Control Module discovers and properly initializes the line card.
Per-GBIC RX	**Green** – indicates when the GBIC's transceiver receives packets **Amber** – indicates when the GBIC's transceiver receives flow-control packets
Per-GBIC TX	**Green** – indicates when the GBIC's transceiver transmits packets **Amber** – indicates when the GBIC's transceiver transmits flow-control packets
Per-GBIC AN	**Green** – indicates that the port hardware has auto negotiated the operating mode of the link between full-duplex and half-duplex. **Amber (intermittent)** – indicates that auto negotiation is in process. **Amber (solid)** – indicates a problem with auto negotiation configuration. **Red** – indicates an auto negotiation failure. This fault may occur if the link partner does not support full duplex. **Off** – indicates that auto negotiation has been disabled or the link is down.
Per-GBIC LINK	**Green** – indicates that the port hardware detects a cable plugged into the port and a good link is established. **Red (intermittent)** – indicates that port hardware received an error during operation. **Red (solid)** – indicates that the port hardware detects a cable plugged into the port, however, a bad link is established. **Off** – indicates that no link from the port exists.

2.4.11 MPLS Gigabit Ethernet GBIC Line Card

Figure 2-14 shows the front panel of the 4-port MPLS-activated Gigabit Interface Converter (GBIC) line card.

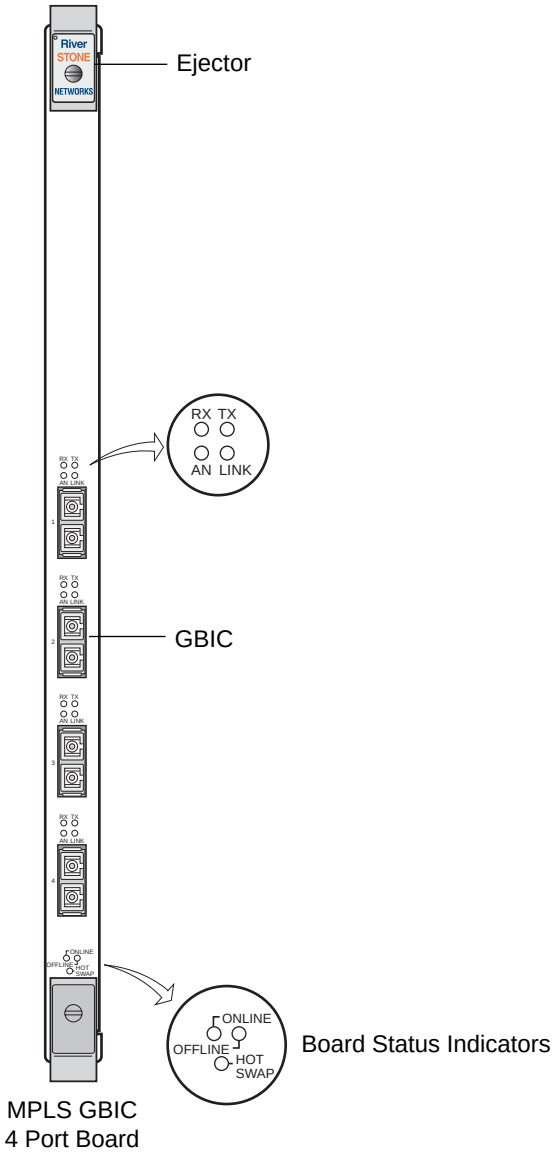


Figure 2-14 Front panel of MPLS GBIC line card

GBIC modules provide the media-specific portion of the MPLS GBIC line-card (see Figure 2-13). GBICs support Gigabit Ethernet connectivity across multiple media types and distances. The GBIC line card provides the power, initialization, and control for each GBIC module. Any combination of GBICs can be used on an MPLS GBIC line card.

Note 802.2 IPX encapsulation is not supported on any MPLS-capable line card.

Table 2-16 lists the GBIC modules that can be used by the MPLS Gigabit Ethernet GBIC line cards.

Table 2-16 GBIC modules media specification

Port type	Specification
GBIC SX (MMF)	• Multi-mode fiber interface • 50 or 62.5 125-mm multi-mode fiber cable terminated with SC connectors • Maximum of 300 m of cable
GBIC LX (SMF-IR)	• Single-mode fiber (intermediate range) interface • 8 or 9 125-mm single-mode fiber cable terminated with SC connectors • Maximum of 10 km of cable
GBIC LH (SMF-LR)	• Single-mode fiber (long range) interface • 8 or 9 125-mm single-mode fiber cable terminated with SC connectors • Maximum of 70 km of cable
GIC-12	• Twisted pair copper with RJ-45 interface • Conforms to all 1000 BaseT specifications
GIC-CWDM	• See Section 2.4.18, *"CWDM GBICs"* for details about using CWDM GBICs with this line card.

Note When the GIC-12 GBIC is plugged into a port, the link LED for the line card is lit even when there isn't a cable plugged into the GBIC.

When the GIC-12 GBIC is plugged into a port, autonegotiation should be set for that port.

Table 2-17 explains the LEDs used by the MPLS Gigabit Ethernet GBIC line card.

Table 2-17 MPLS GBIC line card LEDs

LED	Description
Online	When lit, this green LED indicates that the line card is online and is ready to receive, process, and send packets if configured to do so.

Table 2-17 MPLS GBIC line card LEDs (Continued)

LED	Description
Offline	When lit, this amber LED indicates that the line card is offline (powered off) and is ready for hot swap. The Offline LED also is lit briefly during a reboot or reset of the RS and goes out as soon as the Control Module discovers and properly initializes the line card.
Per-GBIC RX	**Green** – indicates when the GBIC's transceiver receives packets **Amber** – indicates when the GBIC's transceiver receives flow-control packets
Per-GBIC TX	**Green** – indicates when the GBIC's transceiver transmits packets **Amber** – indicates when the GBIC's transceiver transmits flow-control packets
Per-GBIC AN	**Green** – indicates that the port hardware has auto negotiated the operating mode of the link between full-duplex and half-duplex. **Amber (intermittent)** – indicates that auto negotiation is in process. **Amber (solid)** – indicates a problem with auto negotiation configuration. **Red** – indicates an auto negotiation failure. This fault may occur if the link partner does not support full duplex. **Off** – indicates that auto negotiation has been disabled or the link is down.
Per-GBIC LINK	**Green** – indicates that the port hardware detects a cable plugged into the port and a good link is established. **Red (intermittent)** – indicates that port hardware received an error during operation. **Red (solid)** – indicates that the port hardware detects a cable plugged into the port, however, a bad link is established. **Off** – indicates that no link from the port exists.

2.4.12 Channelized T3 Line Card

The channelized T3 line card has 4 ports, each port connection consists of a pair of BNC connectors (transmit/receive pairs). The line card also has an internal CSU/DSU. Each channelized T3 port has an associated test port, which provides access to any of the T1 channels within a channelized T3 group. A total of 28 T1 lines on each T3 port are available for the transmission of data. Figure 2-15 shows the front panel of the channelized T3 line card.

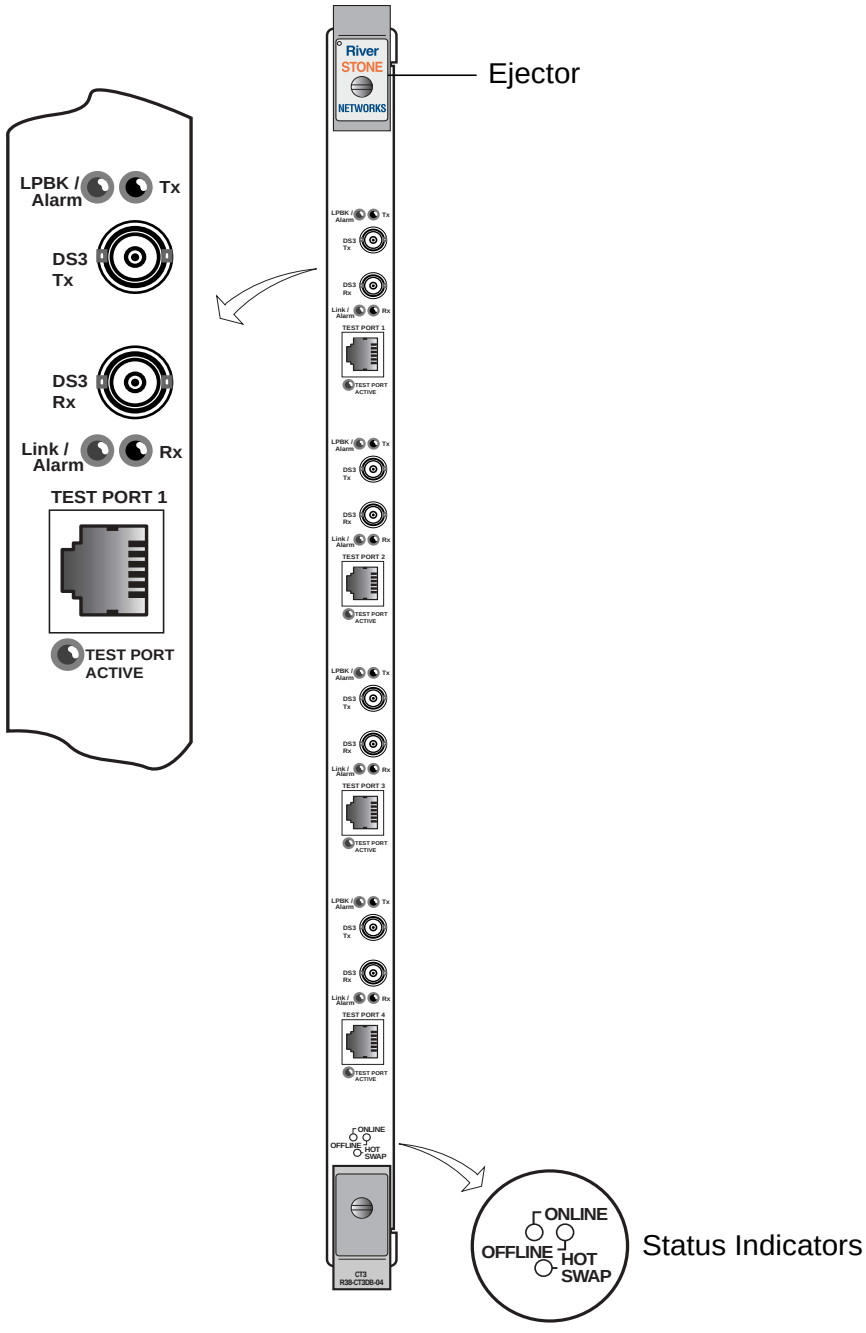


Figure 2-15 Front panel of channelized T3 line card

Table 2-18 Channelized T3 line card media specifications

Port type	Specification
channelized T3	• SJA 44 connectors/75-ohm coaxial BNC connectors • T1 RJ48c test port for each DS3 (test port only) • ANSI T1.102, T1.107, and T1.404a compliant

Table 2-19 RJ-48c test connector pin assignments

T3 line card test port connector	Pin number	RJ-48c connector at other end of segment
RXD	1	TXD
RXD	2	TXD
reserved	3	reserved
TXD	4	RXD
TXD	5	RXD
reserved	6	reserved
reserved	7	reserved
reserved	8	reserved

Table 2-20 Channelized T3 line card LEDs

LED	Description
Online	When lit, this green LED indicates that the line card is online and is ready to receive, process, and send data if configured to do so.
Offline	When lit, this amber LED indicates that the line card is offline (powered off) and is ready for hot swap. The Offline LED also is lit briefly during a reboot or reset of the RS and goes out as soon as the Control Module discovers and properly initializes the line card.
Per-port Loopback/Alarm	**Amber (solid)** – the Remote Alarm Indicator (RAI), commonly called the Yellow Alarm signal. It indicates that the failure is at the remote end. **Amber (intermittent)** – AIS received. **Red** – indicates that there is a loopback.
Per-port TX	**Green** – indicates that the port's transceiver is transmitting data. **Off** – indicates a loss of signal or service disruption.

Table 2-20 Channelized T3 line card LEDs (Continued)

LED	Description
Per-port Link /Alarm	**Green** – indicates that the line card detects a cable plugged into the port and a good link is established. **Amber** – T1 any alarm. **Red** – the Alarm Indication Signal (AIS); indicates that there is a transmission fault located either at or upstream from the transmitting terminal.
Per-port RX	**Amber** – indicates that the port's transceiver is receiving data. **Off** – indicates a loss of signal or service disruption.
Test Port Active	**Green** – indicates that the test port is active and in monitor mode. **Amber** – indicates that the test port is active and in drop and insert mode

2.4.13 Four-Port WDM Line Card

The single-port WDM line card provides 4-ports (channels) of 1000Base-SX Ethernet over a single fiber link using Wave Division Multiplexing (WDM) technology. Figure 2-16 shows the front panel of the WDM line card.

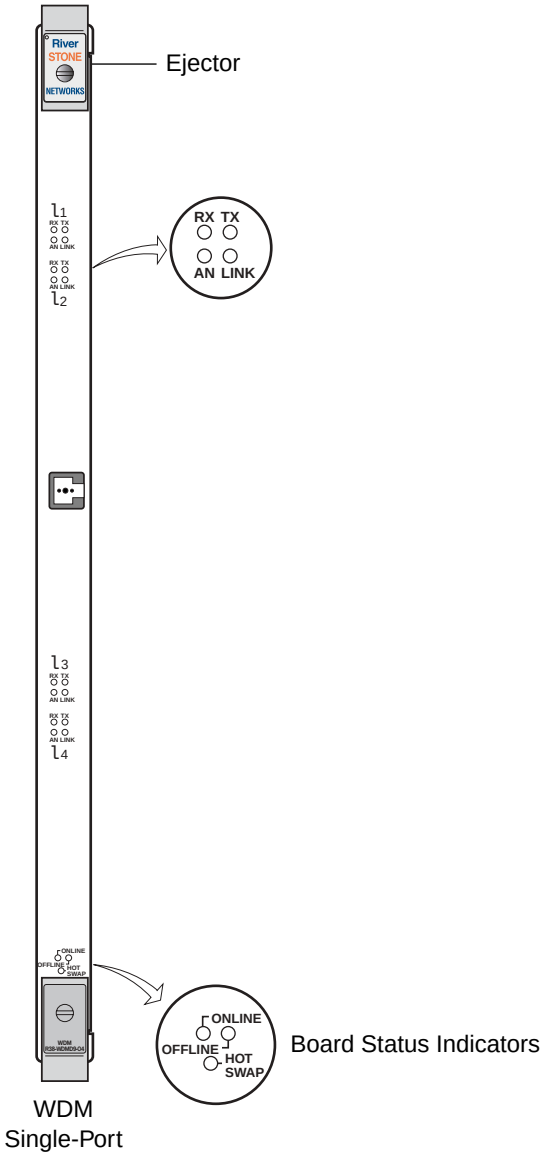


Figure 2-16 Front panel of four-channel WDM line card

Table 2-21 WDM channel wavelengths

Channel (Ln)	Wavelength[1]	Port Numbering[2]
L1	1500 nm	Port 1 gi.x.1
L2	1520 nm	Port 1 gi.x.2
L3	1540 nm	Port 1 gi.x.3
L4	1560 nm	Port 1 gi.x.4

[1] All wavelengths are approximations.

[2] The x represents the number of the slot within which the WDM line card resides.

Table 2-22 WDM media specifications

Port type	Specification
SX (SMF)	• Single-mode fiber (intermediate range) interface • 8 or 9 125-mm single-mode fiber cable terminated with SC/APC connectors • Maximum of 35 km cable • Receiver sensitivity -17.5 dBm • Optical power budget (Tx power) 10.5 dB

Caution You must connect to the four ports of the WDM module using an SC/APC connector (Angled Polished Connector).

Table 2-23 WDM line card LEDs

LED	Description
Online	When lit, this green LED indicates that the line card is online and is ready to receive, process, and send packets if configured to do so.
Offline	When lit, this amber LED indicates that the line card is offline (powered off) and is ready for hot swap. The Offline LED also is lit briefly during a reboot or reset of the RS 38000 and goes out as soon as the Control Module discovers and properly initializes the line card.

Table 2-23 WDM line card LEDs (Continued)

LED	Description
Per-L RX	**Green** – indicates when the channel transceiver receives packets **Amber** – indicates when the channel transceiver receives flow-control packets
Per-L TX	**Green** – indicates when the channel's transceiver transmits packets **Amber** – indicates when the channel's transceiver transmits flow-control packets
Per-L AN	**Green** – indicates that the port hardware has auto negotiated the operating mode of the link between full-duplex and half-duplex. **Amber (intermittent)** – indicates that auto negotiation is in process. **Amber (solid)** – indicates a problem with auto negotiation configuration. **Red** – indicates an auto negotiation failure. This fault may occur if the link partner does not support full duplex. **Off** – indicates that auto negotiation has been disabled or the link is down.
Per-L LINK	**Green** – indicates that the port hardware detects a cable plugged into the port and a good link is established. **Red (intermittent)** – indicates that port hardware received an error during operation. **Red (solid)** – indicates that the port hardware detects a cable plugged into the port, however, a bad link is established. **Off** – indicates that no link on the port exists.

Configuring the WDM Line Card

By default, all WDM ports are disabled. When connected to another 4-port WDM line card, use the **`port enable wdm`** command to enable one or all of the WDM ports on each RS 38000 (see Table 2-21 for correspondence between channels, L1 through L4, and port numbering).

The following example enables port 1 (channel L1) on a WDM line card in slot 5 of the RS 38000:

```
rs(config)# port enable wdm ports gi.5.1
```

Notice in the example above that the WDM port is specified as a Gigabit Ethernet port (**`gi.5.1`**). Furthermore, this port one (channel L1) must be connected to the same port one (channel L1) on the other RS 38000.

The following example enables all four ports (channels L1 through L4) on a WDM line card in slot 5 of the RS 38000:

```
rs(config)# port enable wdm ports gi.5.(1-4)
```

2.4.14 ATM Multi-Rate Line Card

The ATM Multi-rate line card houses various Physical Layer (PHY) interface cards in its two available slots. ATM PHY cards provide the media-specific portion of an ATM interface to support ATM connectivity across multiple platforms using different media types. The line card provides the power, initialization, and control for the PHY card.

Figure 2-17 shows the front panel of the ATM multi-rate line card.

