APPENDIX F

Switching

Switching is the process by which a routing process forwards packets. The routing process switches data packets through the router by looking up the destination logical address in an address-to-port association table and then moving the packets to the selected outgoing interface. Switching performance can be enhanced by using route caches. Route caches contain information about the destination address, encapsulation type, and outgoing port number. Entries in route caches are constructed as packets are forwarded to their logical destinations.

Switching can occur at four levels, which are listed here in order of increasing performance:

- Process switching. With this type of switching, an incoming packet is associated with a destination network or subnet entry in the routing table located in main memory. Process switching is a scheduled process that is performed by the system processor.
- Fast switching. With this type of switching, an incoming packet matches an entry in the fast-switching cache located in main memory. Fast switching is done via asynchronous interrupts, which are handled in real time. Fast switching allows higher throughput by switching a packet using a cache created by previous packets.
- Autonomous switching. With this type of switching, an incoming packet matches an entry in the autonomous-switching cache located on the interface processor. Autonomous switching provides faster packet switching by allowing the ciscoBus controller to switch packets independently without having to interrupt the system processor. It is available only on Cisco 7000 series routers and in AGS+ systems with high-speed network controller cards.
- SSE switching. With this type of switching, an incoming packet matches an entry in the silicon-switching cache located in the silicon switching engine (SSE) of the Silicon Switch Processor (SSP) module. This module is available only on Cisco 7000 series routers. Silicon switching provides very fast, dedicated packet switching by allowing the SSE to switch packets independently without having to interrupt the system processor.

The first time a packet is processed for a specific destination, it is always process switched by the router. This allows the entries in the route caches to be created.

By default, fast switching is enabled on all interfaces that support fast switching.

The tables in this appendix list the types of switching supported by each router platform. For each platform, these tables include the following information:

- Encapsulation type
- Interface type

- Routing or bridging protocol
- Type of switching supported. This can be one or more of the following values:
  - P: process switching
  - F: fast switching
  - A: autonomous switching
  - S: silicon switching

Notes about Switching

The switching information provided in this appendix is general and may not apply under all circumstances.

Currently, information about switching over bridging protocols is incomplete.

If header or packet compression is enabled, packets are process switched. Fast switching is not available.

Switching Tables

The following tables identify the types of switching supported for routing protocols or bridging on various platforms:

- Switching Routing Protocols on the Cisco 7000 Series with a Switch Processor (SP)
- Switching Bridging Protocols on the Cisco 7000 Series with a Switch Processor (SP)
- Switching Routing Protocols on the Cisco 7000 Series with a Silicon Switch Processor (SSP)
- Switching Bridging Protocols on the Cisco 7000 Series with a Silicon Switch Processor (SSP)
- Switching Routing Protocols on the AGS+
- Switching Bridging Protocols on the AGS+
- Switching on the Cisco 4500
- Switching on the Cisco 4000 and Cisco 4000-M
- Switching on the Route Switch Processor (RSP)
- Switching on the Cisco 2500 Series

Table F-1 Switching Routing Protocols on the Cisco 7000 Series with a Switch Processor (SP)

