TRANSITION networks

The Conversion Technology Experts

Media Conversion: *Cost-Effectively Integrating T1 into your Fiber Network*

Media Conversion: Cost Effectively Integrating T1 into Your Fiber Network

Revealing some simple steps you can take to protect your existing investment in network infrastructure while expanding its performance bandwidth

Introduction

T1/E1 is one of the most popular forms of data transmission today. It has been around for many years. Originally, T1 was solely a Telco transmission mechanism tool to reduce the number of wires being installed between central offices. One T1 circuit can provide 24 channels of digitized voice, which means the phone company can install one line to a business to handle up to 24 separate phone calls; rather than installing 24 individual phone cables. Today we are finding more and more uses for T1; moving it out of the Telco propitiatory environment into private networks. It's in these private networks where T1 has become popular and where media conversion plays a significant roll in reducing cost of installation and equipment. These private networks are typically Campus or Metropolitan Area Networks (MANs) where a significant part of the T1 circuit falls inside the private environment.

Background

In 1957, the Bell systems installed the first T1 trunk to carry high-speed digital voice signals over two twisted pair (four wires). In 1997, the Extended Superframe Format (ESF) was created which provides in-service diagnostics. In addition, in 1983, T1 was tariffed so corporations could combine their voice and data traffic over one line. Now in the 90's we have adapted T1 to Fast Packet Technology, which instantaneously multiplexes and allocates bandwidth on demand. As you can see, as our needs have change we have also changed the basic workings on T1. Although T1 is basically the same, it is how we use the bits it transfers that has varied.

T1 is based on 24 voice channels of 64 Kbps. If you multiply that out (24 x 64K) you get 1.536 Mbps and not 1.544 Mbps. The reason is that after each byte (8 bits) of data is sent from each channel there is an extra bit sent for synchronization a Frame sync bit. This adds another 8Kbps to the transmission for a total of 1.544 Mbps. The E1 standard is slightly different, but it is basically the same technology and provides the same services in Europe and in other parts of the world.

The basic building blocks of a T1 network are the CSU/DSU, multiplexer and a bridge or router. Depending on the type of T1 network being created, not all of these components need to be used. The CSU/DSU (channel service unit/data service unit) is the actual connection point for the T1 wires. It provides line diagnostics and keep-alive functions for the line. The T1 line connects to the unit via an RJ-45 connector and connects to premise equipment via a V.35 interface. The CSU/DSU also provides signal conversion and clocking over the T1 line. The multiplexer

provides the circuitry to direct multiple channels of voice or data onto a T1 line. Many multiplexers have built-in CSU/DSU units for direct connection to T1 lines. The bridge or router provides the interface that allows internal servers and networks to use the T1 line as a network extension or interconnection. As the following illustrations show, different devices are used to complete the network depending on the application.

