



Intelligent Switching for the **Evolving** Network

Catalyst: An agent that precipitates or accelerates
a reaction, development, or change.



Intelligent switching
for the **evolving** network:
Easing network migration,
adaptation, and expansion.

Q: Why change anything?

A: Because there really isn't any alternative.

Just as living things must adapt to changing conditions in their environments, businesses and other organizations must continually adapt their networks to changing requirements. After all, it's hard to find a network manager who isn't contemplating a change of some sort, whether it's adding more users, rolling out new applications, converging voice and data services, or even making the jump from hubs to switches.

That's why Cisco Systems created this guide—to provide an overview of the issues confronting countless businesses, schools, government agencies, and other organizations as they migrate, adapt, and expand their networks to meet new needs. And to explain how Cisco Catalyst® switches can help, both in the short term and the long haul.

Q: Why start with intelligent switching?

A: Because of all the changes after that.

Change can be a major source of stress—for networks as well as network managers. The proliferation of powerful new desktop computers, bandwidth-intensive applications, and devices such as IP phones and wireless access points all can leave networks straining to keep up. As a result, unpredictable traffic patterns can emerge, bogging down mission-critical applications. Holes can appear in security, leaving the network vulnerable to internal and external threats. And demand for bandwidth can outstrip the supply, causing one bottleneck after another.

Cisco Catalyst switches spare networks from these and other growing pains. They provide the advanced quality of service (QoS) needed to ensure mission-critical traffic is assigned top priority. They enhance security with new features that protect the network from risks within and without. And they provide the bandwidth needed to grow, all the way up to 10 Gigabit Ethernet.

Migrating to intelligent switching is not a difficult step in a network's evolution, but it's an important one, providing a solid foundation for all the steps to come.



The Cisco Catalyst Series switches run the range from chassis to stackable switches, with models available to address special requirements, such as support for inline power and Gigabit Ethernet over copper.

Q: How important is QoS?

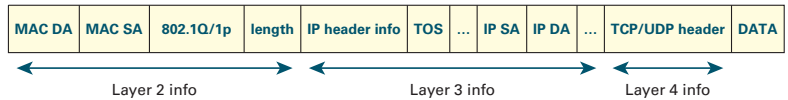
A: QoS is very important—and becoming more so every day.

Advanced QoS prioritizes and directs traffic to minimize congestion and ensure applications are allotted the bandwidth they need. Without those features, the performance advantages of Gigabit Ethernet (or Fast Ethernet, for that matter) cannot be fully realized.

Cisco Catalyst switches classify and mark data packets at the network edge, minimizing congestion and allowing traffic to be prioritized, so time-sensitive applications such as IP telephony or videoconferencing take precedence over less critical traffic, such as Web browsing.

Extending intelligence to the network edge also makes it possible for network managers to set up policies on a per-user basis, and frees up router processing power.

This illustration shows the contents of a data packet:



Layer 2 switches only process Layer 2 information. Cisco Catalyst switches look deeper into the packet and make decisions based on Layer 3 and Layer 4 information—that’s why they’re called “intelligent.” As a result, traffic flows more efficiently through the network, helping to prevent bottlenecks. Utilizing Layer 3 and Layer 4 information also provides a superior level of control over network traffic, making it easier to adjust to changing requirements and priorities as networks grow and evolve.

Q: What about security?

A: Security needs to evolve with the network, too.

As companies expand their networks, security becomes increasingly important—and increasingly challenging to deliver. Adding users, deploying new services, extending Internet access, and providing remote access can all increase the potential risk to networks and data, both internally and externally.

According to a recent study by the FBI and Computer Security Institute, reported financial losses due to security breaches in the United States approached \$378 million in 2001, up from \$266 million the year before. So it’s not surprising that for many organizations, enhancing security is a major concern. Fortunately, it’s also a major benefit of deploying Cisco Catalyst switches.

The primary security features and applications supported by these switches include access control lists (ACLs), filtering, port security, IEEE 802.1x, multilevel console security, and Secure Shell (SSH) Protocol. This unique combination provides the enhanced security needed to support new and expanding network services, addressing three distinct areas of concern in the network:

- **Authentication** In other words, is the user supposed to have network access?
- **Authorization** What's the user permitted to do on the network?
- **Accounting** Who's using the network and what are they doing?

