

Easy Migration to Gigabit Ethernet over Copper



1000BaseT: The LAN Solution for Deploying Sophisticated Applications in the Midmarket

New World Applications Require Speed, Intelligence in the LAN
Midmarket organizations have long used local-area networks (LANs) to conduct file sharing and e-mail communications. In the process, they have reaped tremendous gains in productivity and profitability. Now, the LAN is undergoing historic change, raising many new challenges. For one, midmarket companies are increasingly implementing highly sophisticated enterprise software, including enterprise resource planning (ERP), customer relationship management (CRM), and payroll automation applications. As a result, the responsibility on the LAN has skyrocketed, compromising network availability, performance, and bandwidth. The emergence of the Internet has led to increased network congestion and a reversal in the 80/20 rule, as most traffic today heads for destinations outside the LAN. Finally, with the advent of intranets and extranets, the midmarket LAN truly is in need of immediate enhancement.

Many midmarket organizations already have migrated to Fast Ethernet speeds (100 Mbps) for their desktop connections to boost LAN performance. However, that solution has solved only part of the problem. Now, bottlenecks are moving upstream, to the wiring closet. To relieve LAN congestion, desktop switches linking users

to the LAN require much faster connections to the backbone switch. Gigabit Ethernet makes this possible. With the latest 1000BaseT (Gigabit Ethernet over copper) switching solutions from Cisco, desktop switches now can be aggregated at Gigabit speeds in the backbone or in the wiring closet at the top of the stack. So, midmarket customers with a copper infrastructure can easily, dramatically, and powerfully upgrade their LAN performance to drive all their latest enterprise, Internet, intranet, and extranet applications. And they can do so for a very small incremental cost.

The 1000BaseT Standard: The Latest Stop for Ethernet

Two decades old, Ethernet has become the most widely deployed and well-known internetworking topology in the world. Throughout its existence, Ethernet has evolved from supporting simple workgroup environments to serving as the primary communications medium for entire corporate campuses. At the same time, its line speed has surged from 10 to 100 Mbps—and, now, to 1000 Mbps. This incredible scalability has allowed Ethernet to continue to meet the needs of companies that deploy increasingly sophisticated applications.

Overview of the 1000BaseT Standard
The 1000BaseT standard (IEEE 802.3ab) is an extension of the existing and highly popular Fast Ethernet standard. It specifies Gigabit Ethernet operation over the Category 5 cabling systems