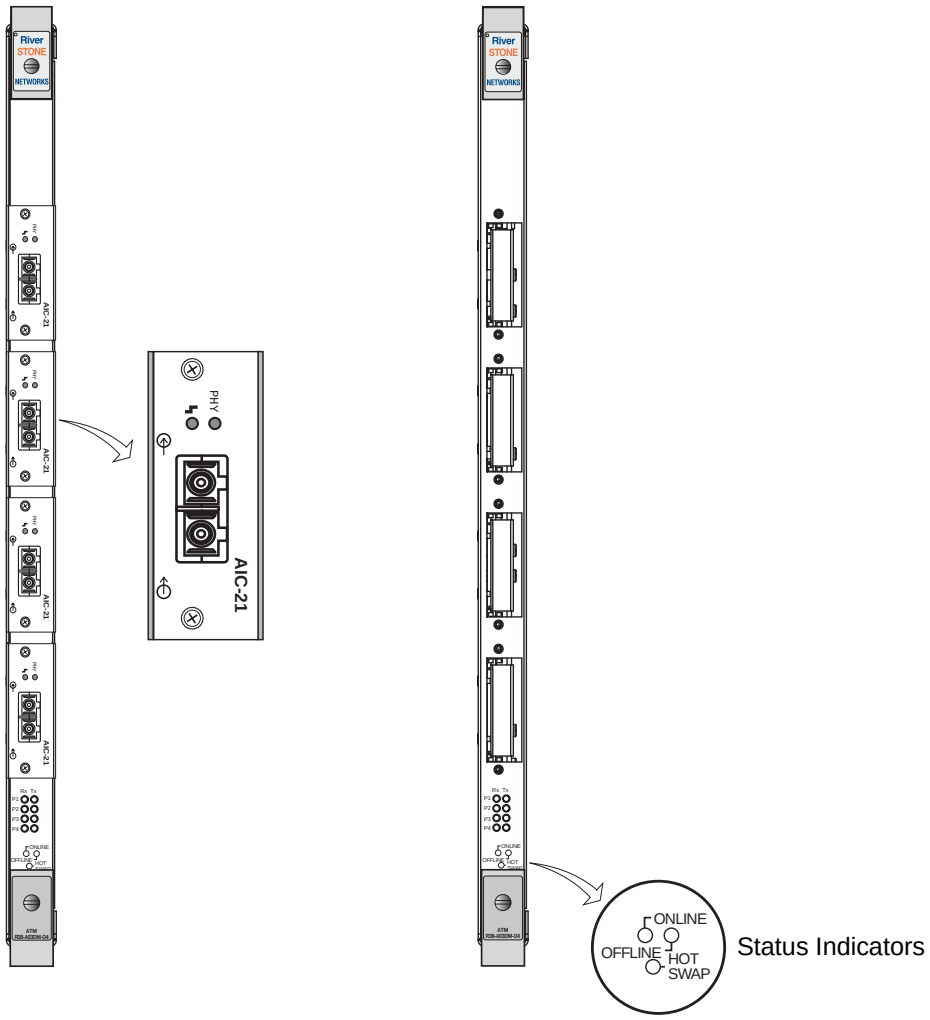
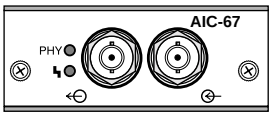
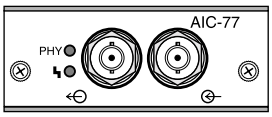
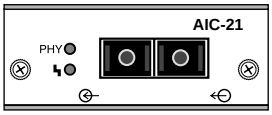
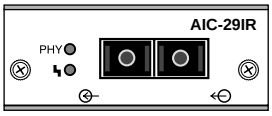


Figure 2-17 Front panel of ATM Multi-rate line card

See Section 3-11, *"Installing an ATM PHY card"* for instructions on installing PHYs into the ATM multi-rate line card.

The ATM Multi-rate line card has four available slots. Each slot accepts the following PHY interface modules:

Table 2-24 PHY modules for ATM Multi-rate line card

Port type	Specification
AIC-67 	• DS-3/T-3 interface (BNC Coax). • 75 coaxial (RG-59B or equivalent) terminated with 75-ohm BNC connectors • Maximum of 450 ft (137 m) of cable
AIC-77 	• E-3 interface (BNC). • 75 coaxial (RG-59B or equivalent) terminated with 75-ohm BNC connectors • Maximum of 450 ft (137 m) of cable
AIC-21 	• OC-3c MMF interface (SC-style). • EIA/TIA 492-AAAA • 62.5/125 µm • Maximum of 2 kilometers of cable • 0 to 9 dB loss at 1300 nm
AIC-29IR 	• OC-3c SMF-IR interface (SC-style). • EIA/TIA 492-CAAA • 9/125 µm • Maximum of 15 kilometers of cable • 0 to 15 dB loss at 1300 nm

The ATM Multi-rate line card uses the following LEDs.

Table 2-25 LED description for ATM Multi-rate line card

LED	Description
PHY	**Green** – indicates that the PHY is operating properly and a link is established **Amber** – indicates that the PHY is inactive due to media errors Blinking Green – indicates that the PHY has been disabled by management **Off** – indicates no connection
↳	**Amber** – indicates that the diagnostics have detected a fault **Blinking Green** – indicates that the PHY port has been redirected elsewhere

Table 2-25 LED description for ATM Multi-rate line card

LED	Description
Per-PHY Rx	**Green** – indicates when the PHY's transceiver receives packets **Amber** – indicates when the PHY's transceiver receives flow-control packets
Per-PHY Tx	**Green** – indicates when the PHY's transceiver transmits packets **Amber** – indicates when the PHY's transceiver transmits flow-control packets

2.4.15 MPLS POS OC-3c and OC-48c Line Cards

The Packet-over-SONET line cards support either OC-3c or OC-48c line rates. The OC-3c line card supports four connections while the OC-48c line card supports one connection. Both line cards are designed to use Small Form-Factor Pluggable (SFP) connectors suoort use of single-mode fiber (SMF). These line cards are designed to function either as short-reach or intermediate-reach, depending on which type of laser is used in the SFP receptacle.

Figure 2-18 shows the front panel of the POS OC-3c and POS OC-48c line cards.

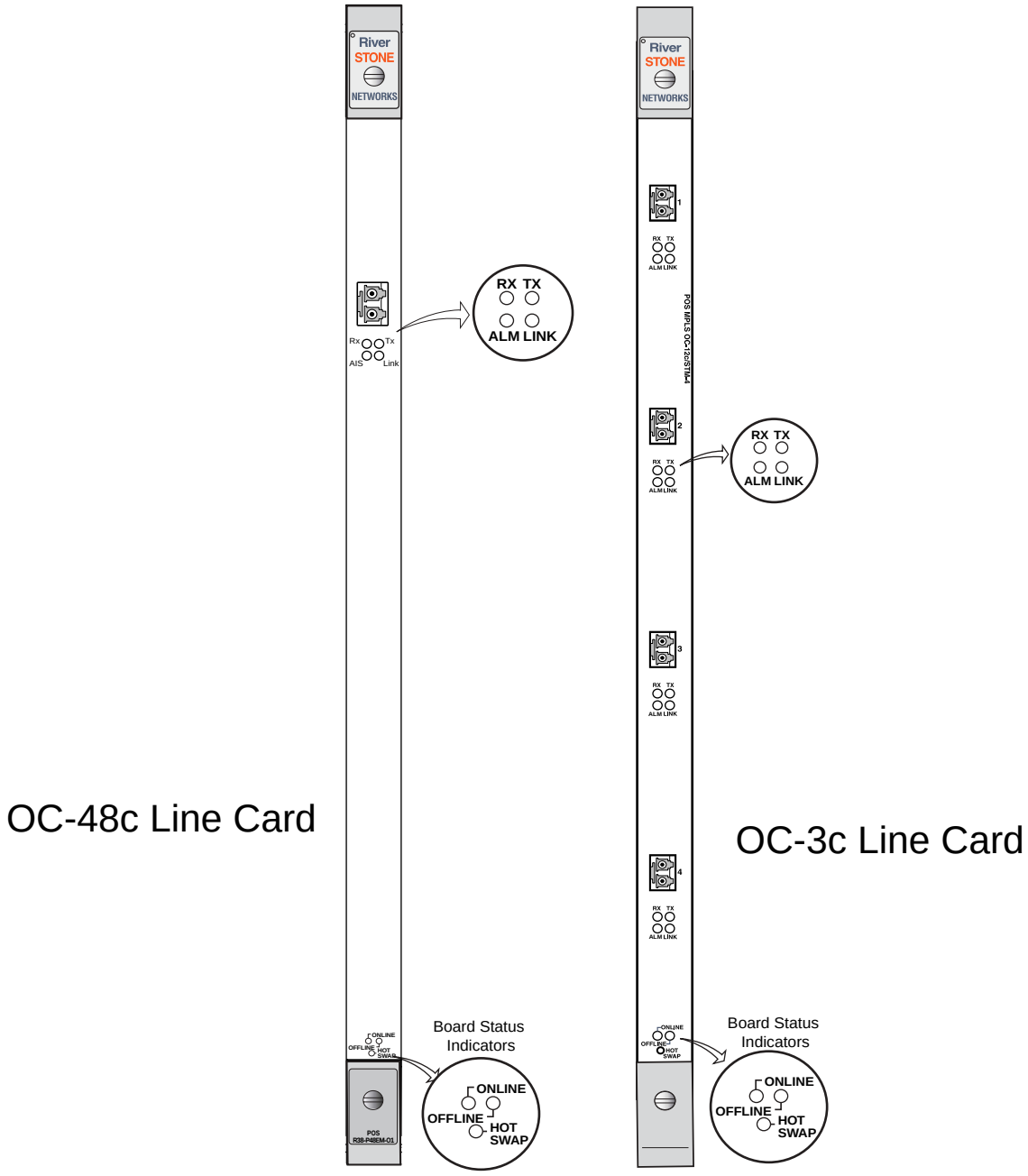


Figure 2-18 MPLS POS OC-3c and MPLS POS OC-48c line cards

The following table lists the media specifications for the MPL:S POS OC-3c and MPLS POS OC-48c line cards.

Note 802.2 IPX encapsulation is not supported on any MPLS-capable line card.

Table 2-26 Connector specifications for MPLS POS OC-3c/OC-48c line card

Port type	Specification
POS OC-12c and OC-48c	• Bellcore GR253, ITU -T G.957, ITU-T G.958 • PPP over SONET/SDH (RFC 1619), PPP in HDLC framing (RFC 1662) • Small form-factor pluggable (SFPs) optics with LC connectors • 1310 nm SMF support • Typically up to 15 kilometers when using intermediate reach lasers

Table 2-27 lists the LEDs used by the MPLS POS line cards.

Table 2-27 LED description for POS OC-12c line card

LED	Description
Offline	When lit, this amber LED on the left side of the line card indicates that the line card is offline (powered off) but is ready for hot swap. The Offline LED also is lit briefly during a reboot or reset of the RS but goes out as soon as the Control Module discovers the line card.
Online	When lit, this green LED indicates that the line card is online and is ready to receive, process, and send packets if configured to do so.
Per-port Link	**Green** – indicates the port hardware detects that a good PPP link is established **Off** – indicates that no link from the port exists
ALM	**Solid Red** – when signal alarms are present **Off** – when no alarms are present

Table 2-27 LED description for POS OC-12c line card (Continued)

LED	Description
Per-port Rx	**Green** – indicates when the port's transceiver receives packets **Red** – indicates when the port's transceiver receives flow-control packets
Per-port Tx	**Green** – indicates when the port's transceiver transmits packets **Red** – indicates when the port's transceiver transmits flow-control packets

2.4.16 ATM OC-12c Line Card

The ATM OC-12c line card supports four OC-12c connections. The ATM line card is designed to work with single-mode fiber (SMF), and uses OC-12 Small Form-factor Plug-able (SFP) type connector. The line card is designed to function either as short-reach or intermediate-reach, depending on which type of laser is used in the SFP receptacle.

Figure 2-19 shows the front panel of the ATM OC-12c line card.

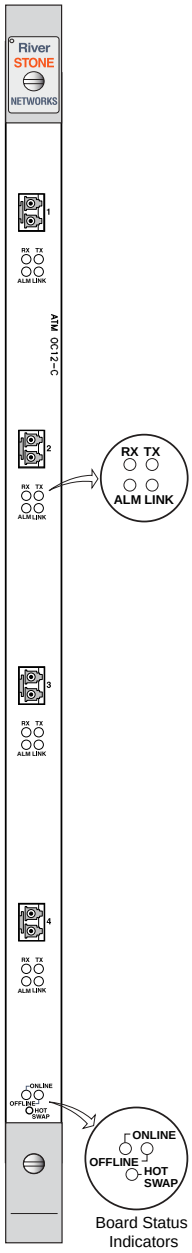


Figure 2-19 Four-port ATM OC-12c line card

The following table lists the media specifications for the ATM OC-12c line card.

Table 2-28 Connector specifications for ATM OC-12c line card

Port type	Specification
ATM OC-12c	• Small form-factor pluggable (SFPs) optics with LC connectors • 9.5 micron single-mode fiber-optic cable • 1310 nm SMF support • Typically up to 15 kilometers when using intermediate reach lasers

The ATM OC-12c line card use the following LEDs.

Table 2-29 LED description for ATM OC-12c line card

LED	Description
Offline	When lit, this amber LED on the left side of the line card indicates that the line card is offline (powered off) but is ready for hot swap. The Offline LED also is lit briefly during a reboot or reset of the RS but goes out as soon as the Control Module discovers the line card.
Online	When lit, this green LED indicates that the line card is online and is ready to receive, process, and send packets if configured to do so.
ALM	**Solid Red** – when signal alarms are present **Off** – when no alarms are present
Per-port Link	**Green** – indicates the port hardware detects that a good link is established **Off** – indicates that no link from the port exists
Per-port Rx	**Green** – indicates when the port's transceiver receives packets **Red** – indicates when the port's transceiver receives flow-control packets
Per-port Tx	**Green** – indicates when the port's transceiver transmits packets **Red** – indicates when the port's transceiver transmits flow-control packets

2.4.17 ATM OC-48c Line Card

The ATM OC-48c line card supports one OC-12c connection. The ATM line card is designed to work with single-mode fiber (SMF), and uses OC-12 Small Form-factor Plug-able (SFP) type connector. The line card is designed to function either as short-reach or intermediate-reach, depending on which type of laser is used in the SFP receptacle.

Figure 2-20 shows the front panel of the ATM OC-48c line card.

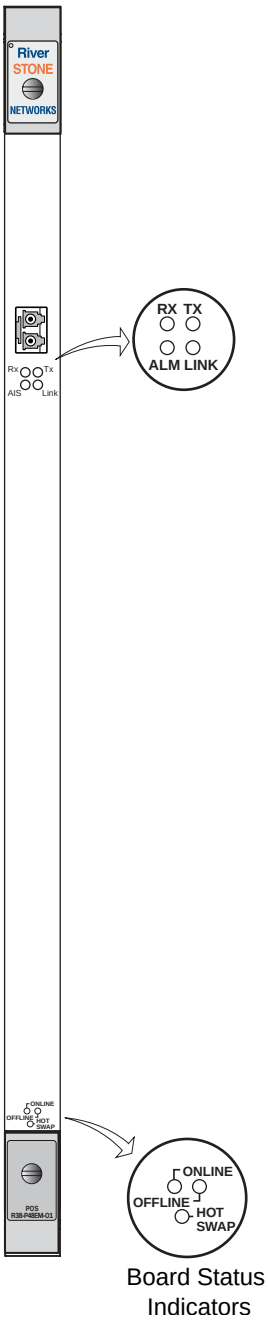


Figure 2-20 One-port ATM OC-48c line card

The following table lists the media specifications for the ATM OC-48c line card.

Table 2-30 Connector specifications for ATM OC-48c line card

Port type	Specification
ATM OC-12c	• Small form-factor pluggable (SFPs) optics with LC connectors • 9.5 micron single-mode fiber-optic cable • 1310 nm SMF support • Typically up to 15 kilometers when using intermediate reach lasers

The ATM OC-48c line card use the following LEDs.

Table 2-31 LED description for ATM OC-48c line card

LED	Description
Offline	When lit, this amber LED on the left side of the line card indicates that the line card is offline (powered off) but is ready for hot swap. The Offline LED also is lit briefly during a reboot or reset of the RS but goes out as soon as the Control Module discovers the line card.
Online	When lit, this green LED indicates that the line card is online and is ready to receive, process, and send packets if configured to do so.
ALM	**Solid Red** – when signal alarms are present **Off** – when no alarms are present
Per-port Link	**Green** – indicates the port hardware detects that a good link is established **Off** – indicates that no link from the port exists
Per-port Rx	**Green** – indicates when the port's transceiver receives packets **Red** – indicates when the port's transceiver receives flow-control packets
Per-port Tx	**Green** – indicates when the port's transceiver transmits packets **Red** – indicates when the port's transceiver transmits flow-control packets

2.4.18 CWDM GBICs

All Gigabit Ethernet ports on the RS can be configured for Coarse Wavelength Division Multiplexing (CWDM) through use of CWDM GBICs. CWDM allows a single fiber to carry up to eight separate wavelengths, enabling 8 full duplex GigE links over a pair of fibers. Each wavelength is supported by a seperate GBIC that is tuned to that wavelength. Mux/DeMux modules are used to aggregate up to eight different wavelengths for transmission onto a single fiber. Add/ Drop modules are used to extract a single wavelength from a fiber. Figure 2-21 and Figure 2-22 describe two common applications for use of CWDM with the RS.

Figure 2-21 describes a CWDM point-to-point configuration. In this example, eight ports on each of two RS Switch/Routers are configured with CWDM GBICs tuned to different wavelengths. Each of the eight GBICs are then connected with two fibers, for full duplex connectivity, to a port configured for the same wavelength on a MUX/DEMUX module. All of the eight wavelengths are multiplexed on a single fiber in each direction (two fibers for full duplex connectivity). This fiber is then connected to a remote MUX/DEMUX module where it is demultiplexed and routed to the GBIC with the corresponding wavelength.

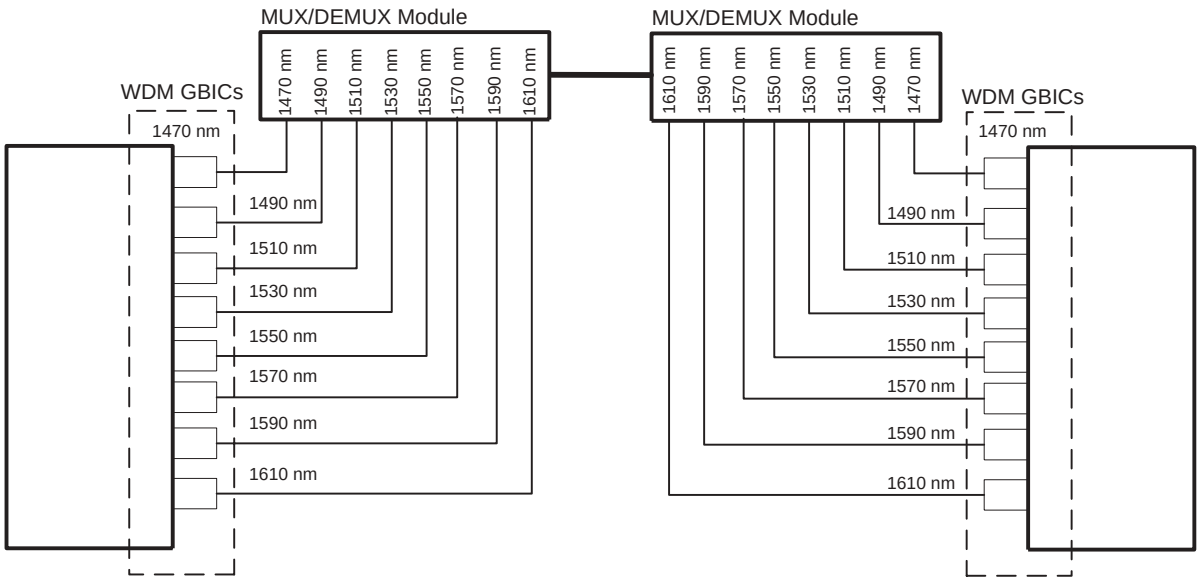


Figure 2-21 CWDM Point to Point Configuration

Figure 2-22 describes a CWDM ring configuration. In this example, four ports on an RS Switch/Router are configured with CWDM GBICs tuned to different wavelengths. Each of the four GBICs are then connected with two fibers, for full duplex connectivity, to a port configured for the same wavelength on a MUX/DEMUX module. All of the four wavelengths are multiplexed on a single fiber in each direction (two fibers for full duplex connectivity). At four different locations, a CWDM Add/Drop Module is used to demultiplex one of the wavelengths that is on the fiber and routed to the GBIC with the corresponding wavelength.