All together, the security features supported by Cisco Catalyst switches offer the protection and control needed to prevent both malicious acts and inadvertent mishaps.

These features can be used to address performance as well as security issues. Hardware-based filtering, for instance, is typically used to screen MAC addresses to restrict access to sensitive areas of the network. But it can also be used to deal with a specific host that's been bogging down the network, denying it access while allowing all others to enter. The protected port feature eliminates the possibility of unauthorized IP traffic on virtual LANs (VLANs).

Finally, it's worth noting that Cisco Catalyst switches support applications to deal with another concern: physical security. Their multiservice capabilities make them ideally suited for IP video surveillance applications, providing an effective, yet affordable, alternative to conventional video monitoring systems.

Q: Why make the move to Gigabit Ethernet?

A: Because networks need room to grow.

At speeds of 1000 megabits per second (Mbps), Gigabit Ethernet provides the bandwidth that networks need to evolve and meet new demands, alleviating bottlenecks, boosting performance, and increasing the return on existing investments in infrastructure.

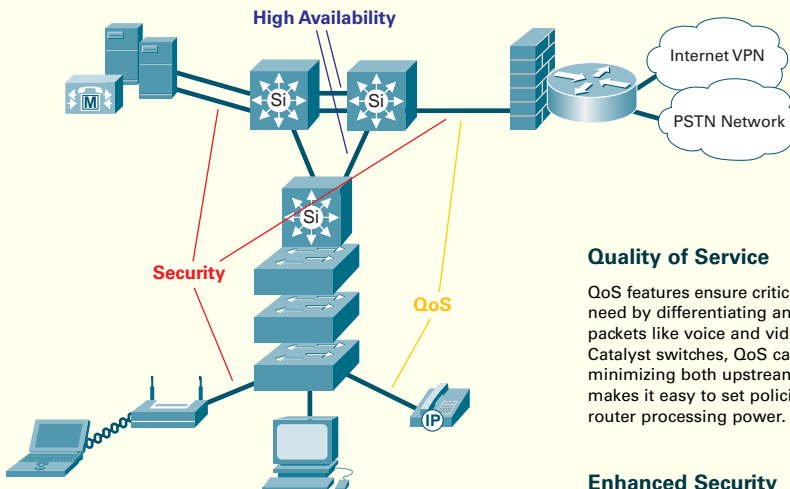
As the industry leader in LAN switching, Cisco makes the transition to Gigabit Ethernet faster and easier with standards-based solutions for both fiber-optic and copper cabling. Cisco products can also be deployed in stages for a more gradual migration to Gigabit Ethernet, starting at the core and moving on to the wiring closet.

Organizations can use Cisco Catalyst switches to extend Gigabit Ethernet to the desktop, simply and affordably, to support today's powerful computers, sophisticated applications, and high traffic volumes. Delivering up to 10 gigabits per second (Gbps), the range of solutions offered by Cisco will satisfy even the most bandwidth-hungry environments.

Network Intelligence—from the Core to the Edge

Whatever the size of the network, intelligent services can ease the strain of migration and expansion. By delivering Layer 2–4 services across the entire network, from the core to the edge, Cisco Catalyst switches provide the advanced quality of service, enhanced security, and high availability evolving networks require. All Cisco Catalyst network platforms run on Cisco IOS® Software, creating a unified network and a solid foundation for building Internet applications.

Medium-Sized Network



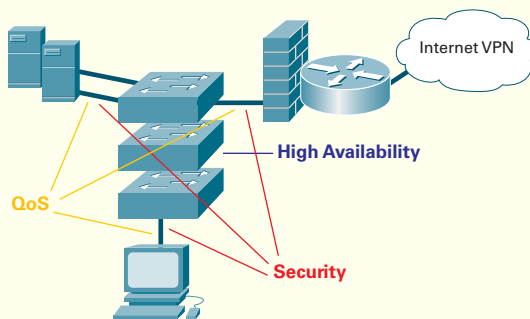
Quality of Service

QoS features ensure critical applications receive the bandwidth they need by differentiating and prioritizing traffic, so time-sensitive packets like voice and video are handled accordingly. With Cisco Catalyst switches, QoS can be extended to the network edge, minimizing both upstream and downstream congestion. This also makes it easy to set policies on a per-user basis and frees up router processing power.

