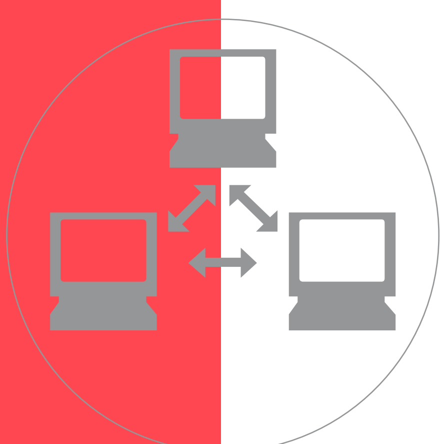
TRANSITION networks

The Conversion Technology Experts

Saving Money with Media Conversion



How media converters can be used to resolve networking problems and save money

Computer networks have evolved into an indispensable asset for corporations around the world. These complex systems of cables, jacks, patch panels, switches, routers, and servers provide the foundation for the communications of our global economy. Many corporations view their networks as a strategic advantage over their competition and focus on constant improvement in performance of their networks.

While network managers yearn for the latest equipment and higher speeds, budgetary restrictions impose limitations and precipitate a less than homogenous network. Inevitably, network administrators must contend with a variety of protocols, speeds, and media in their networks. Media conversion technology was developed to address these problems and has evolved from a stop gap technology into an a technology that offers network administrators new choices for deploying fiber optics into their networks cost effectively.

Very simply stated, conversion technology enables connections of disparate media (cabling) types in networks where non-homogeneous cabling exists. Most commonly, media converters are used where UTP (un-shielded twisted pair) copper cabling and fiber optic cabling coexist in a network cabling plant. Less common, but also available, media converters are also used where legacy cabling types such as Coaxial or Twinaxial cabling must be integrated with UTP or fiber optic cabling. Converters exist in a variety of form factors, which are standalone, multiport, and modular chassis. These different physical forms address the various applications that exist.

Stand-Alone

Media converters are protocol specific, meaning that you need to have an Ethernet converter to convert 10BASE-T to 10BASE-FL. Furthermore media converters do not convert protocols, such as Token Ring to Ethernet. However, media converters do exist for a broad range of protocols including Ethernet, Fast Ethernet, Gigabit Ethernet, Token Ring, T1, DS3, RS232, RS485, V.35, X.21, analog phone lines, video, and much more. This article will show some examples of how media converters are used in a variety of networks and explore how utilizing media converters can be a cost-saving solution.

Multiport

Typical Applications for Media Converters

Enterprise Networks

Enterprise networks come in variety of sizes and configurations. Some consist of large multi-building locations; others are small flat networks. In this section, we will explore some of these various network layouts and how media conversion can be utilized to save money.

Modular Chassis

A LAN (local area network) is generally defined as the interconnection of multiple devices such as servers, PCs, printers, etc. in a confined geographical area (most often within the same building). LANs can vary in sizes, ranging from fewer than five users (peer-to-peer network) to hundreds or even several thousand users (client/server network). As networks grow, users are located beyond the reach that copper cable offers. Network managers are placed in a position of adding an additional communications closet near the new users and back hauling fiber to the central data closet, or running fiber to the desk or work group.

A network manager must either buy a new switch or blade with fiber interfaces or he/she can use existing equipment with copper ports and utilize media converters.

The network manager may have existing ports on a copper switch that could be used with a media converter to drive the data to the user. A multimode 100Mbps converter can be purchased for less than $200. Furthermore, 10/100 switches are widely available and can be very inexpensive depending on the manufacturer and the features that are included. The port density is much higher for the copper based switches and the cost is significantly lower. A 10/100 switch will cost a few hundred dollars, where a 100Mbps fiber switch will cost several thousand dollars. So it is not hard to see where media converters can offer some cost savings if you need to run fiber to certain users.

In smaller networks, fiber is not often required, however, occasions due arise where fiber may be needed. A service provider could have their demarcation point, the location where they run the cable to the building, too far away from a company's data closet. For example, if a small company is receiving Ethernet service from their Internet service provider and the demarcation point is placed on the other side of the building complex, standalone 10BASE-T to 10BASE-FL converters can be used back to back to extend the data connection to the company's data closet on the other side of the building complex.

