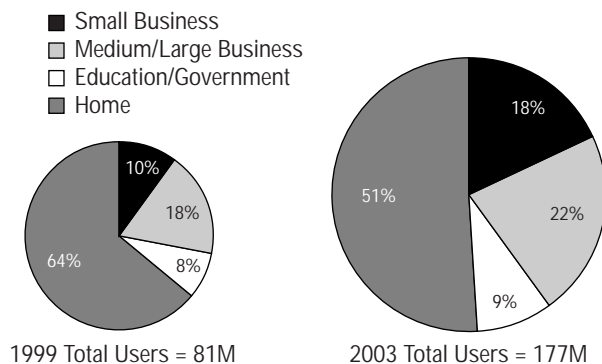


THERE IS A HIGH PROBABILITY THAT DECADES-OLD BUSINESS MODELS IN THE TELECOMMUNICATIONS INDUSTRY WILL NOT SURVIVE THE NEW INTERNET ECONOMYSM. COMPANIES WHO WISH TO THRIVE IN THIS NEW WORLD OF COMMUNICATIONS MUST ADOPT NEW WAYS OF DOING BUSINESS.

Within the next five years, the Internet will affect the quality of your life. U.S. Internet commerce is expected to grow from \$74 billion in 1999 to \$708 billion in 2003 (IDC, March 1999) with the number of computer users in the U.S. more than doubling from 81 million to 177 million. Each one of those potential customers will need access to information at an ever-increasing rate. (See Figure 1).

Figure 1 U.S. Internet Commerce Users by Segment



Broadband Fixed Wireless Solutions Meet the Growing Need

As this data-driven demand increases, the customer will, of course, expect the price of connectivity to go down. Currently, business spends approximately \$500 per employee annually for local access. Four years from now, that number is expected to drop to \$300-\$400¹. This represents a 20 percent decrease in price demand while the number of users expands at a similar 20 percent rate. Service providers are caught in a true paradox. How can they roll out new services, install new infrastructure, and modify existing plants to meet the growing need while lowering prices to remain competitive?

This unprecedented demand is forcing service providers to discard old concepts and business models and adopt New World business models that rely on one network infrastructure to deliver multiple services over the Internet. No company can rely on one method of transportation to satisfy this need.

1. Terrestrial Wireless Broadband Local Access Study, International Engineering Consortium Inc., Chicago, Ill. 1999

Communications companies the world over are struggling to meet this exciting new demand for services. To succeed in the next five years, providers must react now by installing flexible, scalable networks that meet today's requirements and are designed to support the emerging new world broadband fixed packet-based services that scale with the customers need to grow.

Cisco Systems is using its expertise in data communications and networking technology to assist companies in developing and rolling out new systems that will support present and future needs for connectivity. Broadband fixed wireless solutions provide a major step forward to meet these needs. Evolutions in wireless signal processing technologies now enable information service providers to reach new customers that were not accessible with traditional techniques and expand the available services to existing ones. With the deployment of wireless networks, service providers will benefit from:

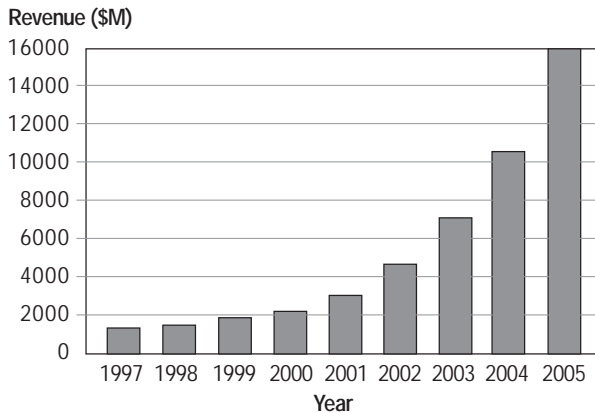
- *Improved Revenue Opportunities*—Wireless systems install quickly and provide services in under-served areas in substantially less time than wire-line alternatives.
- *Differentiated Services*—High-speed broadband fixed scalable services such as Internet access and combined data, voice, and video are now possible in non-traditional wireless markets.
- *Competitive Local Loop Bypass*—Broadband fixed wireless solutions make it possible to deploy bypass solutions over existing incumbents providing competitive solutions to the end user.