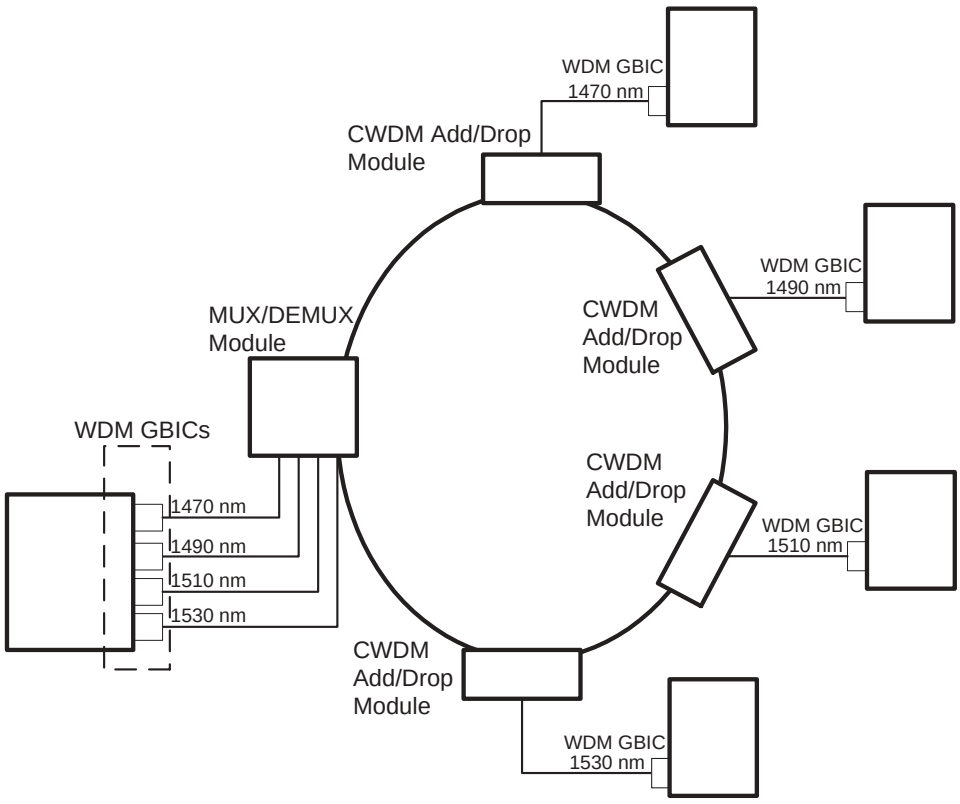


Figure 2-22 CWDM Ring Configuration

Table 2-32 shows each of the GBICs used for configuring an RS-based CWDM network. For information on obtaining the additional equipment used for an installation, contact your sales representative.

Table 2-32 CWDM GBICs

Model Number	Specification
GIC-CWDM-1470	• Single-mode fiber interface • Terminated with SC connectors • 1470 nm wavelength
GIC-CWDM-1490	• Single-mode fiber interface • Terminated with SC connectors • 1490 nm wavelength

GIC-CWDM-1510	• Single-mode fiber interface • Terminated with SC connectors • 1510 nm wavelength
GIC-CWDM-1530	• Single-mode fiber interface • Terminated with SC connectors • 1530 nm wavelength
GIC-CWDM-1550	• Single-mode fiber interface • Terminated with SC connectors • 1550 nm wavelength
GIC-CWDM-1570	• Single-mode fiber interface • Terminated with SC connectors • 1570 nm wavelength
GIC-CWDM-1590	• Single-mode fiber interface • Terminated with SC connectors • 1590 nm wavelength
GIC-CWDM-1610	• Single-mode fiber interface • Terminated with SC connectors • 1610 nm wavelength

3 HARDWARE INSTALLATION

This chapter provides hardware installation instructions and information on safety considerations, environmental considerations, and regulatory standards.

3.1 SAFETY CONSIDERATIONS *EN ESPANOL -- APPENDIX B*

Warning Read the following safety warnings and product cautions to avoid personal injury or product damage.

3.1.1 Preventing Injury

- To avoid injury, be careful when lifting the chassis out of the shipping box.
- Never attempt to rack mount the RS 38000 chassis unaided. Ask an assistant to help you hold the chassis.
- Never operate the RS 38000 with exposed power supply bays or line card slots. You can leave the PC card slots exposed but make sure you do not insert any objects other than the appropriate PC flash RAM card into the PC card slot.
- Never operate the RS 38000 if the chassis becomes wet or if the area in which the chassis is installed is wet.

3.1.2 Preventing Equipment Damage

To prevent accidental product damage, observe the following precautions:

- Always use proper electrostatic discharge (ESD) gear when handling the Control Module, backplane, line cards or other internal parts of the RS 38000.
- Make sure there are at least 3 inches (7.62 centimeters) of room above and behind the RS 38000 chassis for air flow to the cooling fans.
- Install the RS 38000 as low as possible in the rack to prevent tipping of the rack.
- If the RS 38000 is to be installed in a closed or multi-unit rack, make sure that the ambient temperature around the unit does not exceed the temperature range listed in Table 3-1.

- It is recommended that you use a support tray under the RS 38000 chassis when installing in an equipment rack (see Figure 3-1). This is especially advisable for chassis that are fully populated with line cards and power supplies.
- When installing components into the rack-mounted chassis, maintain a balanced and even distribution of components in the chassis. For example, even though power supplies and line cards can be installed in any available slot, you should not install all components on one side of the chassis.
- Maintain reliable grounding of rack-mounted equipment, with particular attention to power supply connections other than direct connections to the branch circuit (i.e., use of power strips, etc.)

3.2 HARDWARE SPECIFICATIONS

The following table lists the physical and environmental specifications for the RS 38000.

Table 3-1 Physical and environmental specifications

Specification	Measurement
Dimensions	Inches: 19.0” x 19.0” x 35.0” Centimeters: 48.26 cm x 48.26 cm x 88.90 cm
Weight (out of shipping crate)[a]	Pounds: 124 Kilograms: 56.25
Weight (fully loaded)[b]	Pounds: 225 Kilograms: 102.06
AC power	100-120 VAC, 16A maximum per power supply; 24A total maximum per system 200-240 VAC, 8A maximum per power supply; 12A total maximum per system 50-60 Hz.
DC Power	36-72V, 50 A @ 48 V nominal
Operating Temperature	Fahrenheit: 41^{o}F to 104^{o}F Centigrade: 5^{o}C to 40^{o}C
Non-Operating Temperature	Fahrenheit: -22^{o}F to 164^{o}F Centigrade: -30^{o}C to 73^{o}C
Operating Humidity	15% to 90% (non-condensing)

a. Shipping pallet and packing material weigh an additional 51 pounds (23.13 kilograms).
b. With one DC power supply, redundant Control Modules, and line cards installed in each slot.

3.3 INSTALLING THE HARDWARE

This section contains descriptions of the necessary operations for a successful installation of the RS 38000.

3.3.1 Verifying Your Shipment

Before you begin installing the RS 38000, check your shipment to ensure that everything you ordered arrived securely.

Warning To avoid possible personal injury, be careful when lifting the chassis out of the shipping box.

Advertencia Para evitar posibles lesiones personales, solicite la ayuda de otra persona al levantar y sacar el chasis fuera de la caja de embalaje.

Open the shipping box(es) and verify that you received the following equipment:

- RS 38000 chassis containing a backplane, Control Module, Fan Module, Switch Fabric Module, Clock Module, console cable for connecting a terminal to the Control Module's DB-9 port.
- One or more RS 38000 power supplies
- One country-specific power cable per power supply (if AC power supplies were ordered)
- RS 38000 Media Kit:
  - *Riverstone Networks Documentation CD*
  - One PC card containing the RS operating system software
  - *Riverstone Networks RS 38000 Getting Started Guide*
  - Release Notes

Depending on your order, your shipment may also contain some or all of the following:

- One or more redundant power supplies
- Redundant Control Module
- Redundant Switch Fabric module
- One or more line cards
- One or more GBIC modules

3.3.2 Installing the Chassis

Warning Riverstone Networks, Inc. recommends that only qualified personnel conduct installation of any RS 38000 chassis.

Advertencia Riverstone Networks, Inc. recomienda que el chasis RS 38000 sea instalado únicamente por personal capacitado.

Install the RS 38000 in a standard 19” equipment rack. The RS chassis is equipped with front-mounting brackets. Figure 3-1 shows an example of how to install an RS 38000 chassis in an equipment rack.

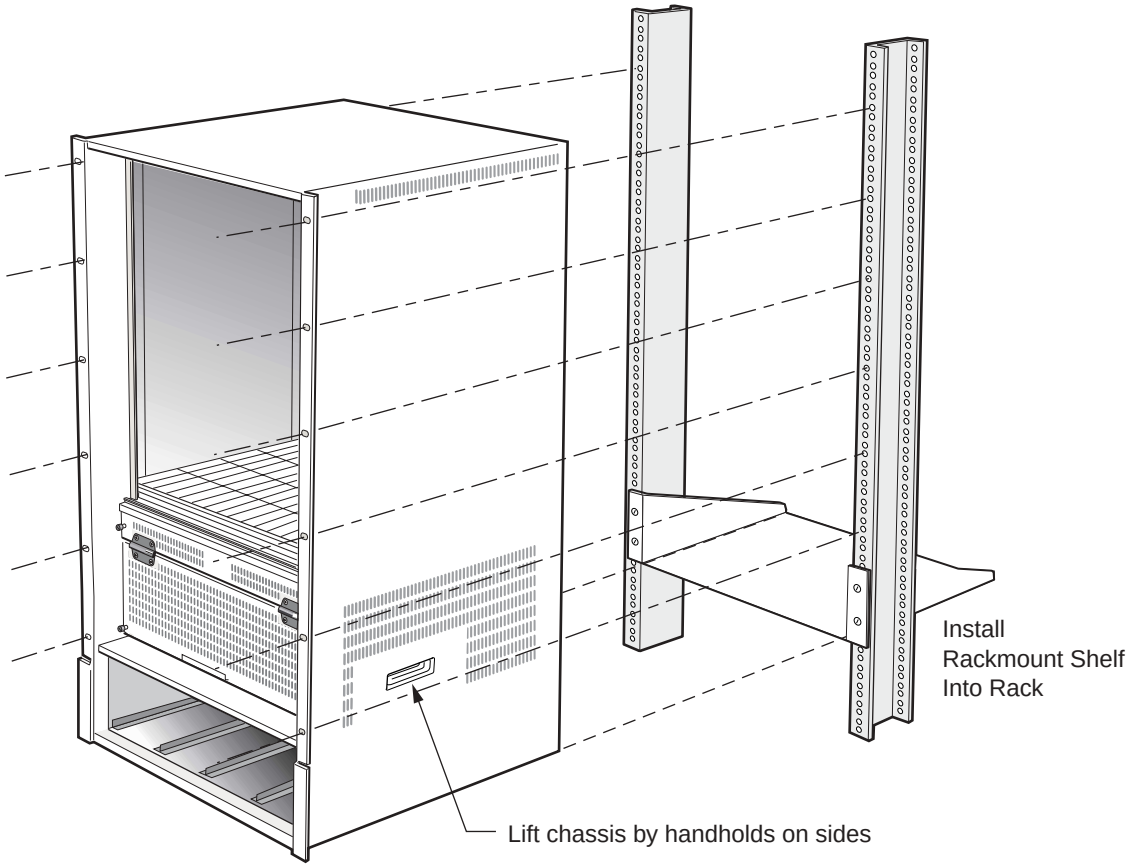


Figure 3-1 Installing the RS 38000 chassis in an equipment rack

Warning Never attempt to install an RS 38000 chassis into a rack by yourself.

Advertencia Nunca intente instalar el chasis del RS 38000 en un rack sin la ayuda de otra persona.

Warning To make lifting and holding the chassis easier, it is recommended that you install the RS 38000 chassis while empty. Remove all line cards, Control Modules, and power supplies.

Advertencia Para facilitar el proceso de levantamiento y sujeción del chasis, se recomienda instalar el chasis del RS 38000 mientras éste se encuentre vacío. Retire todas las tarjetas de línea, los módulos de control y los suministros de energía.

To install the RS chassis in an equipment rack, use the following procedure:

1. Along with an assistant, lift the chassis into place in the mounting rack.
2. While your assistant holds the chassis in place, use an appropriate screwdriver and mounting screws to attach the front-mounting brackets of the chassis to the mounting rack.

Warning Make sure there are at least 3 inches (7.62 centimeters) of room above and behind the unit for air flow to the cooling fans.

Advertencia Cerciórese de dejar un claro mínimo de 3 pulgadas (7.62 centímetros) en ambos lados de la unidad para permitir el flujo de aire hacia los ventiladores de enfriamiento.

Warning Make sure the screws are tight before your assistant releases the chassis. If you accidentally leave the screws loose, the chassis can slip and fall, possibly becoming damaged.

Advertencia Cerciórese de que los tornillos estén debidamente ajustados antes de que su asistente suelte el chasis. Si los tornillos no están debidamente ajustados, es posible que el chasis se salga de su sitio y se dañe.

3.3.3 Installing AC Power Supplies

To install an AC power supply follow this procedure. For AC power supply environmental specifications, see Table 3-2.

1. Ensure that the AC power supply is not powered on, and is disconnected from its line cord.

2. Position the power supply between the guides in an open power supply slot (see Figure 3-2).

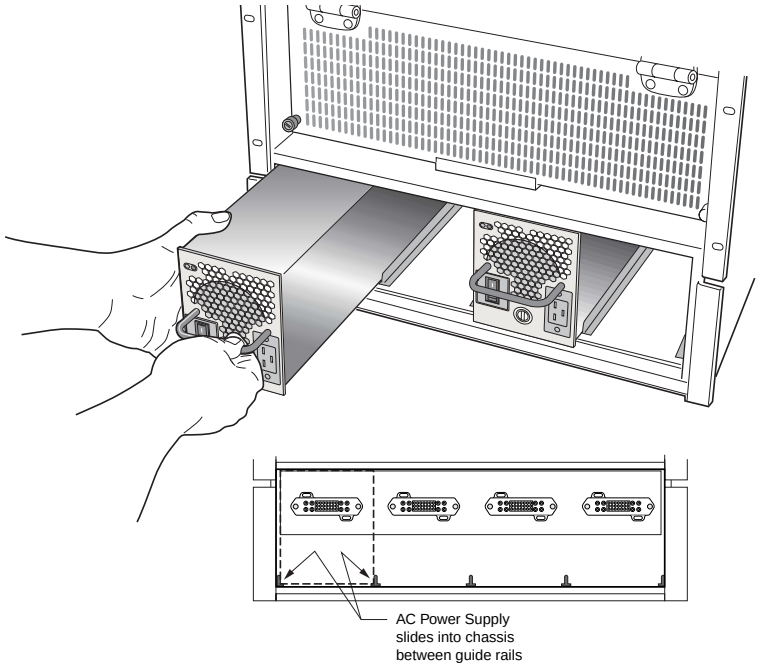


Figure 3-2 Installing an AC power supply

3. Slide the AC power supply all the way into the slot, firmly but gently pressing to ensure that the connectors on the back of the power supply are completely seated in the backplane.
4. Using a straight-blade screwdriver, turn the screw on the power supply's front panel clockwise 180 degrees to lock the power supply into the chassis.
5. Attach the power cable to the AC power supply.

Warning Use a single-phase grounded power source located within 6 feet (1.89 meters) of the installation site.

Advertencia Utilice una fuente de poder monofásica y puesta a tierra, misma que deberá localizarse a un máximo de 6 pies (1.89 metros) de distancia del sitio de instalación.

Warning High leakage current can be caused by multiple power supplies. For this reason, it is essential that each power cord be connected to separate branch circuits with proper earth connections.

Advertencia El uso de suministros de energía múltiples puede ocasionar altas corrientes de fuga. Por este motivo, resulta esencial conectar cada cable de energía a distintos ramales del circuito, mismos que deberán estar puestos a tierra.

Table 3-2 AC power supply environmental specifications

Specification	Measurement
Operating Temperature	+5° to +40°C (41° to 104°F)
Non-operating Temperature	-30° to +73°C (-22° to 164°F)
Operating Humidity	15% to 90% (non-condensing)

3.3.4 Installing DC Power Supplies

Warning The RS 38000 with DC power supplies should be installed only in Restricted Access Areas (Dedicated Equipment Rooms, Electrical Closets, or the like) in accordance with Articles 110-26 and 110-27 of the 1999 National Electrical Code ANSI/NFPA 70.

Advertencia El RS 38000 con suministros de energía DC únicamente deberá instalarse en Areas de Acceso Restringido (recintos dedicados al equipo, armarios eléctricos o similares) según lo estipulado en los Artículos 110-26 y 110-27 del Código Eléctrico Nacional de 1999 ANSI/NFPA 70.

To install a DC power supply in the RS 38000 perform the following steps. For DC power supply environmental specifications, see Table 3-4. For special DC power safety considerations, see Table 3-3.

1. Ensure that the DC power supply is not powered on or connected to its DC power supply source.
2. Position the power supply between two guides, making sure that the groove at the bottom of the power supply aligns with the guide underneath it (see Figure 3-3).
3. Slide the DC power supply all the way into the slot, firmly but gently pressing to ensure that the pins on the back of the power supply are completely seated in the backplane.
4. Using a straight-blade screwdriver, turn the screw on the power supply's front panel clockwise 180 degrees to lock the power supply into the chassis.

.