Encapsulation/ Interface	IP	IPX	DECnet	AppleTalk Phase 1	AppleTalk Phase 2	ISO CLNS	Banyan VINES	XNS	Apollo Domain
ARPA									
Ethernet[1]	PFA	PFA	PF	PF	PF	PF	PF	PF	P
LAN Extender	PF	PF	P	PF	PF	P	P	P	P
SNAP									
FDDI[2]	PFA	PFA	PF	—	PF	PF	PF	PF	P
Token Ring[3]	PFA	PFA	P	—	PF	P	PF	P	P
Frame Relay (Cisco, IETF), ATM-DXI									
Serial[4], Channelized T1/E1[5]	PF	PF	P	P	PF	P	PF	P	—
PRI[5]	P	P	P	P	P	P	P	P	—
SMDS									
Serial[4]	PF	P	P	P	PF	P	PF	P	P
Channelized T1/E1[5]	PF	P	P	P	P	P	P	P	P
PRI[5]	P	P	—	—	P	P	P	P	P
X.25									
Serial[4], Channelized T1/E1[5], PRI[5]	P	P	P	P	P	P	P	P	P
PPP									
Serial[4], Channelized T1/E1[5]	PFA	PF	P	P	PF	P	PF	P	P
PRI[5]	PA	P	P	P	P	P	P	P	P
HDLC									
Serial[4], Channelized T1/E1[5]	PFA	PFA	PF	P	PF	PF	PF	PF	P
PRI[5]	PA	PA	P	P	P	P	P	P	P
AAL5 SNAP, AAL5 MUX, AAL5 NLPID, AAL3/4 SMDS									
ATM[6]	PFA	PF	P	PF	PF	PF	PF	P	—
AAL5 LANE									
ATM[6]	PFA	PF	—	P	PF	—	—	—	—

1. Ethernet interfaces are available on the Ethernet Interface Processor (EIP) card.
2. FDDI interfaces are available on the FDDI Interface Processor (FIP) card.
3. Token Ring interfaces are available on the Token Ring Interface Processor (TRIP) card.
4. Serial interfaces are available on the Fast Serial Interface Processor (FSIP) and HSSI Interface Processor (HIP) cards. The HIP card does not support X.25.
5. Channelized T1/E1 and PRI interfaces are available on the MultiChannel Interface Processor (MIP) card.
6. ATM interfaces are available on the ATM Interface Processor (AIP) card. The AIP card does not support AAL5MUX encapsulation of ISO CLNS.

Table F-2 Switching Bridging Protocols on the Cisco 7000 Series with a Switch Processor (SP)

Encapsulation/ Interface	Source-Route Bridging	Remote Source-Route Bridging	Transparent Bridging
ARPA			
Ethernet[1]	—	FA	FA
SNAP			
FDDI[2]	PA	FA	FA
Token Ring[3]	—	F	F
Frame Relay (Cisco, IETF), ATM-DXI			
Serial[4], Channelized T1/E1[5]	—	—	F
PRI[5]	—	—	P
SMDS			
Serial[4], Channelized T1/E1[5], PRI[5]	—	—	P
X.25			
Serial[4], Channelized T1/E1[5], PRI[5]	—	—	P
PPP			
Serial[4], Channelized T1/E1[5]	—	—	P
PRI[5]	—	—	PF
HDLC			
Serial[4]	—	FA	FA
Channelized T1/E1[5]	—	PF	F
PRI[5]	—	P	P
AAL5 SNAP			
ATM[6]	—	—	F
AAL3/4 SMDS			
ATM[6]	—	—	P
AAL5 LANE, AAL5 MUX, AAL5 NLPID			
ATM[6]	—	—	—
Direct			
FDDI[2], Token Ring[3]	PFA	—	—

1. Ethernet interfaces are available on the Ethernet Interface Processor (EIP) card.
2. FDDI interfaces are available on the FDDI Interface Processor (FIP) card.
3. Token Ring interfaces are available on the Token Ring Interface Processor (TRIP) card.
4. Serial interfaces are available on the Fast Serial Interface Processor (FSIP) and HSSI Interface Processor (HIP) cards. The HIP card does not support X.25.
5. Channelized T1/E1 and PRI interfaces are available on the MultiChannel Interface Processor (MIP) card.
6. ATM interfaces are available on the ATM Interface Processor (AIP) card.