Backbone Deployments
The LAN backbone allows lower capacity portions of the network to be aggregated into higher capacity connections to optimize throughput across the entire network. For example, in a multi-story building you may have workstations and printers connected to a small 10Mbps hub for a given work group. This hub may be connected into a 10/100 dual speed switch in the wiring closet of the building that is in turn, connected to another switch in the main data center via a Gigabit up-link port. The connection between these two switches would serve to aggregate the multiple, relatively low bandwidth users, from the 10Mbps hub into a high bandwidth 1000Mbps connection to the data center for efficient access to servers, storage devices, etc. that may be shared by many users throughout the organization.

Media converters are often used in backbone connections to facilitate the disparity between media types being used. Many times converters are used to enable the interconnection of devices such as switches and servers with copper UTP interfaces to multi-mode fiber optic cabling that is commonly used in network backbones. Multi-mode fiber is quickly becoming the media of choice in many network backbones because it accommodates longer transmission distances than its copper counterparts (UTP copper cable is limited to 100 meters where multi-mode fiber can go as far as 2000 meters without repeaters). Fiber can support higher speed protocols available now and for several years to come. Also, fiber optic cable is impervious to EMI (electromagnetic interference) as well as security breaches (cannot easily be tapped into and monitored remotely).

The most common applications for media converters in a network backbone are the connection of either two switches, or a switch and a server with copper interfaces across multi-mode fiber interfaces (see figure 1). Medium-to-large size companies can benefit by using a

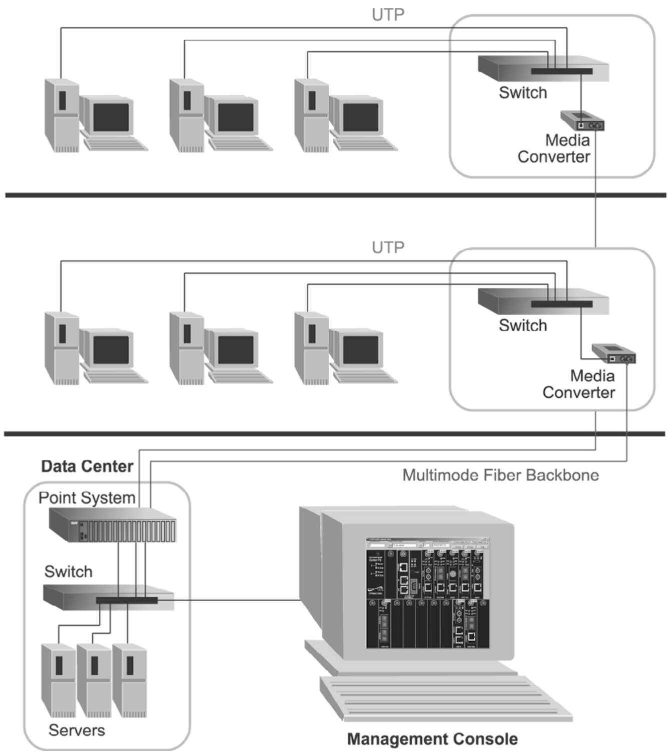


Figure 1: Point System - LAN Backbone

Chassis-based conversion solution in the data center and stand-alone or managed remote media converters on devices such as switches and hubs that may reside in multiple wiring closets. In cases where more than one protocol may be present (i.e., Ethernet, ATM, TI/EI, etc.), the modular conversion center can support multiple protocols in a single chassis. This co-mingling of protocols in a modular system offers cost savings because the network manager can purchase one platform, yet support fiber interfaces for disparate protocols. In backbone applications the port density is not high and the network manager does not want to invest in equipment with multiple ports if most of the ports will go unused.

Campus Deployments

A campus environment is typically a group of buildings connected together via an extended LAN. The LAN commonly has a central location (data center) located in one of the buildings which houses shared devices such as servers, storage devices, etc. LAN connections are made between the central building and devices such as switches, PBXs, CSU/DSUs to other buildings. The media used almost exclusively for interconnecting buildings in a campus is fiber optic cabling. Fiber is used to connect buildings in a campus environment primarily because of its ability to allow data transmission over long distances and because of its resilience to the elements and EMI in outdoor environments (see figure 2).

Connections between buildings can be viewed as extended backbone connections in a LAN. As with the backbone examples given earlier, typically media converters are used to facilitate the connection of the fiber optic cabling and copper interfaces on switches, etc. located in the various locations.