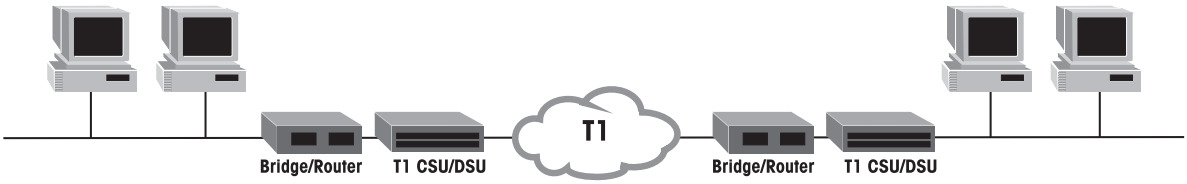


Figure 1: T1 Data Network Application

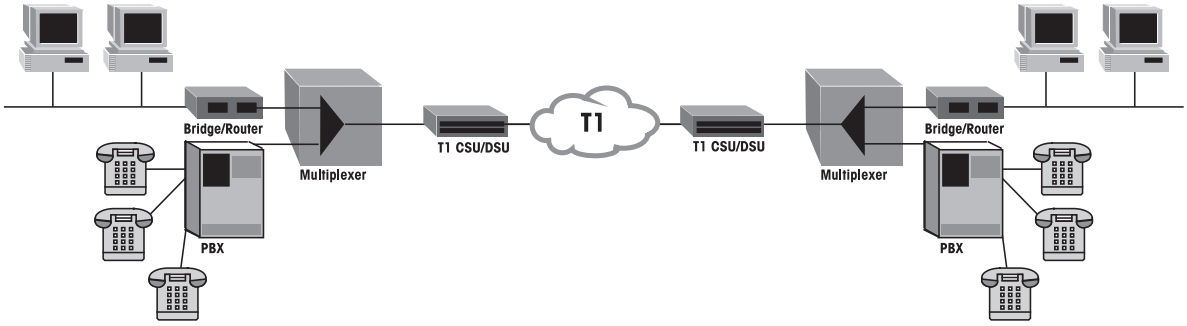


Figure 2: T1 Voice and Data Network Application

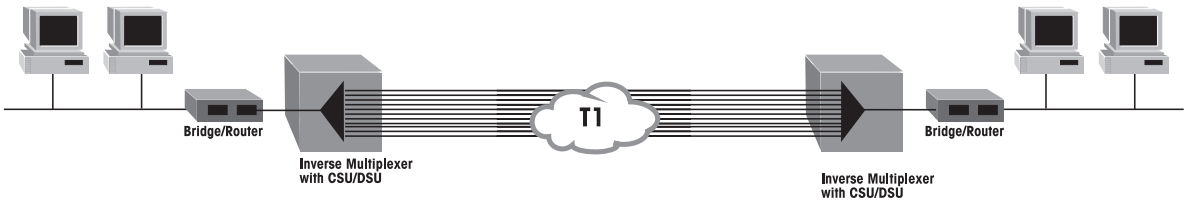


Figure 3: T1 Data Network Application with Multiple T1 Lines

Installing a T1 Line

The installation of T1 lines is demanding. Typically, the two twisted pairs of wires needed for the T1 line is in a 25-pair bundle. The installer, at random, picks two pairs and tests them to see if they will support a T1 circuit. Due to crosstalk between pairs of wires, the pairs that the installer picked may not support the circuit. This process is repeated until two pair of suitable wires are found. This hunt for the correct wire pairs can be compounded by bridge taps. Bridge taps are wire pairs that have multiple appearances of the same wire pair at several distribution points. Originally, the phone company wired areas like this to support party

lines. Party lines have long gone away but some of the original wiring still exists. In the worst case, the installer will have to run new wire to support the T1 circuit.

Another factor in the installation of a T1 line is that it needs line conditioning. Line conditioning means that the signal is regenerated at regular intervals. In the case of T1, a repeater is added every 6,000 feet (2km). However, to maintain a high signal quality, the first and last repeaters must be within 3,000 feet (1km) from the endpoints.

Cost of T1 Lines

Typically, T1 circuits are dedicated lines that are leased on a monthly basis. Some carriers will offer switched services for special applications such as videoconferencing or temporary data services such as backups. T1 lines are commonly used to provide private data links between an organization's local and remote facilities. They also may provide links between a company's internal network and an ISP (Internet Service Provider) or to a public packet-switched network such as a frame-relay network that provides packet delivery services to one or more sites. For example, the customer may choose to use the entire T1 line for data and not for voice and data.

While private networks built with T1 lines have many benefits, cost is not one of them if the lines are long distance. T1 leased rates increase with distance. A short distance line within a metropolitan area may cost $1,500 per month while a long-distance line across the Unites States may cost $20,000 per month. To create long-distance network connections, it is often better to lease a short-haul T1 line to create a connection into a carrier's packet-switched network, as shown on the right in Figure 4. The short T1 line will be inexpensive, and the packet-switched network can deliver traffic on a pay-for-use basis to other sites.

Fractional T1 is another way to lower the cost of the T1 line. Fractional T1 lets you lease a T1 line in increments of 64Kbps each. The normal T1 line installation cost is incurred (typically $300), but you only pay for the channels you use. Since T1 provides 24 channels of 64Kbps the customer can scale the cost of the line based on the bandwidth demand.

How Media Conversion Plays a Role

A T1 to Fiber Media Converter can assist in several areas of the T1 circuit. They can help with installation costs, equipment costs and troubleshooting network problems. Typically, media conversion is used in two types of private network applications. Either a completely private network where the customer owns and operates all of the T1 equipment; or a premise side network where the customer only owns the T1 equipment in their building, campus or metropolitan area. The following figures show examples of these networks.

