Configuring SMDS

The Switched Multimegabit Data Service (SMDS) is a wide-area networking service offered by some Regional Bell Operating Companies (RBOCs) and by MCI. This chapter describes the configuration tasks for the SMDS packet-switched software. For a complete description of the commands mentioned in this chapter, refer to the "SMDS Commands" chapter of the *Router Products Command Reference* publication. For historical background and a technical overview of SMDS, see the *Internetworking Technology Overview* publication.

Cisco's Implementation of SMDS

Cisco's implementation of the SMDS protocol is based on cell relay technology as defined in the Bellcore Technical advisories, which are based on the IEEE 802.6 standard. We provide an interface to an SMDS network using DS-1 or DS-3 high-speed transmission facilities. Connection to the network is made through a device called an SDSU—an SMDS CSU/DSU (Channel Service Unit/ Digital Service Unit) developed jointly by Cisco Systems and Kentrox. The SDSU attaches to a Cisco router through an RS-449 connection. On the other side, the SDSU terminates the line.

Cisco's implementation of SMDS supports the IP, DECnet, AppleTalk, XNS, Novell IPX, Banyan VINES, and OSI internetworking protocols, and transparent bridging.

IP routing is fully dynamic; that is, the routing tables are determined and updated dynamically. Routing of the other supported protocols requires that you establish a static routing table of SMDS neighbors in a user group. Once this is set up, all interconnected routers provide dynamic routing.

Note   When configuring IP routing over SMDS, you may need to make adjustments to accommodate split horizon effects. Refer to the "Configuring IP Routing Protocols" chapter of this manual for details about how our routers handle possible split horizon conflicts. By default, split horizon is *disabled* for SMDS networks.

Cisco's SMDS implementation includes multiple logical IP subnet (MultiLIS) support as defined by RFC 1209. This RFC describes routing IP over an SMDS cloud where each connection is considered a host on one specific private network and points to cases where traffic must transit from network to network.

Cisco's implementation of SMDS also provides the Data Exchange Interface (DXI) version 3.2 with heartbeat. The heartbeat mechanism periodically generates a heartbeat poll frame.

And finally, when a multicast address is not available to a destination, *pseudo-broadcasting* can be enabled to broadcast packets to those destinations using a unicast address.

SMDS Addresses

All addresses for SMDS service are assigned by the service provider and can be assigned to individuals and groups.

A group address (also defined as a multicast address) is entered in the Cisco SMDS configuration software using the standard E prefix, as follows: the E1 prefix specifies North American addresses; the E0 prefix specifies European addresses.

Our software expects the addresses to be entered in E.164 format. The E.164 format is 64 bits. The first four bits are address type code, followed by four bits of country code, followed by 10 BCD digits, with the final 16 bits all ones.

An example of an E.164 address follows:

```
C14155561313FFFF
```

Note   The full E.164 address is not required. We support the first 12 digits and force the last 4 digits to 0xF. The trailing Fs are not needed. They are not displayed, and it is not necessary to type them when entering an address.

The addresses can be entered with periods in a manner similar to Ethernet-style notation, or simply as a string of digits.

The following is an example of an individual address entered in Ethernet-style notation:

```
C141.5555.1212
```

The following is an example of a group address:

```
E180.0999.9999
```

For additional technical references about SMDS, see Appendix A, "References and Recommended Readings," in the *Router Products Command Reference* publication.

SMDS Hardware Requirements

You need the following hardware, equipment, and special software to configure SMDS:

- A CSC-MCI or CSC-SCI serial interface controller card, or HSSI interface (chassis-based systems), or the serial port on an IGS router

  — To operate on CSC-SCI or CSC-MCI cards, SMDS requires that the appropriate microcode version be installed. Version numbers are 1.2 (or later) for CSC-SCI and 1.7 (or later) for CSC-MCI.