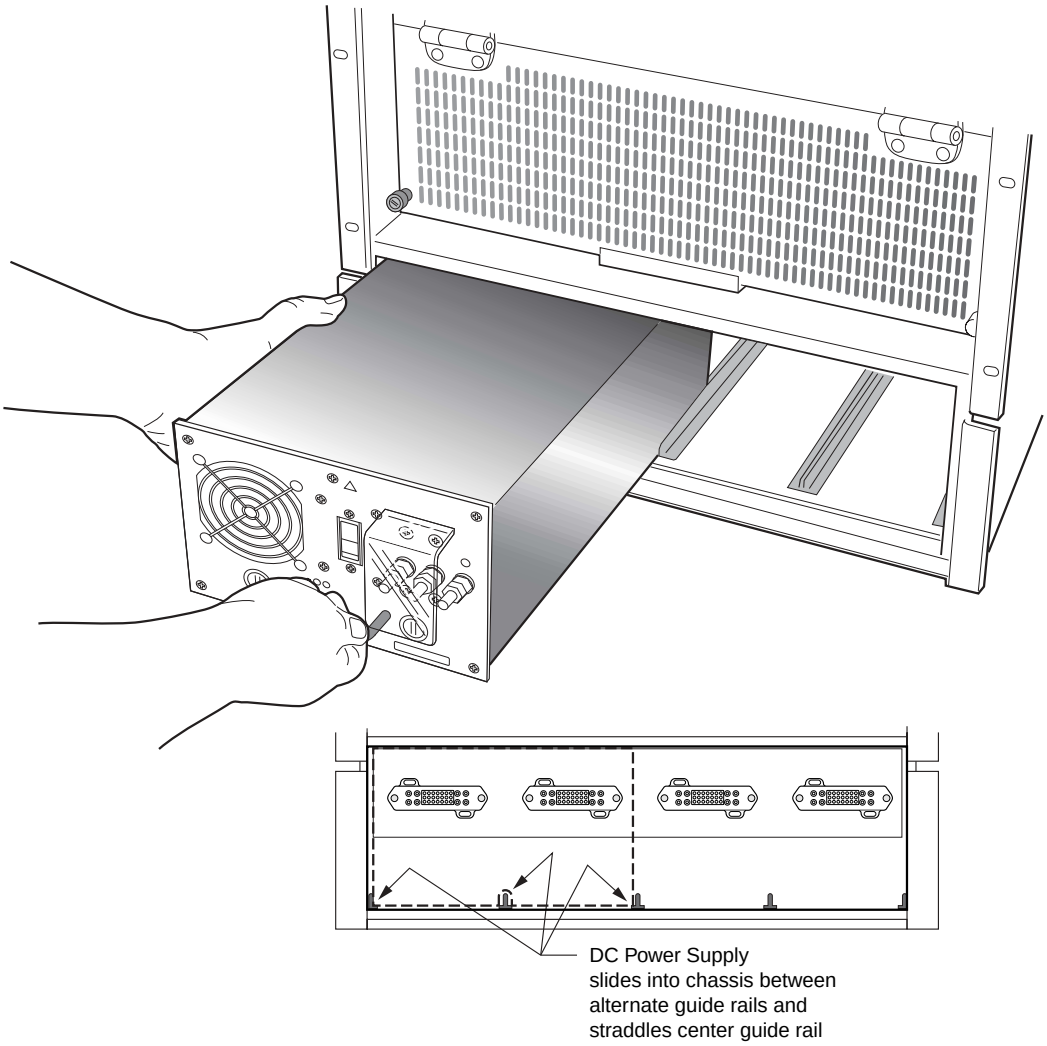


Figure 3-3 Installing a DC power supply

5. Attach wires to the terminals on the front of the unit. To attach a wire, remove the terminal nut, place the cable's wiring lug over the terminal stud, replace and tighten the terminal nut.
6. Connect the safety ground wire to a reliable earth ground.
7. Connect the DC input wiring to the DC power source.

Note If power to the DC power supply is connected incorrectly (reversed), the power supply emits an audible alarm.

For safety, observe all of the following conditions for DC power connections.

:

Table 3-3 DC power safety conditions

All power connection wiring should conform to the rules and regulations in the National Electrical Code (NEC), as well as any local codes.
Each DC-input power supply connection is rated at 60A maximum. A dedicated, commensurately-rated DC power source is required for each power entry module connection.
For DC power cables, Riverstone recommends that you use commensurately rated, high-strand-count copper wire cable. Connection to the DC-input power supply requires one earth ground cable for the power supply and two cable leads (a DC source and a DC return) for each power supply. The length of the cables depends on your RS 38000 location. These cables are not available from Riverstone. They are available from any commercial cable vendor.
DC power cables must be terminated by cable lugs at the power supply end. The lugs should be able to fit over 1/4-20 terminal studs.
The source of power for the DC power supplies must be a reliably grounded SELV source.
Branch circuit overcurrent protection must be rated a maximum of 60A.
A readily accessible disconnect device that is suitably approved and rated should be incorporated in the field wiring.

Table 3-4 DC power supply environmental specifications

Specification	**Measurement**
Operating Temperature	+5° to +40°C (41° to 104°F)
Non-operating Temperature	-30° to +73°C (-22° to 164°F)
Operating Humidity	15% to 90% (non-condensing)

3.3.5 Installing a Redundant Switch Fabric Module

On the RS 38000, the primary Switch Fabric module is installed in the chassis at the factory. If ordered, an optional redundant Switch Fabric module is shipped separately from the RS 38000 chassis.

To install a Switch Fabric module perform the following steps:

1. Open the Switch Fabric door, as shown in Figure 3-4.

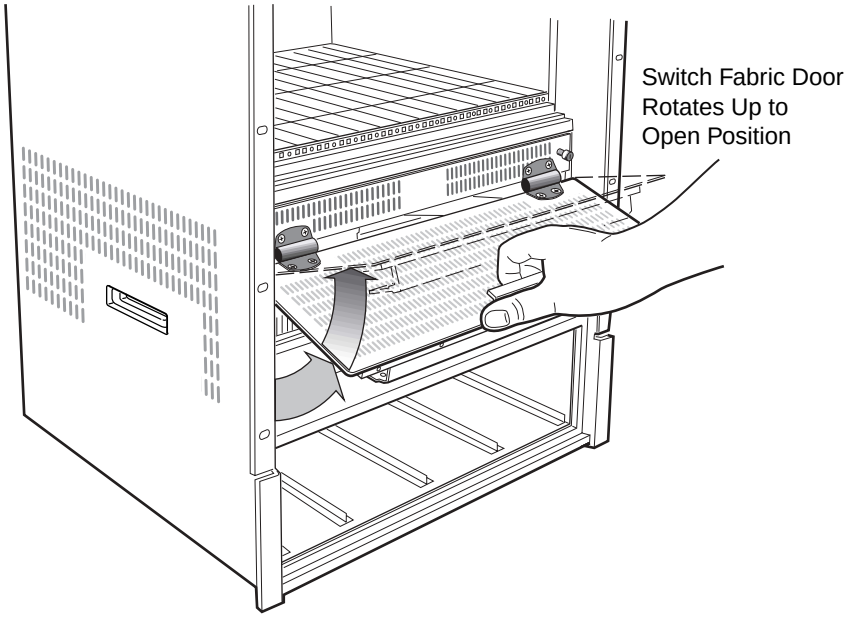


Figure 3-4 Opening the Switch Fabric door

2. Open the ejectors on both sides of the Switch Fabric module you are installing.
3. Position the Switch Fabric module into the available slot.
4. Slide the Switch Fabric module all the way into the slot, firmly but gently pressing to ensure that the pins on the back of the module are completely seated in the backplane.
5. To lock the module into the slot, close the ejectors.

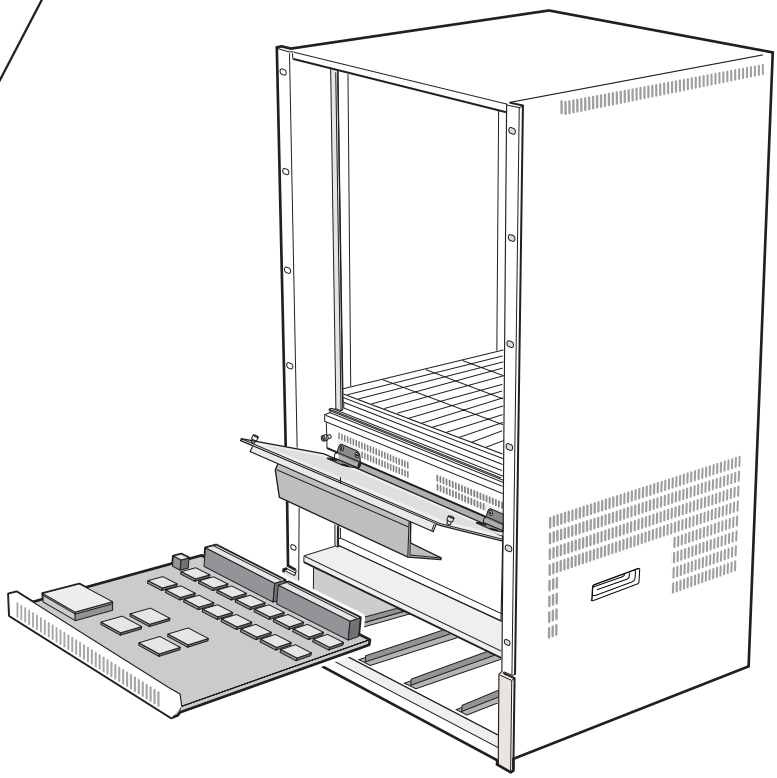


Figure 3-5 Installing a redundant Switch Fabric module on the RS 38000Switch Fabric Module(1 of 2)

To install the Control Module preform the following steps:

1. If a cover plate is installed in the Control Module slot (slot number CM/8 or CM/9), remove the cover plate: loosen the screws on the ejectors until the screws pop out, then open the ejectors and pull out the plate.
2. Open the ejectors at the top and bottom of the Control Module.
3. Align the backsheet of the Control Module with the card guides at the top and the bottom of the slot opening, as shown in Figure 3-6.

Note Make sure that the backsheet (metal plate) of the Control Module and not the circuit card is between the card guides. Check both the upper and lower tracks.

4. Slide the Control Module all the way into the slot, firmly but gently pressing to ensure that the pins on the back of the Control Module are completely seated in the backplane.
5. To lock the Control Module into the slot, close the ejectors. Using a straight-blade screwdriver, tighten the screw on each ejector.
6. When you are ready to attach the management cables to the Control Module, use the procedures in *"Attaching the Control Module Management Cables."*

Installing PC Flash Cards in the Control Module

The Control Module 16 megabyte PC flash card contains the system image software.

To install the PC flash card into the Control Module, perform the following steps:

1. Make sure the power is off on the RS 38000. You cannot install or remove a PC card while the RS 38000 is running.
2. Insert the PC card into either of the slots on the Control Module. You can choose either slot.

Note The RS 38000 supports the use of dual PC cards, one in slot0, the other in slot1. Each PC card is treated as an independent file system by the RS 38000. For detailed information regarding the PC flash file system and the management of configuration files, see the "*Riverstone RS Switch Router User Guide*."

3. Lock the PC card into the slot by pushing the PC card all the way into the slot (see Figure 3-7).

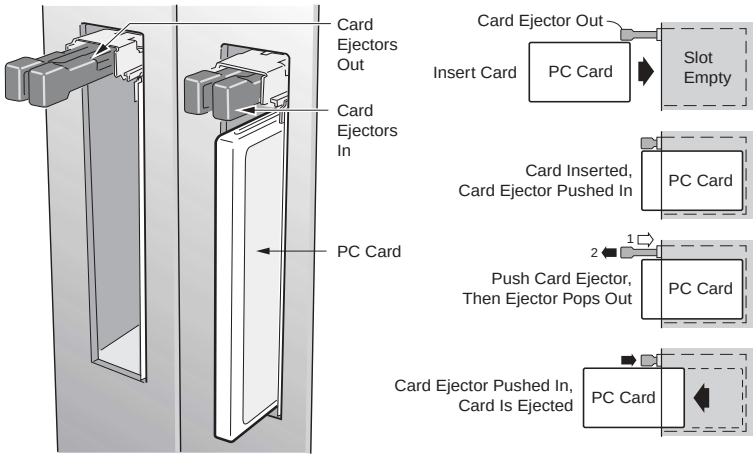


Figure 3-7 Installing PC flash memory card

Note If the message "**SYS-E-NOFLASHCARD**" appears while booting the RS 38000, the system has not detected a PC card. If this occurs, ensure that the PC card is properly inserted, then reboot. If the system still does not recognize the card, contact Riverstone Networks, Inc. technical support.

Attaching the Control Module Management Cables

The Control Module has two ports for attaching management devices to the RS 38000.

- A male DB-9 DCE port for direct serial connection from a terminal or PC running terminal emulation software. Use this port to perform basic setup, including setting up the RS 38000 for management through the Control Module's RJ-45 Ethernet port.
- An RJ-45 10/100Base-T DTE port for Telnet connection from a host on the network. The port is configured for Media Data Interface (MDI). You use this port to manage the RS 38000 using a Telnet session or SNMP-based management software.

4. Slide the line card all the way into the slot, firmly but gently pressing the line card in place to ensure that the pins on the back of the line card are completely seated in the backplane.
5. To lock the line card into the slot, close the ejectors. Using a straight-blade screwdriver, tighten the screw on each ejector.
6. Repeat the above steps for the remaining line cards.

3.3.8 Installing GBIC Modules into GBIC Line Cards

GBIC line cards support either four or eight sockets for installing GBIC modules. One GBIC module can be installed into each available socket.

Figure 3-9 shows an example of a GBIC module. The procedure following the figure describes how to install the module into the GBIC line card.

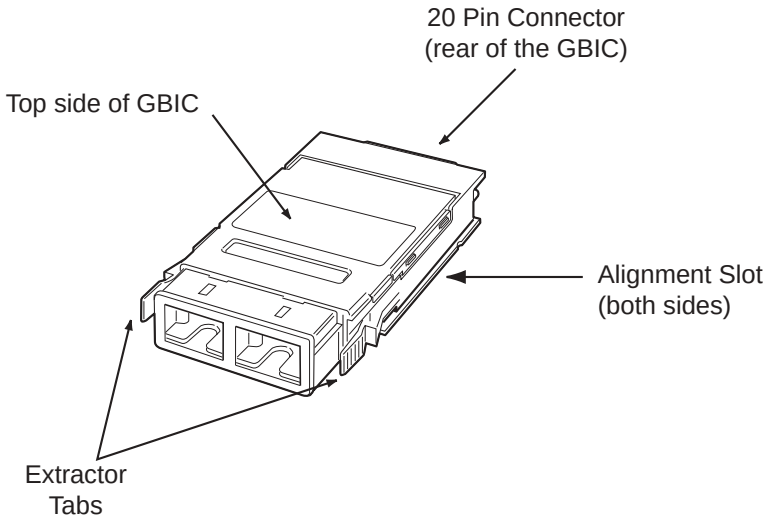


Figure 3-9 GBIC module

To install a GBIC module into a GBIC line card perform the following steps:

1. Hold the GBIC module by the edges with the network port facing away from the line card, and position the GBIC module so that it is parallel with the slot door. The 20-pin connector should be facing toward the empty GBIC slot of the line card, see Figure 3-10.

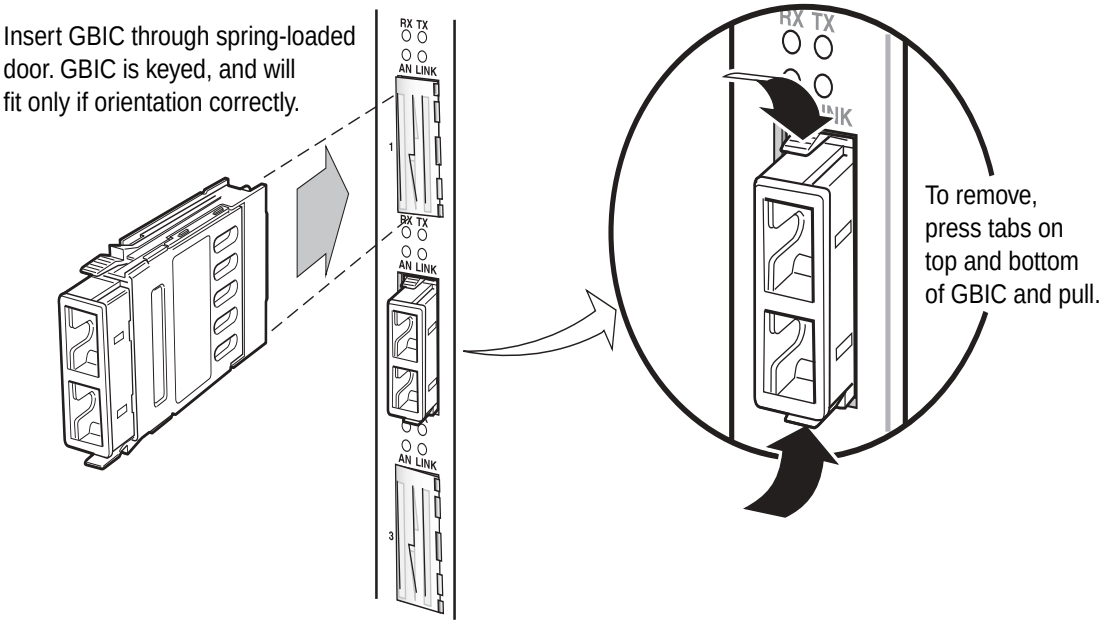


Figure 3-10 Inserting a GBIC module

2. Gently insert the GBIC module into the GBIC slot opening. The GBIC door on the line card folds in, and the internal guides engage the alignment slots on the sides of the GBIC module.

Warning If the GBIC module does not go in easily, do not force it. If the GBIC is not oriented properly, it will stop about one quarter of the way into the slot and should not be forced any further. Remove and reorient the GBIC module so that it slides easily into the slot.

3. Push the GBIC module in until the connector engages the 20-pin port. The GBIC is now installed.

3.3.9 Installing ATM Physical Media Cards (PHYs)

The ATM multi-rate line card has four option slots available for Physical Layer (PHY) interface cards. One PHY card can be installed into each available slot. You will need a #2 Phillips-head screwdriver to perform this procedure.

1. Use the #2 Phillips-head screwdriver to loosen the two captive screws that hold the option slot cover plate in place.

2. Save the option slot cover plate.

3. Insert the PHY card through the opening of the slot, and align the sides of the PHY card with the guides in the option slot.

4. Push the PHY card through the front of the line card until the 96-pin connector is firmly seated in the connector at the back of the option slot.