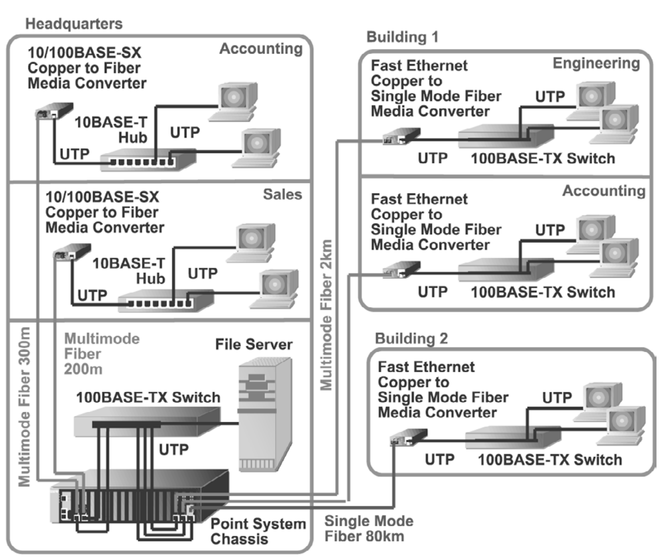


Figure 2: Campus Environment

Typically campus LANs are relatively large (several hundred or even thousands of clients) and they also often must support multiple protocols. Large networks with multiple locations also have a greater propensity to require some form of SNMP management for active devices for efficient resource allocation and troubleshooting capability from a central location. Unique requirements of a campus LAN lend themselves well to modular chassis conversion platforms.

In the example above, remote devices in outlying buildings are connected back into the data center via fiber with the interconnection between disparate copper and fiber interfaces facilitated by modular converter chassis in each of the locations. Another way that media conversion can offer a cost savings is by helping to troubleshoot and configure networks that are in a remote location. When network managers need to support remote facilities often times there is not someone in that location knowledgeable about networks. Transition Networks offers several products that allow network managers to manage the remote converters as well as the chassis based products located in a data center. With products such as Transition Networks Management Aggregation Converter for Fast Ethernet, the network administrator can troubleshoot problems or modify settings without making a trip to the remote site. While this may be less tangible than a savings in hardware cost, saving time is no less important when looking at the total cost of running a network.

Other protocols can also be accommodated in a campus environment. TI/EI connections from the demarcation located in the data center can be extended out to other campus buildings to allow voice (PBX) or data (CSU/DSU) extensions. The remote end can also be managed as some T1/E1 converters have built-in remote management capabilities. Protocols commonly used in campus environments such as Ethernet, fast Ethernet, gigabit Ethernet, ATM, DS-3, etc. can all be supported by existing conversion products.

Horizontal Deployments

The horizontal portion of the network is commonly where devices such as printers and workstations are connected to a given network. A good example of this would be a multi-story building where the data center is located on the first floor and is connected to wiring closets on upper floors via a high-speed backbone connection. In each of these wiring closets would reside a switch. Switch ports are connected either directly to devices such as workstations or may be connected to work group hubs that are in turn, connected to the workstations. The point from the wiring closet switch to the devices on a given floor in this building would be referred to as the horizontal portion of the network. Smaller networks may be "flat networks" that do not require a backbone to aggregate bandwidth. In smaller networks the entire network can typically be considered horizontal.

Conversion technology is used in horizontal networks where fiber optic cabling must be used for distance extension, EMI considerations or in some cases, for security reasons.

An example of an application for chassis-based conversion in a horizontal network to overcome a distance issue would be a large distribution or retail facility where devices such as workstations, printer, scanners or cash registers are further than 100 meters from the data