New Revenue Opportunities Through Expanded Broadband Fixed Services

Service providers have a unique opportunity to generate revenues from new services in the residential, business, and education markets by expanding capabilities with broadband fixed wireless solutions. The current access mediums such as enhanced copper, cable and fiber competently serve only a portion of the available market and, with the exception of fiber, provide insufficient symmetrical bandwidth to meet multi-megabit needs of the current broadband fixed market—much less allow for future data

speeds. Reports estimate that the available market opportunity for broadband fixed wireless solutions will grow from \$1.7 billion in 1999 to \$16 billion in 2005². (See Figure 2).

Figure 2 Growth of Broadband Wireless Market

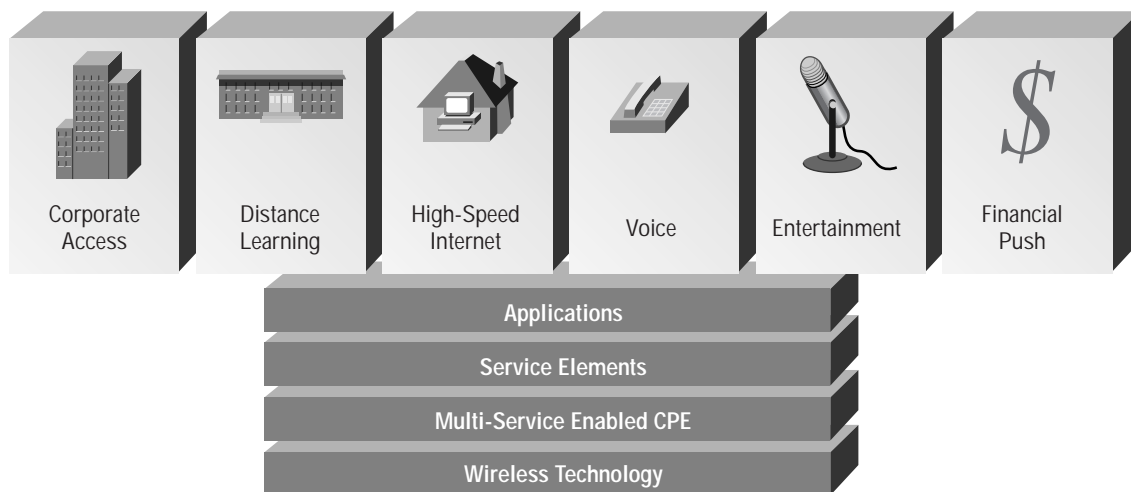


As demand for information, entertainment, and communications explodes, a broadband fixed wireless network presents the single best medium for delivering these services reliably, cost-effectively, and profitably. In fact, studies propose that the cost for deployment of fixed wireless networks is the lowest of all currently available transport streams³ and has the potential to provide connectivity solutions to new areas in significantly less time. Technology advances in wireless modulation techniques enable wireless links to provide the scalable multi-megabit services needed to meet today's requirements. And when used as a local loop bypass wireless solutions can significantly reduce or eliminate the recurring cost of leased lines.

2. Broadband Wireless Market Strategies, Ovum Inc. Burlington, MA. 1997

3. Terrestrial Wireless Broadband Local Access Study, International Engineering Consortium Inc., Chicago, Ill. 1999

Figure 3 Differentiated End-User Services



The range of potential services is limited only by the needs of the customer. The networking industry is in a state of rapid transition from the old-world model based on closed systems providing a single product offering—data—to a new world driven by the need for multiple combined formats such as voice-over-IP (VoIP) with high-speed two-way data and video services. The required levels of quality mandated by good business practices requires that certain standards be maintained to ensure that the interleaving of services does not distract from the usability of the information.

Service providers can now offer a multitude of differentiated services based on an integrated platform of data, voice, and video capabilities over a variety of transport streams to meet their customers' discriminating needs. Cisco broadband fixed wireless solutions provide the platform that enables providers of all sizes to derive new revenue streams from their existing systems and, more importantly, to leap well ahead of other local access providers in terms of service offerings and customer mindshare. (See Figure 3). Being the first to offer these new services is critical in a local-access market expected to become fiercely competitive. The first provider to enter these new markets will acquire and maintain speed-hungry customers at a much higher rate than that of the competing access providers that follow.

