

Cisco Long-Reach Ethernet Technology

Long-Reach Ethernet: Delivering Cost-Effective Broadband to Multiunit Buildings

In the highly competitive world of telecommunications, service providers constantly seek new market niches that will yield robust revenue and profits. In this spirit, service providers are preparing to meet an emerging, highly lucrative market opportunity focused on providing cost-effective, high-bandwidth service to multiunit (MxU) buildings, such as hotels, residential, and commercial buildings.

In the United States, the broadband market for multiunit buildings is vast. Among all multiunit buildings, the U.S. market for high-speed Internet access is expected to jump from \$371 million in 2000 to \$2 billion in 2004. In the U.S. hospitality industry alone, the broadband market will explode from \$137 million in 2000 to \$674 million in 2004, according to Cahners In-Stat Group.¹ And the Gartner Group reports that residential high-speed access penetration “will jump from 5.9 percent of total U.S. households in 2000 to more than 26.7 percent in 2004.”² Inevitably, multidwelling units (apartment buildings, condominiums, and dormitories) will grab a large portion of that market.

The market opportunity in Europe and Asia is just as substantial. Currently, high-bandwidth Internet access is negligible for most users outside North America. However, that situation is about to change. In Europe alone, total households with broadband access will skyrocket in the coming years. In fact, residential broadband access in Europe is expected to jump from about 1 percent household penetration in 2000 to 11 percent by 2004. “There is a US\$23 billion-plus local broadband opportunity [in Europe] in the next few years,” according to NorthPoint Communications.

Why is the MxU building market for broadband about to take off? Because hotel guests, office workers, and apartment dwellers require faster and faster connections to drive increasingly complex Internet-based applications. Typically, these applications devour bandwidth as they feature sophisticated video, graphics, and audio. Meanwhile, many service providers see an excellent opportunity to serve a largely captive audience of millions of potential customers by providing broadband connectivity to individual buildings.

1. “The Wired Room: Hotel Broadband Preference Analysis,” Cahners In-Stat Group, June 2000, p. 1.

2. “The Residential Broadband Revolution: Finally,” Gartner Group, August 2000, p. 17.

Before initiating service, though, service providers face a critical choice that will determine their success in this booming market. They must decide how best to provision service. Certainly, many options exist. But, increasingly, service providers are turning to the new innovative Cisco technology called Long-Reach Ethernet (LRE). LRE extends Ethernet over single-pair wiring at distances of up to 5,000 feet. The result is a cost-effective, highly available, and rapidly deployable means to provide needed bandwidth to multiunit buildings.

Broadband Options

The market opportunity exists because most buildings are not wired with Category 5 cable, high-grade wiring that allows native Ethernet connections throughout a building. In fact, nearly all buildings constructed before 1985 (as well as many after this date) are almost guaranteed *not* to be appropriately wired for Ethernet. In the absence of Category 5 cable, service providers are faced with a handful of inadequate choices to provision buildings with high-speed service. These include:

- **Asymmetric digital subscriber line (ADSL)**—A widely deployed broadband technology developed for the commodity market, ADSL supports distances up to 6 kilometers (20,000 feet) and offers as much as 8 Mbps in the downstream direction and 1 Mbps in the upstream direction. Typical deployments, though, provide 1 to 2 Mbps downstream. On the downside, ADSL is very complex, somewhat expensive to install, and it consumes a great deal of power (about 5 watts per line), particularly with in-building installations.
- **Symmetric digital subscriber line (SDSL)**—SDSL overcomes some of the shortcomings of ADSL. For instance, its performance is more scalable, providing anywhere from ISDN to T1 speeds. It also consumes far less power. However, SDSL can be difficult to deploy, and it suffers from similar cost restrictions. In fact, both ADSL- and SDSL-based options can cost up to five times that of Long-Reach Ethernet.
- **Home Phoneline Networking Alliance (HPNA)**— HPNA technology combines IP and DSL technology to yield a competitively priced broadband solution. The HPNA 1.0 specification provides a data rate of 1 Mbps. The HPNA 2.0 specification is somewhat more robust. This technology, though, is best suited for the single-residence home. Scalability and performance limitations make it an unattractive choice for multiunit buildings.