Table F-3 Switching Routing Protocols on the Cisco 7000 Series with a Silicon Switch Processor (SSP)

Encapsulation/ Interface	IP	IPX	DECnet	AppleTalk Phase 1	AppleTalk Phase 2	ISO CLNS	Banyan VINES	XNS	Apollo Domain
ARPA									
Ethernet[1]	PFAS	PFAS	PF	PF	PF	PFS	PF	PF	P
SNAP									
FDDI[2]	PFAS	PFAS	PF	—	PF	PFS	PF	PF	P
Token Ring[3]	PFAS	PFAS	P	—	PF	P	PF	P	P
Frame Relay Cisco, ATM-DXI									
Serial[4], Channelized T1/E1[5]	PF	PF	P	P	PF	P	PF	P	P
PRI[5]	P	P	P	P	P	P	P	P	P
Frame Relay IETF									
Serial[4], Channelized T1/E1[5]	PFAS	PF	P	P	PF	P	PF	P	P
PRI[5]	PAS	P	P	P	P	P	P	P	P
SMDS									
Serial[4]	PF	P	P	P	PF	P	PF	P	P
Channelized T1/E1[5]	PF	P	P	P	P	P	P	P	P
PRI[5]	P	P	—	P	P	P	P	P	P
X.25									
Serial[4], Channelized T1/E1[5], PRI[5]	P	P	P	P	P	P	P	P	P
PPP									
Serial[4], Channelized T1/E1[5]	PFAS	PF	P	P	PF	P	PF	P	P
PRI[5]	PAS	P	P	P	P	P	P	P	P
HDLC									
Serial[4], Channelized T1/E1[5]	PFAS	PFAS	PF	P	PF	PFS	PF	PF	P
PRI[5]	PAS	PAS	P	P	P	P	P	P	P
AAL5 MUX, AAL5 NLPID, AAL5 SNAP, AAL3/4 SMDS									
ATM[6]	PFAS	PFS	P	PF	PF	PF	PF	P	—
AAL5 LANE									
ATM	PFAS	PFS	—	P	PF	—	—	—	—

1. Ethernet interfaces are available on the Ethernet Interface Processor (EIP) card.
2. FDDI interfaces are available on the FDDI Interface Processor (FIP) card.
3. Token Ring interfaces are available on the Token Ring Interface Processor (TRIP) card.
4. Serial interfaces are available on the Fast Serial Interface Processor (FSIP) and HSSI Interface Processor (HIP) cards. The HIP card does not support X.25.
5. Channelized T1/E1 and PRI interfaces are available on the MultiChannel Interface Processor (MIP) card.
6. ATM interfaces are available on the ATM Interface Processor (AIP) card. The AIP card does not support AAL5MUX encapsulation of ISO CLNS. It also does not support silicon switching of AAL3/4 SMDS.

Table F-4 Switching Bridging Protocols on the Cisco 7000 Series with a Silicon Switch Processor (SSP)

Encapsulation/ Interface	Source-Route Bridging	Remote Source-Route Bridging	Transparent Bridging
ARPA			
Ethernet[1]	—	PFAS	FAS
SNAP			
FDDI[2]	—	PFAS	FAS
Token Ring[3]	PAS	PA	PFA
Frame Relay (Cisco, IETF), ATM-DXI			
Serial[4], Channelized T1/E1[5]	—	—	F
PRI[5]	—	—	P
SMDS			
Serial[4], Channelized T1/E1[5]	—	—	P
PRI[5]	—	—	P
X.25			
Serial[4], Channelized T1/E1[5], PRI[5]	—	—	P
PPP			
Serial[4]	—	—	PFA
Channelized T1/E1[5]	—	—	PF
PRI[5]	—	—	P
HDLC			
Serial[4]	—	PFAS	PFAS
Channelized T1/E1[5]	—	PFS	PFS
PRI[5]	—	P	P
AAL5 SNAP			
ATM[6]	—	—	F
AAL3/4 SMDS			
ATM[6]	—	—	P
AAL5 LANE, AAL5 MUX, AAL5 NLPID			
ATM[6]	—	—	—
Direct			
FDDI[2], Token Ring[3]	PFAS	—	—

1. Ethernet interfaces are available on the Ethernet Interface Processor (EIP) card.
2. FDDI interfaces are available on the FDDI Interface Processor (FIP) card.
3. Token Ring interfaces are available on the Token Ring Interface Processor (TRIP) card.
4. Serial interfaces are available on the Fast Serial Interface Processor (FSIP) and HSSI Interface Processor (HIP) cards. The HIP card does not support X.25.
5. Channelized T1/E1 and PRI interfaces are available on the MultiChannel Interface Processor (MIP) card.
6. ATM interfaces are available on the ATM Interface Processor (AIP) card.