Advances in Broadband Fixed Wireless Technology Enables Significant New Opportunity

Dramatic advances in network technology and broadband fixed wireless systems are what make this high level of access possible today. Cisco is working with other leaders in the industry to provide this new technology to the market at competitive prices in the time frame needed for service providers to succeed.

Advances in digital signal processing capability have enabled Cisco to break the traditional barriers of broadband fixed wireless products such as limited data rates and the need for line-of-site radio paths. Using these advances, Cisco is providing products to the industry with exciting new capabilities that will differentiate the service providers that use them from all of the competition.

Utilizing advanced modulation techniques such as Vector Orthogonal Frequency Division Multiplexing (VOFDM) to provide scalable bandwidth solutions and spatial and frequency diversity to take advantage of multi-path signal reflections, the products provide robust broadband fixed packet-based solutions in obstructed, non-line-of-site (NLOS) environments with exceptional fiber-like speeds and qualities.

Based on industry accepted standards, Cisco broadband fixed wireless solutions provide scalable networks incorporating the widely accepted Cisco IOS® software operating system. This allows current networking solutions to be expanded to include a wireless interface thus offering a scalable migration path for data, voice, and video integration with unmatched security, protocols and network management.

New Broadband Fixed Wireless Opportunities in the Business Market

For service providers, offering IP-based data and voice services over fixed wireless to the business market is an opportunity to substantially expand revenue streams. This is because small and medium-sized businesses can benefit not only from high-speed Internet access but also from higher-value-added services such as virtual private network (VPN) connectivity to corporate intranets, telecommuting capabilities for work-at-home employees, and economical voice and fax calls over the Internet.

It is not anticipated that broadband fixed wireless solutions will dominate the market in the foreseeable future. Using the New World model concept, the market will be a conglomeration of solutions focused on meeting individual and changing needs. The true value for fixed wireless solutions is in its ability to supplement other technologies that can provide high-data-rate

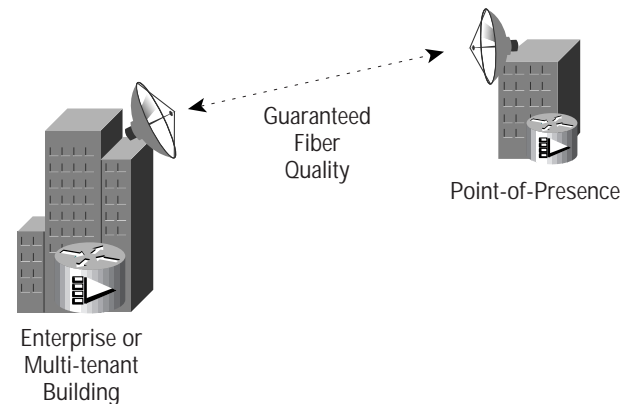
services. As mentioned earlier, key areas for expansion of fixed wireless solutions will be in under-served markets such as small to medium-sized business where high-speed fiber alternatives are prohibitively expensive due to right-of-way issues, have limited accessibility, or are not feasible to the incumbent due to limited return on investment.

Dedicated Access

Broadband Fixed Wireless Bulk Access

Broadband fixed wireless solutions will play a key role in situations such as dedicated point-to-point links where users need guaranteed bandwidth and fixed quality-of-service (QoS). A dedicated link provides the customer with a controlled environment for transmitting large amounts of data in a symmetrical two-way connection. (See Figure 4).

Figure 4 Wireless Bulk Access



Branch Office Expansion

Rapidly growing companies need to expand. With that expansion, they cannot be without broadband fixed data services for any period of time. Annexation of new branch offices or adjacent buildings can be quickly supported with dedicated broadband fixed services through the use of wireless links. This enables both temporary access that can move as facility needs change or permanent connectivity when demand stabilizes.

Vendor Management

Establish temporary or permanent fixed lines of communications with suppliers for inventory management. The security of a wireless link allows for transfer of sensitive inventory data between a vendor and a customer to provide instant feedback on material needs.