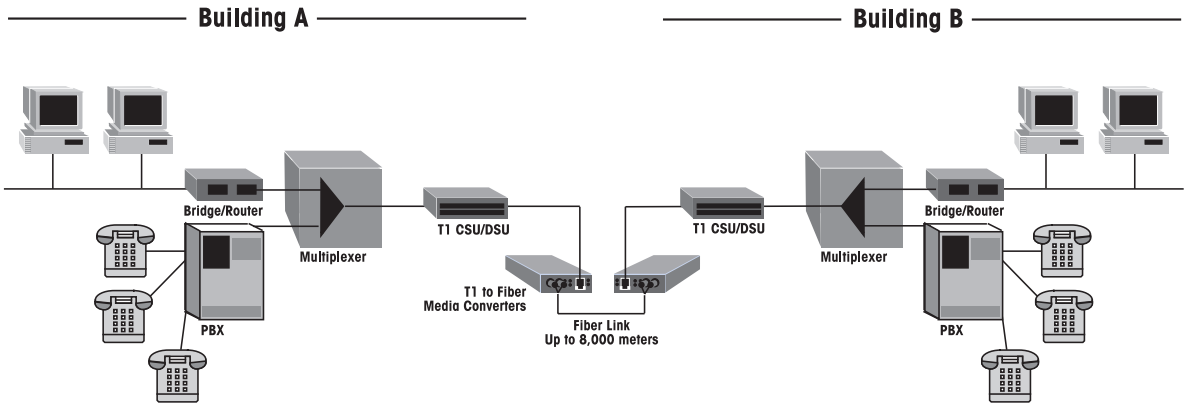


Figure 4:
Typical Media Converter Application for a Completely Private Network

A completely private network application may exist between two buildings where the customer wants to transfer voice, data or both. The phone company is not involved at all with this kind of network. The customer owns the complete installation: all the equipment and the problems that go with it.

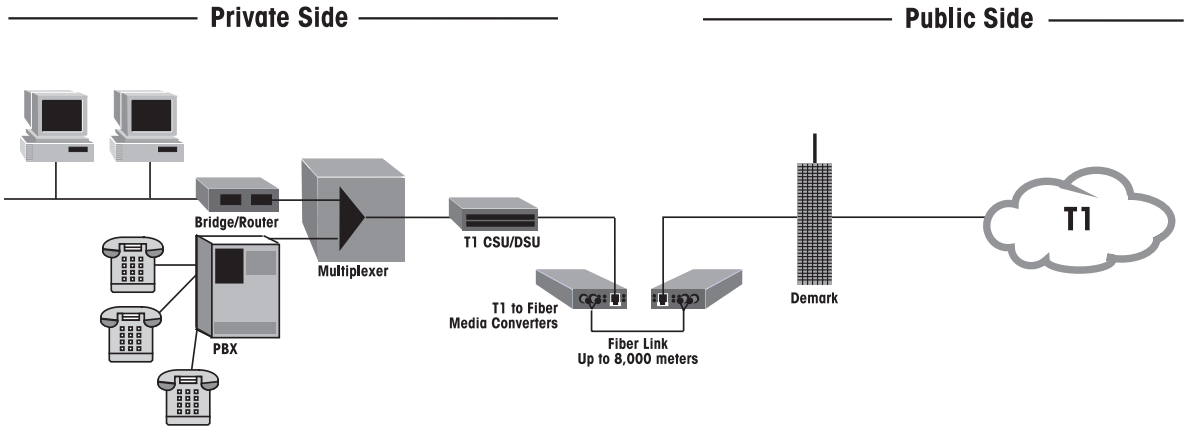


Figure 5: Typical Media Converter Application for a Premise Side Network

In a premise side application, when a T1 line is installed by the phone company they stop at the demark point. That is the point at which the phone company terminates their lines. The demark may actually be hundreds of feet from the CSU/DSU and in a building, campus or MAN network. In some cases, this could be as much as thousands of feet away.

Media conversion can be used in both of these types of applications. It can simplify the link between two buildings or from the demark to the location where the customers T1 equipment resides. The fiber link can be up to 8,000 meters (26,000 feet or 5 miles) long. It does not need any

line conditioning, which eliminates costly repeaters. Installation can be done without any concern for cross talk between lines or their placement in regards to external electrical interference.

Integrate T1 into existing Fiber

In the private or premise side applications we have discussed earlier, they require a fiber link. Unless this is a new installation, these fiber links would be installed in locations where network backbones currently exist. Since fiber is the most popular network backbone media, it is very likely that there is already an existing unused fiber link available for these applications. Currently, when a company installs fiber they typically install more than one. Statistics indicate that right now about 80% to 90% of the installed fiber is dark. Dark fiber is fiber that has been installed and is unused. This is another reason that media conversion makes sense for building, campus or metropolitan area networks. Most of these networks already have fiber backbone media installed. It would not make sense to revert back to a costly copper link.

What to look for in a Media Converter

Some media converters, like the ones provided by Transition Networks, incorporate a variety of other features including troubleshooting aids, fault detection and Jitter attenuators.