Table F-5 Switching Routing Protocols on the AGS+

Encapsulation/ Interface[1]	IP	IPX	DECnet	AppleTalk Phase 1	AppleTalk Phase 2	ISO CLNS	Banyan VINES	XNS	Apollo Domain
ARPA									
Ethernet (ciscoBus)[2]	PFA	PFA	PF	PF	PF	PF	PF	PF	P
Ethernet (Multibus)[3]	PF	PF	PF	PF	—	PF	PF	PF	P
SNAP									
FDDI[4]	PFA	PFA	PF	—	PF	PF	PF	PF	P
Token Ring (ciscoBus)[5]	PFA	PFA	P	—	PF	P	P	P	—
Token Ring (Multibus)[6]	PF	PF	P	—	PF	P	PF	P	—
Frame Relay (Cisco, IETF)									
Serial (all)[7,8]	PF	PF	P	P	PF	P	PF	P	P
SMDS									
Serial (all)[7,8]	PF	P	P	P	PF	P	PF	P	P
X.25									
Serial (Multibus)[8]	P	P	P	P	P	P	P	P	P
PPP									
Serial (ciscoBus)[7]	PFA	PF	P	P	PF	P	PF	P	P
Serial (Multibus)[8]	PF	PF	P	P	PF	P	PF	P	P
HDLC									
Serial (ciscoBus)[7]	PFA	—	PF	P	PF	PF	PF	PF	P
Serial (Multibus)[8]	PF	—	PF	P	PF	PF	PF	PF	P

1. This table lists all switching possibilities. The actual switching available depends on the microcode version.
2. CiscoBus Ethernet interfaces are available on the CSC-C2MEC cards.
3. Multibus Ethernet interfaces are available on CSC-*n*E cards.
4. FDDI interfaces are available on the CSC-FCI and CSC-C2FCIT cards.
5. CiscoBus Token Ring interfaces are available on the CSC-C2CTR card.
6. Multibus Token Ring interfaces are available on the CSC-*n*R and CSC-R16M cards.
7. CiscoBus serial interfaces are available on the CSC-C2HSCI card.
8. Multibus serial interfaces are available on CSC-*n*S and CSC-*n*T cards.

Table F-6 Switching Bridging Protocols on the AGS+

Encapsulation/ Interface[1]	Source-Route Bridging	Remote Source-Route Bridging	Transparent Bridging
ARPA			
Ethernet (high speed)[2]	—	PFA	PFA
Ethernet (low speed)[3]	—	PF	PF
SNAP			
FDDI[4]	—	PFA	PFA
Token Ring (high speed)[5]	—	PFA	PFA
Token Ring (4 Mbps, 16 Mbps)[6]	—	PF	PF
HDLC			
Serial (high speed)[7]	—	PFA	PFA
Serial (low speed)[8]	—	PF	—
Direct			
Token Ring (high speed)[5]	PFAS	—	—
Token Ring (4 Mbps, 16 Mbps)[6]	PF	—	—

1. This table lists all switching possibilities. The actual switching available depends on the microcode version.
2. High-speed Ethernet interfaces are available on the CSC-C2MEC cards.
3. Low-speed Ethernet interfaces are available on CSC-*n*E cards.
4. FDDI interfaces are available on the CSC-C2FCIT card.
5. High-speed Token Ring interfaces are available on the CSC-C2CTR card.
6. 4-Mbps and 16-Mbps Token Ring interfaces are available on the CSC-*n*R and CSC-R16M cards, respectively.
7. High-speed serial interfaces are available on the CSC-C2HSCI card.
8. Low-speed serial interfaces are available on CSC-*n*S and CSC-*n*T cards.