Education

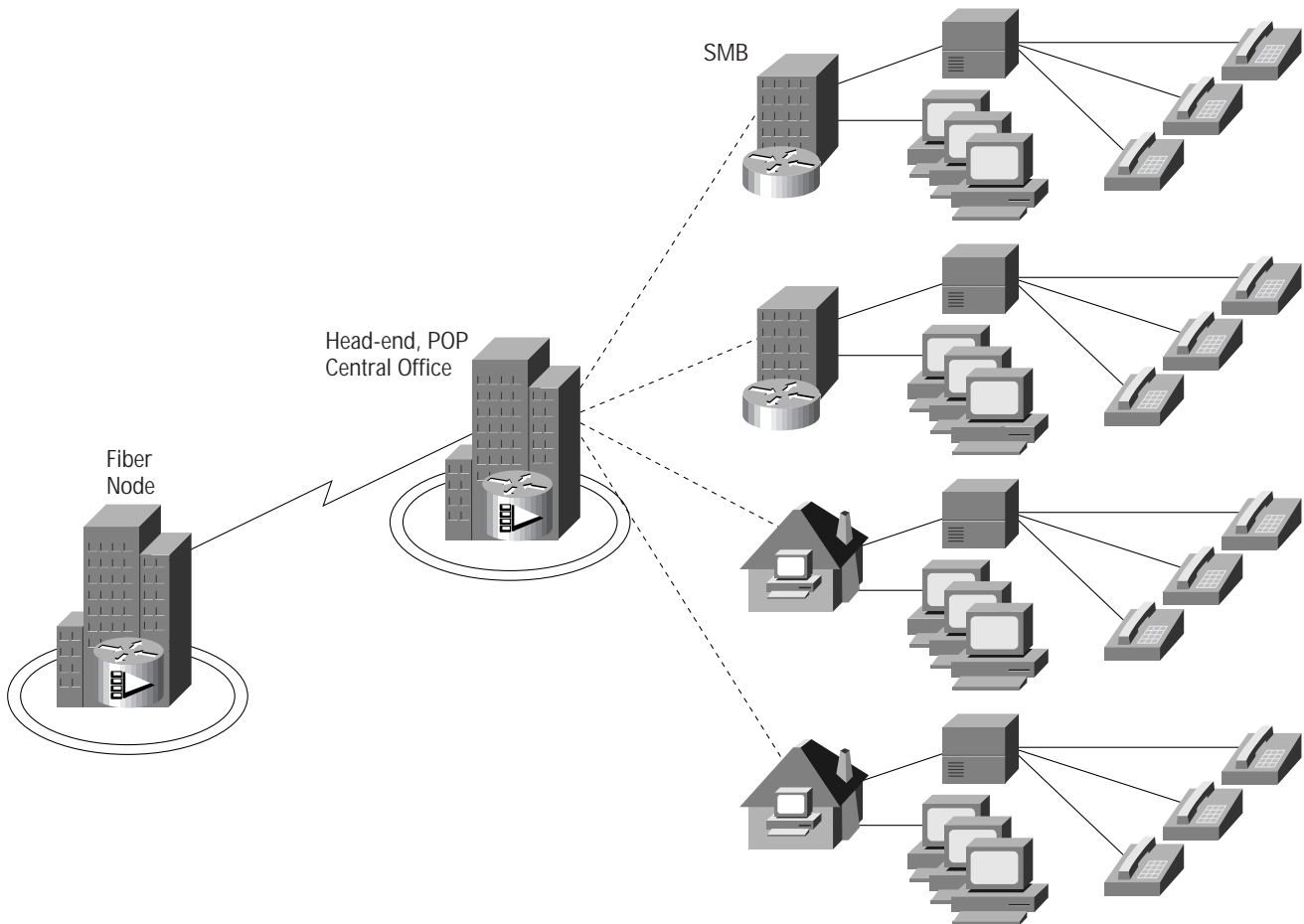
As the World Wide Web becomes a larger part of the education system, at all levels, fixed wireless broadband networks will play a key role in bringing the Internet to the student. Fixed wireless links provide the backbone for connecting new buildings and remote sites to the educational infrastructure to permit tools such as distance learning and two-way, interactive training to reach every student. Using fixed wireless solutions, concentrated users such as dormitories can be linked to existing networks without the need and the permanency of trenching cables or fiber.

Fixed wireless networks are perfect for links from district offices to local school facilities creating a private connection for sensitive information or for high-speed connectivity between schools as an intranet.

Shared Access

Broadband fixed wireless solutions are an invaluable pipeline for creating a shared access network where bandwidth-on-demand is needed for interactive opportunities such as data, voice, and video. The varying bandwidth needs of the small to medium sized business, small office home office (SOHO), telecommuter or residential customer can be met with a point-to-multipoint solution. (Figure 5).