- RS-449 or V.35 applique (chassis-based systems) or RS-449 transition cable (IGS)

- The SDSU device

- The packet-switched software option with the system software

Figure 1-1 illustrates the connections between the different components.

Figure 1-1   Typical SMDS Configuration
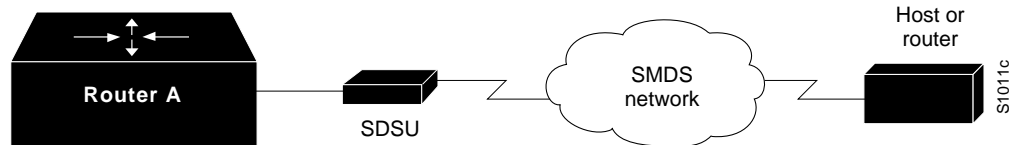
SMDS Configuration Task List

Before you can begin the configuration tasks, you must have already obtained your SMDS addresses from your service provider. You need two types of addresses:

- The group address for broadcasts
- The SMDS hardware (individual) address for each router that will interface directly into the SMDS network (that is, customer premises equipment).

There are basic steps that you must perform to enable SMDS. In addition, you can customize SMDS for your particular network needs and monitor SMDS connections. All of these tasks are outlined in the list that follows:

- Enable SMDS on the Interface
- Customize Your SMDS Network
- Monitor the SMDS Connections

The following sections describe these tasks. See the examples at the end of this chapter for ideas of how to configure SMDS on your network. See the *Router Products Command Reference* publication for information about the commands listed in the tasks.

Enable SMDS on the Interface

You must perform the following tasks to enable SMDS:

- Set SMDS encapsulation
- Specify the SMDS address
- Establish address mapping
- Provide a map to a multicast address
- Enable address resolution protocol (ARP)
- Enable broadcast ARP messages

Set SMDS Encapsulation

To set SMDS encapsulation at the interface level, perform the following task in interface configuration mode:

Task	Command
Enable SMDS on the interface.	**encapsulation smds**

For examples of enabling SMDS encapsulation, see any of the examples in the section "SMDS Configuration Examples" later in this chapter.

Specify the SMDS Address

To specify the SMDS individual address for a particular interface, perform the following task in interface configuration mode:

Task	Command
Enter an individual address provided by the SMDS service provider.	**smds address** *SMDS-address*

For examples of specifying the SMDS address, see any of the examples in the section "SMDS Configuration Examples" later in this chapter.

Establish Address Mapping

Routing tables are configured dynamically when IP and CLNS routing are configured. For any other protocol, you must configure a static map between an individual SMDS address and a higher-level protocol address. To establish address mapping, perform the following task in interface configuration mode:

Task	Command
Define static entries for those routers that are SMDS remote peers.	**smds static-map** *protocol-type protocol-address SMDS-address* [**broadcast**]

The supported protocols and the keywords to enable them are as follows:

- IP—**ip**
- DECnet—**decnet**
- AppleTalk—**appletalk**
- XNS—**xns**
- Novell IPX—**ipx**
- ISO CLNS—**clns**
- Banyan VINES—**vines**
- Bridging—**bridge**

Bridging is not a protocol, but the **bridge** keyword is valid for establishing address mapping.

For examples of establishing address mapping, see any of the examples in the section "SMDS Configuration Examples" later in this chapter.

Provide a Map to a Multicast Address

You can map an SMDS group address to a broadcast or multicast address used by higher-level protocols. If you use this feature, the **broadcast** keyword does not need to be specified in the **smds static map** command, and the router will not need to replicate each broadcast address. To map to a multicast address, perform the following task in interface configuration mode:

Task	Command
Map an SMDS group address to a multicast address used by higher-level protocols.	**smds multicast** *protocol-type SMDS-address*

The protocols supported and the keywords to enable them are as follows:

- IP—**ip**
- ARP—**arp**
- DECnet—**decnet**
- DECnet multicast address for all routers—**decnet_router**
- DECnet multicast address for all end systems—**decnet_node**
- AppleTalk—**appletalk**
- AppleTalk ARP address—**aarp**
- XNS—**xns**
- Novell IPX— **ipx**
- ISO CLNS—**clns**
- Multicast address for all CLNS intermediate systems—**clns_is**
- Multicast address for all CLNS end systems—**clns_es**
- Banyan VINES—**vines**
- Bridging—**bridge**

Bridging is not a protocol, but the **bridge** keyword is valid for providing a map to a multicast address.