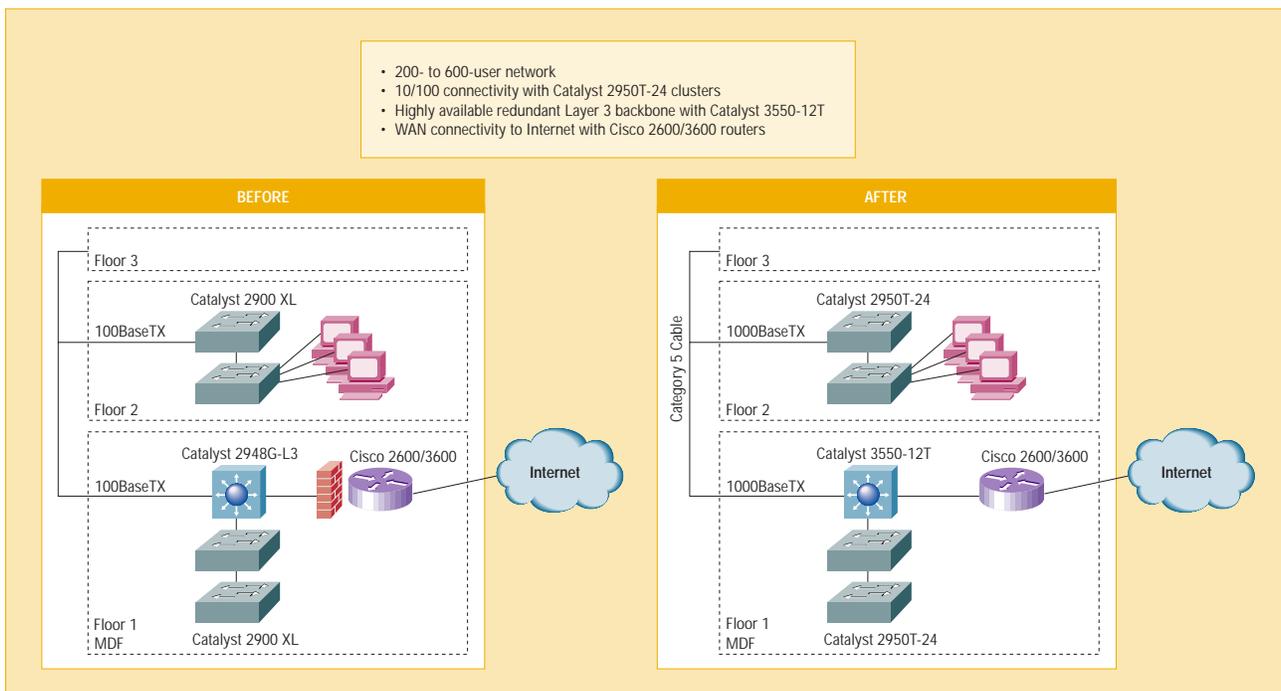
already widely installed, making it a highly cost-effective solution for the midmarket. The 1000BaseT standard also supports 1000-Mbps operation over the newest emerging EIA/TIA Category 5e cabling specifications. As a result, all copper-based environments that run Fast Ethernet also can run Gigabit Ethernet over the existing network infrastructure in order to dramatically boost network performance for demanding applications. And migration to Gigabit Ethernet is seamless and easy, because companies can take advantage of their existing Ethernet training and knowledge base. Finally, the 1000BaseT standard was designed to be extremely robust, supporting all the popular features of Fast Ethernet—and more. This quality makes 1000BaseT highly desirable for Ethernet-based infrastructures that rely upon such sophisticated features as quality of service (QoS), advanced security, and policy enforcement.

Deployment of the 1000BaseT Standard

The 1000BaseT standard allows for tremendous flexibility in the LAN. The 1000BaseT standard can be deployed in three parts of a network:

- **Switch uplinks**—The 1000BaseT standard provides high-bandwidth connectivity from desktop switches to the next point of aggregation. With such uplinks, switches can be linked to servers and other resources at gigabit-per-second speeds. These connections can substantially relieve network congestion—improving access to high-bandwidth applications and data.
- **Server connectivity**—The 1000BaseT standard links can be used to connect high-performance servers to the switch. This use dramatically improves traffic flow. Moreover, the price of 1000BaseT network interface cards has been falling, while availability has risen. As a result, adoption rates of Gigabit Ethernet for server connectivity are expected to rise significantly.
- **Desktop connectivity**—As desktop network interface cards become available, users will begin implementing 1000BaseT at the desktop. At first, only very high-power desktop users will require such performance. However, over time, 1000BaseT is expected to migrate more gradually to the desktop as prices decrease.

Figure 1 Network Migration of the 1000BaseT Standard





As shown in Figure 1, Cisco 1000BaseT switches can be deployed anywhere in the network that currently supports Fast Ethernet or 10BaseT devices. Generally, these devices are found in wiring closets and other in-building locations because of the 100-meter distance limitation of copper. Within this building environment, Gigabit Ethernet provides the most cost-effective option for high-speed connectivity over copper.

The Tremendous Value of 1000BaseT

All the Benefits of Ethernet

As an evolutionary technology, 1000BaseT delivers all the benefits of Ethernet, while providing far greater speeds to support midmarket companies' most demanding applications. It enables all upper-layer services, including all Cisco IOS® Intelligent Network Services that operate at Layer 2, Layer 3, and higher in the Open System Interconnection (OSI) seven-layer model. These services include high availability, QoS, security, and policy enforcement. The 1000BaseT standard also supports all standard Layer 2 functions such as 802.1p-based QoS, EtherChannel® technology, virtual LANs (VLANs), 802.1Q, and spanning tree. By using their substantial institutional knowledge of Ethernet advantageously to deploy Gigabit Ethernet devices, companies can decrease training, installation, and maintenance costs.

