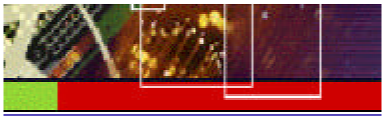

March 18, 2002

TeleChoice Perspective:

Super-Broadband Deployment Initiatives

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The Strategic Catalyst™
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TeleChoice Perspective on Super-Broadband Deployment Initiatives

If you are a service provider wanting to provide super high-speed broadband in the U.S., you had better get your network into shape, according to a new study from TeleChoice, Inc., a strategic catalyst firm headquartered in Tulsa, OK. A slew of broadband-boosting proposals are circulating through the halls of Washington these days—ranging from the Broadband Deployment Bill, and its various amendments, to the TechNet folks lobbying for 100Mbps to 100M homes by 2010. Carrier network planners need to take a hard look at how their network will handle prioritization of traffic to remain profitable in such a big bandwidth world.

“The sheer volume of traffic coming off these fiber on-ramps will hit the metro and long haul networks very hard,” says Russ McGuire, chief strategy officer for TeleChoice and author of the study. “That goes straight to the operational costs of the network and is hard to recoup in service revenues. To beat this, carriers will have to make some major changes in the way they handle traffic in their network and how they price for their services to maintain a profitable network operation.”

Specifically, carriers will have to do something they have either ignored in the past or have been unsuccessful in doing—forcing enterprises and applications to shape their data. “ATM, Frame Relay, and now MPLS have enabled carriers to have their customers prioritize traffic, which in turn gives the carriers more options in sizing their networks,” says McGuire. “However, customers have failed to seriously confront properly categorizing their traffic. There has been no need to because there was no penalty for just saying ‘It’s all important.’”

TeleChoice has looked at the various broadband proposals including a detailed analysis of the nation’s fiber routes and existing and projected equipment capabilities, combined with a review of current service provider practices and policies. The initial results show an incredibly poor return on investment for the carriers if today’s data practices are maintained. However, proper changes to the IP services could severely improve the profitability of the overall business case for super-high bandwidth in the local loop.

TeleChoice has enhanced its Model for Advanced Capital Planning (MADCAP) to introduce a new factor into its IP traffic modeling—traffic shifting. The “traffic shifting factor” indicates what percent of peak IP traffic can be shifted slightly to an off-peak moment, reducing the peak accordingly through various prioritization schemes.

“Traffic shifting will make or break these broadband proposals in the long run,” says McGuire. “This will really accelerate the effective use of MPLS and other such mechanisms in the core and make them more important than ever. The carriers simply cannot ignore this anymore.”

The Broadband Task at Hand

With the telecommunications industry in a rut and most players looking for some path out of the mess, a number of lobbying groups, industry forums, and other entities have flooded key political and economic influencers with proposals to jumpstart the sector and the economy at large using broadband technologies. One proposal from TechNet, for instance, calls for a "Man To The Moon"-type program to make 100Mbps available to 100M homes and small businesses by the end of the decade. Others focus on wider competition in broadband by incenting deployment of competing broadband options.

The list of players pushing for broadband packages is extensive and covers the virtual "Who's Who" of telecommunications, including Cisco, Compaq, HP, Intel, Lucent, and Microsoft. Everyone seems to be in on one, if not all, of these initiatives.

"Where the positive effect of broadband on an economy is well documented, there's a lot of money between point A and point B," says McGuire. McGuire expects such deployments to focus on extension of the nation's optical network closer to and into residential homes. TeleChoice estimates that up to $1T worth of equipment is required to jumpstart the path towards such a 100Mbps optical-based national infrastructure—and that's just in the first five years of the effort. (These first years alone would drive a whole new round of R&D and innovation that makes projections past a five-year period almost impossible.)

But the growth factors that make all this so exciting for the industry, make it very scary as well. Having to absorb $1T in investment requirements can destroy even the best network capital budgets, especially when the applications driving the need for 100Mbps access are yet to be defined. We have already seen what can happen when investment in capacity is out of balance with the demand for that capacity.

"MADCAP was designed to model this balance and to provide insight into issues such as these," says McGuire.

Going MADCAP

The MADCAP framework is a comprehensive, market-specific modeling tool designed to assist long haul and metro carriers in making critical capital investment decisions. MADCAP enables extensive what-if scenario playing as part of the carrier's strategic planning activities. TeleChoice has loaded the model with assumptions covering extensive broadband deployments of 100Mbps building to 100M homes and small offices by the end of the decade.