Enhanced Security

The need for security increases as services and devices are added to the network. Safeguards must be taken to ensure only authorized users can gain access to the network, to restrict access to sensitive network areas, and to prevent data and voice traffic from traveling to the wrong PC or IP phone. Cisco Catalyst switches support multiple layers of security for end-to-end protection of network controls and resources.

Small-Business Network



High Availability

The Cisco Catalyst family also increases network uptime—and employee productivity—through a unique combination of features designed to ensure maximum availability. Capabilities include high-performance IP routing, Layer 2 and Layer 3 load balancing, bandwidth aggregation technology, multicast management via Internet Group Management Protocol (IGMP) snooping and Protocol Independent Multicast (PIM), and Cisco Spanning-Tree Protocol enhancements such as BackboneFast, UplinkFast, PortFast, and CrossStack UplinkFast.

Q: Why use Cisco Catalyst switches to ease network evolution?

A: Lots of reasons—as lots of people can attest.

Cisco Systems' achievements and contributions have made it one of the world's most admired companies. Service providers, PTTs, governments, academic institutions, *Fortune* 500 companies, and small-to-medium businesses around the world look to Cisco to enable and support their diverse networking requirements.

Cisco is uniquely qualified to help organizations adapt as their requirements change. After all, Cisco solutions are as scalable as the Internet itself, powering more than 80 percent of the World Wide Web.

Here are some of the reasons why Cisco Catalyst switches are the right choice:

- Cisco Catalyst 2950, 3550, 4500, and 6500 Series switches provide a complete Gigabit Ethernet switching solution, from the edge of the network to the core.
- The Cisco Catalyst family, a complete range of stackable and chassis switches, provides industry-leading performance, functionality, scalability, and flexibility, which deliver valuable enhancements to your network operations.
- Cisco offers end-to-end solutions for a variety of applications, from basic connectivity all the way up to complete edge-to-core IP telephony systems with Cisco CallManager, voice services gateways, IP phones, inline power support, and voice and auxiliary VLANs.
- Cisco Catalyst network platforms run on Cisco IOS Software, which creates a unified network and provides a solid foundation for building Internet applications. Extending common services and interfaces across the network also reduces training, management, and troubleshooting costs.
- Cisco provides comprehensive service and support, with the expertise to handle any situation that arises after installation. Warranty and SMARTnet support services ensure that operations staff can refresh their system software and access a wealth of knowledge. Customers can keep their technology up to date, augment their knowledge and skills, gain access to resources and tools for rapid problem resolution, and minimize the challenges associated with the stocking of replacement hardware.

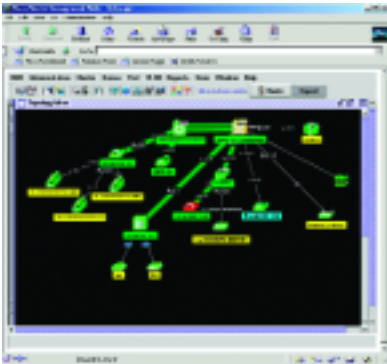
Q: But anything this advanced must be difficult to deploy and manage, right?

A: Not at all—that's a key advantage of these switches.

The whole point, after all, is to make it easier to accommodate new services and requirements. So Cisco Catalyst switches are designed to simplify all aspects of network management by providing a variety of deployment and management software solutions. All of the Catalyst switches offer Simple Network Management Protocol (SNMP) support, along with a comprehensive set of MIBs enabling effective in-band management, while Remote Monitoring (RMON) software support provides for granular traffic monitoring across the switch.

The Cisco Catalyst Series switches provide a comprehensive set of management tools to simplify the deployment and management of switches and intelligent network services. The CiscoWorks family of Web-based management tools enables network administrators to easily and quickly deploy end-to-end network services. Configuration, administration, monitoring, fault detection, troubleshooting, and remote monitoring capabilities can all be handled through an easy-to-use interface.

In addition to these Catalyst family management tools, the individual switches offer enhanced management tools:



Cisco CMS Software enables network managers to manage the entire LAN through a single Web interface.