Easy Migration to Gigabit Speeds in the Backbone

With the 1000BaseT standard, 1000BaseT network interface cards and switches will support both 100/1000 and 10/100/1000 auto-negotiation between Fast Ethernet and Gigabit Ethernet. These flexible products will enable network managers to deploy 1000BaseT incrementally into the network. For instance, a 100/1000 server network interface card may be installed into a new server while the server switch remains 100BaseTX—or vice versa. And new 100/1000 server switches may be deployed while maintaining the investment in the existing 100-Mbps server network interface cards. So, companies do not have to undergo an expensive, time-consuming infrastructure upgrade. In comparison, fiber-based solutions support only Gigabit server speeds.

Taking Advantage of Existing Category 5 Cabling Infrastructure

As mentioned previously, Gigabit Ethernet runs over the same Category 5 cabling that supports 10BaseT and 100BaseT. Therefore, midmarket companies can add Gigabit Ethernet devices easily to their existing copper infrastructures. And, by running on copper, 1000BaseT vastly improves performance without additional cabling costs. In the end, Gigabit Ethernet lets organizations reap ten times the network performance as Fast Ethernet for very little extra expense.

Ease of Management

The 1000BaseT standard is an extension of Ethernet, so LAN administrators can continue to use their existing methods of network management. The revolutionary Cisco Switch Clustering technology allows companies to quickly expand and upgrade their networks across multiple wiring closets and various LAN media without having to add resources or replace existing switching equipment. With the availability of the new 1000BaseT solution, midmarket companies can, for the first time, manage the entire LAN with one tool—Cisco Cluster Management Suite (CMS). The Cisco CMS Software allows network managers to increase control of their entire LAN by combining the power and functionality of Cisco IOS Intelligent Network Services with the simplicity of Web-based management.

The Cisco Advantage

Cisco offers an end-to-end product line designed to meet the current and emerging needs of midmarket companies. As shown in Figure 2, the state-of-the-art Cisco 1000BaseT products include the Catalyst 2950T-24, Catalyst 3550-12T switches, Cisco 1000BaseT Gigabit Interface Converter (GBIC), and the Catalyst 4000 switch. These devices can be deployed into any copper-based Ethernet environment, facilitating an easy and rapid move to Gigabit LAN speeds.

Figure 2 Cisco Gigabit Ethernet over Copper Solutions

<p style="text-align: center;">Catalyst 2950T-24</p>  <ul style="list-style-type: none"> • 24 10/100 ports for desktop connectivity • 2 10/100/1000BaseT ports for uplink or server connectivity • Wire-speed Layer 2 connectivity at the edge • Dual fixed Gigabit uplinks for redundancy • Superior LAN Edge 802.1p-based QoS • Outstanding multicast management 	<p style="text-align: center;">Catalyst 3550-12T</p>  <ul style="list-style-type: none"> • 10 10/100 ports for aggregation or server connectivity • 2 GBIC ports for uplink connectivity • Layer 3 IP routing in the backbone or at the top of the stack • Enhanced 802.1p or DSCP-based QoS • Sophisticated traffic management and security
<p style="text-align: center;">Catalyst 4000 Switch</p>  <ul style="list-style-type: none"> • Modular Layer 2 or Layer 3/4 flexibility and investment protection • 24 Gbps Switching Engine • Up to 120-ports of 10/100/100BaseT for desktop or server connectivity • Cisco AVVID common infrastructure architecture • LAN/WAN/Voice integration for Enterprise branch offices 	
<p style="text-align: center;">Solutions with the 1000BaseT Standard: The Cisco Advantage</p> <ul style="list-style-type: none"> • Optimized for Gigabit Ethernet over Copper aggregation • Increased control of the network with the power of Cisco IOS Intelligent Network Services—IP routing, advanced QoS, and security • Manage the entire LAN with Cisco Cluster Management Suite 	

Catalyst 2950T-24

The Cisco Catalyst 2950T-24 switch features 24 10/100 ports with two 10/100/1000BaseT uplink ports. This switch is ideal for standalone connectivity to the desktop or end station with Gigabit connectivity to servers. The Cisco Catalyst 2950T-24 delivers:

- **Exceptional performance**—The Catalyst 2950T-24 switch provides wire-speed performance on all ports. It features an 8.8-Gbps switching fabric and forwarding performance of 6.6 million packets per second.
- **Powerful migration path**—The Catalyst 2950T-24 allows easy migration to Gigabit network speeds over an existing copper infrastructure. Users enjoy ten-times faster connections to the backbone compared to Fast Ethernet for only a 10-percent incremental price per port.

