

# The Need for Flexible Bandwidth in the Internet Backbone

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Backbone carriers are in an unenviable position. Competition is forcing prices down, and carriers must increase sales volume to compensate for lower revenues per sale. Flexible bandwidth helps carriers contend with this stark reality, and it helps customers get what has until now been denied them, the ability to buy bandwidth in the increments they need rather than the big chunks that carriers have been forced to sell. At last technology is emerging to support enhanced flexibility in the previously inflexible Internet core. This is good news for all links in the Internet supply chain, from backbone carriers to local exchange carriers, to value added service providers, and ultimately to end-users.

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## The Internet Is Changing

As businesses evolve to take advantage of the Internet, and as Internet technology evolves to meet the needs of business, both are forever changed. This evolution is unstoppable, and those unable to adapt are at risk. As a critical link in the Internet supply chain, carriers must anticipate and support a growing array of Internet-based business applications. This is forcing carriers to change, just as (and to a large extent because) Amazon.com has forced retailers to change.

### *New Wide Range of Applications*

There seems no end to the number and variety of new applications which customers are running over backbone networks, and each of these applications requires different network bandwidth and network performance characteristics (see Figure 1). In recent memory, when applications were few in number, applications were routinely paired with networks that had the attributes they needed to perform well. For example, there was the public switched telephone network for plain old telephone service, and there were satellite networks for TV.

These days, with new applications emerging daily, it is simply infeasible to build separate networks for different applications. This means that single networks must support many applications with diverse and often competing requirements. Not only that, carriers are being asked to deliver services reflecting diverse business priorities, and to accommodate transient bandwidth needs.

Given the diversity of network requirements that today's applications demand, the simple one size or a few sizes fit all service packages which are normal fare among carriers are clearly not what the world needs anymore. The one size fits all packages that were good enough in the past, now no longer provide the flexibility needed to move Internet-based business applications forward.

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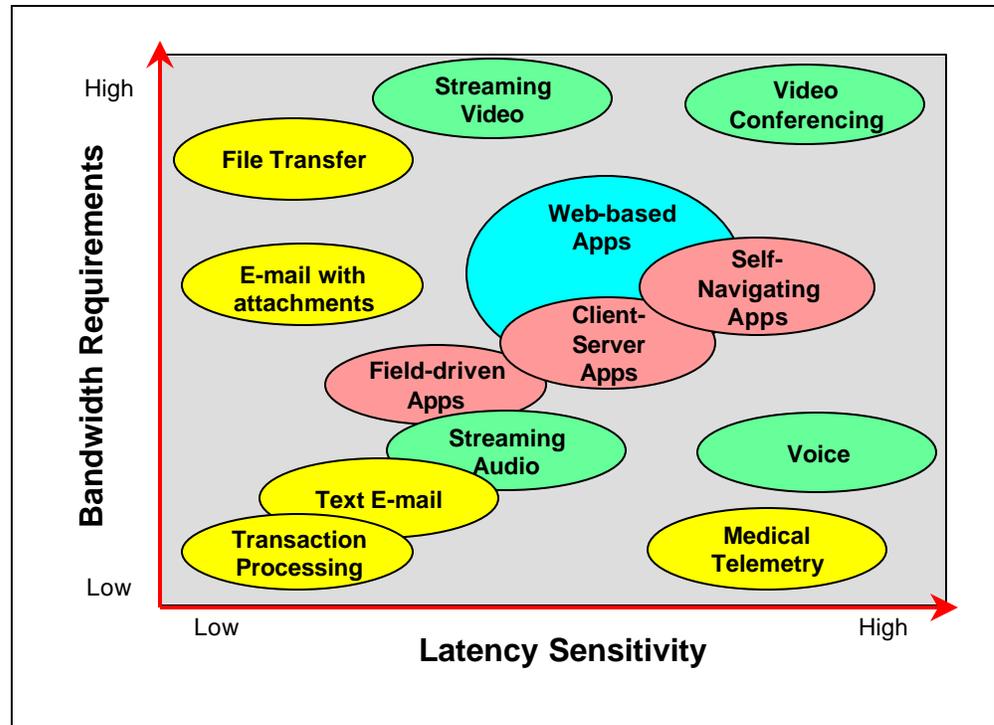