For examples of mapping to a multicast, see any of the examples in the section "SMDS Configuration Examples" later in this chapter.

Enable Address Resolution Protocol (ARP)

When you enable the Address Resolution Protocol (ARP), you can choose to enable either a dynamic ARP cache or one built statically. To enable ARP, perform the following task in interface configuration mode:

Task	Command
Enable ARP and dynamic routing.	**smds enable-arp**
Enable ARP and a static routing table	**arp** *IP-address SMDS-address* **smds**

An SMDS network can be thought of in much the same way as an X.25 cloud. The premises equipment (in this case our router) represents the edge of the cloud. The service provider enables communication across the cloud. However, proper configuration is needed for communication to occur. This configuration will differ between protocol families.

One major difference between protocol families is dynamic versus static routing among the routers (called remote peers) on the periphery of the cloud. For IP, routing across the SMDS cloud is fully dynamic. No action on the user's part is needed to map higher-level protocol addresses to SMDS addresses. Both IP and ARP can be configured and a dynamic ARP routing table enabled. See the section "Configure Specific Protocols" later in this chapter for more information.

Enable Broadcast ARP Messages

When an ARP server is present in the network, you can enable broadcast ARP messages that are sent to all ARP SMDS addresses or to all IP SMDS multicast addresses when ARP addresses are not present. To enable broadcast ARP messages, perform the following task in interface configuration mode:

Task	Command
Enable broadcast ARP messages.	**smds multicast arp** *SMDS-address*

For an example of how to enable broadcast ARP messages, see the section "Typical Multiprotocol Configuration Example" later in this chapter.

Customize Your SMDS Network

Perform the following tasks, as appropriate, for your network:

- Configure specific protocols

- Enable transparent bridging

- Configure multiple logical IP subnets

- Reenable the Data Exchange Interface version 3.2 with heartbeat support

- Configure pseudo-broadcasting

- Enable IP fast switching

Configure Specific Protocols

Some protocol families are dynamically routed. For IP and CLNS, routing is fully dynamic, and no action on your part is needed to map higher-level protocol addresses to SMDS addresses. But for the other supported protocols, you must make a static entry for each router to communicate with all other peer routers. The static entries only need to be made for those routers that are SMDS remote peers. Nothing additional needs to be done to assure communication with other nodes behind the peer routers.

For an example of how to configure specific protocols, see the section "Typical Multiprotocol Configuration Example" later in this chapter.

Table 1-1 lists protocol families and the multicasts that are needed.

Table 1-1   Protocol Families and Types of Multicasts Needed

Protocol Family	Multicasts Needed
IP	IP, ARP
DECnet	DECNET, DECNET_NODE, DECNET_ROUTER
CLNS	CLNS, CLNS_ES,CLNS_IS
Novell IPX	NOVELL
XNS	XNS
AppleTalk	APPLETALK, AARP
Banyan VINES	VINES

ARP and IP

For both IP and ARP, the multicast address must be configured and ARP must be enabled. ARP multicast is required for only ARP servers; the IP multicast is used for ARPs and routing updates.

DECnet

Static maps must be configured for DECnet. In addition, a separate **smds multicast** command is needed for DECNET, DECNET_NODE, and DECNET_ROUTER.

CLNS

Multicasts must be configured for CLNS_ES and CLNS_IS. No static maps are necessary. ESHs, ISHs, and Router Hellos are sent to the multicast address, and neighbor entries are created automatically.