- **Robust QoS**—Four egress queues provide granularity and flexibility in prioritizing mission-critical applications. Weighted Round Robin (WRR) scheduling ensures that all traffic receives service without compromising priority settings.
- **Superior manageability**—Web-based management of Catalyst 2950/3550-12T switch clusters is easy with the Cisco CMS Software. Cisco CMS provides the power of Cisco IOS Intelligent Network Services in a simple, Web-based management interface. Cisco CMS enables single-IP management of up to 16 interconnected Catalyst 3550-12T, 2950, 3500 XL, 2900 XL, and 1900 switches. Moreover, the Catalyst 2950T-24 eases management with auto-sensing, auto-configuration, and auto-negotiating features.

Catalyst 3550-12T

The Cisco Catalyst 3550-12T switch features ten Gigabit Ethernet 10/100/1000BaseT ports and two GBIC ports. This 1.5-rack unit (RU) Gigabit Ethernet multilayer switch is ideal for use with high-performance end stations or for server-farm aggregation. The Cisco Catalyst 3550-12T delivers:

- **High-performance routing**—The Catalyst 3550 provides robust IP routing without any additional hardware. It features unmatched performance with a 24-Gbps switching fabric and delivers up to 12-Gbps forwarding rate to a stack of single IP-managed switches.
- **Enhanced QoS**—QoS features abound in the Catalyst 3550-12T, which supports:
 - Standard 802.1p class of service (CoS) and differentiated-services-code-point (DSCP) marking at the edge
 - Layer 3 QoS with CoS-DSCP mapping and reclassification mark-down of out-of-profile traffic
 - Four egress queues and two ingress queues
 - WRR scheduling on egress ports
 - Weighted Random Early Detection on ingress ports to avoid congestion
- **Sophisticated traffic management**—Traffic management features include rate limiting based on source and destination Media Access Control (MAC) or IP, protocol, and application.
- **High-quality security**—The Catalyst 3550-12T Switch offers robust security, including standard and extended access control lists and superior TCAM, hardware-based access-control-list (ACL) lookup.
- **Easy administration**—Cisco CMS software allows network managers to increase control of their entire LAN by using Cisco IOS Intelligent Network Services with the simplicity of Web-based management. Cisco CMS and Switch Clustering technology enable single-IP management of up to 16 interconnected Catalyst 3550-12T, 2950, 3500 XL, 2900 XL, and 1900 switches.

Cisco 1000BaseT Gigabit Interface Converter

The Cisco 1000BaseT GBIC is an ideal solution for Catalyst 2950T-24 and 3550-12T customers. It provides full-duplex Gigabit Ethernet connectivity to high-end workstations and between wiring closets over existing copper infrastructures. This GBIC technology allows for a simple, low-cost migration path to Gigabit Ethernet. The Cisco 1000BaseT GBIC features:

- **Flexible Gigabit Ethernet connectivity**—The switch can be hot-swapped when deployed, eliminating the need to reboot. It also allows users the flexibility to deploy other 1000BaseX GBICs in the future.
- **Ease of use/deployment**—The 1000BaseT GBIC was designed for simplicity and ease of management, featuring:
 - “Plug-and-play” deployment
 - Self-locking mechanism that ensures correct installation
 - Easy management through the Web-based Cisco CMS and Cisco IOS Software
- LED displays that indicate link status, link activity, and link fault

Cisco Catalyst 4000 Family of Switches

The Catalyst 4000 family of switches is a cost-effective, flexible network solution that scales to meet today's high-performance needs and provides investment protection for the future. With 3-slot and 6-slot alternatives and a new 24-port 10/100/1000BaseT line card (RJ-45), the Catalyst 4000 family provides a common architecture that scales from 24 ports to 120 ports of 10/100/1000 Gigabit Ethernet. Cisco is the only modular switch vendor today that offers 10Mbps, 100Mbps, and 1000Mbps on the same interface, which optimizes flexibility and investment protection. The Catalyst 4000 family provides a flexible network solution that scales to meet today's high-performance needs and enhances the Cisco commitment to affordable enterprise and branch scalability. The Cisco Catalyst 4000 family delivers:

- **Performance**—Powered by leading-edge ASIC technology that offers high-performance Layer 2 and Layer 3 10/100 or gigabit switching. Layer 2 switching

is powered by a 24 Gbps, 18 Mpps engine. Layer 3 switching is powered by a scalable 8 Gbps, 6 Mpps engine.

