

Overview and Specifications

This chapter is an overview of Ethernet and how Catalyst equipment is used with Ethernet. The last section of this chapter lists the features and specifications for the Catalyst Stack equipment described in this guide.

The following topics are discussed in this chapter:

- Ethernet Network Performance
- Switching Technology
- Specifications

Ethernet Network Performance

The restrictions of Ethernet performance can impede network performance as follows:

- Ethernet supports only one conversation at a time. With this restriction a network can quickly become congested, forcing users to wait until bandwidth becomes available before they can send a message.
- As network utilization increases, throughput decreases. When two packets are transmitted at the same time, they collide and both transmissions are aborted. The transmitting devices try again after a random interval. As a result, actual Ethernet throughput is less than the theoretical 10 Mbps. Ethernet performance declines significantly at 20% network utilization; between 40–50% utilization, throughput declines to less than 2 Mbps. With the Catalyst 3000 and Catalyst Stack, throughput remains steady even at 70% network utilization.
- High-bandwidth devices and applications quickly consume available bandwidth. The speed of network devices is continually increasing. Today's powerful servers and workstations can claim a large portion of available bandwidth, as can the transmission

Switching Technology

of large graphics and multimedia files. Ethernet's 10 Mbps bandwidth must be divided among all users on the network; if a fileserver uses 8 Mbps, the remaining users must share the remaining 2 Mbps among themselves.

Methods For Improving Network Performance

There are several methods for alleviating congestion and improving performance.

- Partitioning a network into smaller workgroups using routers and bridges.
 - This approach improves network performance by reducing the number of users in a workgroup.
 - However, partitioning also has some problems. For example, it does not relieve congestion caused by high-bandwidth devices within a workgroup. Actually, it can slow down interworkgroup communications because each bridge or router imposes a delay as it reads the packet address.
 - Another disadvantage of partitioning is that the network administrator must continually adjust the network configuration in response to changing network use patterns—for example, by moving a file server from one workgroup to another.
- High-speed technologies such as Fiber Distributed Data Interface (FDDI) and Asynchronous Transfer Mode (ATM).
 - FDDI and ATM are new media that have greater bandwidth than Ethernet. For example, FDDI provides 100 Mbps bandwidth. However, the bandwidth must be shared among all users, just as it is with Ethernet. In theory, a 100 Mbps FDDI network with 10 users gives each user only 10 Mbps bandwidth, just like a 10 Mbps Ethernet network.
 - The solution for these performance problems is Ethernet switching.

Switching Technology

Ethernet switches, such as the Cisco Catalyst 3000, increase throughput between Ethernet segments by supporting simultaneous, parallel conversations. Switched connections between Ethernet segments last only for the duration of the packet—new connections can be made between different segments for the next packet.

Ethernet switches solve congestion problems caused by high-bandwidth devices and powerful applications as well as the number of users. Therefore, each of these devices—servers, for example—can be assigned its own 10 or 100 Mbps segment.

In Ethernet networks, the major bottleneck is typically the throughput to high-bandwidth devices such as servers, and between routers, bridges, and switches. An effective solution is full-duplex communication, an option for each segment connected to a Catalyst 3000 port. Normally, Ethernet operates in half-duplex communication mode, which means stations can either receive or transmit. With full-duplex technology, two communicating stations can transmit and receive at the same time, like telephones. When packets can flow in both directions simultaneously, effective Ethernet bandwidth doubles from 10 Mbps to 20 Mbps for 10Base-T ports and on Fast Ethernet ports to 200 Mbps.

The Catalyst 3000 and Catalyst Stack are IEEE 802.3-compliant devices designed to boost throughput on Ethernet networks from 300 to 1,000 percent. They operate as a media access control (MAC)-layer device that is protocol independent; therefore, they are fully compatible with TCP/IP, DECnet, LAT, XNS, AppleTalk, and NetWare.

Switch of Switches

The Catalyst 3000 and Catalyst Stack can be deployed in a variety of network configurations, all of which provide a significant increase in network performance. The Cisco Catalyst product family allow users to build a network system that can transport data efficiently and scale upwards as throughput requirements increase. The Catalyst 3000 and Catalyst Stack deliver high-reliability and media flexibility. These features combine to allow the Catalyst 3000 and the Catalyst Stack to be used as a switch of switches providing media flexibility in an Ethernet configuration.

Along with the EtherChannel™, the Catalyst 3000 or the Catalyst Stack can connect with other Catalyst products, to deliver a broad range of network carrying capacity. Bandwidth is easily scaled to meet all performance requirements.