5. Fasten the PHY card to the front of the ATM line card with the two captive screws. Torque to 5 in-lb (0.56 N-m).

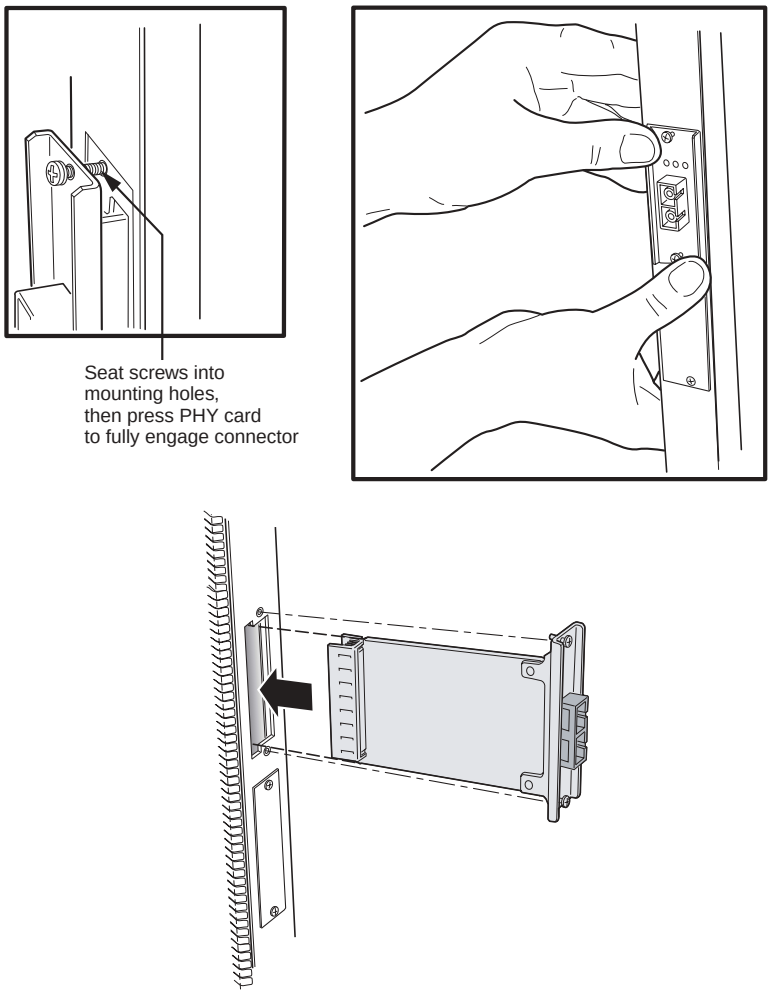


Figure 3-11 Installing an ATM PHY card

3.3.10 Installing OC-12 SFP Transceivers

Warning If the SFP transceiver does not go in easily, do not force it. If the transceiver is not oriented properly, it will stop about one quarter of the way into the slot. Remove and reorient the transceiver so that it slides easily into the slot.

Advertencia Si un factor Enchufable de Forma Pequeña (SPF) transceptor no entra fácilmente, no lo force. Si el transceptor no está orientado apropiadamente, se detendrá apróximadamente a un cuarto de la entrada de la ranura, Remuévalo y reoriente el transceptor para que se deslice fácilmente en la ranura.

OC-12 SFP transceivers vary slightly among manufacturers, but the insertion process is virtually the same for all. To install an SFP transceiver in either the Gigabit Ethernet line card or the Gigabit Ethernet Control Module:

1. Orient a transceiver as shown in Figure 3-12. Note that the multi-pin PCB connector is on the left-hand side of the SFP.

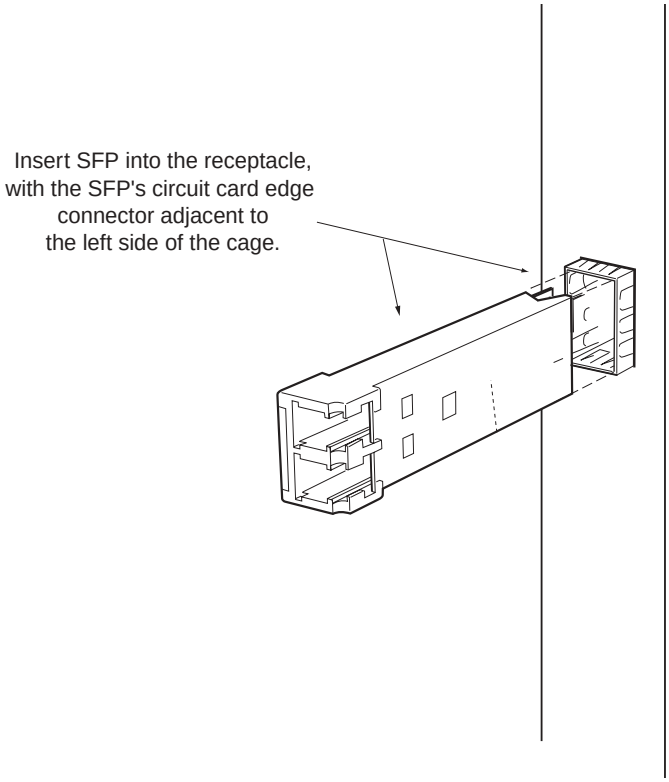


Figure 3-12 Installing SFP transceivers

2. Insert the transceiver into the receptacle until it locks into position. Leave the dust plug in the transceiver until you are ready to attach a fiber cable. Clean the optic surfaces of the fiber cable prior to plugging it into the optical bores of the SFP transceiver.

Warning Keep the dust plug in an SFP transceiver when there is no fiber cable plugged in. The optics will not work properly when obstructed with dust or contaminants.

Advertencia Mantenga el enchufe de polvo en un transceptor SPF cuando no haya cable de fibra enchufado. Los ópticos no servirán apropiadamente cuando son obstruídos por polvo o contaminantes.

3.3.11 Extracting SFP Transceivers

The extraction process varies among different SFP transceivers. We have illustrated and documented several examples in this section. It is likely that your transceiver is similar to one of the examples. The transceiver removal process is essentially to disengage the unit from its port via the extraction mechanism, then pull the unit straight out of the receptacle.

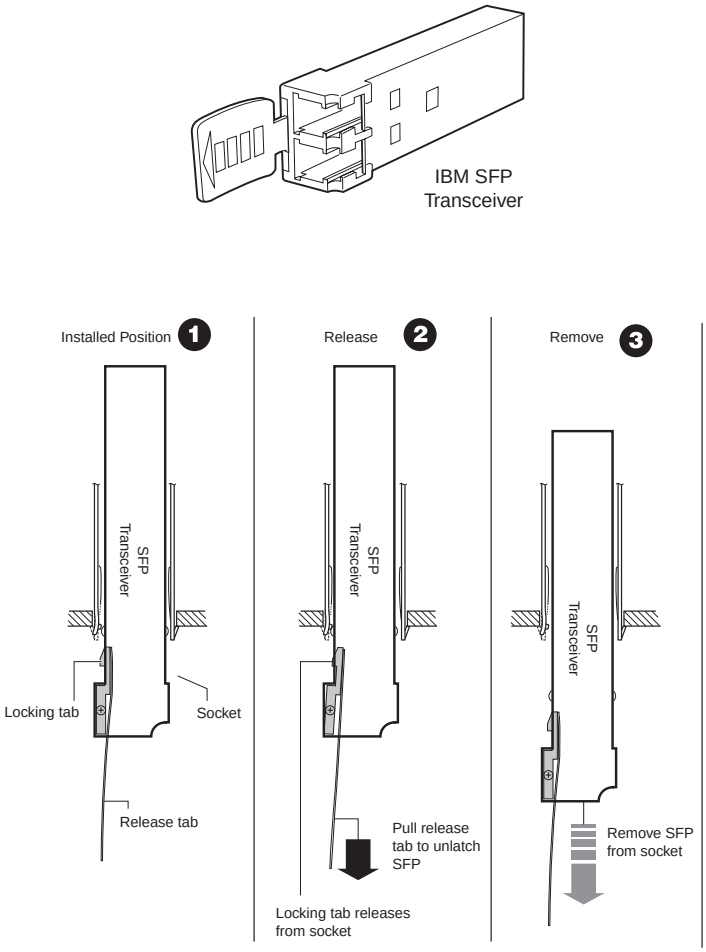


Figure 3-13 Extracting an IBM SFP transceiver

To extract an IBM SFP transceiver:

1. Remove the fiber cable from the target SFP transceiver.

2. Grasp the extraction tab between the thumb and forefinger and pull the tab straight outwards until the transceiver is fully extracted from the guide cage (refer to Figure 3-13).
3. If the transceiver is not defective (disposable), protect it by inserting a dust plug.

Warning When extracting an IBM SFP transceiver, pull straight outwards so that the unit leaves the receptacle in a parallel motion. Do not twist or pull on the tab at any angle that does not allow this straight, parallel motion.

Advertencia Cuando esté extrayendo un transceptor IBM SFP, jale directamente hacia afuera para que la unidad abandone el receptáculo con un movimiento paralelo. No jale o tuerza la lengüeta en ningun ángulo que no le permita este movimiento derecho y paralelo.

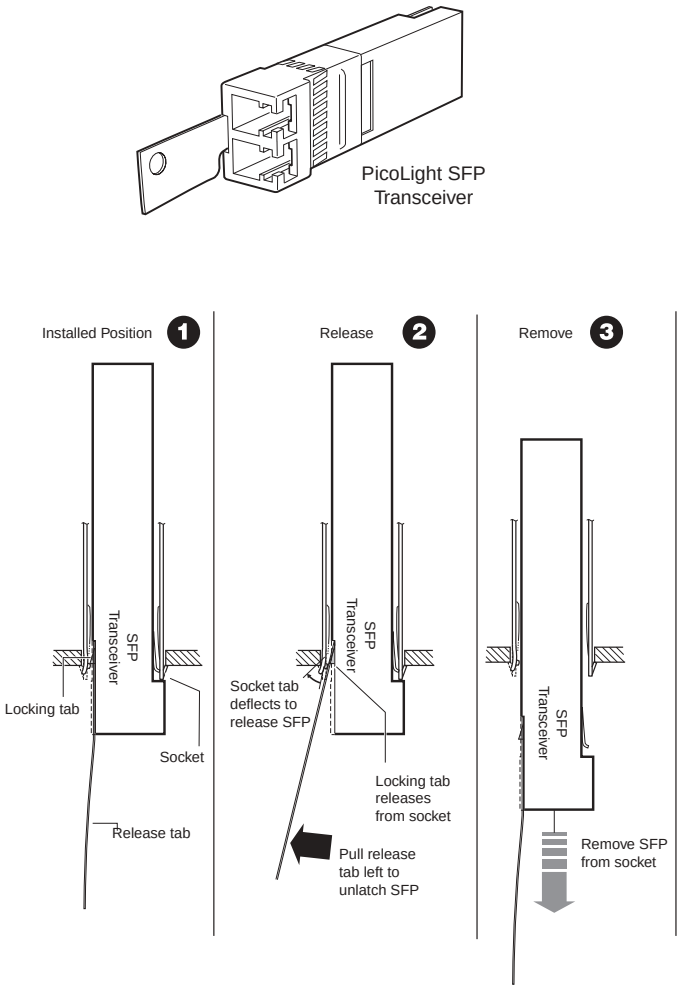


Figure 3-14 Extracting a PicoLight SFP transceiver

To extract a PicoLight SFP transceiver:

1. Remove the fiber cable from the target SFP transceiver.
2. Grasp the extraction tab between the thumb and forefinger and pull the tab to the left until the transceiver is unlatched from its port, then pull the unit straight out of the guide cage (refer to Figure 3-14).
3. If the transceiver is not defective (disposable), protect it by inserting a dust plug.

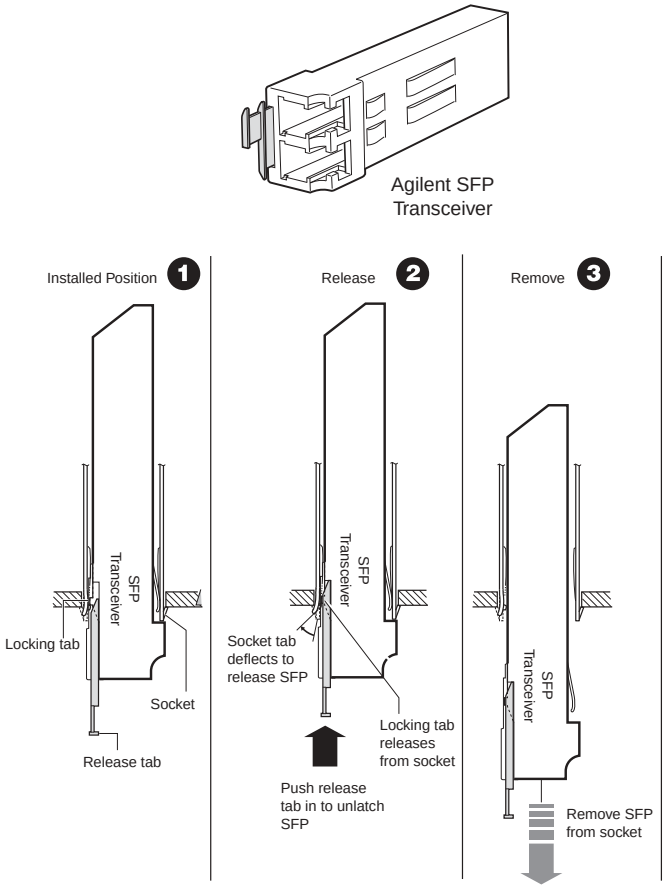


Figure 3-15 Extracting an Agilent SFP transceiver

To extract an Agilent SFP transceiver:

1. Remove the fiber cable from the target SFP transceiver.
2. Push the release tab to unlatch the transceiver then pull the unit straight out of the receptacle (refer to Figure 3-15).
3. If the transceiver is not defective (disposable), protect it by inserting a dust plug.

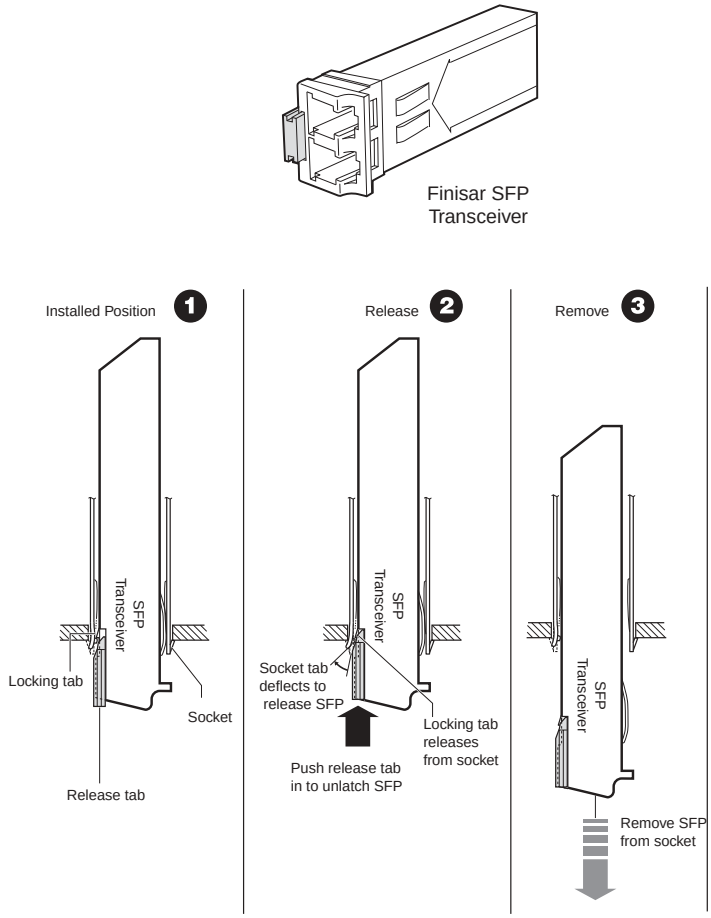


Figure 3-16 Extracting a Finisar SFP transceiver

To extract a Finisar SFP transceiver:

1. Remove the fiber cable from the target SFP transceiver.
2. Push the release tab to unlatch the transceiver then pull the unit straight out of the receptacle (refer to Figure 3-16).
3. If the transceiver is not defective (disposable), protect it by inserting a dust plug.

3.3.12 Attaching the Segment Cables

With your RS 38000 installed and connected to a management console, you are now ready to attach the RS 38000's line cards to your network. The RS 38000 uses industry standard copper and fiber cables and connectors. For information regarding required connector types, cable types, and pin-out assignments, see the tables associated with each line card in Chapter 2, *"Introduction."*

Proceed to Chapter 4, *"Initial Configuration"* for instructions about powering on the RS 38000 and performing initial configuration.

4 INITIAL CONFIGURATION

This chapter provides the following information on powering up the RS 38000 and performing basic setup procedures. Basic setup includes:

- Powering on the RS 38000 and booting the software
- Starting the Command Line Interface (CLI)
- Activating and saving configuration changes
- Assigning passwords
- Using the CLI to add an IP interface, subnet mask, and default gateway
- Setting up SNMP
- Assigning a DNS server(s) to the RS 38000
- Configuring the SYSLOG server and server message levels

4.1 POWERING ON THE RS 38000

To power on the RS 38000 perform the following steps:

1. Make sure all exposed line card slots and power supply bays are free of foreign objects such as tools and are covered with blanks.
2. Check the power supplies to make sure they are attached to your power source.
3. Make sure that the RS 38000's DB-9 console port is connected to an active terminal or a PC running terminal emulation software.
4. Turn the switch on each power supply to the ON position.

   If this is the first time you have powered on the RS 38000, it will automatically boot using the software image on the PC flash card. While the software is booting, the amber Offline LED on the Control Module is lit. When the software finishes booting, the Offline LED goes dark and the green Online LED lights up, indicating that the Rapid Operating System (ROS) software is online.

   As the software boots, the management terminal or PC attached to the Control Module's DB-9 DCE port displays messages related to the phases of the boot sequence.

   Here is a partial example:

```
Boot Software Version 2.0.1.1, Built Jan 25 2001 20:55:16

Processor: R7000 rev 2.1 [0x2721], 280 MHz, (bus: 93 MHz), 256 MB DRAM

I-Cache 16 KB, linesize 32. D-Cache 16 KB, linesize 32.
```

```
L2-Cache 256 KB, linesize 32, cache enabled.

Mounting 16MB external flash card . . . Done
Autoboot in 2 seconds - press ESC to abort and enter prom

using link: bootsource
link pointed at file:/pc-flash/boot/ros80/
source: file:/pc-flash/boot/ros80/
  Loaded version file
 Loading kernel (base 0x80001000, size 50592)
(base 0x8000d5a0, size 2803976)
  100% -  Image checksum validated
------------------------------------------------------------------------
RS 38000 System Software, Version 8.0.0.0
Copyright (c) 2000, Riverstone Networks
Processor: R7000, Rev 2.1, 280 MHz
System started on 2001-09-01 18:57:40
------------------------------------------------------------------------
2001-09-01 18:57:45 %SYS-I-FLASHCRD, Mounting 16MB Flash card
2001-09-01 18:57:53 %SYS-I-FLASHMNTD, 16MB Flash card mounted
2001-09-01 18:57:53 %SYS-I-INITSYS, initializing system RS 38000
2001-09-01 18:57:53 %SYS-I-DSCVMOD, discovered 'Control Module' module in slot CM/8
2001-09-01 18:57:58 %SYS-I-INITSLOTS, Initializing system slots - please wait
2001-09-01 18:58:07 %SYS-I-MODPROBE, Detecting installed media modules - please wait
2001-09-01 18:58:10 %SYS-I-DSCVMOD, discovered '8-Gigabit "T" (GBIC)' module in slot 3...
```

5. When the software is fully booted, the following messages appears on the management console:

```
Press RETURN to activate console...
```

6. As prompted, press Return (or Enter) to activate the Command Line Interface (CLI) on the console.

Note If the message "**SYS-E-NOFLASHCARD**" appears while booting the RS 38000, the system has not detected a PC card. If this occurs, ensure that the PC card is properly inserted, then reboot. If the system still does not recognize the card, contact Riverstone Networks, Inc. technical support.