- **Density**—Capable of meeting network element connectivity requirements of up to 240 Fast Ethernet ports or 120 Gigabit Ethernet ports in a chassis. The hot-swappable modular plug-and-play switching solution of the Catalyst 4000 family reduces complexity and easily supports the changing desktop environments of today's networks.
- **Investment protection**—The Catalyst 4000 architectural advantage extends the useful deployment life of Catalyst 4000 family line cards. Flexible modular architecture provides cost-effective change management of dynamic desktop connections and a seamless upgrade path for all system ports to higher-layer switching functionality by simply adding additional fabric engine modules.
- **Manageability**—Increased control and security are assured with advanced manageability enhanced with flexible Web-graphical user interface (GUI), and command line interface (CLI)-based management alternatives.
- **Protecting the performance of mission-critical applications**—Centralized enterprise-wide policy creation with CiscoAssure support and network-wide QoS for both Layer 2 CoS and Layer 3 ToS combine to guarantee application performance from the edge to the core.

Compatibility with Industry-Leading 1000BaseT Network Interface Cards
Cisco and Intel have teamed to further boost the usability, flexibility, and ease of deployment of Cisco Gigabit Ethernet solutions. Specifically, Cisco 1000BaseT desktop switches now offer seamless compatibility with the Intel PRO/1000 T Server Adapter, a Gigabit Ethernet adapter for Category 5 infrastructures. So, midmarket customers will have ready access to all the tools they need for rapid network integration and for a quick migration to Gigabit Ethernet performance with established industry leaders, Cisco and Intel.

Together, the Cisco products—the Catalyst 2950T-24, the Catalyst 3550-12T, Cisco 1000BaseT GBIC, and the Catalyst 4000—combine for a powerful, easy-to-use, industry-leading solution for copper-based Gigabit Ethernet environments. Cisco complements its solution with Gigabit Ethernet server adapters available from Intel.

Deployment Scenarios

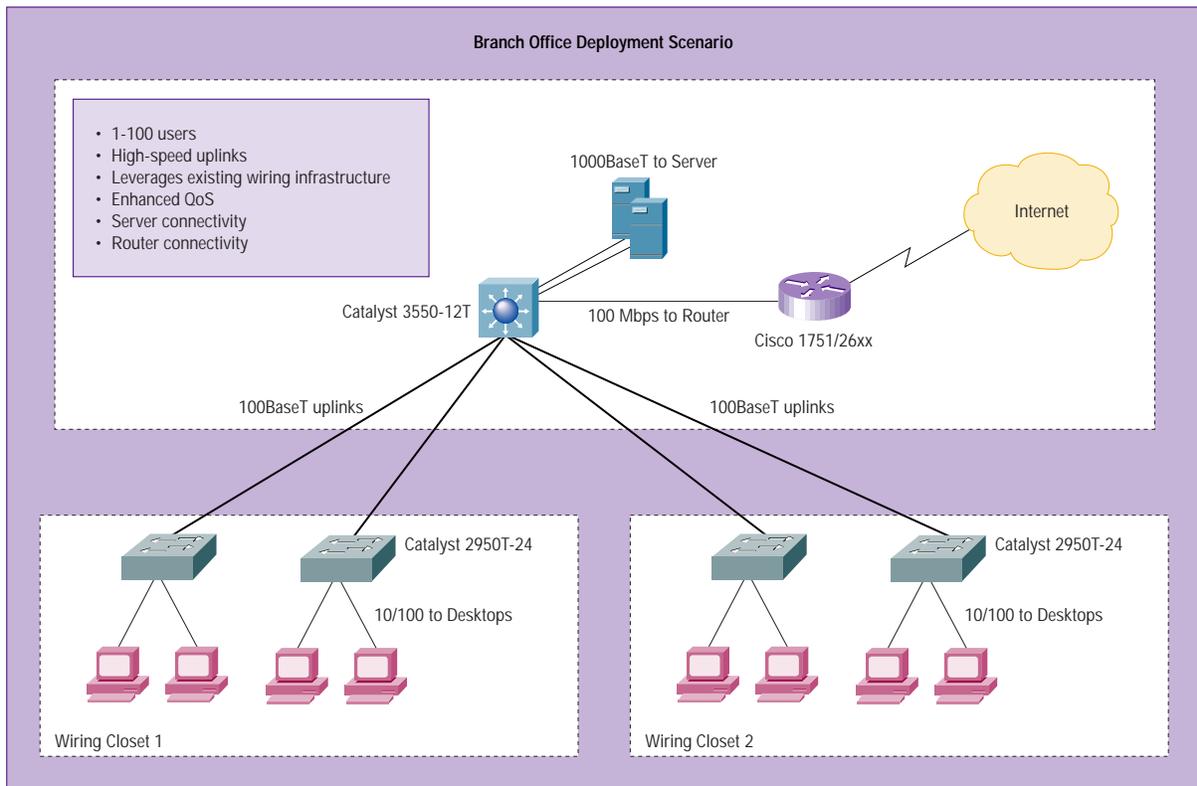
Midmarket companies will select differing 1000BaseT deployment scenarios, based upon their requirements, goals, and cabling infrastructure. Below are several deployment options for companies seeking either a low- or high-end approach.

