"Rewiring" Frame Relay: The Promise of ATM

BY LEO A. WROBEL

The revolutionary changes occurring in the telecommunications environment represent not only cost-savings but also the perfect opportunity to expand the capabilities of your network.

EVERYONE who has enjoyed the popular TV series *Home Improvement* knows that Tim Taylor's favorite saying is: "This would run much better if it only had more power."

In a sort of backhanded way, this saying holds true when users look at improved methods of interconnecting high-speed LANs over a wide area network link. Users look at their network and make much the same determination — that things would run much better if they only had more power.

"Rewiring" telecommunications services, however, is easier said than done. Until recently, even the largest users were limited in their selection of services. For example, you could select a garden variety T1 or T3 as defined in your telephone company tariff. However, if you asked for an alternative solution you were basically out of luck. After all, the phone company is not Burger King – it's hard to have it your way.

This is about to change. With the advent of competition in local telecommunications, if a user can't get what he wants from his incumbent telephone company, another company will be more than willing to build it for him. This creates new opportunities to not only save money but more importantly take advantage of the deployment of new technologies and services.

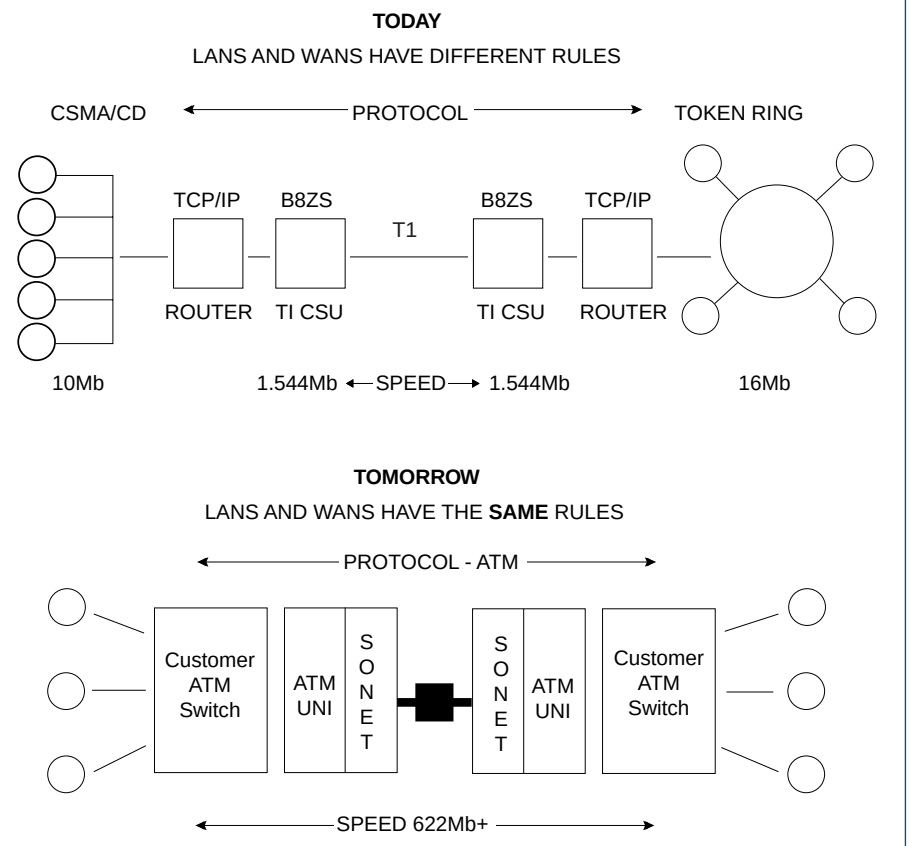
These unprecedented changes in telecommunications, fostered by the Telecom Reform Act of 1996, bode well for LANs. Additionally, WAN capabilities may soon match this impressive local environment. Currently, LANs and WANs have different rules when it comes to transmission capabilities; however, this may soon change. When the local incumbent telephone company or a competitive upstart telco installs a SONET (Synchronous Optical Network) terminal in your company's basement, you will bury T1 forever. When ATM cards drop in price below Fast Ethernet cards, you will retire Ethernet as well. Sound ambitious? It's only a matter of time. This article will provide some of the "whens and whys" of how your traditional network will begin to be replaced by new and exciting technologies brought about in large part by the dramatic changes in telecommunications legislation. As illustrated in Figure 1, these changes will manifest themselves in both the local and wide area networks, since ATM will be the first widely-available technology that lives equally well in either world. Let's start with the LAN.