4.2 STARTING THE COMMAND LINE INTERFACE

To start the Command Line Interface (CLI), power on the system, as described in Section 4.1, *"Powering on the RS 38000."* After the software is fully booted, press Return (or Enter) to activate the CLI. If prompted for a password, simply press Return; the factory default passwords for all access levels is blank.

4.2.1 CLI Access Modes

The CLI has four levels of access, each of which provides the ability to perform specific operations on the RS 38000 (see Table 4-1).

Table 4-1 CLI access modes

Access Mode	Description
User	Allows you to display basic information and use basic utilities such as ping but does not allow you to display SNMP, filter, and access control list information or make other configuration changes. You are in User mode when the command prompt ends with the "**>**"character.
Enable	Allows you to display SNMP, filter, and access control information, as well as all the information you can display in User mode. To enter Enable mode, enter the **enable** command, then supply the password when prompted. When you are in Enable mode, the command prompt ends with the "**#**" character.
Configure	Allows you to make configuration changes. To enter Configure mode, first enter Enable mode (**enable** command), then enter the **configure** command. When you are in Configure mode, the command prompt ends with "**(config)**."
Boot	This mode appears when the external PC card or the system image is not found during bootup. Enter the **reboot** command to reset the RS 38000. If the RS still fails to boot, contact Riverstone Networks, Inc. technical support. Certain tasks can be performed only from Boot mode. To enter the Boot mode intentionally, boot the RS 38000, and then interrupted the normal bootup sequence by pressing the "Esc" key. When you are in Boot mode, the command prompt is "**rs-boot>**."

Note The command prompt will show the name of the router in front of the mode character(s). The default name is "rs." The procedure in Section 4.4, *"Setting the Basic System Information"* describes how to change the system name.

When you are in Configure or Enable mode, use the **exit** command or press Ctrl+z to exit to the previous access mode.

4.2.2 Basic Line Editing Commands

The CLI supports Emacs-like line editing commands. The following table lists some commonly used commands. For a complete set of commands, see the *Riverstone RS Switch Router Command Line Interface Reference Manual*.

Table 4-2 Common CLI line editing commands

Key sequence	Command
Ctrl+a	Move cursor to beginning of line
Ctrl+b	Move cursor back one character
Ctrl+d	Delete character
Ctrl+e	Move cursor to end of line
Ctrl+f	Move cursor forward one character
Ctrl+n	Scroll to next command in command history (use the **`cli show history`** command to display the history)
Ctrl+p	Scroll to previous command in command history
Ctrl+u	Erase entire line
Ctrl+x	Erase from cursor to end of line
Ctrl+z	Exit current access mode to previous access mode

4.3 CONFIGURATION CHANGES AND SAVING THE CONFIGURATION FILE

The RS 38000 uses three special configuration files:

Table 4-3 Configuration file contents

File	Descriptions
Scratchpad	The configuration commands you have entered during a management session. These commands do not become active until you explicitly activate them. Because some commands depend on other commands for successful execution, the RS 38000 scratchpad simplifies system configuration by allowing you to enter configuration commands in any order, even when dependencies exist. When you activate the commands in the scratchpad, the RS 38000 sorts out the dependencies and executes the commands in their proper sequence.
Active	The commands from the Startup configuration file and any configuration commands that you have made active from the scratchpad.
Startup	The configuration file that the RS 38000 uses to configure itself when the system is powered on.

Caution The active configuration remains in effect only during the current power cycle. If you power off or reboot the router without saving the active configuration changes to the Startup configuration file, the changes are lost.

4.3.1 Activating the Configuration Commands in the Scratchpad

Use the following procedure to activate the configuration commands in the scratchpad.

1. Ensure that you are in Enable mode by entering the **`enable`** command in the CLI.
2. Ensure that you are in Configure mode by entering the **`configure`** command in the CLI.
3. Enter the following command:

```
save active
```

The CLI displays the following message:

```
Do you want to make the changes Active? [y]
```

4. Enter **`y`** to activate the changes.

Note If you exit the Configure mode (by entering the **exit** command or pressing Ctrl+z), the CLI will ask you whether you want to make active the changes in the scratchpad. If you do not make the changes in the scratchpad active, the changes will be lost when you log out.

4.3.2 Saving the Active Configuration to the Startup Configuration File

Use the following procedure to save Active configuration changes into the Startup configuration file so that the RS 38000 remembers and uses the changes when you reboot the software.

1. Enter the following command from Configure mode:

```
rs(config)# save startup
```

2. When the CLI displays the following message, enter **y** to save the changes:

```
Are you sure you want to overwrite the Startup configuration [no]? y
%CONFIG-I-SAVED, configuration saved to Startup configuration.
rs(config)#
```

Alternately, to save the Active configuration to the Startup configuration from Enable mode, perform the following steps

1. Ensure that you are in Enable mode by entering the **enable** command in the CLI.
2. Enter the following command to copy the Active configuration to the Startup configuration:

```
copy active to startup
```

3. When the CLI displays the following message, enter **yes** to save the changes.

```
Are you sure you want to overwrite the Startup configuration? [n]
```

The new configuration changes are added to the Startup configuration file located in the Control Module's boot flash.

4.3.3 Viewing the Current Configuration

To view the current configuration:

1. Ensure that you are in Enable mode by entering the **enable** command.
2. Enter the following command to display the status of each command line:

```
system show active-config
```

Note Remember that the Active configuration contains both the Startup configuration and any configuration changes that you've made active in the current configuration session.

The CLI displays the Active configuration file with the following possible annotations:

- Commands without errors are displayed without any annotation.
- Commands with errors are annotated with an "**E:**."
- If a particular command has been applied such that it can be expanded on additional interfaces/line cards, it is annotated with a "**P:**." For example, if you enable STP on all ports on the RS 38000, but the RS 38000 contains only one line card, the configuration lines that enable STP will be applied to all ports on all other line cards as they are added to the system.

A command like **stp enable et.*.*** would be displayed as follows:

```
P: stp enable et.*.*
```

If you update the configuration file to state specifically which Ethernet ports STP is enabled on, the "**P:**" annotation in the above command line would disappear.

4.4 SETTING THE BASIC SYSTEM INFORMATION

Follow the procedures in this section to set the following system information:

- System time and date
- System name
- System location
- Contact name (the person to contact regarding this router)
- IP address for the management port on the Control Module

Note Some of the commands in this procedure accept a string value. String values can be up to a maximum of 255 characters in length including blank spaces. Surround strings that contain blanks with quotation marks (for example: **"string with internal blanks"**).

1. Enter the **enable** command to get to Enable mode in the CLI.
2. Enter the following commands to set the system time and date and to verify your settings.

```
system set date year <number> month <month-name> day <day> hour <hour> minute <minute> second
<second>

system show date
```

Here is an example:

```
rs# system set date year 2003 month march day 27 hour 11 minute 54
second 0
Time changed to: Mon Mar 27 11:54:00 2003
rs# system show date
Current time: Mon Mar 27 11:54:04 2003
```

3. Enter the **configure** command to get to Configure mode in the CLI. The following commands can be entered only from Configure mode.
4. Enter the following commands to set the system name, location, and contact information:

```
system set name <string>
system set location <string>
system set contact <string>
```

Here is an example:

```
rs(config)# system set name rs
rs(config)# system set location "Houston, TX"
rs(config)# system set contact "John Smith"
```

5. Use the **interface add ip** command to set the IP address and netmask for the en0 Ethernet interface. The en0 Ethernet interface is used by the management port on the Control Module.

   Here is an example:

```
rs(config)# interface add ip en0 address-netmask 16.50.11.22/16
```

Note The en0 interface is automatically created by the system and is reserved for the management port on the Control Module.

6. To activate the system commands entered in the previous steps, use the following command:

```
save active
```

   The CLI displays the following message:

```
Do you want to make the changes Active? [y]
```

7. Enter "**y**" to activate the changes.
8. To display the Active configuration, exit the Configuration mode, then enter the following command:

```
system show active-config
```

   Here is an example:

```
rs# system show active-config
Running system configuration:
     !
     ! Last modified from Console on Mon Jan 25 11:55:35 2001
     !
 1 : system set name "rs"
 2 : system set location "Houston, TX"
 3 : system set contact "John Smith"
```

9. Save the Active configuration to the Startup configuration file using the following command:

```
copy active to startup
```

10. When the CLI displays the following message, enter **y** to save the changes to the Startup configuration file:

```
Are you sure you want to overwrite the Startup configuration [no]? y
%CONFIG-I-WRITTEN, file copied successfully
rs#
```

4.5 SETTING UP PASSWORDS

You can password-protect CLI access to the RS 38000 by setting up passwords for User mode access, Enable mode access, and Diag mode access. Users who have a User password but not an Enable password can use only the commands available in User mode. Users with an Enable password can use commands available in the Enable and Configure modes, as well as the commands in User mode.

In addition, you can set up the RS 38000 for TACACS, TACACS+, and/or RADIUS authentication by a TACACS or RADIUS server. Procedures for configuring the router for TACACS and RADIUS can be found in the *Riverstone Networks RS Switch Router User Guide*.

To add password protection to the CLI, use the following procedure.

1. Ensure that you are in Enable mode by entering the **`enable`** command in the CLI.
2. Ensure that you are in Configure mode by entering the **`configure`** command in the CLI.
3. Type the following command for each password you want to set:

```
system set password login|enable|diag <string>|none
```

4. Use the **`show`** command to examine the commands you just entered.
5. Use the **`save active`** command to activate the commands.
6. Exit the Configuration mode, then use the **`system show active-config`** command to verify the active changes.

Here is an example of the commands in the previous steps:

```
rs(config)# system set password login demo
rs(config)# system set password enable killer
rs(config)# system set password diag trouble
rs(config)# save active
rs# exit
rs# system show active-config

Running system configuration:
!
! Last modified from Console on Mon Mar 27 12:12:19 2003
!
 1 : system set name "rs"
 2 : system set location "Houston, TX"
 3 : system set contact "John Smith"
 4 : system set hashed-password login jNIssH c976b667e681d03ccd5fc527f219351a
 5 : system set hashed-password enable zcGzbO 5d1f73d2d478ceaa062a0b5e0168f46a
 6 : system set hashed-password diag jdfbyp 67e681d3d2d478cf21935a0b5e016f2193
```

Notice that the passwords are shown in the Active configuration in an encrypted format. Passwords also appear this way in the Startup configuration. To keep your passwords secure, the router does not have a command for displaying passwords in an unencrypted format.

Caution Test all new passwords before saving the active configuration to the Startup configuration file.

4.5.1 If You Forget Your Passwords

If you forget your passwords follow the procedure below to regain access to your RS 38000.

Note To perform this procedure, you must use a terminal or PC running terminal emulation software that is connected directly to the RS 38000 through its DB-9 console port.

1. Power cycle the RS 38000.
2. Enter Boot mode by interrupting the normal boot-cycle by pressing the “Esc” key.
3. From the boot prompt enter the **`set`** command and note the image name displayed for **`bootsource`**. For example:

```
...
mfg_loop_by = time        [time count]
mfg_loop_max = 86400
 bootdelay = 2
  autoboot = boot
promsetaddrs = 1
   netaddr = 134.152.179.132
  bootaddr = 0.0.0.0
   netmask = 255.255.255.224
   gateway = 134.152.179.129
bootsource = /pc-flash/boot/ros80       <This is the image name for this example>
   ethaddr = 00:00:1d:12:34:56
     sysid = -1
rs-boot>
```

4. Enter the following line to reboot the RS 38000:

```
boot <image name> skipconfig=yes
```

Here is an example:

```
rs-boot> boot /pc-flash/boot/ros80 skipconfig=yes
```

5. When the RS 38000 finishes booting, enter the following commands (when prompted, answer **yes**):

```
rs> enable
rs# copy startup to scratchpad
rs# config
rs(config)# system set password login none
rs(config)# system set password enable none
rs(config)# system set password diag none
rs(config)# save startup
Are you sure you want to overwrite the Startup configuration [no]? yes

There are non-committed configuration changes. Do you want to make
these changes active and then save everything to Startup [yes]? yes

%CONFIG-I-SAVED, 2001-09-02 21:53:54 %GATED-I-RECONFIGDONE, Routing
configuration changes completed (pid 0x809eab20).
configuration saved to Startup configuration.
rs(config)#
```

6. The User, Enable, and DIag access mode passwords are now reset to the default “blank” values.

7. Enter new passwords for the User, Enable, and Diag access modes.

4.6 SETTING UP SNMP

To use SNMP to manage the RS 38000, you need to set up an SNMP community and specify the IP address of the target host for SNMP traps. Otherwise, the RS 38000's SNMP agent runs in local trap process mode, unless disabled using the **snmp stop** command.

For additional information about configuring SNMP, see the *Riverstone Networks RS Switch Router User Guide.*

4.6.1 Setting the Community string

Use the following procedure to add the SNMP community string, specify the target host for traps, and the trap interface.

1. Ensure that you are in Enable mode by entering the **enable** command in the CLI.
2. Ensure that you are in Configure mode by entering the **configure** command in the CLI.
3. Use the following commands to add an SNMP community string and set a target host IP address for the traps:

```
rs(config)#snmp set community <community-name> privilege read|read-write
rs(config)#snmp set target <IP-addr> community <community-name> status enable|disable
```

Note If the IP address of the trap target is more than one hop away from the RS 38000, configure the RS with a static route to the target. If the RS 38000 is rebooted, the static route allows a cold start trap to be sent to the trap target. Without a static route, the cold-start trap is lost while the routing protocols are converging.

4. Use the **save startup** command to activate the commands entered in the previous steps.

   Here is an example of the commands and output for configuring SNMP and saving the changes.

```
rs# config

rs(config)# snmp set community public privilege read-write

rs(config)# snmp set target 16.50.11.12 community public status enable

rs(config)# save startup
Are you sure you want to overwrite the Startup configuration [no]? yes

There are non-committed configuration changes. Do you want to make
these changes active and then save everything to Startup [yes]? yes

%CONFIG-I-SAVED, 2001-09-02 21:53:54 %GATED-I-RECONFIGDONE, Routing
configuration changes completed (pid 0x809eab20).
configuration saved to Startup configuration.
rs(config)#
```

By default, SNMP information is sent and received on the Control Module's en0 Ethernet port. If you want SNMP to use a different port on the RS 38000, use the following command.

```
snmp set trap-source <interface>|<IPaddr>
```

Here is an example:

```
rs(config)# snmp set trap-source 134.152.78.192
```

SNMP will now use the port with IP address 134.152.78.192. Remember, to make this change permanent, enter the **save startup** command.

4.6.2 Improving SNMP Security

SNMPv1 is not a secure protocol. Messages containing community strings are sent in plain text from manager application to agent. Anyone with a protocol decoder and access to the wire can capture, modify, and replay messages.

Applying ACLs to SNMP

When using SNMPv1, it is important to protect your RS 38000 by applying an Access Control List (ACL) to the SNMP agent to prevent unauthorized access and route your SNMP traffic through trusted networks only.

Here are the basic configuration commands to apply an ACL to the RS 38000's SNMP agent, allowing access to the RS 38000 by only one management station.

```
rs(config)# acl mgmt_only permit udp <IPaddr> any any any
rs(config)# acl mgmt_only apply service snmp
```

The above ACL applied to the SNMP service allows messages from source IP address *<IPaddr>* to be processed by the SNMP agent, packets form any other source IP address are dropped.

Disabling Authentication Traps

To provide additional security to the RS 38000, disable the sending of authentication traps. Authentication traps are sent when SNMP v1 packets are received with invalid community strings. A common security attack on an SNMP v1 agent is to send a message containing an invalid message, and then capture the authentication trap to learn the community string.

Here is an example of how to turn off the sending of authentication traps:

```
rs(config)#snmp disable trap authentication
```

For additional information about RS 38000 security and ACLs, see the *Riverstone Networks RS Switch Router User Guide.*

4.6.3 Supported MIBs

The following lists the MIBs that are supported by the RS 38000 SNMP agent.

Table 4-4 Supported MIBs

MIB II	Layer 1	Layer 2	Layer 3	System Related	Enterprise
IP-MIB RFC 2011	ETHERLIKE-MIB | RFC 2665	FRAME-RELAY-DTE-MIB | RFC 2115	BGP4-MIB RFC 1657	RADIUS-AUTH-CLIENT-MIB | RFC 2618	NOVELL-IPX-RIPSAP 2/94
TCP-MIB RFC 2012	SONET-MIB RFC 1595	BRIDGE-MIB RFC 1493	RIPv2-MIB RFC 1724	RADIUS-ACC-CLIENTMIB RFC 2620	NOVELL-IPX 10/94
UDP-MIB RFC 2013	DS0 MIB RFC 2494	Q-BRIDGE-MIB RFC 2674	OSPF-MIB RFC 1850	DISMAN-SCHEDULE-MIB RFC 2591	RIVERSTONE-STP-MIB 7/16/00
IP-FORWARD-MIB RFC 2096	DS1-MIB RFC 2495	P-BRIDGE-MIB RFC 2674	OSPF-TRAP-MIB | RFC 1850	ENTITY-MIB | RFC2737	RIVERSTONE-RS-AGENT-CAP-MIB
IF-MIB RFC 2233	DS3-MIB RFC 2496	PPP-LCP-MIB RFC 1471	RMON2-MIB RFC 2021	SNMPv3-MIB Modules| RFC 2570-2576	RIVERSTONE-ATM-MIB | 1/31/01
SNMPv2-MIB RFC 1907	DS0BUNDLE-MIB RFC 2494	PPP-SEC-MIB RFC 1472	VRRP-MIB RFC 2787	DIFF-SERV-MIB | Draft #5	RIVERSTONE-IMAGE-MIB | 3/16/01
	MAU MIB RFC 2668	PPP-IP-NCP-MIB RFC 1473	DVMRP-MIB Draft #4	PING-MIB RFC 2925	CISCO-BGP-POL-ACCOUNTING-MIB | 12/17/99
		PPP-BRIDGE-NCP-MIB RFC 1474	IGMP-MIB RFC 2933	TRACEROUTE-MIB RFC 2925	RIVERSTONE-LFAP-MIB | 6/15/01
		RMON-MIB RFC 1757	ISIS-MIB Draft #4	NOTIFICATION LOG-MIB RFC 3014	RIVERSTONE-RL-MIB | 10/10/02
		ATM-MIB RFC 2515	MPLS-LSR-MIB Draft #7	DHCP-SERVER-MIB Draft #7	RIVERSTONE-SNMP-MIB 12/4/00
		LAG MIB | 802.3ad			RIVERSTONE-NOTIFICATIONS-MIB 3/12/02
		ATM2-MIB Draft #17			CTRON-LFAP (deprecated) 8/28/99
					CTRON-SSR-POLICY (deprecated) 8/11/99
					CTRON-SSR-CONFIG 6/27/00
					CTRON-SSR-HARDWARE (deprecated) 6/27/00
					CTRON-SSR-SERVICE-STATUS (deprecated) 6/27/00
					CTRON-SSR-CAPACITY-MIB 6/27/00

	RIVERSTONE-INVENTORY-MIB 8/22/01
	RIVERSTONE-MPLS-MIB 5/24/02
	RIVERSTONE-QUEUE-MIB 6/12/02
	RIVERSTONE-VLAN-EXTENSION-MIB 8/5/02
	RIVERSTONE-PING-EXTENSIONS-MIB 10/9//02
	RIVERSTONE-TRACEROUTE-EXTENSIONS-MIB 10/11/02
	RIVERSTONE-IF-MIB 10/17/02
	RIVERSTONE-VLAN-EXTENSIONS-MIB 8/5/02
	CISCO-SRP-MIB 3/28/01
	RIVERSTONE-DHCP-MIB 9/10/02
	RIVERSTONE-CONFIG-MIB 11/30/02

4.7 SETTING THE DNS DOMAIN NAME AND ADDRESS

Associating a DNS name server with your RS 38000 allows you to use device names (rather than IP addresses) when entering certain commands. For example, you can use a device's name (which the DNS server knows) when using the **ping** command.