Branch Office Deployment Scenario

For branch offices of 200 to 500 users that are deploying a 100BaseT backbone, migrating to 1000BaseT can be easily completed since 1000BaseT runs on the same existing Category 5 copper wiring. A 1000BaseT backbone will provide the high-speed connectivity throughout the LAN necessary to handle high traffic and high bandwidth applications, but without the expense of rewiring.

Catalyst 2950T-24 switches can be used to provide 10/100 connectivity to connected PCs, as well as provide 1000BaseT switch uplinks to a Catalyst 3550-12T switch at the top of the stack. The Catalyst 3550-12T also provides 1000BaseT connectivity to servers and 100 Mbps to the router. Midmarket companies or branch offices can use such a simple 1000BaseT design to significantly relieve bottlenecks throughout the network and optimize performance and productivity.

Figure 3 1000BaseT Branch Office Network

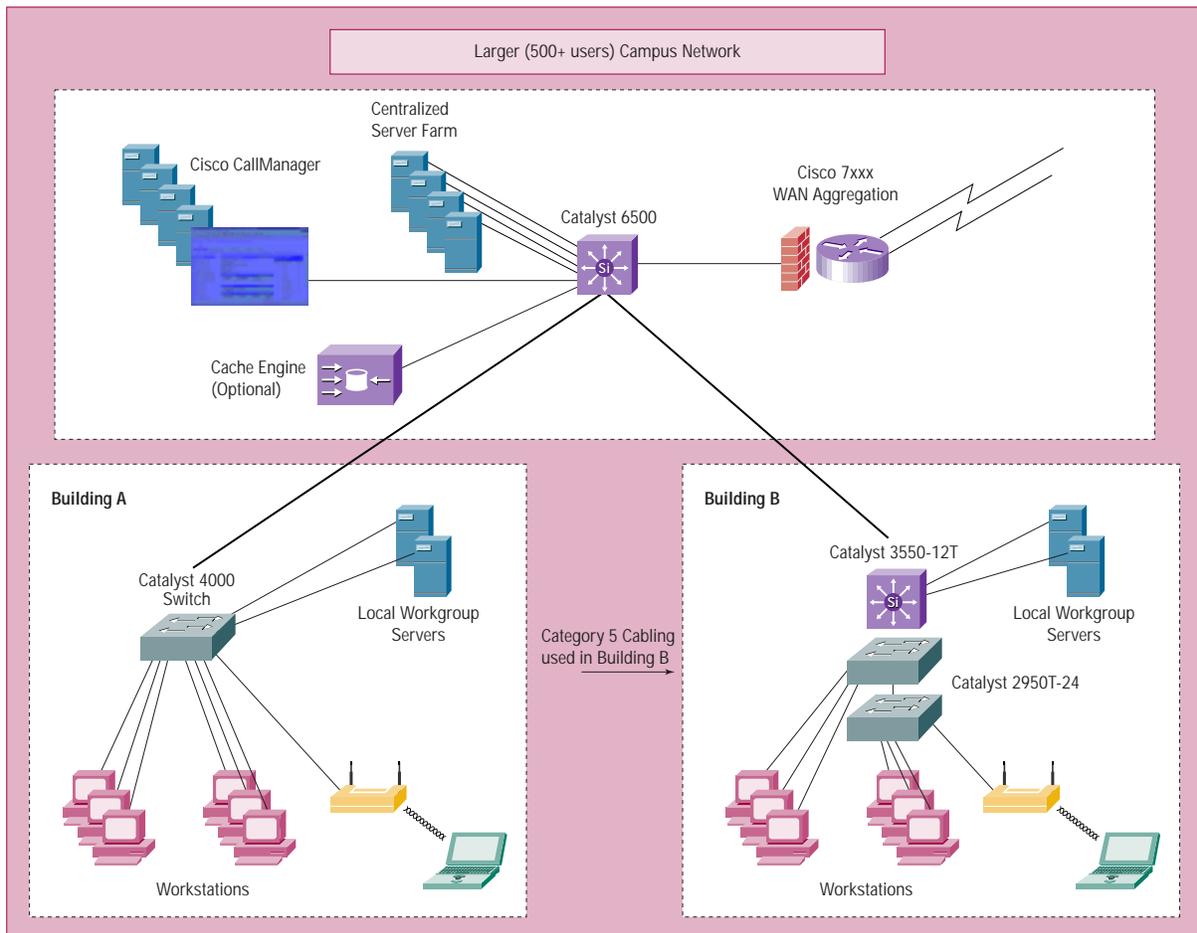


1000BaseT Campus

In a larger, more complex network of 500 or more users, Gigabit Ethernet over fiber connections can be used to link different buildings throughout the campus. In the wiring closet of each building, Catalyst 3550-12T switches can be used to provide 1000BaseT connectivity to servers and to aggregate multiple Catalyst 2950T-24 switches. In addition, the GBIC ports on the Catalyst 3550-12T can be used to connect to the core using 1000BaseSX or LX GBICs.

The Catalyst 2950T-24 switches have Gigabit uplinks and deliver 10/100 speeds to desktop devices like PCs or wireless access points. In another building, Catalyst 4000 switches with a 24-port 10/100/1000BaseT Line Card offers the flexibility to support 10, 100 and 1000 Mbps on the same interface. The Catalyst 4000 switch supports Gigabit speeds up to 100 meters over Category 5 cable. Catalyst 3500 XL switches provide 10/100 access to desktop devices, and Gigabit uplinks using Cisco GBICs.