Figure 5 Shared Bandwidth for Broadband Access



Small to Medium-sized Business Opportunities

For the small to medium-sized business (SMB) fixed wireless solutions provide unique opportunities to enhance and replace existing capabilities. In a wireless environment, PBX trunking to connect telephone systems can co-exist with high bandwidth needs such as high-speed data transfer, video conferencing, push video services and VPN capability to supply the SMB with the majority of their data, voice, and video needs in a cost-effective package.

Small Office, Home Office

For the SOHO, broadband fixed wireless solutions make it possible to establish high-speed services quickly, as important for the SOHO as it is for the service provider. Using micro-cellular deployment techniques, such as those used in the mobile cellular world, the service provider can quickly expand existing wireless systems to meet the growing needs of a community. This rapid expansion capability better positions the service provider to capture and retain new customers while offering differentiated services to the SOHO. Similar to the power telecommuter, the SOHO needs bandwidth-on-demand to meet fluctuating needs while being more sensitive to the cost of access.

Rural Connectivity

When cable isn't available, digital subscriber line (DSL) won't reach, and fiber is too expensive, fixed wireless solutions provide the perfect solution for connection of rural customers or remote metropolitan areas to the backbone network. The cost effectiveness of fixed wireless links proves itself on the long haul link by enabling the service provider to reach remote customers quickly and efficiently. Links of up to 30 miles over a variety of terrains eliminate the need for expensive long fiber runs and provide the same high data rates and high quality as short runs.

Telecommuting

Fixed wireless links have the ability to share and dynamically allocate bandwidth to maximize the efficiency of the frequency spectrum. This "bandwidth-on-demand" gives telecommuting power users the bandwidth they need when, and only when, it is needed. High-bandwidth, symmetrical links enable such home use as large file transfer, private branch exchange (PBX) extension, fax, voice over IP (VoIP), two-way video conferencing and, of course, Internet connectivity. With bandwidth on demand, the service provider has the ability to sell value-added services at

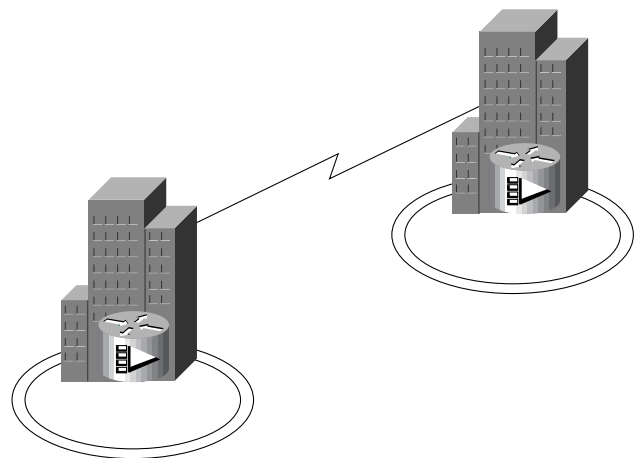
different levels to different customers by allowing such levels of service as guaranteed bandwidth, optional high bandwidth (burst levels) and shared services.

Network Connections

Using fixed wireless connectivity in a backhaul application provides a unique opportunity to expand an existing system by installing a fixed wireless link from a remote facility such as a point of presence (POP) or head-end back to the installed fiber node. (See Figure 5). This is especially useful during, or immediately after, new construction when high-speed fiber access is not available. This allows the service provider to quickly activate service to new facilities, such as office parks or new multi-tenant dwellings. Using the wireless link as a fiber extension quickly activates remote sites without either the costly delay of trenching high-speed fiber or needing to rely on the local exchange carrier (LEC) to provide leased access.

The flexibility of this solution also enables it to be used as a method for interconnecting various access technologies such as a cable modem to Fast Ethernet or Fast Ethernet to ATM over the wireless link (See Figure 6). Fixed wireless solutions can also be used as a backup to existing services in the same role to enhance QoS by providing redundant services or to provide additional access to a given facility.

Figure 6 Network to Network Connections



Security

Information that requires a high level of security such as financial institutions and medical facilities will also benefit from fixed wireless links where the integrity of the data is of the utmost importance. Security of the information is provided through a high level of Data Encryption Standard (DES) encoding.