The model makes some base assumptions about broadband and Internet adoption, based on any of the broadband-boosting proposals. In these aggressive adoption scenarios, TeleChoice has modeled the number of business Internet connections in the U.S. increasing to 113M by 2006, with 7.5% of those using Ethernet services for access. TeleChoice has modeled the number of consumer Internet connections increasing to 155M by 2006, with 8% of those using 100Mbps broadband services.

"We started with the assumption that the services offered over these broadband connections would be similar to the way service providers offer IP services today," explained McGuire. "The results are very ugly for everyone except the equipment vendors who might sell hundreds of billions or trillions of dollars of equipment to create the necessary infrastructure. Margins are thin or negative and there is no clear path to payback on the huge investment involved."

So what does it take to fix the model? TeleChoice has identified some changes that have had a tremendous impact on the financial model of broadband deployments. The first is in the way the network is designed to accommodate peak traffic load, and the second is the way that the IP services offers were actually designed.

"Of course, all this requires change and the industry today is not favorably inclined to change," says McGuire. "But we still think it is important to understand how some changes can transform the industry outlook from bleak to actually pretty rosy. Our model shows that relatively minor changes can have a huge impact."

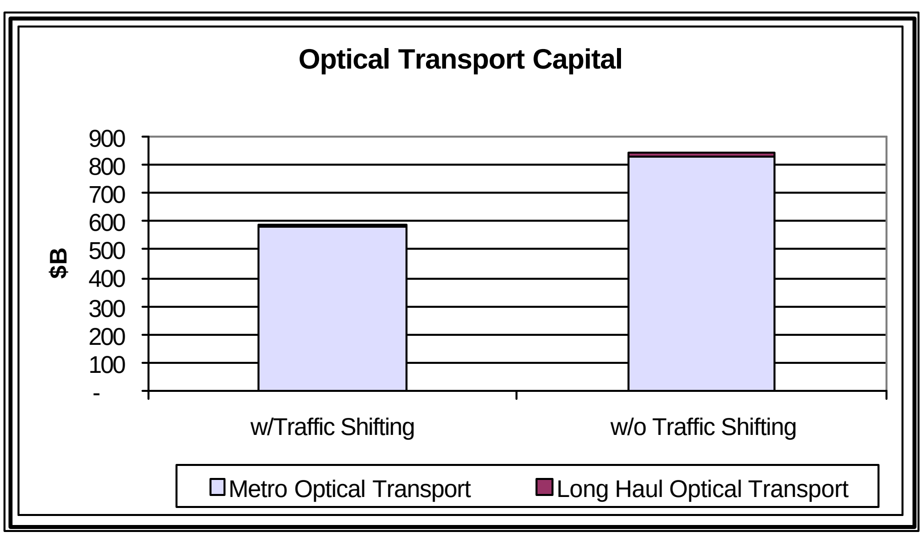
Time Shifting the Network

The key to carrying broadband traffic profitably across the network lies in what TeleChoice calls "traffic shifting." For a reasonable end-user experience, packet networks are designed around peak loads. Traffic shifting is the attempt on the part of a carrier to move traffic around so that the peak load is lower, allowing the network itself to be more streamlined and balanced. In the MADCAP model, the traffic-shifting factor indicates what percent of peak IP traffic can be shifted slightly to an off-peak moment, therefore reducing the peak accordingly. The variable for this analysis was set at 10%, 15%, 20%, 25%, and 30% for this factor, for the years 2002 to 2006 respectively.

The effect of this factor represents a quarter of a trillion dollar impact on capital expenditures:

- Total optical transport CapEx without traffic shifting = $840B
- Total optical transport CapEx with traffic shifting = $590B

So the lack of traffic shifting adds more than 40% to the network cost over the first five years of traffic.



However, a more important change is on the profitability of services. If you assume a 2002 IP services market size of $6B and a 2002 profit margin of -20%, in either scenario revenues increase to $613B by 2006. In the non-shifted scenario, industry costs increase to $554B by 2006 (10% margin); in the traffic-shifted scenario, industry costs only increase to $422B by 2006 (31% margin).

Cumulative profit over the 2002 to 2006 period is also dramatically different: Non-shifted scenario yields $114B (less than 15% of the CapEx) while the traffic-shifted scenario yields $267B (45% of the CapEx).