Table F-7 Switching on the Cisco 4500

Encapsulation/ Interface	IP	IPX	DECnet	AppleTalk Phase 1	AppleTalk Phase 2	ISO CLNS	Banyan VINES	XNS	Bridging
ARPA									
Ethernet[1]	PF	PF	PF	PF	PF	PF	PF	PF	PF
SNAP									
FDDI[2]	PF	PF	PF	—	PF	PF	PF	PF	PF
Token Ring[3]	PF	PF	P	—	PF	P	PF	PF	PF
Frame Relay Cisco, ATM-DXI									
Serial[4]	PF	PF	P	P	PF	P	PF	P	F
BRI/PRI[5]	P	P	P	P	P	P	P	P	P
Frame Relay IETF									
Serial[4]	PF	—	—	—	—	P	PF	—	P
BRI/PRI[5]	P	P	P	P	P	P	P	P	P
SMDS									
Serial[4]	PF	P	P	P	P	—	PF	P	P
BRI/PRI[5]	P	P	P	P	P	P	P	P	P
X.25									
Serial[4], BRI/PRI[5]	P	P	P	P	P	P	P	P	P
PPP									
Serial[4]	PF	PF	P	P	PF	P	PF	P	P
BRI/PRI[5]	P	P	P	P	P	P	P	P	
HDLC									
Serial[4]	PF	PF	PF	P	PF	PF	PF	PF	PF
BRI/PRI[5]	P	P	P	P	P	P	P	P	PF
AAL5 SNAP, AAL5 MUX, AAL5 NLPID									
ATM[6]	PF	PF	P	P	P	P	P	P	P

1. Ethernet interfaces are available on the Ethernet network processor module.
2. FDDI interfaces are available on the FDDI network processor module.
3. Token Ring interfaces are available on the Token Ring network processor module.
4. Serial interfaces are available on the serial network processor modules.
5. BRI and PRI interfaces are available on the ISDN BRI network processor module.
6. ATM interfaces are provided on the Network Processor Module (NPM).

Table F-8 Switching on the Cisco 4000 and Cisco 4000-M

Encapsulation/ Interface	IP	IPX	DECnet	AppleTalk Phase 1	AppleTalk Phase 2	ISO CLNS	Banyan VINES	XNS	Bridging
ARPA									
Ethernet[1]	PF	PF	PF	PF	PF	PF	PF	PF	F
SNAP									
FDDI[2]	PF	PF	P	—	PF	PF	PF	PF	F
Token Ring[3]	PF	PF	P	—	PF	P	PF	PF	F
Frame Relay (Cisco, IETF), ATM-DXI									
Serial[4]	PF	P	P	P	PF	P	P	P	F
BRI/PRI[5]	P	P	P	P	P	P	P	P	P
SMDS									
Serial[4]	PF	P	P	P	PF	P	P	P	P
BRI/PRI[5]	P	P	P	P	P	P	P	P	P
X.25									
Serial[4], BRI/PRI[5]	P	P	P	P	P	P	P	P	P
PPP									
Serial[4]	PF	P	P	P	PF	P	P	P	P
BRI/PRI[5]	P	P	P	P	P	P	P	P	P
HDLC									
Serial[4]	PF	PF	P	P	PF	PF	PF	PF	F
BRI/PRI[5]	P	P	P	P	P	P	P	P	PF
AAL5 SNAP, AAL5 MUX, AAL5 NLPID									
ATM[6]	F	F	P	P	P	P	P	P	P

1. Ethernet interfaces are available on the Ethernet network processor module.
2. FDDI interfaces are available on the FDDI network processor module.
3. Token Ring interfaces are available on the Token Ring network processor module.
4. Serial interfaces are available on the serial network processor modules.
5. BRI and PRI interfaces are available on the ISDN BRI network processor module. The channelized E1 and channelized T1 controllers for the Cisco 4000 and Cisco 4500 can also be configured to run ISDN PRI.
6. ATM interfaces are provided on the Network Processor Module (NPM).