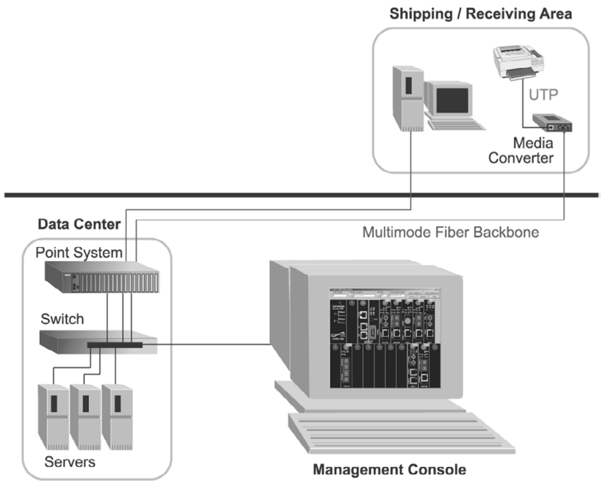


Figure 3: Point System - Connecting Remote Devices

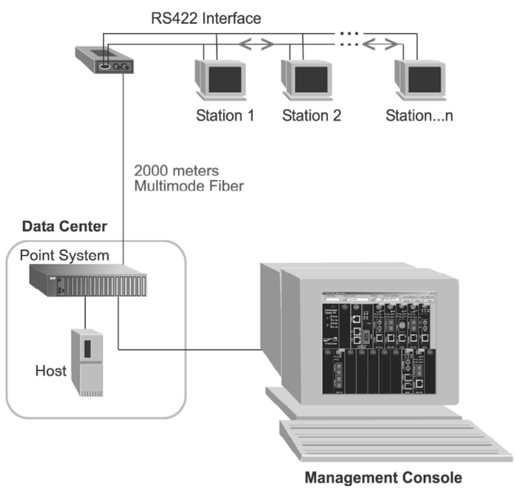


Figure 4: Point System - Industrial or POS Application

center. A media converter chassis would be used in the data center to facilitate the copper-to-fiber connection to the switch. On the remote end, a stand-alone converter would be used to convert the copper and fiber media (see figure 3).

There are also instances in a large factory where you may have to connect devices where the cabling must run through the manufacturing facility (see figure 4). Some factory environments have equipment that may produce significant levels of EMI (electromagnetic interference). This EMI can have adverse effects on data transmitted across copper based cabling. In these cases, fiber optic cabling would be used in areas where EMI is an issue (fiber optic cables are impervious to EMI). Media converters would be used at either end of the fiber optic cable to allow for the connection of fiber-to-copper interfaces. A chassis-based conversion platform works well in situations where multiple cables need to be converted from copper to fiber. In industrial environments, many different protocols may be present as well. Industrial automation equipment use everything from Ethernet to RS232/485/422 to ARCNet for different operations. Multiple connections as well as multiple protocols can be easily accommodated by media conversion chassises or in a rack for standalone converters. A chassis solution offers the option of remote SNMP management; which can prove useful in industrial environments where devices may not be accessible during factory operations or may be inconvenient due to distance or location.

The use of fiber optic cabling to interconnect devices in networks where classified information is transmitted has been rapidly increasing in popularity. Government subcontractors working on highly classified projects are required to transmit any data that moves from a secured area (red zone) through an unsecured area (blue zone) over fiber optic cabling and encode it. The reason for this is simple, fiber optic cabling does not emit an electronic signal (emits light pulses) that could potentially be monitored remotely nor can it be tapped into without detection. Stand alone converters or fiber NIC cards are commonly used on the workstations and are aggregated back into a converter chassis at the data center or wiring closet.

Not as popular, but slowly gaining in popularity, is fiber to the desktop. The cost of fiber interfaces, and therefore the cost of fiber to the desktop, is still perceived by most as too expensive and currently not a necessity. However, there are documented studies that have demonstrated that fiber to the desk may be, in fact, a low-cost, long-term solution (see figure 5). Fiber can eliminate the need for the intermittent wiring closets (fiber can be run all the way from the data center to the workstation). These studies contend that fiber will eventually be required at every desktop at some point due to bandwidth requirements (fiber can support high bandwidth transmission over greater distances). The useful life of a fiber cabling plant is expected to exceed 20 years while the copper infrastructure may be useful for only the next 5 to 10 years, according to these studies. High-density conversion technology products offer additional cost savings and convenience to this argument for fiber to the desktop.