Figure 1 - Network Requirements by Application

### *New Industry Layering*

Business, technological and regulatory changes are transforming the traditional world order for carriers. As if these changes weren't challenging enough, forces are altering the rules of engagement, including:

- Deregulation
- Demand for openness
- Downward price pressure
- User choice to compare and switch carriers

Carriers are finding it hard to support emerging networked applications, which is prompting new value added service providers to jump in to the void, thus adding new service provider layers to the industry. New service provider layers include application service providers (ASPs) catering to individual communities of interest with innovative and often customized application-specific service packages, and value added service providers specializing in virtual private networks (VPNs), hosting, voice over IP (VOIP), streaming media, and content distribution offerings - among others (see Figure 2).

The combined forces of change buffeting carriers are causing them to change direction, and evolve or die.

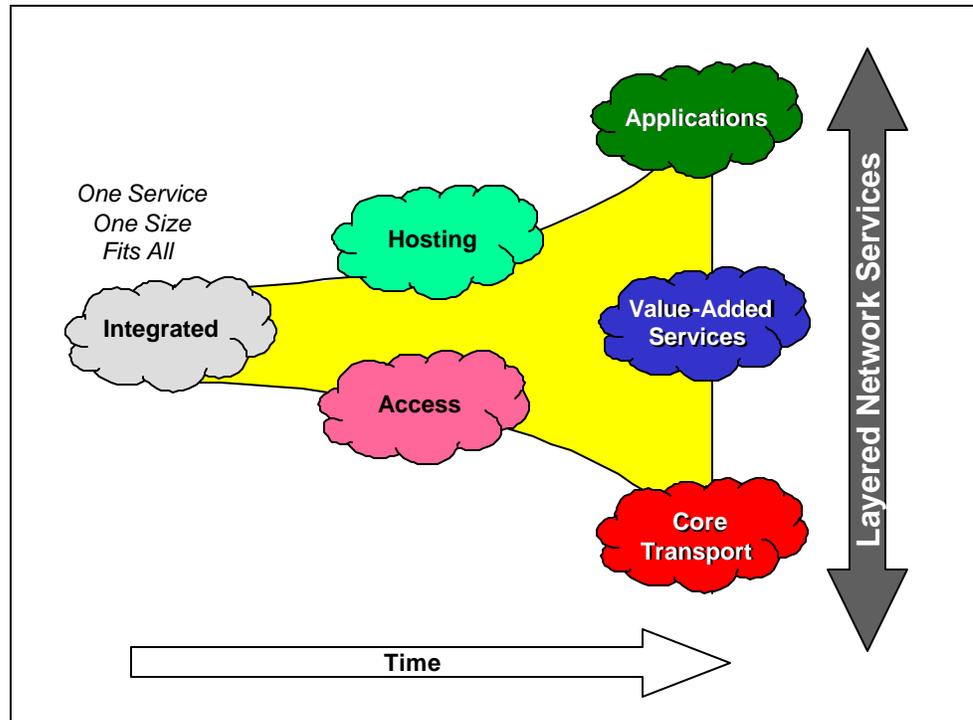


Figure 2 - Layering of Network Service Providers

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## Carriers Which Don't Change Will Die

To survive, carriers must embrace change. This change must increase revenue while jealously protecting current revenue from erosion due to customer churn. This means attracting new customers while keeping existing ones happy.