- **EtherLoop**—A new technology, EtherLoop combines Ethernet packet delivery, burst technology, and either ADSL or high-data-rate DSL (HDSL) to provide relatively high bandwidth to home users. Although EtherLoop overcomes some of the shortcomings of a straight ADSL deployment, it still suffers from significant speed and scalability limitations, restricting its appeal to the multiunit building market.

As can be seen, none of these solutions adequately meets the needs of service providers to deliver on this market opportunity. All suffer from a variety of shortcomings that limit their usefulness for the multiunit building market. Most significantly, *none* of these technologies delivers the three vital components—speed, scalability, and cost-effectiveness—that will enable the next generation of broadband services to users. And, without new high-bandwidth service offerings, service providers ultimately will gain little new revenue from offering broadband.

Long-Reach Ethernet: A Superior Solution

LRE significantly broadens the applications for Ethernet technology. LRE technology encapsulates Ethernet packets for robust, high-frequency transmission over telephone wiring, and extends the distance reach from 100 meters for traditional Ethernet over copper to up to 5,000 feet (1,524 meters). This creates valuable opportunities for service providers to deliver high-speed access based on cost-effective, robust Ethernet technology. Ethernet is a standards-based, highly regarded networking topology with 750 million ports shipped over the past two decades. With LRE, Ethernet is now expanding from being the predominant corporate LAN access technology to being a universal access technology. LRE enables the high-bandwidth services that users want over existing telephone wiring, which in turn saves significant service provider time and expense. LRE also opens up new service possibilities that were once not possible using older xDSL technologies. Long-Reach Ethernet features include:

- **Low cost**—Ethernet is generally recognized as the most cost-effective networking technology available. Not only is an Ethernet-based switching platform relatively inexpensive, particularly when compared to an asynchronous transfer mode (ATM) switching fabric, but LRE technology enables Ethernet to also run over existing, unconditioned telephone-grade wire that is already widely deployed. In addition, LRE transmissions are able to coexist with Plain Old Telephone Service (POTS), advanced Private Branch Exchange (PBX), or ISDN signaling services over the same pair of ordinary copper wires, and can be provisioned in the same wire bundle as ADSL. So, service providers can take advantage of their existing networking and telecommunications infrastructures in conjunction with LRE, providing broadband services for a very low overall cost.

- **High speed**—The Cisco LRE solution is highly flexible, featuring several unique modes to serve different types of customers. This capability allows service providers to offer tiered levels of service at distinct price points. LRE modes include:
 - 5-Mbps symmetric rate (up to 5,000 feet)
 - 10-Mbps symmetric rate (up to 4,000 feet)
 - 15-Mbps symmetric rate (up to 3,500 feet)
- **Robust capabilities**—LRE allows the real-time, simultaneous transmission of data, voice, and video for integrated applications such as IP telephony, video streaming, or multicasting. Thus, it enables the services sought most today by users who want a high-bandwidth solution. Moreover, LRE can provide an additional revenue stream for hotels, apartments, and office buildings—and well as service providers—that offer these value-added services to users.

With LRE, service providers can serve the burgeoning multiunit building market confidently and cost-effectively, delivering impressive price/performance for established and emerging high-bandwidth applications.