THE CHANGING FACE OF THE LAN

Imagine Tim Taylor describing his latest adventure rewiring his LAN: "I started off with a measly little 10 base T Ethernet, but I rewired it. Now I have a 622 megabit (Mb) network over a SONET backbone carrier... Aurgh, aurgh, aurgh!

So is 10Mb Ethernet outmoded? Is it obsolete? For most of us, probably not. When you consider business applications such as word processing, spreadsheets, and email run by the preponderance of users out there, 10Mb is quite adequate. However, the increase in number of users and the more complex the application, the more congested the network becomes and the slower its overall performance. For example, how many times during the day have you heard someone yell, "Why do they have to run this in the day time?" What this statement usually means is that one user is being a resource hog on the network, either performing large file transfers or consuming

Figure 1: LANs and WANs Have Different Rules



an inordinate amount of LAN resources with the transaction. However, for a department that performs primarily interactive transmissions over the LAN, such as customer service transactions, 10Mb works fine. The reason is that not all users transmit at the same time. Sometimes they are on the phone talking to customers, while other times they are on break or engaged in other tasks. In fact, in many environments a user may be actually online only 7 percent to 10 percent of the time, even in a busy customer service environment. This means many users are sharing the same bandwidth, but at different times.

In the 10Mb Ethernet environment we can't create more capacity, but we *can* segment what is there. That's been the modus operandi for about the last 10 years — a whole team of "filter kings" constantly monitoring LAN performance, usually staying just one step ahead of the wrath of the users. But just suppose users had access to virtually unlimited bandwidth on a virtually instantaneous basis? This is the promise held by Asynchronous Transfer Mode (ATM). ATM will make data communications similar to the telephone. Moreover, ATM will offer true isochronous capability — suitable for not only data but voice and video as well. Let me explain.

For example, imagine you are doing a full motion video transfer of me at one of my speaking engagements. Typically a video link is isochronous, meaning that the bits leave the location while I'm speaking, and arrive at the location where you are viewing in sequence with each other and with the timing relationship maintained. Another example of isochronous is a voice telephone call. Once again, in order to move an intelligible voice from one end to the other, the words that leave the location from where I am speaking have to arrive at the location where you are listening in the same order. In the case of the video conference and the voice call, imagine if the video and the voice where broken up and all of these packets arrive at the far end out of sequence with each other. Additionally, imagine that other users could jump in the middle and send their data at the same time, thereby delaying packets in my transmission from one end to the other. This would mean the voice coming through on the other end would be unintelligible since the words would be out of sequence, phrases would be mixed, and everything would be out of sync. The video would be even funnier, as you watched me go from one end of the room instantly to the other end of the room, up on the ceiling, down on the floor and every which way. I'm being a little lighthearted with this, but you get the idea why isochronous capability is important.

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LANs are non-isochronous since they are shared by a number of users. For data, momentary transmission delays are no problem. To the user they appear as slightly lengthened response time. For isochronous transmissions, such as voice or video, most LANs will not work.

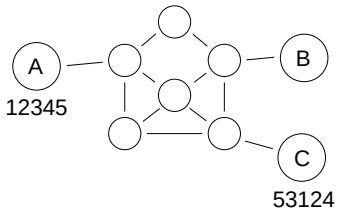
ATM VS. FRAME RELAY

ATM is a high-speed cell switching technology that promises to revolutionize both local and wide area telecommunications. In fact, many experts believe ATM's impact will be as revolutionary in scope as the advent of fiber optic communications was on telecommunications in general. ATM is designed primarily for speed — T3 (44.736Mb) and up. However, applications are being written for ATM as low as T1 (1.544Mb) How does this compare with that other popular service, frame relay?

Well for starters, 75 percent of frame relay deployments today are at 56kbps. Frame relay is designed to operate up to and including about T1. However, new applications are being written for frame relay that will take it up to about T3 speeds. The only real overlap between the two is between T1 (1.544Mb) and T3 (45Mb), and even here is gets hazy.

Frame relay is a non-isochronous packet switch technology. Many users today are running voice over frame relay, although it is not well suited for voice or video. If you don't

Figure 2: Rewiring Frame Relay



Video over frame relay poses problems. The nonisochronous nature of the medium can cause bits to arrive out of sequence.