Figure 4 1000BaseT Campus Network



Gigabit Ethernet over Copper:
A Challenge Resolved

Midmarket companies today face a challenging future. Increasingly, they are deploying state-of-the-art ERP and other demanding, high-bandwidth applications on their LANs. At the same time, their ever-expanding networks are becoming more and more congested. The result: slowing performance that can compromise employee productivity and efficiency. Fortunately, the Cisco 1000BaseT switching solution is able to remedy these challenges. The standard offers unmatched performance in an Ethernet environment for a very reasonable price. In addition, it operates easily with existing copper-based infrastructures and LAN devices. So, midmarket companies quickly get access to the speed and availability they need to drive their most sensitive mission-critical applications without a big investment.



Corporate Headquarters

Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 526-4100

European Headquarters

Cisco Systems Europe
11, Rue Camille Desmoulins
92782 Issy-les-Moulineaux
Cedex 9
France
www.cisco.com
Tel: 33 1 58 04 60 00
Fax: 33 1 58 04 61 00

Americas Headquarters

Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
www.cisco.com
Tel: 408 526-7660
Fax: 408 527-0883

Asia Pacific Headquarters

Cisco Systems Australia, Pty., Ltd
Level 9, 80 Pacific Highway
P.O. Box 469
North Sydney
NSW 2060 Australia
www.cisco.com
Tel: +61 2 8448 7100
Fax: +61 2 9957 4350

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