The Multiunit Building Marketplace

The LRE solution has special appeal for the hospitality industry, multidwelling unit, and multitenant unit buildings:

The Hospitality Industry

Hotels, hospitals, convention centers, and even airports already offer a broad variety of business and entertainment services to their guests. In fact, many of these buildings today generate substantial revenue from such value-added services. With broadband connectivity, these services will increase dramatically in number and variety, becoming even more valuable to guests and more lucrative to the provider. And the market opportunity is vast. Currently, there are about 51,000 hotels in the United States with 39 million rooms. According to Jupiter Communications, only 15 percent of these rooms will feature high-speed access by the end of 2000. However, Jupiter says that by 2002, hotels will extend broadband to 50 percent of all their hotel rooms. Naturally, full-service, high-end hotels will be among the first to convert. “For the service provider, the sheer quantity of the multihospitality unit market offers an extraordinary opportunity,” reports Cahners In-Stat Group.³

Multidwelling Units

Apartment complexes, condominiums, university dormitories, townhouse complexes, and other multidwelling unit (MDU) buildings represent a largely untapped market for the delivery of broadband services. In fact, fewer than 5 percent of an estimated

21 million MDU households in the United States had high-speed Internet access in 1999, according to the Yankee Group. But 95 percent want broadband service, a trend that will turn 210,000 high-speed users into 3 million users by the end of 2003. In all, the Yankee Group estimates that 14 million households are interested in and willing to pay \$40 per month for broadband services. This sum presents a highly lucrative opportunity for both service providers and MDU property owners.

Multitenant Units

Multitenant unit (MTU) buildings represent a third major market for LRE. MTUs include many commercial properties, such as office buildings, office campuses, and industrial campuses. According to the U.S. Department of Energy, there are 705,000 commercial office buildings in the United States, with 150,000 containing more than five tenants. Like MDU residents, these tenants generally lack—but desire—greater bandwidth, representing significant pent-up demand. For the most part, building owners have not provided broadband access because of the high cost and disruption of wiring existing buildings with Category 5 cabling. So, there is a great need for a cost-effective, high-speed solution that does not require threading additional wire throughout a building.

LRE Overcomes Obstacles

Certainly, MTU owners are not alone in their quest for a solution that does not necessitate an expensive, burdensome rewiring of buildings. Hospitality and MDU buildings have an even greater need. Why? Because, unlike some newer office buildings, most hotels, apartments, and condominiums are not wired for Ethernet. In fact, many are older, historically significant buildings that could be wired only at tremendous cost and challenge. Others have significant accumulations of asbestos or are framed in concrete, making the deployment of Category 5 lines almost impossible.

With LRE, these challenges do not exist. LRE uses the existing telephone-grade wire infrastructure, typically Category 3 or lower-grade cabling. So, there is no need to rewire a facility with Ethernet-grade (Category 5) cables, saving the cost of rewiring and the possible loss of revenue while areas are shut down for laying wires. In addition, there is significant fiber being deployed in metropolitan areas, thus making it possible to bring “true” broadband connectivity to the basement of buildings. The end result: up to 15 Mbps per port can be delivered cost-effectively to locations that traditional Ethernet cannot reach.

3. “The Wired Room: Hotel Broadband Preference Analysis,” pp. 4–7.

Thus, LRE is a perfect solution for the following areas:

- **Hospitality industry**—LRE brings up to 15-Mbps Ethernet to every telephone extension over the existing telephone infrastructure. Ethernet connectivity can be brought to each room in a hotel or hospital, to every telephone extension on the exhibition floor of a convention center, and to the conference rooms of these facilities. Ethernet access can even be offered in telephone booths and travel lounges at airports.
- **MDUs**—LRE brings up to 15-Mbps connectivity to residential users in apartment complexes, condominiums, dormitories, and so on. It provides the infrastructure that enables broadband services to be delivered easily to each apartment or unit over the installed telephone-grade wiring. Switching units simply need to be installed in the basement, along with the telephone equipment, using 100BaseTX to uplink to the Internet router or local servers. Then, it's a simple "plug-and-play" connection—just hook up your PC LAN connection to the in-room customer premise equipment (CPE) unit.
- **MTUs**—LRE allows building owners to provide broadband service over the telephone-grade wire infrastructure of a building. Therefore, LRE delivers up to 15-Mbps Ethernet connectivity to tenants without rewiring. In addition, LRE can act as a vital business local-area network (LAN) extension. Such a LAN extension can connect floors within a building, in addition to linking branch-office and small office/home office (SOHO) users to the corporate LAN. In each case, LRE delivers greater performance for far less cost than competing delivery technologies, such as Frame Relay or T1 service.