Switch of Servers

With client/server applications, many client workstations may attempt to access a single server at the same time. This traffic pattern may create bottlenecks at the server. To further enhance performance, the Catalyst 3000 and Catalyst Stack can deliver dedicated bandwidth to high-speed file servers. All servers perform better with dedicated 10 Mbps bandwidth.

The performance of new, powerful servers can improve dramatically with a dedicated Fast Ethernet connection (100 Mbps) to the Catalyst 3000 or Catalyst Stack. Fast Ethernet provides ample bandwidth for multiple clients to access the server simultaneously.

The switch ties together all Ethernet devices lined to a local wiring center. In networks, where a significant portion of the traffic moves locally between client and server, the switch can be quite effective.

Switch of Hubs

When network traffic increases beyond the capability of hubs, contention results. Applications suffer and may even fail. The Catalyst 3000 and Catalyst Stack can be quite effective when used as a switch of hubs. Intelligent hubs have helped to make Ethernet the most widely utilized LAN protocol in today's networks, yet conventional design mechanics have forced users to daisy-chain several hubs together to accommodate more devices. The net effect of such a network configuration is that all devices share a single 10 Mbps data path, thus reducing overall network efficiency.

The Catalyst 3000 or Catalyst Stack can alleviate contention through microsegmentation, or reducing the number of devices in each shared segment. To provide microsegmentation, the Catalyst 3000 divides a single 10 Mbps segment into multiple 10 Mbps segments. As an example, a workgroup has 10 Mbps of capacity. After collisions, the actual throughput is 3 to 4 Mbps. However, the 16 ports on the Catalyst 3000 support 8 simultaneous conversations with 8 Hubs, thus providing the workgroup with 80 Mbps bandwidth throughput, which results in a significant gain in bandwidth.

Switch of Desktops

The Catalyst 3000 and Catalyst Stack are a cost-effective means of providing dedicated bandwidth to individual workstations. In this application, the Catalyst 3000 or Catalyst Stack replace a hub, providing excellent, hub-like network management statistics. Total network capacity and throughput increase dramatically.

Switch of Workgroups

Network managers can switch workgroups by using the 100Base-TX expansion modules.

Switch of Floors and Buildings

For network managers, multistory buildings and campuses can represent a unique networking challenge. How can a network manager provide an efficient LAN interconnect for users that are located on several floors of a building or in different buildings?

Ethernet switching and the Catalyst product family can provide the best solution. The Catalyst 3000 and Catalyst Stack provide enhanced throughput to local wiring closets that can be connected to an Catalyst located in the data center.

Many networks consist of users located in different buildings of a campus environment. The Catalyst 3000 or Catalyst Stack can be used as a collapsed backbone interconnecting multiple buildings of a campus. The Catalyst 3000 or Catalyst Stack can provide the connectivity solution and enhanced throughput that such campus environments require.

Switch of Routers

Router technology has had a significant impact on the design of today's internetworks. Routers have become the cornerstone of most production networks. Although well equipped to provide firewall, WAN connectivity, security, and connection between dissimilar LANs, routers are unable to provide high throughput between desktop devices and servers. Because of these limitations, routers and Catalyst units perform complimentary functions in the network.

The Catalyst 3000 or Catalyst Stack can be used as a front-end to routers to increase performance in each subnet. Communication between local clients and servers is enhanced at the workgroup level below the router.

Specifications

The Catalyst 3000 and Catalyst Stack can also be used to back-end routers. In networks where many routers are interconnected over Ethernet and backbone performance is not acceptable, the Catalyst 3000 and Catalyst Stack provide non-blocking communication between the routers for enhanced network performance. This provides protocol transparency with enhanced throughput in each subnet between local servers and desktops, thus allowing network managers to build logical networks as large as network layer protocol and broadcast traffic allow.

The SwitchProbe™ (Switched Port Analyzer) also gives a collapsed backbone network superior network management and the ability to perform protocol analysis from a single location. The SwitchProbe (Switch Port Analyzer) provides the latest technology for monitoring switch-based networks and helps to reduce the cost of managing these networks.

Specifications

The following sections list the features and specifications of the Catalyst 3000 and the Catalyst Stack Matrix. The Catalyst Matrix is used to combine up to eight Catalyst 3000 units together to form one logical unit, which is called an Catalyst Stack. See Chapter 3 “Catalyst 3000 Stack Theory of Operation” for an explanation of the Catalyst Stack.

Information within this section:

- Features of the Standard version of the Catalyst 3000 and the additional features of the optional Enhanced version of the Catalyst 3000.
- Features of the Catalyst Matrix.
- The physical specifications of the Catalyst 3000.
- The physical specifications of the Catalyst Matrix.
- Stack Port link signals between the Catalyst 3000 and the Catalyst Matrix.

Catalyst 3000 Features

The Catalyst 3000 is available in a Standard and an Enhanced model.