Table F-9 Switching on the Cisco 2500 Series

Encapsulation/ Interface[1]	IP	IPX	DECnet	AppleTalk Phase 2	ISO CLNS	Banyan VINES	XNS	Bridging
ARPA								
Ethernet	PF	PF	PF	PF	PF	PF	PF	PF
SNAP								
Token Ring	PF	PF	P	PF	PF	PF	P	PF
Frame Relay (Cisco, IETF), ATM-DXI								
Serial	PF	PF	P	P	P	PF	P	P
BRI/PRI	P	P	P	P	P	P	P	P
SMDS								
Serial	PF	P	P	PF	P	PF	P	P
BRI/PRI	P	P	P	P	P	P	P	P
X.25								
Serial, BRI/PRI	P	P	P	P	P	P	P	P
PPP								
Serial	PF	P	P	PF	P	PF	P	P
BRI/PRI	P	P	P	P	P	P	P	P
HDLC								
Serial	PF	PF	PF	PF	PF	PF	PF	PF
BRI/PRI	P	P	P	P	P	P	P	PF

1. Available interfaces depend on the Cisco 2500 series model.

Table F-10 Switching Routing Protocols on the Cisco 7500 Series with a Route Switch Processor (RSP)

Encapsulation/ Interface	IP	IPX	DECnet	AppleTalk Phase 1	AppleTalk Phase 2	ISO CLNS	Banyan VINES	XNS	Apollo Domain	Bridging
ARPA										
Ethernet[1]	PFA	PF	PF	PF	PF	PF	PF	PF	P	F
SNAP										
FDDI[2]	PFA	PF	PF	—	PF	PF	PF	PF	P	F
Token Ring[3]	PF	PF	P	—	PF	P	PF	P	P	F
Frame Relay (Cisco, IETF), ATM-DXI										
Serial[4], Channelized T1/E1[5]	PF	PF	P	P	PF	P	PF	P	—	F
PRI[5]	PF	PF	P	P	P	P	P	P	—	
SMDS										
Serial[4]	PF	P	P	P	PF	P	PF	P	P	P
Channelized T1/E1[5]	PF	P	P	P	P	P	P	P	P	P
PRI[5]	PF	PF	P	P	P	P	P	P	P	
X.25										
Serial[4], Channelized T1/E1[5], PRI[5]	P	P	P	P	P	P	P	P	P	P
PPP										
Serial[4], Channelized T1/E1[5]	PF	PF	P	P	PF	P	PF	P	P	P
PRI[5]	PF	PF	P	P	P	P	P	P	P	P
HDLC										
Serial[4], Channelized T1/E1[5]	PFA	PF	PF	P	PF	PF	PF	PF	P	F
PRI[5]	PF	PF	PF	P	P	P	P	P	P	P
AAL3/4 SMDS, AAL5 SNAP, AAL5 MUX, AAL5 NLPID										
ATM[6]	PF	PF	P	PF	PF	PF[6]	PF	P	—	P

1. Ethernet interfaces are available on the Ethernet Interface Processor (EIP) card.
2. FDDI interfaces are available on the FDDI Interface Processor (FIP) card.
3. Token Ring interfaces are available on the Token Ring Interface Processor (TRIP) card.
4. Serial interfaces are available on the Fast Serial Interface Processor (FSIP) and HSSI Interface Processor (HIP) cards. The HIP card does not support X.25.
5. Channelized T1/E1 and PRI interfaces are available on the MultiChannel Interface Processor (MIP) card.
6. ATM interfaces are available on the ATM Interface Processor (AIP) card. The AIP card does not support AAL5MUX encapsulation of ISO CLNS.