Long-Reach Ethernet is a highly flexible technology perfectly suited for the MxU building market. It answers customers' immediate need for high-speed, full-duplex access. And it does so for a cost that competing technologies just can't match.

New Applications, New Revenue

Armed with the broadband capabilities of LRE, service providers and building owners will be able to deliver an unprecedented number and variety of new, broadband applications to users. And, not only will these applications make subscriber buildings more attractive to guests and tenants, but they also represent a potentially new source of income to both the service provider and the building owner. High-bandwidth applications include:

- **Much faster Internet access**—Today, most commercial, residential, and hotel users still access the Internet at painfully slow dial-up speeds. This situation is highly frustrating and unproductive, as important e-mail attachments often can take more than a half-hour to download. In fact, business travelers today increasingly are seeking hotels with high-speed Internet

access. In the near future, broadband access will be a non-negotiable requirement for both business travelers and office tenants.

- **"Last-mile" metropolitan-area network (MAN) applications**—Recently, service providers have tried to devise ways to provide high-speed digital service over the "last mile," which connects long-distance trunk cables to the rings that circle cities. LRE offers a compelling solution. LRE technology provides far more bandwidth in the last mile than has previously been available. This added bandwidth, along with increased deployment of fiber to buildings, will move the bottleneck from the last mile back to the data center. Service providers, then, can offer far more advanced services, especially those based on video. A particular beneficiary may be high-definition television (HDTV), a technology that has largely stalled due to unusable bandwidth. HDTV allows service providers to bring a broad portfolio of services directly to television sets. Thus, with LRE, service providers will be able to serve users from both their computers and their TVs.
- **Secure LAN access at LAN speeds**—Telecommuters, SOHO users, and road warriors all need secure access to the company LAN. With LRE coupled with virtual private network (VPN) technology, these users can link to the network securely. As a result, they can enjoy full access to their applications and data, enabling them to work from hotels, small offices, and home offices just as productively as from company headquarters.
- **Multimedia/entertainment/gaming**—To date, low-bandwidth, high-cost technology has stymied the spread of multimedia applications into individual offices, residential units, and hotel rooms. No more. Long-Reach Ethernet offers a high-speed, low-cost solution to deliver real-time data, voice, video, and audio. In turn, this capability delivers a variety of compelling value-added applications that will prove to be highly lucrative for service providers, hotels, and other building owners. These applications include interactive video games, video on demand, and gaming.
- **Low-cost office productivity applications**—With LRE, service providers can market a host of key productivity-boosting applications to small and mid-sized businesses. Such applications—including videoconferencing and virtual LANs (VLANs)—have historically been accessible only to large companies with deep pockets. In addition, LRE enables service providers to easily enter the quickly growing field of application hosting, in which they can offer a suite of business applications that are accessed from a central point by all tenants in a building. Application hosting provides yet another compelling revenue opportunity for service providers.

- **IP telephony**—IP telephony turns an ordinary phone call into a robust, rewarding communications experience. With IP telephony, voice is carried over the IP protocol—just like data. So, this technology allows users to introduce video and data elements to their voice calls, letting callers truly interact and collaborate with one another over ordinary phone lines. IP telephony also can be far more cost-effective than current voice tariffs.

Taken together, these applications present an outstanding opportunity for service providers to substantially boost revenue and profits. And it's not a one-time chance. These services provide service providers and building owners with a recurring source of income year after year. In addition, these applications should not be regarded as a complete list of revenue-generating opportunities. Certainly, the future will yield a plethora of new, high-bandwidth applications that are not yet even on the radar screen.