In the vise grip of market pressures, carriers will choose one of the following survival strategies:

1. Grow revenue by developing a portfolio of new value added services such as Web hosting, VPNs, VOIP, application services, or content distribution services. As each new service becomes a commodity, generate incremental revenue by adding new services. With this strategy, carriers add layers of infrastructure and intelligence in the form of security, content acceleration and data centers onto core network functions to enter new lines of business.
2. Grow revenue by honing existing core services to respond to customers' evolving needs, thus attracting new customers and retaining existing ones. In this strategy, carriers focus on ways to distinguish core services without fundamentally changing direction (e.g. make transport better rather than expanding the current business to add content to transport). In this approach, carriers essentially stick to what they know and do best.

Extensive local infrastructure and direct relationships with businesses of all sizes, favorably positions local exchange carriers to grow revenue by developing new value

added services. Backbone carriers, on the other hand, with their massive core bandwidth resources and ubiquitous reach are best positioned to concentrate on providing high quality, flexible, long haul transport services to businesses and to the emerging value-added-service providers in the service layers shown above in Figure 2.

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### **Backbone Customers Require Flexibility – But Can't Get It**

Customers face two problems when dealing with backbone carriers. First, they are forced to buy inflexible service packages that don't match what they need or want, and then they must endure long waits before their orders are fulfilled.

The limits of optical technology have, until now, locked carriers into offering fiber capacity in 2.5 or 10Gbps increments, rather than allowing them to sell the amount of capacity that customers need. In addition, until now customers could not buy bandwidth to fill temporary or seasonal needs without being saddled with excess unused capacity during periods when it is not needed.

For customers with transient needs for bandwidth, lack of flexibility is also expensive and frustrating. Take for example a retailer who needs extra bandwidth during the months leading up to the holiday shopping season, but at no other time of the year. The retailer must study, purchase, install, test and integrate additional circuits in November only to have to undo all the work in January. Each year the costly cycle repeats. What the retailer really needs is the ability to turn on and pay for the capacity when it's needed, but turn it off and not have to pay for it when it's not. Such an approach would promote carrier loyalty.

It is expensive and frustrating for customers to have to buy bandwidth in large increments, when only small increments are needed. Users need a 100 to 1 dynamic range of bandwidth sales points compared to the 4 to 1 range available today. In fact, broad dynamic bandwidth range turns out to be the most significant driver by which a service provider can continue to maintain competitive costs (see "A Contender With Staying Power," by Peter Sevcik, BCR September 2000).

Take, for example, a value-added-service provider who wants to offer VPN services between major cities, but has only a few customers at the beginning, and needs only 1 Gbps of bandwidth. Unfortunately, the service provider must purchase in increments of 2.5 or 10 Gbps, even though that exceeds what is needed, wasting both money and capacity, and making it difficult for the service provider to justify the business. If the VPN service provider could buy bandwidth in the increments needed, it could ramp up business without incurring burdensome bandwidth expenses.

Lack of flexibility causes customers to defer buying more capacity until the need is urgent, then they buy bandwidth in whatever beefy chunks the backbone carrier can offer based on the constraints of its optical technology, not in the increments nor for the times customers necessarily want. In addition, crude and inefficient provisioning systems underlying today's optical technology cause provisioning to drag on for months (see Figure 3), exacting a hefty toll in lost carrier revenue and eroded customer goodwill.