The Catalyst 3000 Standard model features:

- Immediate plug and play capability
- 16 10Base-T ports
- Error-free cut-through switching
- Address filtering on source and destination addresses
- Automatic on-demand address aging on a per-port basis
- SwitchProbe (Switch Port Analyzer) port
- IEEE 802.1d spanning tree compliant
- 6,000 system addresses, with a memory upgrade option for 20,000
- 1700 addresses per port
- 192 KB buffering per 10 Mbps port (384 packets)
- 40 microseconds latency time
- Console port
- Telnet support
- Bridge MIB, Ethernet MIB, SNMP MIB II and Catalyst extensions
- Flash PROM for software updates

The Enhanced model includes all of the features of the Standard model along with the following features:

- Full-duplex support
- EtherChannel for connectivity to existing Catalyst products
- Virtual LAN (VLAN) capability

Specifications

Catalyst 3000 Specifications

Table 1-1 Catalyst 3000 Specifications

Catalyst 3000 Specification	Description
Rack mount	19" rack mount (hardware included)
Dimensions	Width: 17" (43 cm) Depth: 13.38" (34 cm) Height 3.45" (8.76 cm)
Weight	17 lbs.
Power	90 to 264 VAC auto-sensing
Frequency	47 to 63 Hz
AC current rating	1.5A @ 120V; 0.75A @ 220V
Thermal dissipation	100 Watts 340 BTUs/hr
Temperature:	
Operating	10 to 40 °C
Not operating	-25 to 70 °C
Humidity:	
Operating	8 to 80% (non-condensing)
Not operating	90% @ 45 °C
Electromagnetic Emissions	FCC Class A
Certification	EN55022A VCCI-1
Safety	UL1950 UL-C EN60950 (TUV)
Microprocessor	i960 RISC processor

Catalyst 3000 Specification	Description
Memory	4MB; optional 8MB
Flash EPROM	1024KB standard
LAN compatibility	Ethernet/IEEE 802.3
LAN interface ports	16 10Base-T, RJ45 connectors 1 AUI port, DB15 connector (de-activated if 10Base-T port 1 is used)
Expansion Modules (LAN port)	100Base-TX, RJ45 connector
Console (monitoring port)	EIA(RS)232, DB9 connector
SwitchProbe (monitoring port)	AUI, DB15 connector
Buffers per port	10Base-T: 192 KB (dynamic) 100Base-TX: 512 KB
Address support	1,700 addresses per port 10,000 addresses per system Optional - 20,000 addresses per system
Address Filter Rate	357 K packets/second
Address Forward Rate	714 K packets/second
Address Table Setup	Transparent and automatic
Latency	10 to 10: 40 microsec. 10 to 100: 64 microsec.
Software updates	Flash PROM, bootp/TFTP
Protocol compatibility	Transparent to higher layer protocols
Spanning Tree support	IEEE 802.1d compliant
MIB's supported	Ethernet (RFC1643) Bridge (RFC1493) SNMP MIB II (RFC1213) Catalyst Extensions

Specifications

Catalyst 3000 Specification	Description
Network Management	Applications: <ul style="list-style-type: none">• CiscoView• SNMP Management Platform Console: <ul style="list-style-type: none">• Console sessions• Telnet sessions

Catalyst Matrix Features

The Catalyst Matrix has the following features:

- 8 I/O Stack Ports using 50-pin SCSI-2 type connectors (one per port).
- 280Mbps per port (full duplex).
- 1.12Gbps total Catalyst Matrix capacity.
- The ability to move packets between switches.
- Round-robin output port arbitration.
- Each port operates independently and in parallel (except for multicast).
- Replicates multicast packets.
- No processor. Managed by the attached Catalyst 3000 units.
- Optional redundant Modules.
- Modules are hot swappable.
- Front access to field replaceable Modules.

Catalyst Matrix Specifications

Table 1-2 Catalyst Matrix Specifications

Catalyst Matrix Specification	Description
Rack mount	19" rack mount (hardware included)
Dimensions	Width: 17" (43 cm) Depth: 13.38" (34 cm) Height 3.45" (8.76 cm)
Power	90v to 264v AC voltage range. Universal input.
Frequency	47Hz to 63Hz
AC current rating	1.5A @ 120V; 0.75A @ 220V
Temperature:	
Operating	0 to 55 C.
Not operating	minus 25 to 70 C.
Humidity:	
Operating	8 to 80% (non-condensing)
Not operating	8 to 95% (non-condensing)
Electromagnetic Emissions	FCC Class A
Certification	EN55022 Class B VCCI-1
Safety	UL1950 UL-C EN60950 (TUV)

Specifications