- Embedded at no additional cost in Cisco Catalyst 3550 and 2950 Intelligent Ethernet Series switches, Cisco Cluster Management Suite (CMS) Software enables network administrators to remotely manage and monitor the entire LAN through a simple, point-and-click interface, without having to learn command-line interface (CLI). Up to 16 switches can be configured at once using any standard Web browser, saving tremendous time. This tool also eases the deployment of intelligent services, providing wizards that automatically optimize networks for video streaming or videoconferencing, voice over IP, critical data applications, and security features. A Guide Mode provides step-by-step instructions and online help.
- The Catalyst 4500 Series simplifies network management and control with a single software image and IP address for device management, a comprehensive set of management tools offering a wide variety of interface options, and well-designed system default settings.
- In the Catalyst 6500 Series, Element Manager Software leverages the Cisco Element Manager Framework (CEMF) to manage and monitor one or more specific devices. Through an intuitive user interface, each Element Manager eases and accelerates deployment, enables efficient operation of large network environments, and streamlines the provisioning process. Each Element Manager also provides fault and element management without requiring detailed knowledge of Cisco IOS Software or SNMP.

Q: What are the differences between the various Cisco Catalyst Series switches?

A: They're part of the same team, just playing different positions.

Four distinct Catalyst product lines play key roles in the switched network—the Cisco Catalyst 2950 Series and Cisco Catalyst 3550 Series Intelligent Ethernet Switches, and the Cisco Catalyst 4500 Series and Cisco Catalyst 6500 Series.

The Cisco Catalyst switches you select will vary depending on location, interface, port density, service, and feature requirements. Each series includes a choice of models to suit a range of needs, but here's a general breakdown:

- **Cisco Catalyst 2950 Series** makes it easy and affordable to deploy intelligent services at the network edge with new fixed-configuration, stackable models that provide wire-speed Fast Ethernet, Gigabit Ethernet, and Long-Reach Ethernet desktop connectivity. Long-Reach Ethernet enables network extension over Category 1, 2, and 3 wiring. Designed for small and medium-sized businesses and small enterprises, Catalyst 2950 Series Intelligent Ethernet switches can be paired with a Catalyst 3550 Series Intelligent Ethernet switch to enable IP routing from the core of the network to its edge.

- **Cisco Catalyst 3550 Series** is a new line of enterprise-class, stackable, multilayer switches. With a range of Fast Ethernet and Gigabit Ethernet configurations, it can serve as both a powerful access layer switch for medium enterprise wiring closets, and as a backbone switch for midsize networks. For the first time, customers can deploy network-wide intelligent services—including IP routing—while maintaining the simplicity of traditional LAN switching.
- **Cisco Catalyst 4500 Series** offers wire-speed, multilayer switching with integrated resiliency, control, and intelligent services, including granular QoS, predictable performance, advanced security, and comprehensive management, for converged network deployments. Its modular, high-density, high-performance design supports switched 10/100/1000 in the LAN, packet telephony, enhanced security, and integrated WAN capabilities for converged networks.
- **Cisco Catalyst 6500 Series** offers enterprises industry-leading scalability, flexibility, and performance, supporting a wide range of interface densities and services modules. It's designed to address the growing need for security, gigabit scalability, high availability, rich services, and multilayer switching in backbone, distribution, and wiring closet topologies as well as data center environments, including support for 10 Gigabit Ethernet interfaces and WAN connectivity up to OC-48 speeds.

Stackables

Chassis



Cisco Catalyst 2950

- Stackable, Compact Footprint
- Medium Port Density
- L2 Switching
- Clustering Management
- External Redundant Power



Cisco Catalyst 3550

- Stackable, Compact Footprint
- Medium Port Density
- Gig Density: 12 Ports
- L2-L4 Switching
- Clustering Management
- In-line Power
- External Redundant Power



Cisco Catalyst 4500

- 3-, 6-, 7-slot modular chassis
- 64 Gbps Switching Capacity
- 240 10/100/1000TX, FX
- Non-Blocking Gig Density: 32
- LAN/WAN Interfaces (T1/E1)
- L2-L4 Switching
- Integrated In-line Power
- Redundant Supervisors
- Integrated Redundant Power



Cisco Catalyst 6500

- 3-, 6-, 9-, 13-slot modular chassis
- 256 Gbps Switching Capacity
- 576 10/100 TX, FX
- Non-blocking Gig Density: 142
- 10 Gigabit Ethernet Interfaces
- Integrated Service Modules
- LAN/WAN Interfaces (to OC48)
- L2-L7 Switching
- Integrated In-line Power
- High Availability-Stateful Failover
- Redundant Supervisor, Fabric
- Integrated Redundant Power