WHAT CAN WE DO ABOUT IT? HOW CAN WE "REWIRE" FRAME RELAY?

1. MAKE **LINKS LARGER**
2. MAKE **SWITCHES FASTER**
3. MAKE **PACKETS SHORTER**

ATM DOES ALL OF THESE TO PROVIDE TRUE ISOCHRONOUS CAPABILITY!

mind apologizing for the quality of your voice go ahead and run it over frame relay. Frame relay's strong suit is data; since data traffic is delay tolerant and does not require isochronous transmission.

Frame relay is one of the hottest selling, most widely available, most-cost efficient technologies available today. ATM, on the other hand, is more limited in availability. However, the promise of ATM is its ability to provide an isochronous form of transmission suitable for voice, data, and video with the same pricing dynamics and efficiency of frame relay. How will it do this? See Figure 2.

Using this example, let's assume we want to take this frame relay network and make is suitable for isochronous traffic. Remember that in transmitting any data from A to C, for example, each packet of data may take a different path through the network. Therefore, the data packets from A that are numbered 1-2-3-4-5 may in fact arrive at location C in the order 5-3-1-2-4. This does not present a problem for data, since higher level protocols such as TCP/IP will rearrange the data making sure there are no missing packets and then deliver the data to the premise equipment on the other end within an acceptable timeframe. The problem is what if this is a voice call or video? If a video conference is encoded at location A as 1-2-3-4-5 and arrives at location C as 5-3-1-2-4 you can imagine what the video will look like. On the other hand, packet switching is anenormously efficient way of moving data around, since any facility with the ability to send data instantaneously can be utilized. This provides great facility utilization and actually allows the carrier's cost to serve the same number of users with fewer circuits. So let's consider this diagram and what we need to do to make this scenario suitable for isochronous capability.

First, let's start with the size of the links between the switching nodes and the network. With the advent of fiber optic capabilities we can actually make these links much larger than in the past. So the first thing we will do to this network is to make the inter-nodal links larger.

Next, we need to do something with the switches. Conventional switches are far too slow in propagating data. Therefore, we need to develop a whole new switching technology that includes switches that are literally faster than hellfire and damnation. In order to make switches fast, we need to make them simple — so simple, in fact, that they are more hardware than software and can literally be wired into the network. This is what vendors have done today with ATM switches. The fastest of these today are in excess of 10GB or the equivalent of 45 T3s. That's fast enough to avoid significant network delays (latency), and again, speed the network up to the point where it could possibly support isochronous capabilities.

The next step is to make the switches faster. However, we're still not done yet. To make a network truly fast, the data packets need to be small. We can't have processors in the network waiting around for a large data packet to propagate without increasing latency. Therefore, we need to make the packets small and consistent in size. If all the packets are the same size – small — they can be switched through the network quickly. So, in order to turn a fast packet network like frame relay into an isochronous network such as ATM, we need to shorten the size of the packet — in this case a 53-byte cell instead of a long and potentially slow packet of 1500 bytes or more. Packets don't hang around as long in the network so they are faster. By making the links larger, making the switches faster, and making the packets shorter we can indeed derive the advantages of isochronous transmission with the cost efficiency of a cell-switched technology. This is the promise of ATM.

BREAKING ALL THE RULES

So remember the beginning of this article, when I stated that LANs and WANs have different rules? Well, presently a signal from a network interface card (NIC) in a computer in New York to a NIC in Los Angeles undergoes numerous protocol format and translations along the way. Why? When the price of ATM becomes comparable to Ethernet cards, and when ATM services becomes widely available, the signal will never change from the NIC in New York to the NIC card in California! LANs and WANs will have exactly the same rules.

It gets even better. If the two sites in New York and California are connected over a high-speed SONET link (that terminal the local telco put in your basement, remember?) of say, 622Mbps, a single user theoretically has the whole pipe to himself for a large file transfer — true bandwidth on demand. A 17 second ATM "call" can move a 4GB engineering diagram across the country. Now that's more power. Tim Taylor would be proud. Aurgh, aurgh, aurgh! Good luck in your pursuits. *ts*

Leo A. Wrobel is an active author, lecturer, and technical futurist. He has published 10 books and more than 200 trade articles on a variety of technical subjects. Wrobel is president and CEO of Dallas-based Premiere Network Services Inc., a 12-year-old management consultancy and now a Texas PUC-certified local telephone company. For more information, contact our web site at www.dallas.net/~premiere or call 1-888-REWIRE-IT.