XNS and IPX

For XNS and IPX, the multicast address must be configured.

For IPX, RIP routing packets, SAP packets, NetBIOS Name Lookups, directed broadcasts, and traffic to the helper addresses (if that helper address is a broadcast address) will be sent to the SMDS IPX multicast address.

For XNS, only RIP, directed broadcasts, and helper traffic will be sent to the XNS multicast address.

For XNS and Novell configurations, a static map entry must be made for each remote peer.

AppleTalk

Currently, dynamic address assignment is not supported. AppleTalk only works with static maps. Therefore, an AppleTalk address must be assigned to the interface. ARP must be enabled and multicasts must be used for the AppleTalk protocol to work.

Banyan VINES

For Banyan VINES, the multicast address must be configured. Also note that VINES only works with static maps.

Enable Transparent Bridging

You can enable transparent bridging of packets across an SMDS network. The first step is to assign the interface to the bridge group using the **bridge-group** command. To enable transparent bridging, perform the following task in interface configuration mode:

Task	Command
Configure bridging across SMDS.	**smds multicast bridge** *SMDS-address*

See the "Configuring Transparent Bridging" chapter for more information about bridge groups and the **bridge-group** command.

Configure Multiple Logical IP Subnets

Multiple logical IP subnets (MultiLIS) is supported as defined by RFC 1209. This RFC describes routing IP over an SMDS cloud where each connection is considered a host on one specific private network and points to cases where traffic must transit from network to network.

The MultiLIS solution allows a single SMDS interface to be treated as multiple IP subnets and to support routing of packets from one network to the next without using intervening routers. When enabled, the router will perform routing between the subnets configured using secondary IP addresses on an SMDS interface. Each supported subnet has a secondary IP address and multicast IP address configured on the SMDS interface. Broadcast packets are duplicated and transmitted to all IP networks on the specified SMDS interface and use the associated multicast SMDS address for the network. To configure multiple logical IP subnets, perform the following task in interface configuration mode:

Task	Command
Configure MultiLIS.	**smds multicast ip** *SMDS-address* [*IP-address IP-mask*]

For an example of how to configure MultiLIS, see the section "Example of Configuring a MultiLIS Network" later in this chapter.

Reenable the Data Exchange Interface Version 3.2 with Heartbeat Support

By default, SMDS provides the Data Exchange Interface (DXI) version 3.2 heartbeat process as specified in the SIG-TS-001/1991 standard. If you find you must re-enable the DXI heartbeat, perform the following task in interface configuration mode:

Task	Command
Configure DXI 3.2.	**smds dxi**

The DXI mechanism encapsulates SMDS packets in a DXI frame before they are transmitted. The heartbeat mechanism automatically generates a heartbeat poll frame every 10 seconds. The Interim Local Management Interface (ILMI) is not supported. See the *Router Products Command Reference* publication for more information about DXI 3.2.

Configure Pseudo-broadcasting

Some hosts do not support multicast E.164 addresses. This is a problem in IP where frequent broadcast packets are sent, because routing updates are generally broadcast. IP and ARP depend on the use of multicast addresses to determine a route to a destination IP address. A mechanism was needed to artificially support the use of broadcast where multicast E.164 addresses do not exist; the result is that a multicast address is not available to a destination, pseudo-broadcasting can be enabled to broadcast packets to those destinations using a unicast address.

To configure pseudo-broadcasting, perform the following task in interface configuration mode:

Task	Command
Configure pseudo-broadcasting.	**smds static-map ip** *IP-address SMDS-address* **broadcast**

For an example of how to configure pseudo-broadcasting, see the section "Example of Configuring Pseudo-broadcasting" later in this chapter.

Enable IP Fast Switching

SMDS fast switching of IP packets provides faster packet transfer on serial links with speeds above 56Kbps. Use fast switching if you use high-speed, packet-switched, datagram-based WAN technologies such as Frame Relay offered by service providers.