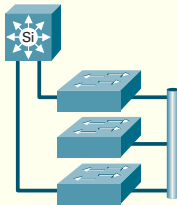


Cisco IOS® Software/End-to-End Solutions/Cisco AVVID/Network Management/Service and Support

Catalyst Wiring Closet Deployment Scenarios

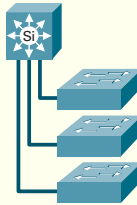
Every network is unique, just like the organizations they serve. These diagrams illustrate four common deployments in wiring closets, utilizing Cisco Catalyst 2950, 3550, 4500, and 6500 switches. Depending on the size of the business, these could be linked into the core network layer. These are merely options, of course—the Cisco Catalyst family supports a far more diverse range of needs than those depicted here.

**Catalyst 3550-12G or 12T
with Catalyst 3550/2950 Stack**



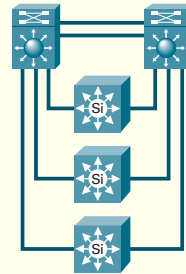
Deployment with Stackables

**Catalyst 6500/4500
with Catalyst 3550 Stack**



Deployment with Stackables and Chassis

**Catalyst 6500 with
Catalyst 6500/4500**



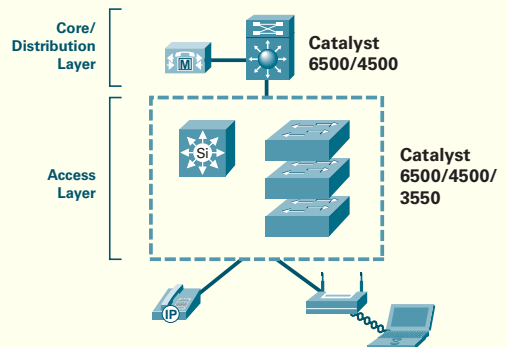
Deployment with Chassis

Functionality →

Deployment for IP Telephony and Wireless LAN Access

IP telephones and wireless LAN access points can connect to Cisco chassis or stackable switches in the access layer.

- Inline power distribution and automatic phone discovery for ease of deployment and management
- Separate voice VLANs for simplified management
- Intelligent QoS features prioritize delay-sensitive voice traffic and provides high-quality communications
- Voice Services and gateway functionality enable ease of migration to IP telephony from legacy TDM services (Catalyst 6500/4500)



A network is, and probably always will be, a work in progress. Companies grow, requirements change, and new applications emerge, presenting opportunities for even greater efficiency and productivity.

Cisco Catalyst switches are designed to make those transitions almost effortless. They provide stability in an ever-changing landscape, delivering the performance and intelligent services needed to ensure networks evolve efficiently, reliably, and securely. And that means network managers can embrace change, rather than struggle with it.

Networks get bigger and more sophisticated all the time. But with Cisco Catalyst switches, they don't have to get more complicated.

For more information, contact Cisco, your Cisco reseller, or visit:

www.cisco.com/go/catalyst2950

www.cisco.com/go/catalyst3550

www.cisco.com/go/catalyst4000

www.cisco.com/go/catalyst6500

AVVID

Cisco Architecture for Voice, Video, and Integrated Data. As the industry's only enterprise-wide, standards-based network architecture, Cisco AVVID provides the roadmap for combining business and technology strategies into one cohesive model.

Availability

The amount of time that a network or device is operational—in other words, the likelihood that it will be available for use when needed.

Backbone

The part of a network that acts as the primary path for traffic moving between, rather than within, networks. See also Core and Edge.

Bandwidth

The data-carrying capacity of a network connection, used as an indication of speed. See also Ethernet, Fast Ethernet, and Gigabit Ethernet.

Client

A networked PC or terminal that shares services with other PCs. These services are stored on or administered by a server. See also Server.

Cisco CMS

Cisco Cluster Management Suite Software. A unique, free software tool embedded in Cisco Catalyst 3550 and 2950 Intelligent Ethernet Series switches. Cisco CMS Software dramatically simplifies network management by enabling remote monitoring and configuration of up to 16 clustered switches at once through a single, easy-to-use Web interface. Cisco CMS Software also eases the deployment of intelligent services at the network edge.

