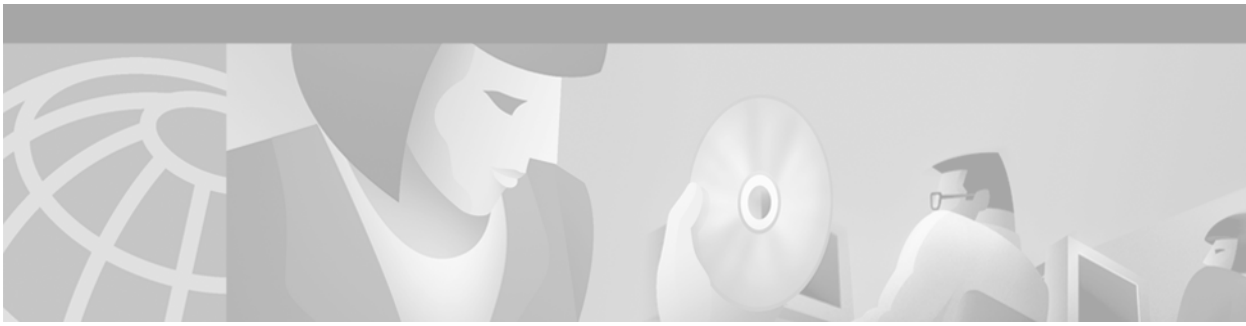

IP Multicast Switching Paths

Version History

Version Number	Date	Notes
1	08/1/2001	This document was created.

As IP multicast applications become more commonly used in network environments, the IP multicast performance requirements placed on routers and switches become increasingly more demanding. It is important that network architects choose a product that can meet the present and future multicast requirements of their networks. Consequently, they must understand how data is switched within a Cisco router or switch.

The purpose of this document is to describe the several possible switching paths available to Cisco routers and switches for the transmission of IP multicast data. The specific switching method used is dependent on the platform. Only the most relevant product families are described in this document. For information on products not discussed, please contact a Cisco software engineer.

The reader should be aware that the switching paths used for IP multicast data are fundamentally different than the paths used for IP unicast data.

This document has the following sections:

- Switching Methods Overview
- Switching Method by Platform
- Related Documents

Switching Methods Overview

Switching methods are described in the following sections:

- Process Switching
- Fast Switching
- Multicast Distributed Fast Switching
- Cisco Express Forwarding
- Parallel Express Forwarding
- IP Multicast Multilayer Switching

Process Switching

In process switching, the Route Processor (RP) must examine, rewrite, and forward each packet. First, the packet is received and copied into the system memory. The router then looks up the Layer 3 network address in the routing table. The Layer 2 frame is then rewritten with the next hop destination address and sent to the outgoing interface. The RP also computes the cyclic redundancy check (CRC).

This switching method is the least scalable method for switching IP packets.

Fast Switching

Fast switching allows routers to provide better packet forwarding performance than process switching. First, the initial packet for a particular destination is forwarded through process switching. However, in fast switching, the result of the route lookup is stored in a route cache. All subsequent packets for that destination are sent through the fast switching path, which does not require the main Route Processor (RP) to perform a route lookup. The Layer 2 frames are then rewritten and sent to the outgoing interfaces. The interface processor computes the CRC instead of the RP.

In multicast fast switching, the routing cache must store information for the source, multicast group, and multiple outgoing interfaces. Unicast fast switching needs to maintain only a cache for the destination address with a single outgoing interface.

Multicast Distributed Fast Switching

Note Multicast Distributed Fast Switching (MDFS) is also known as Multicast Distributed Switching (MDS).

In Multicast Distributed Fast Switching (MDFS), packets are distributed switched on platforms with line cards. This methodology reduces the load on the Router Processor (RP), which now need only perform route lookups.

The Cisco 7500 series routers and Cisco 12000 series Internet routers have processors on their line cards that allow them to perform distributed processing. The line cards for the Cisco 7500 series are called Versatile Interface Processors (VIPs). Each line card can make forwarding decisions independently, allowing fast-switching to operate in a distributed manner.

Cisco Express Forwarding

Cisco Express Forwarding (CEF) uses a Forwarding Information Base (FIB) to make IP destination prefix-based switching decisions. The FIB is conceptually similar to a routing table or information base. It maintains a mirror image of the forwarding information contained in the IP routing table. When routing or topology changes occur in the network, the IP routing table is updated, and those changes are reflected in the FIB. The FIB maintains next hop address information based on the information in the IP routing table.

Because there is a one-to-one correlation between FIB entries and routing table entries, the FIB contains all known routes and eliminates the need for route cache maintenance that is associated with earlier switching paths such as fast switching and optimum switching.