SMDS fast switching is supported between serial and Ethernet interfaces on the IGS and across all interfaces on all the platforms using HDLC or SMDS encapsulation. SMDS fast switching is on by default.

To reenable fast switching, perform the following tasks in interface configuration mode:

Task		Command
Step 1	Define the type and unit number of the interface.	**interface** *type unit*
Step 2	Set SMDS encapsulation.	**encapsulation smds**
Step 3	Enable the interface for fast switching.	i**p route-cache**

Monitor the SMDS Connections

To monitor SMDS connections, perform the following tasks in interface configuration mode:

Task	Command
Monitor ARP activity.	**show arp**
Display the individual addresses and the interface with which they are associated.	**show smds addresses**
Display all SMDS addresses that are mapped to higher-level protocol addresses.	**show smds map**
Display packet traffic activity.	**show smds traffic**

SMDS Configuration Examples

Following are some typical configuration file examples you can use as models for your network configurations:

- Typical multiprotocol configuration example (page 9-11)

- Example of a configuration with a remote peer on the same network (page 9-12)

- Example of configuring a MultiLIS network (page 9-12)

- Example of configuring pseudo-broadcasting (page 9-14)

Typical Multiprotocol Configuration Example

The following example is a typical interface configured for IP, DECnet, ISO CLNS, Novell IPX, XNS, and AppleTalk. DECnet needs to be configured globally and at the interface level.

```
interface Serial 4
ip address 1.1.1.2 255.0.0.0
decnet cost 4
appletalk address 92.1
appletalk zone smds
clns router igrp FOO
ipx net 1a
xns net 17
encapsulation SMDS
! SMDS configuration follows
smds address c120.1580.4721
smds static-map APPLETALK 92.2 c120.1580.4592
smds static-map APPLETALK 92.3 c120.1580.4593
smds static-map APPLETALK 92.4 c120.1580.4594
smds static-map NOVELL 1a.0c00.0102.23ca c120.1580.4792
smds static-map XNS  17.0c00.0102.23ca c120.1580.4792
smds static-map NOVELL 1a.0c00.0102.23dd c120.1580.4728
smds static-map XNS 17.0c00.0102.23aa c120.1580.4727
smds multicast NOVELL e180.0999.9999
smds multicast XNS e180.0999.9999
smds multicast ARP e180.0999.9999
smds multicast IP e180.0999.9999
smds multicast APPLETALK e180.0999.9999
smds multicast AARP e180.0999.9999
smds multicast CLNS_IS e180.0999.9990
smds multicast CLNS_ES e180.0999.9990
smds multicast DECNET_ROUTER e180.0999.9992
smds multicast DECNET_NODE e180.0999.9992
smds multicast DECNET e180.0999.9992
smds enable-arp
```

## Example of a Configuration with a Remote Peer on the Same Network

The following example illustrates a remote peer on the same SMDS network. DECnet needs to be configured globally and at the interface level.

```
interface Serial 0
ip address 1.1.1.1 255.0.0.0
decnet cost 4
appletalk address 92.2
appletalk zone smds
clns router igrp FOO
ipx net 1a
xns net 17
encapsulation SMDS
! SMDS configuration follows
smds address c120.1580.4792
smds static-map APPLETALK 92.1 c120.1580.4721
smds static-map APPLETALK 92.3 c120.1580.4593
smds static-map APPLETALK 92.4 c120.1580.4594
smds static-map NOVELL 1a.0c00.0102.23cb c120.1580.4721
smds static-map XNS 17.0c00.0102.23cb c120.1580.4721
smds static-map NOVELL 1a.0c00.0102.23dd c120.1580.4728
smds static-map XNS 17.0c00.0102.23aa c120.1580.4727
smds multicast NOVELL e180.0999.9999
smds multicast XNS e180.0999.9999
smds multicast IP e180.0999.9999
smds multicast APPLETALK e180.0999.9999
smds multicast AARP e180.0999.9999
smds multicast CLNS_IS e180.0999.9990
smds multicast CLNS_ES e180.0999.9990
smds multicast DECNET_ROUTER e180.0999.9992
smds multicast DECNET_NODE e180.0999.9992
smds multicast DECNET e180.0999.9992
smds enable-arp
```

Example of Configuring a MultiLIS Network

In the following example, Routers A, B, and C are connected to an SMDS cloud (see Figure 1-2).