Congestion

Traffic in excess of network capacity.

Convergence

The speed and ability of a group of internetworking devices running a specific routing protocol to agree on the topology of an internetwork after a change in that topology. Often refers to the merging of video and/or voice services onto a data network.

Core

The innermost part of a network, where services typically originate. See also Backbone and Edge.

Edge

The outermost part of a network, where users are typically directly connected. See also Backbone and Core.

Ethernet

A popular LAN technology that moves packets between workstations and runs over a variety of cable types at 10 Mbps (megabits per second).

Fast Ethernet

An extension of the Ethernet standard, offering speeds of 100 Mbps—or 10 times the speed of standard Ethernet. See also Bandwidth, Ethernet, and Gigabit Ethernet.

Frame

The basic unit of Ethernet data traffic. An Ethernet frame can vary in size from a minimum length of 64 bytes to a maximum length of 1522 bytes. An Ethernet frame contains the Ethernet destination address, Ethernet source address, 802.1Q/1p fields, and TCP/IP packet.

Gigabit Ethernet

An extension of the Ethernet standard, offering speeds of 1 Gbps. That equals 1,000 Mbps—or 100 times the speed of standard Ethernet. See also Bandwidth, Ethernet, and Fast Ethernet.

Hub

A device that interconnects clients and servers, simply repeating or amplifying the signals between them. Hubs act as wiring “concentrators” in networks based on star topologies, rather than bus topologies, in which computers are daisy-chained together. See also Switch.

Inline Power

Inline power is 48-volt DC power delivered to terminal devices such as IP phones over standard network cables, eliminating the need for separate power sources such as wall outlets.

Internet

A massive global network, interconnecting countless computers and networks worldwide. It is accessible from any computer with a modem or router connection and the appropriate software.

IP

Internet Protocol. A network layer protocol in the TCP/IP stack offering a connectionless internetwork service. IP provides features for addressing, type-of-service specification, fragmentation and reassembly, and security.

IP Routing

Unlike static routing, where traffic patterns are established by the network administrator and must be manually adjusted, IP routing is dynamic. When a packet begins its journey through the network, its entire route is not known. Instead, it progresses through the network one “hop” at a time, and at each interval the network automatically calculates the ideal route to the next stop along the way. This improves network performance and availability.

IP Telephony

The transmission of voice and fax telephone calls over data networks using the Internet Protocol.

IP Video

The transmission of video images over data networks using the Internet Protocol.

LAN

Local-area network. Typically, a network or group of network segments confined to one building or a campus. See also WAN (Wide Area Network).

Layer 2

The data link layer in the OSI Model. For Ethernet, this applies to the Ethernet frame that contains the Ethernet destination address, Ethernet source address and 802.1Q/1p fields. See also Layer 3.

Layer 3

The physical layer in the OSI Model. For TCP/IP, this applies to the IP packet that contains the IP destination address, IP source address and ToS byte. See also Layer 2.

Multicast

Single packet copied by the network and sent to a specific subset of network addresses.

Packet

A block of data with a “header” attached that can indicate what the packet contains and the destination where it is headed. Think of a packet as a data envelope, with the header acting as an address.

QoS

Quality of service. A set of intelligent features that enables the network to classify, mark, and prioritize traffic, reducing congestion and bringing order to the flow of data and services.

Router

A device that moves data between different network segments and can look into a packet header to determine the best path for the packet to travel. Routers can connect network segments that use different protocols. They also allow all users in a network to share a single connection to the Internet or WAN.

Server

A computer or even a software program that provides clients with services—such as file storage (file server), programs (application server), printer sharing (print server), fax (fax server) or modem sharing (modem server). See also Client.

Switch

A device that improves network performance by segmenting the network. When a switch port receives data packets, it forwards those packets only to the appropriate port for the intended recipient. This capability further reduces competition for bandwidth between the clients, servers, or workgroups connected to each switch port. See also Hub.

WAN

Wide-area network. Typically refers to a network that connects devices over greater distances, such as geographical regions. A WAN often connect two or more LANs together. See also LAN (Local Area Network).

Catalyst: An agent that precipitates
or accelerates a reaction,
development, or change.

For more information

www.cisco.com/go/catalyst2950

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www.cisco.com/go/catalyst6500



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