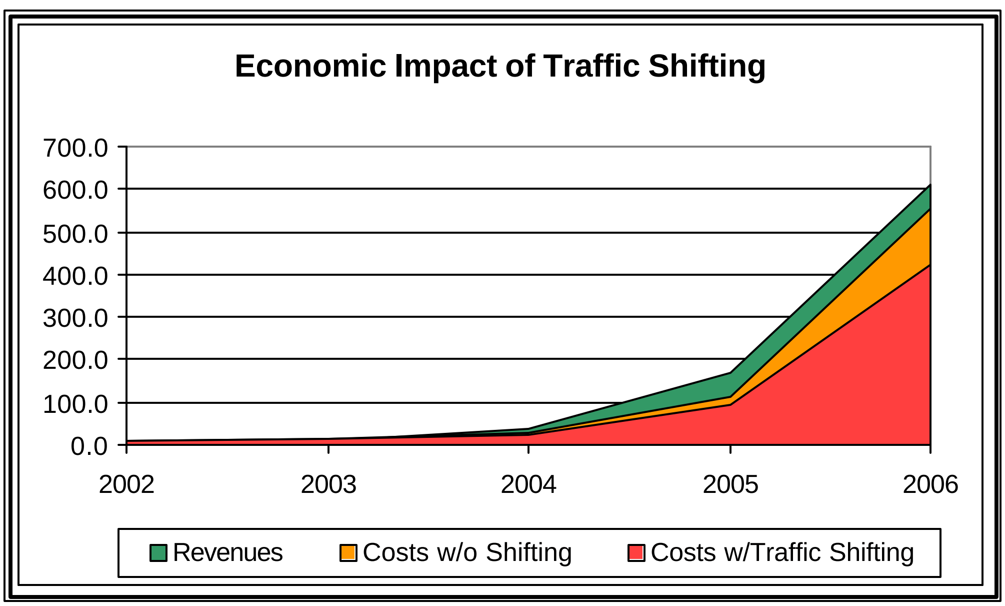
A certain amount of uncertainty exists in all these numbers, if for no other reason than the sheer number of variables. So, for example, where the model shows a 10% margin under the non-shifted scenario, this could just as easily be break-even or negative. "However, the relative positions of the two scenarios would remain, and therein lies much of the insight," says McGuire.

Thus, to summarize our thoughts at this point:

- Without traffic shifting, the 100Mbps/100M homes industry scenario has a very questionable business model and the investment may never be repaid.

- With moderate traffic shifting, the scenario has an attractive business model with a relatively high likelihood that the investment would be repaid.

The fundamental issue is whether traffic shifting will actually occur. "Based on our experience with Frame Relay and ATM, service providers will need to provide meaningful (financial) incentives for their customers to mark some traffic as low priority and shiftable," warns McGuire.



Remaking IP Services

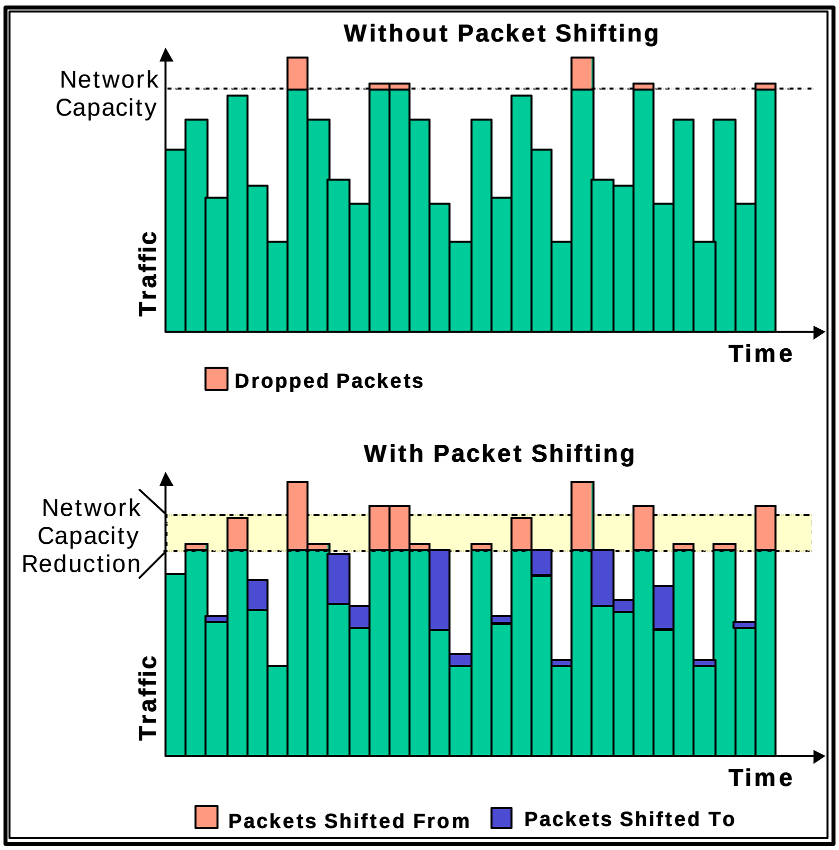
The problem with the service provider model today, at least for IP services, is that there is no incentive for customers to shift traffic to the off-peak. In IP, you need to think in terms of both peak-hour and peak-instant (voice is much less bursty, so you only need to think of peak-hour). Since IP networks traditionally do not handle the peak-instant well if it exceeds the network's capacity (the network drops the packets), service providers need to build networks with enough capacity to handle the peak-instant reasonably well.