CEF does not support IP multicast traffic. Therefore, any features that are dependent on the CEF path may not be applicable to IP multicast.

Parallel Express Forwarding

The Parallel eXpress Forwarding (PXF) processor enables IP parallel processing functions that work with the primary processor to provide accelerated IP Layer 3 feature processing. The PXF processor off-loads IP packet processing and switching functions from the Route Processor (RP) to provide accelerated and highly consistent switching performance when coupled with one or more of several IP services features such as Access Control Lists (ACLs), address translation, quality of service (QoS), flow accounting, and traffic shaping.

The forwarding path for PXF involves a pair of Cisco-designed multiprocessor application-specific integrated circuits (ASICs) called PXF network processors. Each PXF network processor consists of 16 microcoded processors that are customized for packet processing.

The Cisco 7200 series routers with Network Switching Engine (NSE-1) and the Cisco 10000 series Edge Services Router (ESR) have implemented the PXF path. IP multicast forwarding in the PXF path is only supported on the Cisco 10000 series ESR. It is not supported on the Cisco 7200 series with NSE-1.

IP Multicast Multilayer Switching

Note IP multicast Multilayer Switching is also known as IP multicast MLS and MMLS.

IP multicast MLS is hardware-based, Layer 3 switching of IP multicast data for routers connected to high-end Catalyst LAN switches. IP multicast MLS switches IP multicast data packet flows between IP subnets using advanced ASIC switching hardware, thereby off-loading processor-intensive, multicast packet routing from network routers. The packet forwarding function is moved onto the connected Layer 3 switch whenever a supported path exists between a source and members of a multicast group. Packets that do not have a supported path to reach their destinations are still forwarded in software by routers.

The distinction between a router and a LAN switch has become increasingly vague because of the evolution of highly intelligent Layer 3-aware ASIC. The capability of a router to interact with the forwarding mechanism of a LAN switch at Layer 3 has led to a dramatic increase in switching performance.

The Catalyst 5000 family switches and Catalyst 6500 family switches with Supervisor Engine I support IP multicast MLS for only (S, G) flows. The Catalyst 6500 family switches with Supervisor Engine II support IP multicast MLS for both (S, G) and (*, G) flows. For more information on (S, G) and (*, G) flows, refer to the *Internet Protocol (IP) Multicast Technology Overview* Cisco white paper listed in the "Related Documents" section at the end of this document.

Switching Method by Platform

The specific switching methods used by IP multicast platforms are described in the following sections:

- Cisco 1600 Series, 2600 Series, and 3600 Series
- Cisco 7200 Series

- Cisco 7500 Series
- Cisco 10000 Series Edge Services Router
- Cisco 12000 Series Internet Router
- Catalyst 5000 Family
- Catalyst 6500 Family

A summary of the switching capabilities for IP multicast platforms is shown in Table 1.

Table 1 IP Multicast Platform Switching Capabilities

Platform	Process Switching	Fast Switching	MDFS	Multicast MLS	PXF
Cisco 1600 series, 2600 series, and 3600 series	Yes	Yes	No	No	No
Cisco 7200 series without NSE-1	Yes	Yes	No	No	No
Cisco 7200 series with NSE-1	Yes	Yes	No	No	No
Cisco 7500 series	Yes	Yes	Yes	No	No
Cisco 10000 series	Yes	Yes	No	No	Yes
Cisco 12000 series	Yes	Yes	Yes	No	No
Catalyst 5000 family without either of the following options: • Supervisor Engine III, NetFlow Feature Card II (NFFC-II), and Route Switch Module (RSM) • Supervisor Engine II G or III G, and Route Swtich Feature Card (RSFC)	No	No	No	No	No
Catalyst 5000 family with one of the following options: • Supervisor Engine III and NFFC-II • Supervisor Engine II G or III G	No	No	No	Yes[1]	No
Catalyst 5000 family with one of the following options: • Supervisor Engine III, NFFC-II, and RSM • Supervisor Engine II G or III G, and RSFC	Yes	Yes	No	Yes	No
Catalyst 6500 series without MSFC	No	No	No	No	No
Catalyst 6500 series with MSFC	Yes	Yes	No	Yes	No

1. Requires an external router.

Cisco 1600 Series, 2600 Series, and 3600 Series

The Cisco 1600 series, 2600 series, and 3600 series routers are software-based. No hardware acceleration is available. Consequently, fast switching is the only switching option available.