If you want the RS 38000 to access a DNS server, use the following procedure to specify the domain name and IP address for the DNS server.

1. Ensure that you are in Enable mode by entering the **enable** command in the CLI.
2. Use the **ping** command to verify that the RS 38000 can reach the DNS server.

   Here is an example:

```
rs# ping 16.50.11.12                          <IP address of the DNS server>
PING 16.50.11.12 (16.50.11.12): 56 data bytes
64 bytes from 16.50.11.12: icmp_seq=0 ttl=255 time=0 ms

--- 16.50.11.12 ping statistics ---


1 packets transmitted, 1 packets received, 0% packet loss
round-trip min/avg/max = 0/0/0 ms
```

3. Enter Configure mode by entering the **configure** command in the CLI.
4. Enter the following command to specify the domain name for which the DNS server(s) have authority:

```
system set dns domain <domain-name>
```

   For example: <*domain-name*> = **riverstone.com**
5. Enter the following command to add the DNS server to the RS 38000:

```
system set dns server <IP-addr>[,<IP-addr>[,<IP-addr>]]
```

   where <*IP-addr*> is the IP address of the DNS server(s). You can specify up to three DNS servers. Separate the server IP addresses with commas.
6. Enter the **save active** command to activate the commands and enter **yes** to activate the changes.

   Here is an example:

```
rs# config
rs(config)# system set dns domain "mktg.mrb.com"
rs(config)# system set dns server 16.50.11.12
rs(config)# save active
```

7. Exit Configure mode, then enter the **system show dns** command to verify the new DNS settings.

   Here is an example:

```
rs# system show dns
DNS domain: mrb.com, DNS server(s): 16.50.11.12
```

8. Use the **ping** command to verify that the RS can resolve the DNS server name into its IP address.

   Here is an example:

```
rs# ping rs
PING rs.mktg.mrb.com (16.50.11.22): 56 data bytes
64 bytes from 16.50.11.22: icmp_seq=0 ttl=255 time=0 ms

--- rs.mktg.mrb.com ping statistics ---
1 packets transmitted, 1 packets received, 0% packet loss
round-trip min/avg/max = 0/0/0 ms
```

4.8 SETTING THE SYSLOG PARAMETERS

The RS 38000 can use SYSLOG messages to communicate the following types of messages to a SYSLOG server:

Table 4-5 Types of SYSLOG messages

Message Type	Description
Fatal	Information about events that caused the RS 38000 to crash and reset.
Error	Information about errors.
Warning	Warnings against invalid configuration information and other conditions that are not necessarily errors.
Informational	Informational messages such as status messages. The SYSLOG messages that the Control Module displays while booting the software and reading the startup configuration file are examples of Informational messages.

Table 4-6 shows examples of the types of SYSLOG messages. Notice that after the facility type (in this case, "`CONFIG`") the message contains a letter that refers to the message type: "`F`" for fatal, "`E`" for error, and so on.

Table 4-6 Examples of message types

Message Type	Example
Fatal	`%CONFIG-F-CREATE_SEMA4 Unable to create %s semaphore: %d`
Error	`%CONFIG-E-NEED_COMMAND Need at least one command word to match`
Warning	`%CONFIG-W-BACKUP_CFG Cannot find Startup config - using backup on PCMCIA flash`
Informational	`%CONFIG-I-SAVED configuration saved to Startup configuration`

The RS 38000 writes the SYSLOG messages to a SYSLOG daemon on UDP port 514. You can set the CLI to send all or only some of the message types. By default, the CLI sends warning, error, and fatal messages but not informational messages to the specified SYSLOG server.

Use the following procedure to specify the SYSLOG server and the types of messages you want the CLI to send to the server.

1. Ensure that you are in Enable mode by entering the **`enable`** command in the CLI.
2. Use the **`ping`** command to verify that the RS 38000 can reach the SYSLOG server.
3. Ensure that you are in Configure mode by entering the **`configure`** command in the CLI.
4. Enter the following commands to add the SYSLOG server to the RS 38000, set the message level, and set the SYSLOG facility:

```
system set syslog server <hostname-or-IP-addr>
system set syslog level fatal|error|warning|info
system set syslog facility <facility-type>
```

Note The <*facility-type*> is a string of the form: *user*, *kern*, or *local0* through *local7*. These strings are reserved by the SYSLOG server daemon. for information on how <*facility-type*> is used by the SYSLOG server, see the documentation for your server's *syslog.conf* file.

Here is an example:

```
rs# config
rs(config)# system set syslog server 16.50.11.12
rs(config)# system set syslog level info
rs(config)# system set syslog facility local0
```

5. To activate the SYSLOG commands, use the **save active** command. Enter **yes** to activate the changes.

Note Up to four SYSLOG servers can be configured for each RS.

4.9 USING REDUNDANT CONTROL MODULES

The RS 38000 supports the use of redundant Control Modules (CMs), one Control Module acts as the primary CM, while the other Control Module acts as the backup CM. By default, the CM installed in slot CM/8 is the primary CM, while the CM installed in slot CM/9 is the backup CM. The purpose of the backup CM is to take over as the primary CM in the event that the primary CM fails.

Note The backup Control Module must be running a software version of the same level or later than the version running on the primary Control Module.

In normal operation, whenever changes are made to the primary CM's Configuration file, the changes are copied to the backup CM's configuration file. In this way, if the primary CM fails, the backup CM has all the configuration information necessary to take over as the primary CM. For instance, a static route is added to the RS 38000. Notice the messages displayed in the example when the change is saved to both the Active and Startup Configuration:

```
rs1(config)# ip add route 134.141.169.0/24 gateway 134.141.179.129
rs1(config)# save active

%SYS-I-ACTIVECFGTOBACKUP, active configuration updated on Backup CM

rs1(config)# save startup

Are you sure you want to overwrite the Startup configuration [no]? yes

%CONFIG-I-SAVED, configuration saved to Startup configuration.

%SYS-I-STARTUPCFGTOBACKUP, startup configuration file updated on Backup CM
rs1(config)#
```

Each message confirms that the Active and Startup Configurations were saved to the backup CM.

4.9.1 Fail Over

There are two ways that the primary CM can fail – either by a software failure (which causes a *soft fail over*) or by a hardware failure (which causes a *hard fail over*). Each of these failures cause the backup CM to assume the role of primary CM in a different way.

Soft Fail Over

If the primary CM experiences a crash because of a software failure, it sends a command to the backup CM to take over the role of primary CM. Because the backup CM's configuration has been kept in sync with the primary CM's configuration, the switch over to becoming the primary CM occurs immediately. The new primary CM (formerly the backup CM) maintains existing layer-2 and layer-3 flows and begins learning new flows within 5 to 20 seconds. After the routing protocols have had a chance to converge (60 seconds), layer-3 flows are aged out gracefully and replaced with new flows. When the original primary CM reboots or is reset, it assumes the role of the backup CM.

Notice that the default positions for the CMs within the RS 38000 chassis have now changed – the primary CM now resides in slot CM/1 and the backup CM resides in slot CM. As configuration changes are saved on the new primary CM (in slot CM/1) they are copied over to the new backup CM (in slot CM). Again, the two Control Modules always keep their configurations in sync.

Hard Fail Over

During normal operation, the status of the primary CM is communicated to the backup CM through a heartbeat signal. As long as the backup CM receives heartbeats from the primary CM, the backup CM retains its standby status. If, however, the primary CM experiences a hardware failure, the heartbeat signals cease. The backup CM waits 20 seconds for the heartbeats to resume, if they do not, the backup CM assumes the role of primary CM. As with the soft fail over, the new primary CM maintains existing layer-2 and layer-3 flows and begins learning new flows within 5 to 20 seconds. Once the routing protocols have converged (60 seconds), layer-3 flows are aged out gracefully and replaced with new flows.

Note The amount of time that the backup CM waits before taking over as the primary CM because of a hard fail over is configured using the **`system set backup-cm-timeout`** command from within Configure mode. The timeout can be set between 20 and 1000 seconds.

If the failed primary CM (in slot CM/8) is replaced by a new Control Module, the new CM assumes the role of backup CM.

4.9.2 Communicating with the Backup Control Module

There are two ways to establish communication with the backup CM: through the backup CM's console port or through a telnet session from the primary CM to the backup CM using the keyword **`backup-cm`**. For Instance, the following example shows a telnet session from the primary CM to the backup CM.

```
telnet RS1
----------------------------------------------------------------------
RS 38000 System Software, Version 8.0
Copyright (c) 2000-2001 Riverstone Networks
System started on 2001-04-24 09:37:35
----------------------------------------------------------------------


Press RETURN to activate console . . .


rs1> enable
rs1#
rs1# telnet backup-cm
Trying 127.0.0.1, port 10130 ...
Connected to 127.0.0.1.
Escape character is '^]'.


----------------------------------------------------------------------
RS 38000 System Software, Version 8.0
Copyright (c) 2000-2001 Riverstone Networks, Inc.
System started on 2001-04-19 14:40:57
----------------------------------------------------------------------



Press RETURN to activate console . . .

rs1>$
```

Notice in the example above that the prompt displays a dollar sign ($). This indicates that the display belongs to the backup CM. The dollar sign also appears if you connect to the backup CM through its console port.

When connected to the backup CM (either through telnet or the console) you are provided with only a sub-set of the commands available on the primary CM.

For example, enter Enable mode on the backup CM, and then enter the help command (**?**). This produces the following output:

```
rs1>$enable

rs1#$?
 cli                    - Modify the command line interface behavior
 enable                 - Enable privileged user mode
 exit                   - Exit current mode
 file                   - File manipulation commands
 logout                 - Log off the system
 reboot                 - Reboot the system
 system                 - Show system global parameters
rs1#$
```

Notice that most of the Enable mode functionality is missing and there is no access to Configure mode. However, the backup CM does provide access to both the **file** and **system** facilities. These facilities allow you to do the following on the backup CM:

- Copy files
- Delete files
- Rename files
- Reformat the file system
- List system images
- Choose system images

Note Also, you can enter the **reboot** command from the backup CM, however, the command reboots only the backup CM – the primary CM is not affected.

4.9.3 Things to Remember when Using Redundant Control Modules

This section points out several issues that must be taken into account when using redundant Control Modules.

Booting the RS 38000 From the Network

If you have set the RS 38000 to obtain its image software from a TFTP server (see Section 5.3, *"Loading Software from the Network"*), the IP addresses that appear for **netaddr** from within BootPROM mode should be different for both the primary and backup CM. Furthermore, the IP address of the Ethernet management interface (en0) should differ from both **netaddr** addresses. These IP addresses are listed below:

- One unique primary CM boot IP address
- One unique backup CM boot IP address
- One unique en0 interface IP address

If any of these IP addresses are the same, non-unique IP address errors will occur during fail over. Furthermore, none of the IP addresses mentioned above can be used to create an IP interface.

Software/Hardware Versions

Make sure that the software image are the same on the primary CM and backup CM – it is possible to have two different software images on each Control Module. If the images are not the same and fail over occurs, the image on the backup CM may or may not be able to process the configuration of the failed primary CM.

Caution Both the primary and backup Control Modules should be of the same hardware version, and should contain the same amount of memory.

Changing Mastership

Whenever the power is cycled on the RS, the default relationship between the primary and backup CM is reestablished. In other words, the Control Module in slot CM (whatever its role) becomes the primary CM and the Control Module in slot CM/1 becomes the backup CM. If a hardware fail over occurs, do not power down the RS. Instead, hot-swap the new Control Module into slot CM. As it boots, it will assume the role of the backup CM, and will obtain its configuration from the current primary CM. Enter the **`save startup`** command on the primary CM. Once this file transfer is complete, you can restore the default roles of the Control Modules by entering the **`system redundancy change-mastership`** command.

Hot-Swapping

Never hot-swap a line card either in or out of the RS 38000 while the backup CM is still booting. Always wait until both CMs are fully operational before hot-swapping line cards.

5 MANAGING SOFTWARE

This chapter describes how to perform operations regarding RS 38000 operating software and bootPROM images software. The following topics are covered:

- Upgrading the system image software
- Upgrading the Boot PROM image software
- Loading RS 38000 software from a TFTP server
- Loading RS 38000 software from a BootP/TFTP server
- Upgrading the operating software without rebooting the
- Upgrading FPGA code on line cards

5.1 UPGRADING SYSTEM IMAGE SOFTWARE

To upgrade the system software and boot using the upgraded image, perform the following procedure.

1. Display the current boot settings by using the **`system show version`** command. Note the current **`Image Boot Location`**.

   Here is an example:

```
rs# system show version
Software Information
  Software Version   : 8.0
  Copyright          : Copyright (c) 1996-2000 Riverstone Networks, Inc.
  Image Information  : ros8000, built on Mon Jan 25 14:10:21 2000
  Image Boot Location: file:/pc-flash/boot/img/ros8000
  Boot Prom Version  : prom-2.0.0.5
```

   In the example above, the location "**`pc-flash`**" indicates that the RS 38000 is set to use the factory-installed software on the PC card.

2. Copy the upgrade system software onto a TFTP server that the RS 38000 can access. (Use the **`ping`** command to verify that the RS 38000 can reach the TFTP server.)

Note If the TFTP server is one or more hops away from the RS 38000, add a route to the TFTP server's network using the **`ip add route`** command.

3. Enter the following command to copy the software upgrade onto the RS 38000's PC card:

```
system image add <IPaddr-of-TFTP-host> <image-file-name>
```

Note The *<image-file-name>* is the full directory path and filename to the image software file on the TFTP server.

Here is an example:

```
rs# system image add 134.152.178.5 tftpboot/ros8100
Downloading image 'tftpboot/ros8100' from host '134.152.178.5'
 to local image ros8100 (takes a while) . . .
 download: done
 save:
kernel: 100%
done
Image checksum validated.
%SYS-I-BOOTADDED, Image 'ros8100' added.
```

Note If the RS has a redundant Control Module, the upgrade performed on the primary CM will occur automatically on the backup CM.

4. Enter the **system image list** command to list the images on the PC card and verify that the new image is present.

   Here is an example:

```
rs# system image list
Images currently available on Master CM
slot0:
ros8100 (version 8.1.0.0)
ros8000 (version 8.0.0.0)  [selected for next boot]
```

5. Use the **system image choose** command to select the image file that the RS 38000 will use when rebooted.

   Here is an example:

```
rs# system image choose ros8100
Found image in slot0
Making image ros8100 (version 8.1.0.0) the active image
for next reboot on Master CM . . .
%SYS-I-CHS_PRIMARY_OK, image successfully chosen on Primary CM
rs#
```

6. Use the **`system image list`** command to verify the change.

Note You do not need to activate this change.

7. Reboot the RS 38000 to load and run the new system software image.

5.2 UPGRADING BOOT PROM SOFTWARE

The RS 38000 boots using the boot PROM image software installed on the Control Module's internal memory. To upgrade the boot PROM image, use the following procedure.

1. Display the current boot settings by entering the **`system show version`** command. Note the current **`Boot Prom Image`** version.

   Here is an example:

```
rs# system show version
Software Information
  Software Version   : 8.0
  Copyright          : Copyright (c) 1996-2000 Riverstone Networks, Inc.
  Image Information  : ros8000, built on Mon Jan 25 14:10:21 2000
  Image Boot Location: file:/pc-flash/boot/img/ros8000
  Boot Prom Version  : prom-2.0.0.5
```

2. Copy the upgrade boot PROM image software onto a TFTP server that the RS 38000 can access. (Use the **`ping`** command to verify that the RS 38000 can reach the TFTP server.)

Note If the TFTP server is one or more hops away from the RS 38000, add a route to the TFTP server's network using the **`ip add route`** command.

3. Enter the following command to copy the bootPROM upgrade onto the RS 38000's internal memory:

```
system promimage upgrade <IPaddr-of-TFTP-host> <image-file-name>
```

Note The <*image-file-name*> is the full directory path and filename to the bootPROM image file on the TFTP server.

Here is an example:

```
rs# system promimage upgrade 134.152.178.5 tftpboot/prom-211
Downloading image 'tftpboot/prom-211' from host '134.152.178.5'
image is a prom upgrade to version 'prom-2.0.1.1'
tftp complete
checksum valid. Ready to program.
Active-CM: flash found
Active-CM: erasing...
Active-CM: programming...
Active-CM: verifying...
Active-CM: programming successful.
Active-CM: Programming complete.
rs#
```

4. Reboot the RS 38000.
5. Enter the **`system show version`** command to verify that the new boot PROM software is in the internal memory of the RS 38000's Control Module.

5.3 LOADING SOFTWARE FROM THE NETWORK

Typically, the RS 38000 loads its operating software from the PC flash card inserted in the Control Module. Alternately, the RS 38000 can be configured to ignore its PC flash image and obtain its software from a network server. The RS 38000 can obtain its image software from either a TFTP or BootP/TFTP server.

5.3.1 Loading Image Software from a TFTP Server

Perform the following procedure to configure the RS 38000 to load its image software from a TFTP server:

1. Copy the image software onto a TFTP server that the RS 38000 can access.
2. Reboot the RS 38000 and enter Boot mode by pressing the “Esc” key to interrupt the normal boot process.
3. At the Boot prompt, enter the **`set`** command to view the current bootPROM variable values.