Loopback

Loopback is an important troubleshooting feature for ease of installation. It allows the installer to check the promise side of the network before activating the Telco side. This makes for a much smoother installation when the premise side is known to be good and working. Bit Error Rate (BER) testing can be performed in loopback mode on the premise side of the installation and then compared later to a full line testing. Knowing the premise side BER figures can help locate or identify where the circuit is having difficulties.

Jitter Attenuators

Jitter attenuators are another feature to look for in a media converter. Jitter is introduced into a T1 circuit as a result of line conditioning. These attenuators are designed to filter out unwanted jitter and improve BER testing results.

Dry Relay Contacts

Dry relay contacts are a feature that doesn't actually help with installation but provides a means for future fault detection. By connecting the dry relay contacts back to an alarm in the customer premise, it provides a means to detect if the remote media converter fails. A network administrator can quickly check the status of the remote media converter if a network failure occurs. These types of troubleshooting aids and features are important to the proper installation and operation of a T1 circuit.

If your adding multiple T1 circuits to you environment, Transition's T1 media converters can be incorporated into their Conversion Center which with an optional network management card you can monitor up to eight T1 media converters at a time. The following figure shows an example of how the Conversion Center could be used to help maintain a T1 network.

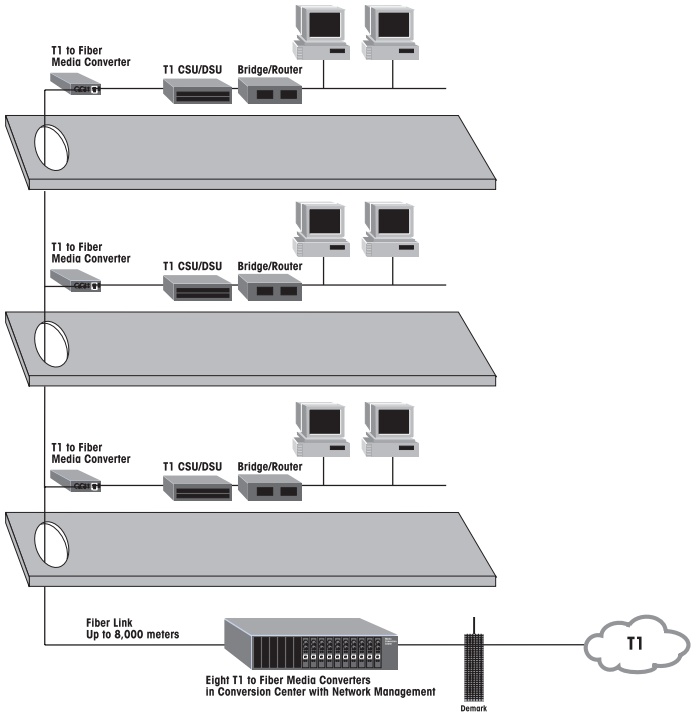


Figure 6: Typical Media Converter Application for a Premise Side Network

Simple Steps to Remember about T1 Media Conversion

As we have described here, T1 is a widely used networking tool. Since T1 has been around since the 1950s, it is common to come across it or want to add it in networks. Media conversion can provide a simple way to integrate T1 into your premise or private network. Here are some things to remember:

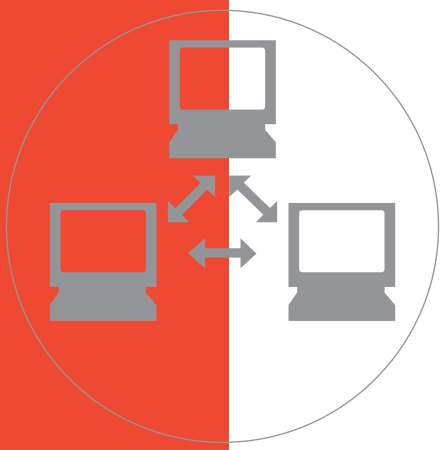
1. T1 media conversion can reduce the cost of installation since line conditioning of the fiber link is not necessary, eliminating costly repeaters.

2. Dark fiber probably already exists where you want to install or expand your T1 circuits.

3. Make sure that you select the right media converter that provides enough features to make installation and maintenance of your T1 network easy.

4. If you do have to install a new link, make it fiber. Fiber is immune to cross talk and external electrical interference making installation of T1 lines easier.

These are some of the advantaged of using copper to fiber media conversion. Fiber has been the choice of network backbones and is increasingly in popularity for other networking applications. Media conversion provides a means to integrate fiber into you network as needed.



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