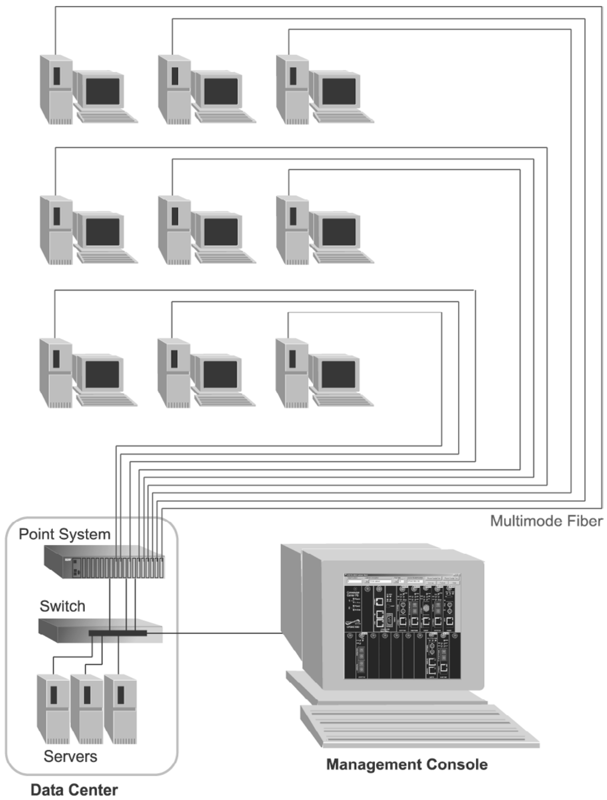


Figure 5: Point System - Fiber to the Desktop

MAN (Metropolitan Area Networks)

The onslaught of single-mode fiber being installed in virtually every available right-of-way has given much access to fiber between remote locations in most major cities. Commonly referred to as "dark fiber" this installed fiber can be leased for the purpose of effectively extending your LAN (local area network) over distances up to 80 Kilometers (see figure 6). This metamorphosis of the LAN from a relatively limited geographic location (within a building or a local campus) to a significantly expanded area is referred to as a MAN (metropolitan area network).

There are significant advantages to a MAN when compared to the alternative, a WAN (wide area network). MANs allow communication between network equipment using native protocols such as Fast Ethernet, Gigabit Ethernet or ATM. In contrast, WANs require conversion from native LAN protocol to a protocol offered by a given carrier/service provider. This requires the use of a network router to deal with conversion between the disparate protocols. This is typically more expensive for the service provided and also reduces the throughput (100Mbps or Gbps traffic must be transmitted across slower speed WAN protocols like T1/E1 at no more than about 2 Mbps).

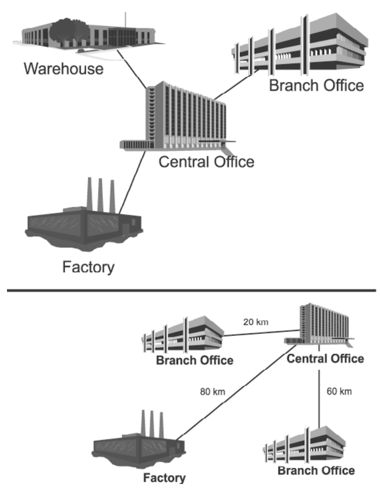


Figure 6: MAN (Metropolitan Area Network)

Yet another advantage is that MAN provides far more control of the connection for end to end. With a MAN, you have complete control of the communication process. This includes the ability to remotely manage, monitor and perform diagnostics yourself in comparison to the WAN connection in which you must rely on your service provider to manage and maintain the link between you and your remote office.

Conversion technology allows common native network protocols to be delivered over distances that can traverse most major metropolitan areas. The two most common network backbone protocols, Fast Ethernet and Gigabit Ethernet, can be transmitted as far as 80 km (65km for Gigabit). Long haul options are also available for T1 DS3, ATM and others. Again, chassis-based conversion technology is capable of handling multiple protocols and multiple interface types in a single modular chassis.

Applications in the Service Provider Market

Service providers are companies that offer Internet services to companies or facilitate the data connections of large corporations with operations in a wide variety of locations. Additional certifications can be required by service providers such as Network Equipment Building Systems (NEBS) or FCC Class B. To address this market, media converters have designed their equipment to meet these more rigid standards.

FCC class B refers to emissions requirements in North America and CISPR class B is effectively the international equivalent of FCC class B for installation of electronics in residential environments (see figure 7). Many carriers for any active electronics device installed in a CO (central office location) require NEBS level 3 certification.