More for Less

Long-Reach Ethernet delivers the most compelling return on investment for the provision of high-bandwidth to the multiunit building. The Cisco LRE solution dramatically lowers both total infrastructure costs and total annual costs. Furthermore, while service providers demand the 15 Mbps solution to deliver value-added services such as IP video, it cannot be provided by most existing broadband technologies. Current broadband options cannot provide all the features that are important in providing high-speed service—speed, distance, high-bandwidth, low cost, scalability, and ease of deployment. But Cisco LRE can fulfill these requirements, allowing service providers to offer value-added broadband services such as IP telephony and video-on-demand to building owners and their customers at very favorable prices.

The characteristics of the Cisco LRE solution are unmatched by any existing broadband technologies:

- **High-speed performance at greater distances**—LRE can offer speeds up to 15 Mbps at up to 3,500 feet or 5 Mbps at up to 5,000 feet. With LRE, distance becomes much less of an obstacle in provisioning high-speed LRE service, which eliminates the requirement to perform distance testing in 80% of the installations, saving time and cost.
- **Speed of Deployment**—Because the Cisco LRE solution works over existing telephone wiring, it can be deployed quickly. Service providers can install it in more properties in a shorter time, giving them the ability to win even more new contracts since they are not overloaded with backlog. The LRE solution leverages the fixed costs of deployment, especially backbone and customer service costs.

- **Higher probability of Success in Deployment**—The Cisco LRE solution has a higher probability of successful deployment because it runs over the existing telephone wiring infrastructure. Site survey rejection rates will be greatly reduced since most are rejected due to distance and complex wiring requirements, challenges that LRE overcomes.

An End-to-End Solution

Cisco Systems provides LRE as a total solution for service providers. The solution contains all the components that a service provider needs to quickly begin to offer high-bandwidth services to hospitality, MDU, and MTU customers.

Hardware—Cisco Catalyst® 2924 LRE XL and 2912 LRE XL switches provide a robust environment for all types of multiunit buildings. The platform provides up to 15-Mbps symmetric Ethernet performance, complete with industry-leading management and security features. In addition, it coexists with both POTS and digital phones through the Cisco 575 LRE CPE device, enabling customers to retain their current communications infrastructure. In addition, the Cisco LRE 48 POTS Splitter enables the co-existence of LRE and POTS traffic on the same telephone line. Cisco complements Catalyst switches with its Aironet® wireless LAN products.

Software—Through the Cisco Building Broadband Service Manager (BBSM), Cisco offers a complete software platform that provides everything a service provider needs to deliver service. These capabilities include plug-and-play access, self-provisioning, authentication, tiered service levels, and integrated billing. Cisco BBSM also lets service providers offer variable levels of bandwidth, so they can deliver different types of service at different price points.

Services—Cisco has partnered with leading professional services companies and integrators to install and service its LRE solution. Therefore, service providers can be assured that all network design, configuration, installation, and ongoing network management issues will be handled efficiently and professionally.

Long-Range Ethernet in the Real World

Long-Reach Ethernet is a fully tested, easily deployable solution consisting of several key components. To better understand how the technology works, some typical network designs are provided in the Figures 1, 2, and 3, for hospitality, MDU, and MTU buildings.