Figure 1-2   Multiple Logical IP Subnet Configuration
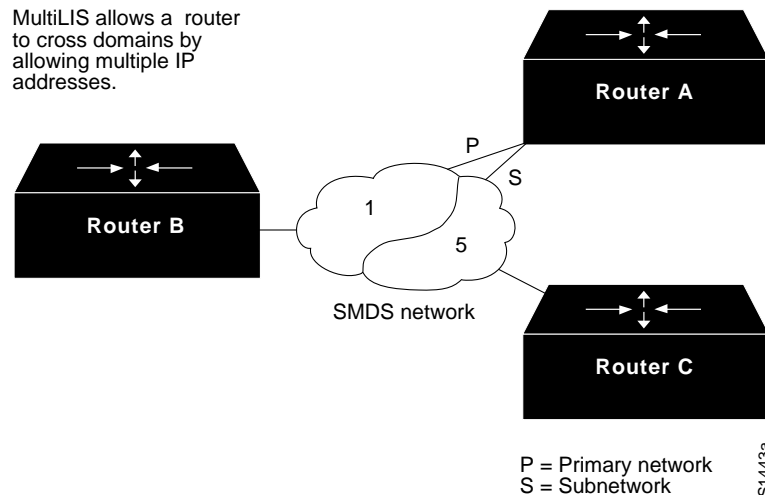
Router A can communicate with Routers B and C directly. Router B can communicate with Router A directly, and with Router C via Router A. Router C can talk to Router A directly and to Router B via Router A. Notice that a packet destined to Router B from Router C must make two hops on the cloud through the same interface on Router A. This issue was considered when the MultiLIS proposal was made and deemed not to be a critical one. It is also a nonstandard configuration.

Configuration for Router A

```
interface serial 0
smds address c120.1111.2222
ip address 131.108.1.30 255.255.255.0
ip address 131.108.5.30 255.255.255.0 secondary
smds multicast ip e180.0999.9999
smds multicast ip e180.0333.3333 131.108.5.0 255.255.255.0
```

Configuration for Router C

```
interface serial 4
smds address c120.9999.8888
ip address 131.108.5.20 255.255.255.0
ip address 131.108.1.20 255.255.255.0 secondary
smds multicast ip e180.0333.3333
smds multicast ip e180.0999.9999 131.108.1.0 255.255.255.0
```

Configuration for Router B

```
interface serial 2
smds address c120.1234.5678
ip address 131.108.1.10  255.255.255.0
smds multicast ip e180.0999.9999 255.255.255.0
```

Example of Configuring Pseudo-broadcasting

In the following example, an ARP broadcast from Router A is sent to multicast address E180.0999.9999 to Router B and to unicast address C120.1234.5678 to Router C. The reply from Router C uses the unicast address C120.1111.2222 E.164 for the return reply if it is the target of the ARP request. IGRP broadcast updates follow the same rules.

Configuration for Router A

```
interface s 0
encapsulation smds
smds address c120.1111.2222
ip address 131.108.1.30  255.255.255.0
smds multicast ip e180.0999.9999
smds static-map ip 131.108.1.10 c120.1234.5678 broadcast
smds enable-arp
```

Configuration for Router B

```
interface s 4
smds address c120.9999.8888
ip address 131.108.1.20
smds multicast ip e180.0999.9999
smds enable-arp
```

Configuration for Router C

```
interface s 2
smds address c120.1234.5678
ip address 131.108.1.10
smds static-map ip 131.108.1.30 c120.1111.2222 broadcast
smds enable-arp
```