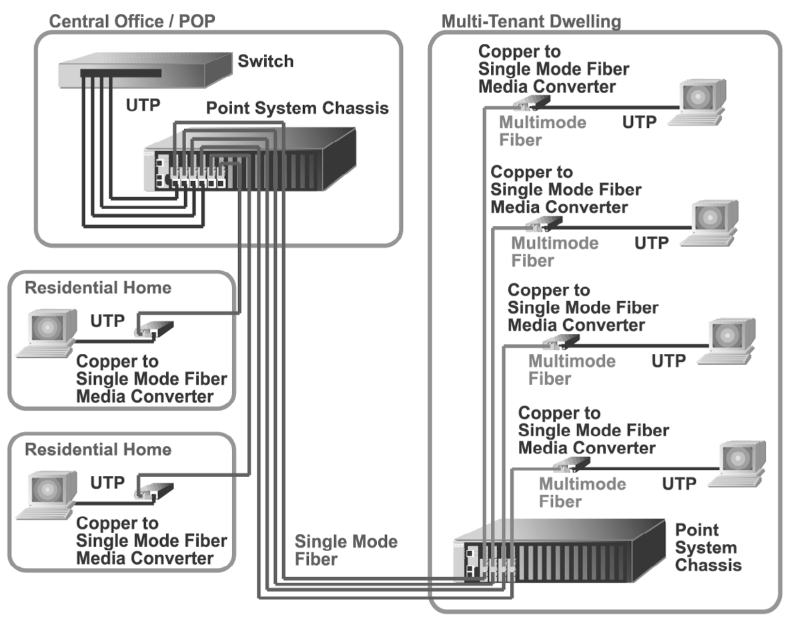


Figure 7: Data Services: Fiber to Multi-Tenant Dwelling / Fiber to the Home

In recent years access to the worldwide web has found it way into the homes of literally millions of people around the globe. As more people access the Internet and place greater demands on the type of content they would like access to, the bandwidth requirements of users have increased as well. Many people, frustrated with slow web access via dial-up POTS (plain old telephone) connections have begun demanding higher speed Internet access. Service providers have offered several solutions to increase the access speed of their customers with technologies such as DSL, VDSL and cable modems. Recently, service providers have started turning to tried-and-true network LAN protocols such as Ethernet as a solution for their customers, bandwidth woes.

A common use for conversion technology in a residential application is enabling the conversion of copper to fiber optic cabling for distance extension from a service provider's central office to a multi-tenant dwelling. High-speed data services are delivered to the basement of these building via fiber and are distributed via copper to clients living in these structures. Clients are able to gain access to the Internet at 10Mbps Ethernet speeds or faster. This (in contrast to 2 Mbps or slower) is the highest speed offered by the majority of providers today.

Chassis-based conversion systems are used on both the service providers' end as well as on the clients side. The modular design of the chassis enables the service provider to easily add connections and also upgrade easily and inexpensively. Chassises are also designed to occupy a relatively small amount of space, which is often at a premium at both sides of the connection. Chassises also provide remote management capability that can significantly reduce costs with less frequent need to dispatch personnel to a customer site. Lastly, chassis offer redundant power options which improves customer satisfaction (less down time) and reduces operating costs by eliminating service calls to remote locations.

Cost Savings Examples

The examples above show the need for implementing fiber into networks. Sometimes the entire network design is done from the beginning, other times fiber is added gradually as needed. Regardless of when fiber is implemented, network managers are faced with purchasing network gear with fiber interfaces. Networking switches and routers with fiber interfaces are significantly more expensive than their copper port counter parts. This is due largely to higher component costs and lower volumes. These devices are also a much less dense solution than copper port devices, although small form factor (SFF) optics have made significant improvements in this area. Network managers will find it cost effective to utilize switches with copper ports used with media converters versus purchasing a new switch with fiber ports.

To illustrate this point let's look at a few examples.

Example 1

A network manager has to add a new department with 24 users. These new cubes extend beyond copper's reach from the data closet so fiber must be deployed. In this example, we will explore two options. The first option would be to use 2 Cisco Catalyst 2912 switches with 12 100Mbps FX ports. The second option would be to use 1 Cisco Catalyst 2950 switch with 24 10/100TX ports and Transition Networks Point System Chassis and 100Mbps converters.