The technology for implementing traffic shifting has been available from vendors for some time. MPLS standards explicitly provide prioritization features as one means of achieving traffic shifting as described here. These features are supported in most carrier-grade equipment today, and this equipment is being deployed throughout service provider networks although service providers have been slow to fully implement the capabilities of MPLS.

Theoretically, MPLS is designed to address this peak-instant problem. The MPLS standards include setting priorities for different flows through the network. Depending on which MPLS mechanism is used, at least eight different priority levels can be set, but for simplicity, assume there are three: standard, low, and high. *[**NOTE**: The service providers will probably hold out at least one additional priority for themselves. The highest priority traffic will be real-time network management traffic, which will take priority over all other traffic.]*

In defining the service and configuring the network, traffic for specific flows is set to one of these priorities. Most importantly for our discussion, the prioritization comes into play when there's congestion in the network at a given router. When this happens, the high-priority flows are sent through, and the low-priority flows are buffered. The standard-priority flows are either buffered or sent through depending on how bad the congestion. As soon as the congestion clears, the buffered traffic is forwarded.

The net result is that packets identified as low priority get delayed by a small amount of time until the peak-instant has passed. If we assume that one-third of traffic can be marked each as low-priority, standard-priority, and high-priority, then we can reduce the peak-instant by at least one-third and maybe by as much as two-thirds. This directly translates into the amount of capacity that the network has to be built to handle.



Service Provider Offer Changes

So what has to happen?

Service providers need to offer MPLS services instead of IP services (although they should be creative in the naming!) They need to incent their customers to fully implement the capabilities of MPLS, especially the setting of the prioritization. Service providers can still keep the "flat-rate" approach to pricing (versus usage-based pricing), but perhaps modify it to provide either credits or premium charges depending on the mix of traffic sent across the network. So, specifically, service providers could count the number of packets in each prioritization level and calculate a weighted average of the prioritization mix. Based on that, the monthly charges may vary anywhere from 80% to 120% of the standard monthly rate. All this requires systems changes and changes to service level agreements, none of which is trivial; however, this may become a survival issue.

Since most IP traffic today is highly delay-tolerant (specifically from TeleChoice's studies - Web and email are huge), enterprises will financially benefit from marking this traffic as low priority. Similarly, since traffic marked high priority will receive preferential treatment and therefore higher performance, there is strong incentive for enterprises to mark that traffic accordingly and for the service provider to receive a premium price for those packets, whether or not they arrive at the peak or off-peak.

What's the financial impact on the service provider?

Worst case, revenues fall by 20% (although they could be smarter about setting the base price). Costs can easily fall by 30% or more (probably much more if customers really mark all their Web and email traffic as low priority).

Furthermore, overall traffic will likely increase. Prioritization will likely increase confidence in using IP for performance-sensitive applications (e.g., voice and video)—without significantly increasing costs. Since these high-priority flows are priced at a premium, the revenues increase faster than the capacity required to carry the traffic.

Mending the Peak Hour

There is another piece that is independent of MPLS and traditional traffic shifting, and that is shifting traffic off the peak-hour. The network needs to be built with both the peak-instant and peak-hour in mind. During the peak-hour, the peak-instants are relatively close together, so the threshold point needs to be relatively high so that you can de-buffer the lower-priority flows between the peak-instants. Shifting any traffic away from this peak-hour creates further benefits.