Comparing Fixed Wireless Solutions to Alternative Transport Products

In the New World, all of the data transport alternatives will play a role in providing high-speed data to customers. Each method will have benefits that make it suitable for a given application and trade-offs that make it unsuitable for others. Table 1 lists some of the transport alternatives.

In addition to the data rate limitations, we must look at other issues revolving around the transport stream decision. Although twisted pair copper is readily available to 99 percent of all users, the data rate is unacceptably slow for broadband data and provides no path for video or combinations of data, voice, and video. Twisted pair copper does provide lifeline services in that power to run the system is supplied over the network connection.

Enhanced copper concepts such as xDSL have the potential to be made available to a great number of users since it uses the twisted pair line. However, roll out of services is limited since the technology limits the physical distance from a POP. For acceptable high bandwidth use, xDSL has a distance limitation of 18,000 feet from the POP. Additionally, since this is not a

dedicated bandwidth solution, actual upstream and downstream data rates will vary with the number of subscribers on the system at any given time.

Fiber appears to be the best solution for symmetrical high-speed data. Gigabit speeds are readily available on fiber-optic cable. Additionally, it is being installed in most large businesses today.

Fiber capable of OC-3 rates can be installed relatively cheaply inside new or existing facilities. However, the installation of fiber outside of the facility can be expensive and require substantial time to complete due to the amount of underground work required.

Hybrid fiber coax (HFC) provides asymmetrical data via a combination of fiber in the backbone network structure and a hybrid coax/fiber cable to the end user. Cable is currently seeing an increase in usage in the business market but at present is primarily a residential access technology and runs to relatively few businesses.

Satellite technologies such as broadband satellite and very small aperture terminal (VSAT) provide asymmetrical data flow to the user and, although a single satellite can cover a wide footprint for point-to-multipoint solutions, the usage has not expanded according to expectations. Possibly because, in the case of broadband satellite, the downstream path is from the satellite while the upstream path is via conventional twisted-pair phone line requiring multiple modems.

Table 1 Various Transport Alternatives

Platform	Current Availability for Business	Maximum Data Rate	Symmetrical or Asymmetrical
Broadband Fixed Wireless	Low	44 Mbps	Symmetrical
Twisted Pair Copper	High	56 kbps	Symmetrical
Enhanced Copper (xDSL)	Low	1.5 Mbps downstream 64 kbps upstream	Asymmetrical
Fiber-in-the-loop	High	2.5 Gbps	Symmetrical
Hybrid Fiber Coax (HFC)	Low	30 Mbps downstream 10 Mbps upstream	Asymmetrical
Broadband Satellite	Medium	400 kbps downstream Phone line upstream	Asymmetrical
Very Small Aperture Terminal (VSAT)	High	2 Mbps	Symmetrical

Although each of the listed methods has its advantages, broadband fixed wireless solutions bridge several of the downfalls of the others and bring unique advantages. Providing symmetrical, fiber quality, high data rate information in a variety of situations, Cisco broadband fixed wireless solutions are quick to install with no external construction required. The use of leading-edge technology enables the use of unobtrusive roof top antennas replacing the need for the trenching requirements in cable and fiber solutions and removes the costly towers in previous wireless products. This makes them perfect alternatives when high-speed, high quality and quick time to market is critical to success.