Figure 1: Hotel Telecommuter Design

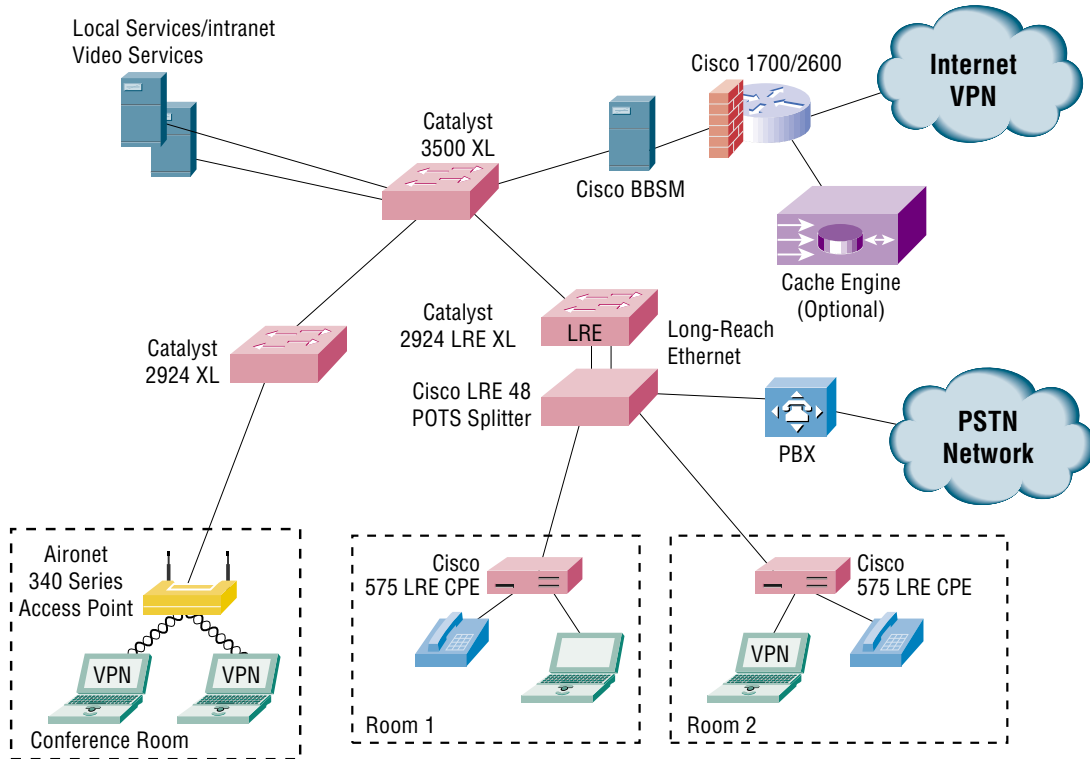


Figure 2 Garden-Style Multidwelling Unit (MDU) Design

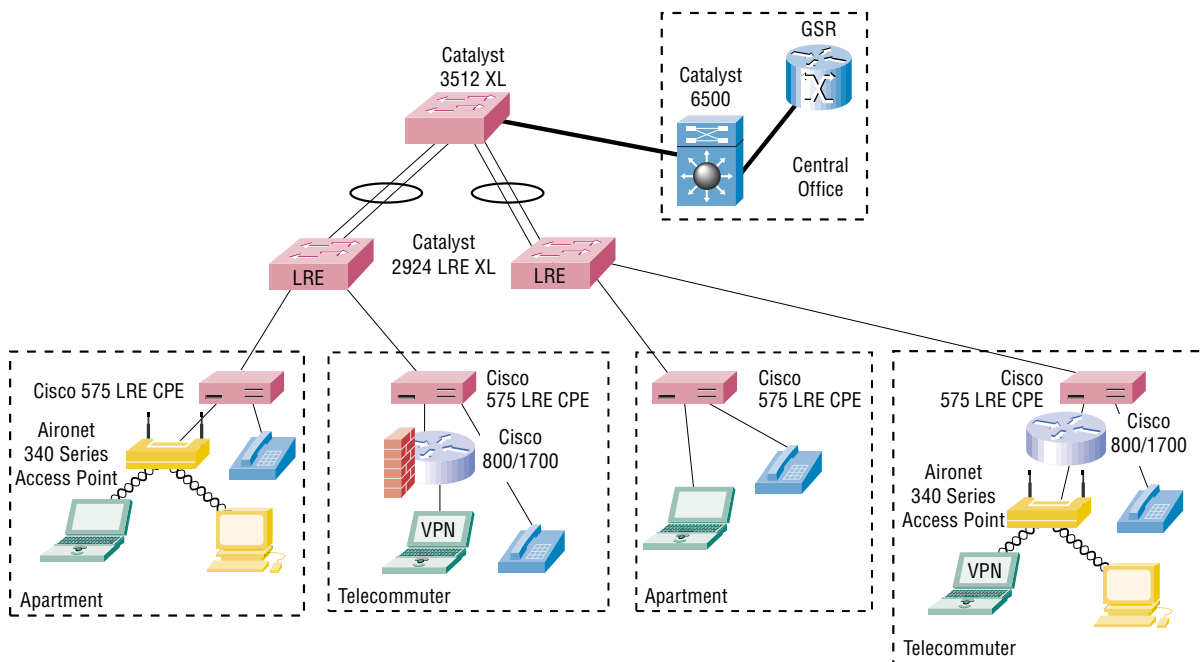
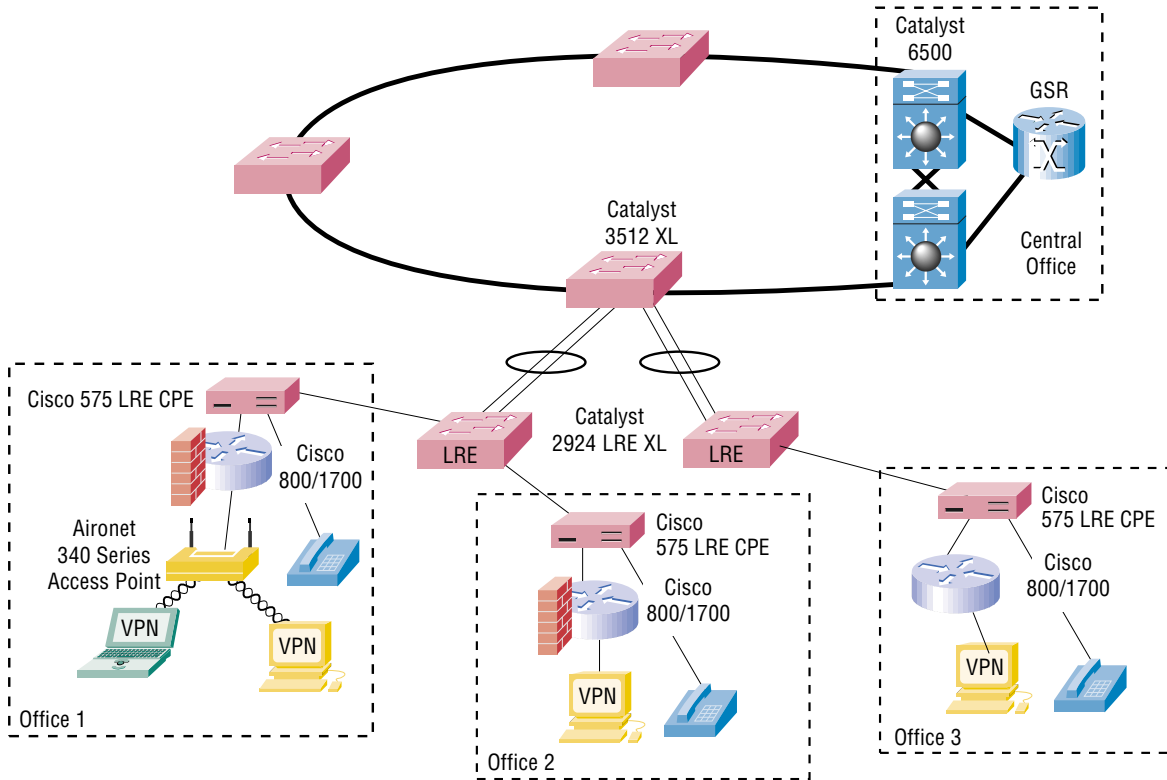




Figure 3: Multitenant Unit (MTU) Design



An Untapped Market

Service providers have long known that occupants of multiunit buildings were an enormous, captive marketplace for the delivery of broadband service. The challenge has been how to get robust services to them quickly and cost-effectively. Long-Reach Ethernet answers that challenge. LRE offers high-speed connections for the lowest possible cost, surpassing competing solutions on price and performance. As a result, service providers can provide high-bandwidth connections to a virtually untapped marketplace. And in turn, they have a tremendous new opportunity to generate substantial revenue and profits.

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