Even better is identifying new applications that use traffic during the non-peak-hour. These new applications would add virtually no cost to your backbone since they use capacity otherwise sitting idle; therefore, you have the opportunity to set bandwidth pricing for these applications quite low.

A number of examples of new services can be created around this concept. One example would be network-based PC backup. By setting the price of network capacity for this application reasonably low and automating the process, the economics for this type of solution can be incredible compared to either the cost of current (more manual enterprise) solutions or the cost/risk of not doing backups at all (today's more likely situation).

Of course, pricing and management of these types of new offers are critical. The service provider must fully understand the incremental cost of delivering the capacity during the off-peak and then must carefully balance the opportunity for high margins with the desire to incent deep market penetration through disruptive pricing.

New vendors are emerging to control and manage the pricing complexity of these types of off-peak applications. An example of technology that can enable this kind of new offer is Merkato from InvisibleHand Networks. This product creates a "market" where users connected to the network have a dynamic price set depending on the current supply/demand dynamic on the network. Pricing is set on a five-minute rolling window, which is well suited to the peak-hour situation. In effect, all network users "bid" on the market for capacity from the service provider.

Building for Better Profits

Broadband has certainly raised the stakes for everyone in the telecommunications industry. Predicting the take up of broadband has become an industry in itself—and one in which most people have been wrong. Major industry players like Global Crossing, Level 3, and most metro players are under intense pressure due to the debt incurred to build out massive fiber networks that have so far only been fractionally lit. Yet prior MADCAP studies and other industry data show that the situation can reverse itself very quickly. Video file sharing can suddenly seize local networks; gigabit Ethernet streams can totally change the business case for metro and long haul capacity; new bandwidth-hungry applications can outrun idle capacity in a matter of a few short years.

When TeleChoice first looked at the economics of outfitting the U.S. with 100Mbps pipes to 100M homes, most of the numbers looked horrendous. "With the proper network and services approach, there is a viable business case here—even for access capacity as massive as 100Mbps and reasonable assumptions about services and their rates," explains McGuire.

The trick is to continually reassess the large number of factors that can change on any day and to flow that through to the bottom line. "So many mistakes have been made in telecom recently because it has taken a while for changes in the market to flow through to the projections and assumptions driving the core business models," McGuire notes.

Having that visibility is worth its weight in, …well… high-priority packets on a 100Mbps access line.

ABOUT MADCAP

The TeleChoice Model for Advanced Capital Planning is available for examining long haul supply and demand growth on the Top 22 U.S. fiber routes or metro core transport demand growth in the Top 40 U.S. MSAs.

The TeleChoice MADCAP tool is available in three configurations:

1. **As a Stand-alone Interactive Model Populated with Industry Data**
   Users can modify any of hundreds of key industry driver variables to create a nearly infinite range of industry scenarios and to gain visibility into the impact of those scenarios on industry supply and demand, individual carrier transport requirements, and the implications of individual carrier technology choices. This version of the model is available for $20,000 and can also be customized to meet a company's specific needs.

2. **As a Simplified Interactive Model**
   Users can make choices relative to a limited set of specific industry drivers. Based on these choices, users can gain visibility into the impact of the resulting scenarios on the industry. This simplified version of MADCAP is available for $10,000.

3. **As a Custom Project**
   TeleChoice can work with a client to populate the model with data relevant to specific markets and the market beliefs that the client holds. The reporting and interface capabilities can also be customized to the individual client's needs. MADCAP can be applied to modeling supply and demand of virtually any telecom infrastructure, including long haul transport, metro transport, service networks, and data center/hosting environments.

ABOUT TELECHOICE, INC.

TeleChoice, Inc., the leading strategic catalyst for the telecom industry, is recognized worldwide as the expert in launching telecom innovations. TeleChoice focuses on the intersection of strategy development and technology for telecom service providers and the vendors who serve them. TeleChoice helps companies crystallize business and market strategy, ignite new market categories, distill the value of innovation, and accelerate adoption of new technologies. Strategic Catalysts like TeleChoice use rapid development methodologies to accelerate project completion. TeleChoice clients can achieve in days or weeks the strategic milestones that usually take months or years. For more information on TeleChoice, visit http://www.telechoice.com.