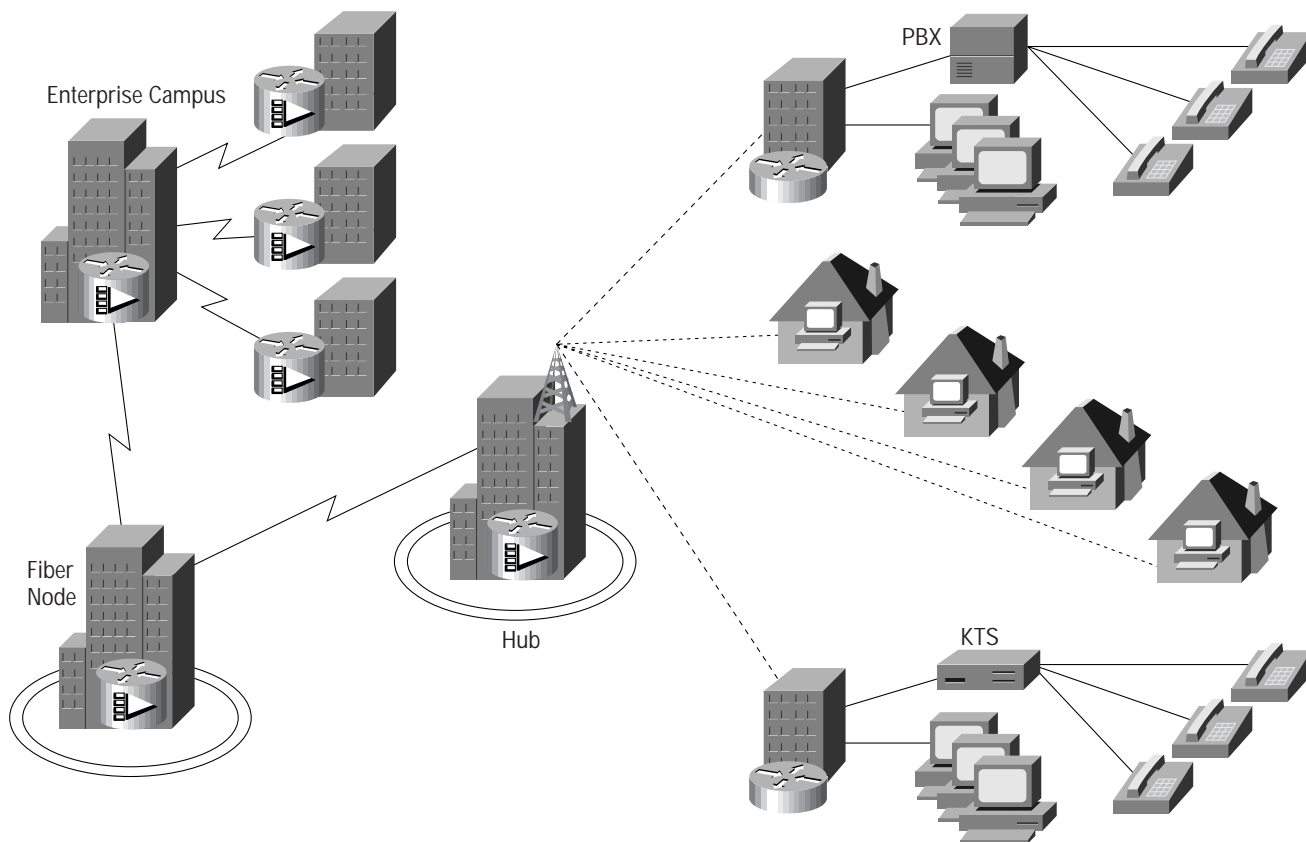
Convergence is Real

As we continue to see the need for connectivity increase and the convergence of voice, video and data becomes real, service providers will be required to look for alternatives to doing business the old fashioned way. The new Internet economy demands that high-quality service be available to all that want it. In the near future, it will no longer be acceptable to ignore a facility (or a single customer within a facility) because the facility had no access. Customers are demanding service. The amount of time

from when a customer calls to when they expect service will be counted in hours—not weeks or months. This requires that service providers have at their disposal a variety of alternatives to solve a customers need for connectivity quickly and efficiently. These alternatives must provide cost effective, scalable solutions that not only result in acceptable solutions to the end user but also enable profitable revenue streams for the service provider.

Cisco packet-based broadband fixed wireless networks provide the service provider with that answer. Broadband fixed wireless networks provide the flexibility to quickly install new links in any part of the network where connection is needed. Figure 7 is an example of a broadband network utilizing fixed wireless links to complete the picture. Wireless access provides the service provider with a cost effective solution that minimizes the up-front investment, enables the service provider to activate new links with little or no recurring cost and provide the service provider with the product differentiation that sets them apart from the competition.

Figure 7 Wireless Links as a Part of a Broadband Network



In addition to the broadband fixed wireless networks powered by Cisco solutions, Cisco Systems has expertise in every part of the network architecture and offers full, end-to-end solutions to meet every need in the network. As you begin to evaluate your current system and design solutions that will meet the needs of the new world, Cisco is there to help.

To find out more about new world architectures using broadband fixed wireless networks and how Cisco can help service providers explore new opportunities for growth, contact your local Cisco representative to arrange a meeting, or visit our the Cisco Web site at <http://www.cisco.com>.



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