Cisco 7200 Series

The Cisco 7200 series routers have several Network Processing Engine (NPE) options such as the NPE-225 and NPE-400. The newer Cisco 7200VXR series routers support all of the NPE options as well as the Network Services Engine (NSE-1). The NSE-1 processor supports Parallel eXpress Forwarding (PXF), which delivers hardware-accelerated IP services including WAN Edge and quality of service (QoS). However, the PXF implementation on the NSE-1 supports hardware acceleration for unicast traffic only, not IP multicast traffic. Consequently, for IP multicast, fast switching is the only switching option available on the Cisco 7200 series routers.

Cisco 7500 Series

The Cisco 7500 series routers provide a highly available, scalable distributed architecture, which leverages the abilities of the Versatile Interface Processors (VIPs). Each VIP has its own CPU and can route packets independently of the Route Switch Processor (RSP). The Cisco 7500 series provides the breadth of support required for LAN and WAN services in terms of redundancy, reliability, and performance.

The Cisco 7500 series routers use Multicast Distributed Fast Switching (MDFS). The following data-link types are supported by MDFS on the Cisco 7500 series routers:

- Ethernet
- FDDI
- ATM
- POS
- Serial

MDFS has limitations when used with older VIPs. It will operate correctly only for packets arriving on a VIP2 interface. If a packet arrives on a VIP1 interface, it will only be fast-switched. Because the incoming interface is the limiting factor, packets that arrive on a VIP2 interface, but that leave the router on a VIP1 interface, will be multicast distributed switched.

Cisco 10000 Series Edge Services Router

The Cisco 10000 series Edge Services Router (ESR) is a high-performance edge router for Internet service providers (ISPs) that require advanced IP services. The ESR is designed to be a high-density and high-performance device. The ESR uses Parallel eXpress Forwarding (PXF), which supports IP multicast.

Cisco 12000 Series Internet Router

The Cisco 12000 series Internet router is the premier routing product family from Cisco designed and developed for the core of service provider and enterprise IP backbones. It uses a distributed architecture with intelligent line cards to deliver scalable Layer 3 switching performance.

The Cisco 12000 series Internet router uses Multicast Distributed Fast Switching (MDFS).

Catalyst 5000 Family

The Catalyst 5000 family switches can perform multilayer switching with the appropriate software and hardware. To operate correctly, IP multicast MLS requires the following versions or later versions of software and hardware:

- Catalyst 5000 family software Release 5.1
- Supervisor Engine III with NetFlow Feature Card II (NFFC II), Supervisor Engine II G, or Supervisor Engine III G

The Catalyst 5000 family switches require a Route Processor (RP) to run IP multicast MLS. The RP can be one of the following options:

- A Route Switch Module (RSM) running Cisco IOS Release 12.0(3a)W5(8) or a later release
- A Route Switch Feature Card (RSFC) (requires Supervisor Engine II G or III G) running Cisco IOS Release 12.0(3c)W5(8) or a later release
- An external router such as the Cisco 7500 series, 7200 series, 4700 series, 4500 series, or 3600 series routers

Catalyst 6500 Family

The Catalyst 6500 family switches are high-performance switching products. To operate correctly, IP multicast MLS requires Catalyst 6000 family software Release 5.3 or a later release.

The Catalyst 6500 family switches use IP multicast MLS with a Multilayer Switching Feature Card (MSFC) or external router.

Related Documents

- *Multicast Distributed Switching*, Cisco IOS Release 11.1 CC feature module

  http://www.cisco.com/univercd/cc/td/doc/product/software/ios111/cc111/mds.htm
- *IP Multicast Multilayer Switching*, Cisco IOS Release 12.0(5)T feature module

  http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/120newft/120t/120t5/ipmctmls.htm
- *IP MultiLayer Switching Sample Configuration*, Cisco Sample Configuration

  http://www.cisco.com/warp/public/473/39.html
- "Switch and ROM Monitor Commands," *Catalyst 6000 Family Command Reference,* Release 6.2

  http://www.cisco.com/univercd/cc/td/doc/product/lan/cat6000/sw_6_2/cmd_ref/sh_ml_n.htm#xtocid883618
- *Cisco 10000 Series ESR System Description*

  http://www.cisco.com/univercd/cc/td/doc/product/aggr/10000/sysdes/index.htm
- *Cisco IOS Switching Services Configuration Guide*, Release 12.2

  http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/fswtch_c/index.htm
- *Cisco IOS Switching Services Command Reference*, Release 12.2

  http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/fswtch_r/index.htm
- *IP Multicast Technology Overview*, Cisco white paper

  http://www.cisco.com/univercd/cc/td/doc/cisintwk/intsolns/mcst_sol/mcst_ovr.htm
- Cisco IOS Software IP Multicast Group External Homepage

  ftp://ftpeng.cisco.com/ipmulticast/index.html
- Cisco IOS Software Multicast Services Web Page

  http://www.cisco.com/go/ipmulticast