   Here is an example:

```
 re-boot> set

...tty1 = 9600
bootdiagmode = off         [off on quick mfg-test]
  diag_log =
mfg_loop_by = time        [time count]
mfg_loop_max = 86400
 bootdelay = 2
promsetaddrs = 1
flow_control = on          [off on]
bootptimeout = 5
   netaddr = 0.0.0.0
  autoboot = boot
   netmask = 0,0,0,0
   gateway = 0.0.0.0
bootsource = /pc-flash/boot/ros80
  bootaddr = 0.0.0.0
   ethaddr = 00:00:1d:12:34:56
(ethaddr is base MAC addr, add one for actual CPU MAC address)
     sysid = -1
rs-boot>
```

4. Notice in the example above that `netaddr`, `netmask`, and `gateway` have the value **`0.0.0.0`**, and that **`bootsource = /pc-flash/boot/ros80`**.
5. From the Boot prompt, use the **`set`** command to set the following:

- IP address of the RS 38000 – (**`netaddr`**)
- Subnet mask for the RS 38000 – (**`netmask`**)
- The IP address of the RS 38000’s default gateway – (**`gateway`**)
- Full path and filename to the software image on the TFTP server – (**`bootsource`**)
- IP address of the TFTP server – (**`bootaddr`**)

```
rs-boot> set netaddr <IPaddr>
rs-boot> set netmask <subnet-mask>
rs-boot> set gateway <IPaddr>
rs-boot> set bootsource <dir-filename>
rs-root> set bootaddr <IPaddr>
```

Here is an example:

```
rs-boot> set netaddr 134.152.179.132
rs-boot> set netmask 255.255.255.224
rs-boot> set gateway 134.152.179.129
rs-boot> set bootsource /tftpboot/ros80
rs-boot> set bootaddr 134.152.176.5
```

6. Enter the **set** command to view the changes:

   Here is an example:

```
 rs-boot> set
...
   netaddr = 134.152.179.132
  autoboot = boot
   netmask = 255.255.255.224
   gateway = 134.152.179.129
bootsource = /tftpboot/ros80
  bootaddr = 134.152.176.5
   ethaddr = 00:00:1d:12:34:56
(ethaddr is base MAC addr, add one for actual CPU MAC address)
     sysid = -1
rs-boot>
```

7. From the Boot prompt, use the **ping** command to verify that the RS 38000 can reach the TFTP server.
8. Reboot the RS 38000. As the RS 38000 initializes, it ignores the software image on the PC card and retrieves its operating software from the TFTP server at **134.152.176.5**.

   Here is an example:

```
rs-boot> boot

Rebooting. . .

. . .source: tftp://134.152.176.5/tftpboot/ros80

  Build location: host 'matrix' by 'adm'...

  Version: 8.0.0.0 . . .
```

5.3.2 Loading Image Software from a BootP/TFTP Server

The RS 38000 contains a BootP client and can be configured to obtain its image software from a BootP/TFTP server. Using the BootP client allows the RS 38000 to obtain its software network address from the server using only its MAC address. This eliminates the need to initially configure the RS's IP address, subnet mask, and boot source.

To configure the RS 38000 to use its BootP client to obtain its image software, perform the following procedure:

1. Load the RS 38000's image software on a BootP/TFTP server that can be reached by the RS 38000.
2. Boot the RS 38000 and enter Boot mode by interrupting the normal startup sequence by pressing the "Esc" key.
3. Use the **`set`** command to obtain the RS 38000's base MAC address (**`ethaddr`**).
4. Add one to the base address to obtain the MAC address of the RS 38000's CPU.

   Here is an example:

```
 re-boot> set

...tty1 = 9600
bootdiagmode = off         [off on quick mfg-test]
  diag_log =
mfg_loop_by = time        [time count]
mfg_loop_max = 86400
 bootdelay = 2
promsetaddrs = 1
flow_control = on          [off on]
bootptimeout = 5
   netaddr = 0.0.0.0
  autoboot = boot
   netmask = 0,0,0,0
   gateway = 0.0.0.0
bootsource = /pc-flash/boot/ros80
  bootaddr = 0.0.0.0
   ethaddr = 00:00:1d:12:34:56             < base MAC address >
(ethaddr is base MAC addr, add one for actual CPU MAC address)
     sysid = -1
rs-boot>
```

   From the example above, adding one to the base MAC address equals **`00:00:1d:12:34:57`**, which is the address of the RS 38000's CPU.

5. Use the **`set`** command to change the value of **`autoboot`** to **`bootp`**.

   Here is an example:

```
rs-boot> set autoboot bootp
```

6. Configure the BootP/TFTP server with the RS 38000's CPU MAC address, an appropriate IP address, and the location of the RS 38000 software image file. Additionally, make sure that the ARP cache of the BootP/TFTP server is set correctly for the RS 38000.
7. Reboot the RS 38000 by entering the **`reboot`** command at the Boot prompt.

Here is an example

```
rs-boot> reboot

Ethernet Base address = 00:00:1d:12:34:56
Ethernet CPU address  = 00:00:1d:12:34:57

Performing Bootp with timeout in 5 seconds.
** plen = 300  plen - sizeof(struct bootp) = 0
BOOTPD='134.141.179.134'
netaddr='134.141.179.132'
* bootp source is C:\TFTPBOOT\ROS80
Booting boot file C:\TFTPBOOT\ROS80.
source: tftp://134.141.179.134/C:\TFTPBOOT\ROS80
 File: version (703 bytes)
  Build location: host 'matrix' by 'adm'
  Version: 8.0.0.0
  Build date: Mon Dec 25 23:56:47 2000
 File: kernel (3568593 bytes)
  Loading kernel (base 0x80001000, size 50528)
(base 0x8000d560, size 3507312)
  100% - kernel loaded...
...
...
Press RETURN to activate console . . .
```

5.4 HITLESS SOFTWARE UPGRADE

The operating software for RS 38000 switch routers equipped with redundant Control Modules (CMs) can be upgraded without having to reboot the system. This ability to update the software without rebooting the RS is known as a "*hitless*" upgrade, referencing the fact that all flows and routes are maintained throughout the upgrade process.

Note OC-12 and all Smartcards in general are reset when performing a hitless upgrade if there is a change to the code for these specific line cards (checksum has changed).

The basic process of performing a hitless upgrade is outlined below:

- New software is placed on a reachable TFTP server
- Software is downloaded to the backup CM
- The backup CM is rebooted
- The backup CM is changed to the primary CM

5.4.1 Hitless Upgrade Example

The following is a step-by-step example of performing a hitless upgrade.Note that for this example, the TFTP server IP address is 134.141.178.5 and the upgrade image path and filename is "/tftpboot/ros12." Furthermore, in this example, the primary CM resides in slot CM and the backup CM resides in slot CM/1.

1. Load the new RS operating software image onto a TFTP server that is reachable by the RS.
2. Enter the **`system image add backup-cm`** command to load the new software image onto the backup CM.

```
rs# system image add 134.141.178.5 /tftpboot/rod12 backup-cm

 **Warning: Be sure to also add this image to the
   Primary Control Module so that the same images
   exist on the Control Modules.  Failure to do so
   may prevent hot failover from working correctly.

Downloading image '/tftpboot/ros12' from host '134.141.178.5'
 download: done

Adding Image (Backup CM)
 to local image ros12 (takes a while) . . .
 save:
kernel: 100%
images/ssr_atm: 100%
images/ssr_cmhe: 100%
images/ssr_wan: 100%
images/ssr_atm155_sar: 100%
images/ssr_atm155_fpga_400: 100%
images/ssr_atm155_fpga_800: 100%
images/ssr_mpls_dp_tmac: 100%
images/ssr_mpls_mc_tmac: 100%
images/ssr_atm622_amac: 100%
images/ssr_atm622_sar_rcv: 100%
images/ssr_atm622_sar_xmt: 100%
images/ssr_atm622_sar_diag: 100%
images/hdrproc2: 100%
 done
Image checksum validated.
%SYS-I-BOOTADDED, Image 'ros12' added.
rs#
```

3. Enter the s**ystem image choose backup-cm** command and choose the new software image as the image to use for the next reboot.

```
rs# system image choose ros12 backup-cm

 **Warning: Be sure to also choose this image on the
   Primary Control Module so that the same images
   are chosen for next reboot on the Control Modules.
   Failure to do so may prevent hot failover
   from working correctly.

Choosing image on Backup CM
Making image ros12 (version 12.0.0.0) the active image
for next reboot . . .
%SYS-I-CHS_OK, image successfully chosen
rs#
```

4. Enter the **system redundancy reboot-backup-cm** command to reboot the backup CM, which contains the new software image.

```
rs# system redundancy reboot-backup-cm
%SYS-I-HOTSWAP_OUTRXD, received hotswapped-out request for slot 1
%SYS-I-HOTSWAP_INQUEUED, hotswap busy, request for hotswap-in slot 1
queued
2001-12-05 18:12:21 %SYS-I-HOTSWAPOUT, module in slot CM/1 is hotswapped
out
rs# 2001-12-05 18:12:21 %SYS-I-HOTSWAP_INRXD, received hotswapped-in
request for slot 1, detecting, please wait
2001-12-05 18:12:24 %SYS-I-MULTICPU, additional CPU Module(s) detected
in slot CM/1
2001-12-05 18:12:24 %SYS-I-HOTSWAPIN, module in slot CM/1 is hotswapped
in
2001-12-05 18:13:42 %SYS-I-ACTIVECFGTOBACKUP, active configuration
updated on Backup CM
rs#
```

5. Once the backup CM is fully active, enter the **system redundancy change-mastership** command

```
rs# system redundancy change-mastership
Upgrading in progress
2001-12-05 18:18:22 %HBT-I-DISABLE, disabled failover
rs# 2001-12-05 18:18:24 %HBT-I-ENABLE, enabled failover
```

The backup CM (in slot CM/1) becomes the primary CM, while the old primary CM (in slot CM) becomes the backup CM.

6. Log into the new primary CM and check for hardware/software incompatibility and configuration file issues (if any). Remember, if needed, the current backup CM (in slot CM) still contains the old software and configuration files.

7. When satisfied with the software upgrade, you can repeat the previous steps to load the upgraded software onto the Control Module in slot CM (currently the backup CM) and return its state to primary CM.

5.5 UPGRADING FPGA CODE

On occasion, Riverstone Networks may make upgraded Field Programmable Gate Array (FPGA) code available for certain line cards. To download an FPGA upgrade, use the **system linecard** command from Enable mode.

The **system linecard** command can download FPGA code from either a flash RAM card residing in one of the active Control Module's flash RAM slots (**slot0** or **slot1**) or from a TFTP server on the network. In either case, a filename is specified that contains the FPGA code, and the line card that receives the upgrade is hot swapped out and then back in for the upgraded code to take effect.

Note No traffic is passed on the line card while the FPGA upgrade process is being performed.

5.5.1 Upgrading FPGA Code from a TFTP Server

Follow these steps to upgrade a line card's FPGA code using a TFTP server.

In this example, the TFTP server address is **10.50.89.88**, the path and filename of the FPGA code is **posrel/oc12_mpls_38k/oc12mr38.000**, and the line card to be upgraded is a 2-port, OC-12c, POS board in slot **6**.

1. Load the FPGA code onto the TFTP server. Make sure that the RS can reach the server across the network.
2. Enter the **system linecard upgrade** command, specifying the IP address of the TFTP server, the full path and filename of the FPGA code, and the slot number within which the line card resides.

```
rs# system linecard upgrade 10.50.89.88 posrel/oc12_mpls_38k/oc12mr38.000 module 6
Downloading package 'posrel/oc12_mpls_38k/oc12mr38.000' from host '10.50.89.88'
 download: done
pos02_oc12_mpls.bin: 100%
pos13_oc12_mpls.bin: 100%
pos_tmac_dp.bin: 100%

About to program the module in slot 6.
This will stop any traffic on that module until the
programming is complete and the module is restarted.

Are you sure you want to do this [no]? yes
upgrading POSITRON_FLSH_0_2 in slot 6 with pos02_oc12_mpls.bin
 flash found
 erasing...
 erasing...
 programming...
```

```
 verifying...
 programming successful.
 Programming complete.
upgrading POSITRON_FLSH_1_3 in slot 6 with pos13_oc12_mpls.bin
 flash found
 erasing...
 erasing...
 programming...
 verifying...
 programming successful.
 Programming complete.
upgrading TMAC_FLSH_0 in slot 6 with pos_tmac_dp.bin
 flash found
 erasing...

 erasing...
 programming...
 programming...
 verifying...
 programming successful.
 Programming complete.
Do you want to restart module 6 at this time [no]? yes
%SYS-I-HOTSWAP_OUTRXD, received hotswapped-out request for slot 6
%SYS-I-HOTSWAP_INQUEUED, hotswap busy, request for hotswap-in slot 6
queued
2002-05-30 14:08:37 %SYS-I-HOTSWAPOUT, module in slot 6 is hotswapped out
2002-05-30 14:08:37 %SYS-I-HOTSWAP_INRXD, received hotswapped-in
request for slot 6, detecting, please wait
2002-05-30 14:08:44 %SYS-I-DSCVMOD, discovered '2-POS OC12 "M"' module in slot 6
2002-05-30 14:08:47 %SYS-I-INITPORT, initialized slot 6, port 1
2002-05-30 14:08:47 %SYS-I-INITPORT, initialized slot 6, port 2
2002-05-30 14:08:52 %SYS-I-HOTSWAPIN, module in slot 6 is hotswapped in
rs#
```

3. After the FPGA upgrade process completes, the line card starts passing traffic.

Notice in the example above that the hot swapping out and in occurs as part of the upgrade process – and does not have to be performed after the upgrade.

5.5.2 Upgrading FPGA Code from a Flash RAM Card

FPGA code can be downloaded directly from a flash RAM card residing within one of the Control Module's RAM card slots. Upgrading a line card's FPGA code from a flash RAM card may be desirable if, for instance, your upgrade involves a large number of RS switch routers. In such a case, the flash RAM card can be moved from RS to RS.

In this example, the FPGA code is downloaded from a network TFTP server and copied directly to the flash RAM card in **`slot0`** of the active Control Module. Once copied to the flash RAM card, the upgrade is performed using the image on the flash RAM card in **`slot0`**.

1. Load the FPGA code files onto the TFTP server. Make sure that the RS can reach the server across the network.

Enter the **system linecard upgrade** command, specifying the IP address of the TFTP server, the full path and filename of the FPGA code, and the slot number within which the flash RAM card resides.

```
rs# system linecard upgrade 10.50.89.88 posrel/oc12_mpls_38k/oc12mr38.000 slot0
Downloading package 'posrel/oc12_mpls_8k/oc12mr8x.000' from host '10.50.89.88'
 download: done
Writing package 'oc12mr8x.000' to '/pc-flash0/linecard'
 save:  done
rs#
```

2. Use the **system linecard list-images** command to see the FPGA code that has been copied to the flash RAM card.

```
rs# system linecard list-images
slot0:  oc12mr8x.000
rs#
```

3. Use the **system linecard upgrade** command to upgrade the line card with the FPGA code on the flash RAM card in **slot0**. Notice that only the filename is specified – the RS knows the correct path to the FPGA files on the flash RAM card.

```
rs# system linecard upgrade slot0 oc12mr8x.000 module 6
Downloading package '/pc-flash0/linecard/oc12mr38.000' from slot0
 download: done
pos02_oc12_mpls.bin: 100%
pos13_oc12_mpls.bin: 100%
pos_tmac_dp.bin: 100%

About to program the module in slot 6.
This will stop any traffic on that module until the
programming is complete and the module is hotswapped.

Are you sure you want to do this [no]? yes
upgrading POSITRON_FLSH_0_2 in slot 6 with pos02_oc12_mpls.bin
 flash found
 erasing...
```

As with the previous example, the line card is hot swapped out and then back in as part of the upgrade process.

APPENDIX A TROUBLESHOOTING

If you experience difficulty with the basic hardware or software setup procedures in this guide, check the following table. If you find a description of the difficulty you are experiencing, try the recommended resolution. If the resolution does not remove the difficulty or it is not listed in this appendix, contact:

Riverstone Technical Assistance Center - RTAC

- Telephone: (408) 844-0010
- FAX: (408) 878-6920
- Internet address: www.riverstonenet.com/support
- Email: support@riverstonenet.com

Table A-1 Troubleshooting

If you experience this difficulty...	Try this remedy...
The RS 38000 exhibits no activity (no LEDs are on, the fan module is not operating, and so on).	Make sure the power supply is installed and plugged into a power source and the power source is active. Also check whether the switch on the power supply is in the ON position.
The power supply is installed but is not operating.	Check the power cable and the circuit to which the power supply is connected.
The fan module is not active.	Check the power cable and the circuit to which the power supply is connected. If the green status LED on the power supply indicates that it is active, immediately power down the chassis, unplug the power supply, and contact technical support. The fan module may be improperly connected or damaged.
The Control Module is not active.	Check the power cable and the circuit to which the power supply is connected. If the power supply is working, make sure the Control Module is inserted all the way into its slot in the chassis and the captive screws are screwed in. The Control Module must be in the Control Module slot (slots 8 or 9) and not in a line card slot.
No line cards are active.	Check the power cable and the circuit to which the power supply is connected.

Table A-1 Troubleshooting (Continued)

If you experience this difficulty...	Try this remedy...
A specific line card is inactive.	Make sure the line card is inserted all the way into the chassis and the captive screws are screwed in.
The chassis LEDs indicate activity but you cannot tell what the RS is doing.	Make sure you have properly connected the primary Control Module to a management console and the console is powered on.
An older software version continues to boot instead of the newer version on a PC card or TFTP server.	Use the procedure in Section 5.1, *"Upgrading System Image Software"* to configure the RS to boot using newer software.
You are unable to access the configuration commands in the CLI.	Enter the **`enable`** command to access the Enable mode, then enter the **`configure`** command to access the Configuration mode.
Configuration changes do not seem to be taking effect.	Use the procedure in Section 4.3.1, *"Activating the Configuration Commands in the Scratchpad"* to activate the changes.
Configuration changes are not reinstated after a reboot.	Use the procedure in Section 4.3.2, *"Saving the Active Configuration to the Startup Configuration File"* to save the configuration changes to the Startup configuration file.
The RS 38000 is not resolving DNS names.	Use the procedure in Section 4.7, *"Setting the DNS Domain Name and Address"* to set up DNS. If you have already performed this procedure, make sure you can use NS lookup on the DNS server to get the default domain.
An SNMP manager cannot access the RS.	Use the procedure in Section 4.6, *"Setting Up SNMP"* to set up an SNMP community string and specify a target for SNMP traps. If you have already performed this procedure, enter the **`snmp show all`** command to check the SNMP settings. Use the **`traceroute`** and **`ping`** commands to verify that the RS 38000 can reach the SNMP management station.
You are unable to ping a certain host.	Create and add an IP or IPX interface for the host. See the *Riverstone RS Switch Router User Guide* for information.

APPENDIX B INTERNATIONAL SAFETY INFORMATION

B.1 CONSIDERACIONES DE SEGURIDAD

Lea las siguientes advertencias relacionadas con la seguridad y el uso del equipo para evitar posibles lesiones personales o daños al producto.

B.1.1 Prevención de Lesiones

Advertencia Tome en cuenta las siguientes advertencias de seguridad para prevenir una posible lesión accidental al manipular el hardware del Riverstone RS Switch Router (RS).

- Para evitar una posible lesión, tenga cuidado al sacar el chasis fuera de la caja de embalaje.
- Nunca intente montar el chasis del RS en un rack sin la ayuda de otra persona. Solicite ayuda para sostener el chasis.
- Nunca opere el RS si las ranuras de los módulos o los compartimientos del suministro de energía están expuestos.
- Nunca opere el RS si el chasis se moja o se instala en un lugar mojado.

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