Option 1
Cisco 2912, model number WS-C2912MF-XL has 12 100Mbps FX ports and has a unit cost of $5516.75. Two of the Cisco 2912 units would be needed to support 24 users and would have a total cost of $11033.51, or a cost of $459.73 per port.

Option 2
Cisco 2950, model number is WS-C2950-24 has 24 10/100Mbps TX ports and has a unit cost of $762.84. Transition Networks 19 Slot media conversion chassis, model number CPSMC1900-100 has a unit cost of $406.55. Transition Networks Fast Ethernet Multimode media converter, model number CFETF1013-105 has a unit cost of $207.02.

For this option the network manager would need to purchase one Cisco 2950 switch, 2 Transition Networks 19 slot chassises, and 24 Transition Networks Fast Ethernet converters for a total cost of $6,544.51 or a cost of $272.69 per port.

24 Users	Per Port Cost	Total Cost
Cisco 2912	$ 459.73	$ 11,033.50
PS & Cisco 2950	$ 272.69	$ 6,544.51
Savings	41%	

Example 2
A service provider is delivering 100Mbps service to 48 customers in a multi-story building. Because the services are homogenous the service provider decides to evaluate a multi-port converter. The service provider is bringing data to the basement of the building and then running fiber to each floor to deliver the data. The service provider has selected the Enterasys Smart Switch 2200 series and must choose between the 16 port 100Mbps FX switch or the 24 port 100Mbps 10/100Mbps TX switch coupled with the 12 port 100Mbps converter from Transition Networks.

Option 1
Enterasys Smart Switch 2200 series model number 2H258-17R with 16 100Mbps FX ports. To support 48 users the service provider must purchase three of these units at a total cost of $30,067.94 or $626.42 per user.

Option 2
The service provider would use the Enterasys Smart Switch 2200 series model number 2H252-25R that has 24 10/100 TX ports. These switches would then be used with a 12 port 100Mbps FX media converter from Transition Networks; model number UFETF1013-120. Because there are 48 users the service provider would need to purchase two of the 24 port switches and four of the 12 port media converters.

The total cost of the two switches would be $7,681.68 or $160.04 per user. The total cost of four media converters would be $11, 477.68 or $239.12 per user. The total solution cost would be $19,159.36 or $399.15 per user.

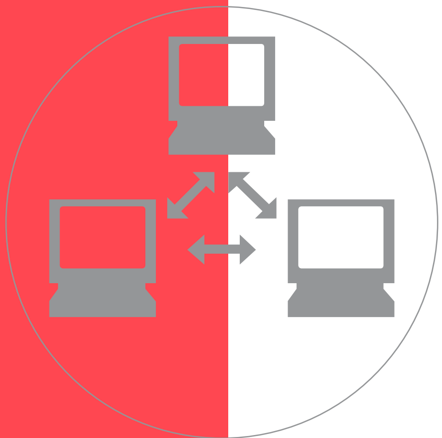
48 Users	Per Port Cost	Total Cost
Enterasys 16 FX Port	$ 626.42	$ 30,067.94
Media Conv & 24 TX Port	$ 399.15	$ 19,159.36
Savings	36%	

In both of these examples, a standalone media converter would be used at the customer's location to convert from fiber back to copper. Because the standalone converter would be used in either option of both scenarios, it does not effect the cost savings calculation.

In both examples above, every port is being used on the fiber switches. This optimal case does not usually occur in actual applications, and while the total cost of the fiber switches does not change, the cost per user does change. Furthermore, if a chassis-based solution is used the service provider will incur the cost of the chassis, but can add media converters as necessary. This not only saves money, but also provides flexibility if the service provider needs to add a single mode card or add a different converter.

Another advantage of media converters is the various distances that are available. Typical fiber blades come with multi-mode optics. While users can choose from a wide variety of distances to extend the reach of their network up to 100km in some cases.

Media converters have evolved from their initial intent of adding one or two fiber strands to a network as a quick resolution to a problem. Today, media converters are offered in a wide variety of form factors to address the complex needs of network managers. Conversion systems now offer management software that allows the network manager to fully monitor and configure the systems. Converters can be deployed in a wide variety of network applications such as small local area networks, large enterprise networks, and service provider networks. Not only do media converters provide unique solutions for difficult problems, they offer flexibility and cost savings when implementing fiber into your network. Media converters are networking hardware elements that need to be considered when designing a network.



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