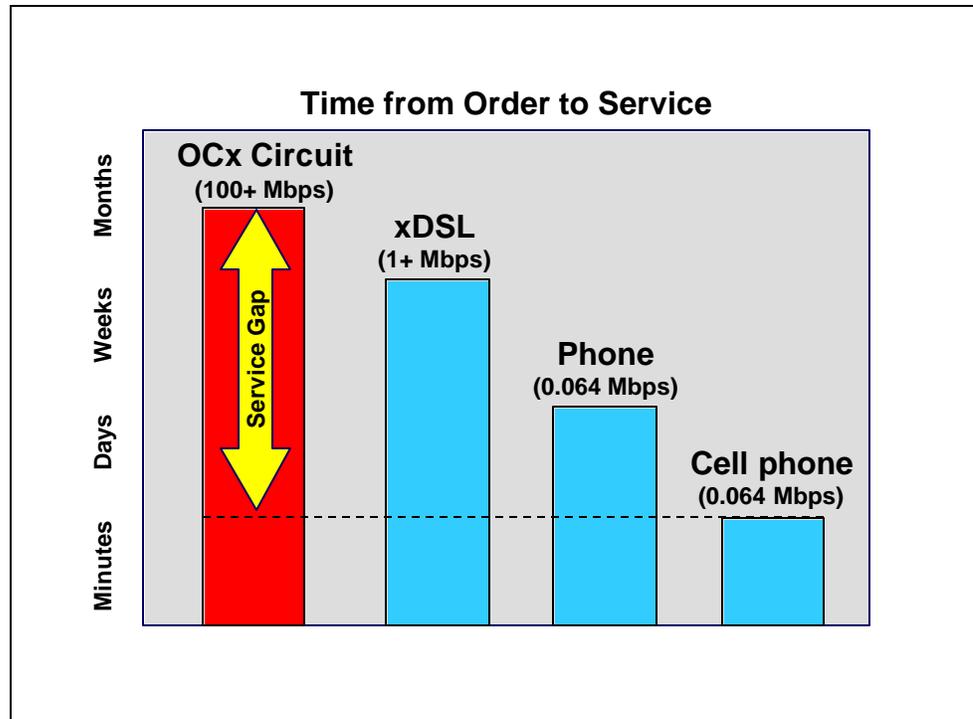


Figure 3 - Average Provisioning Time

Unfortunately, the menu which backbone carriers offer today lacks the choices most customers want. Whether a customer's appetite is big or small, the portions the carrier can serve are the same, and they are too big for most customers. The result is that customers are likely to skip a few meals until they're really hungry, and then buy the only entree on the menu - the double deluxe burger with extra fries, large shake and an ice cream sundae.

If, on the other hand, customers could buy smaller portions, they would eat more frequently and the carrier "restaurant" would earn more money in the long run.

New user business models and applications demand variable amounts of bandwidth over time, but customers are forced to buy and pay for a fixed amount of bandwidth all the time. Using the restaurant analogy again, say you are responsible for your company's annual holiday party - a sit down meal for 100 employees. Rather than own your own dining room and staff, which you need only once a year, chances are you will rent a function room at a restaurant for the time you need it and have the restaurant staff prepare the food.

Customers are constantly putting on occasional bandwidth "parties" to support applications including:

- Business or entertainment events
- Video conferences
- System backups
- Seasonally variable Web traffic due to holiday shopping or tax preparation
- Flash crowds to web sites

Although the need for variable bandwidth is acute and growing, most customers choose to risk insufficient bandwidth during periods of extreme need because they cannot justify owning big pipes that are seldom used. Only a backbone carrier can support transient or shifting demands for optical bandwidth. If the technology allowed a backbone carrier to provide that level of flexibility, the carrier could attract new customers, and delighted existing customers would remain loyal.

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### Backbone Carriers with Flexible Services Will Survive

Backbone carriers are in a rough-and-tumble commodity market, and they must work hard to be profitable. Unfortunately many have yet to show a profit, and absent black ink, their days are numbered. Backbone carriers that focus on their core business and provide high quality, flexible services packaged to meet customers' needs, will be profitable and survive.

In a commodity market, sales volume is key to success, thus carriers must sell as much bandwidth as possible. One way to sell more bandwidth is to offer flexible packages closely tailored to customers' needs. To date, fiber backbone solutions forced carriers to sell 10 Gbps pipes in 2.5 Gbps increments. Also, carriers were forced to sell bandwidth statically rather than offering it dynamically when and where needed.

These limitations make it impossible for carriers to provide what customers want. Large bandwidth increments and the inability to meet dynamic bandwidth needs result in inefficient use of capacity that forces carriers to leave money on the table (see Figure 4).

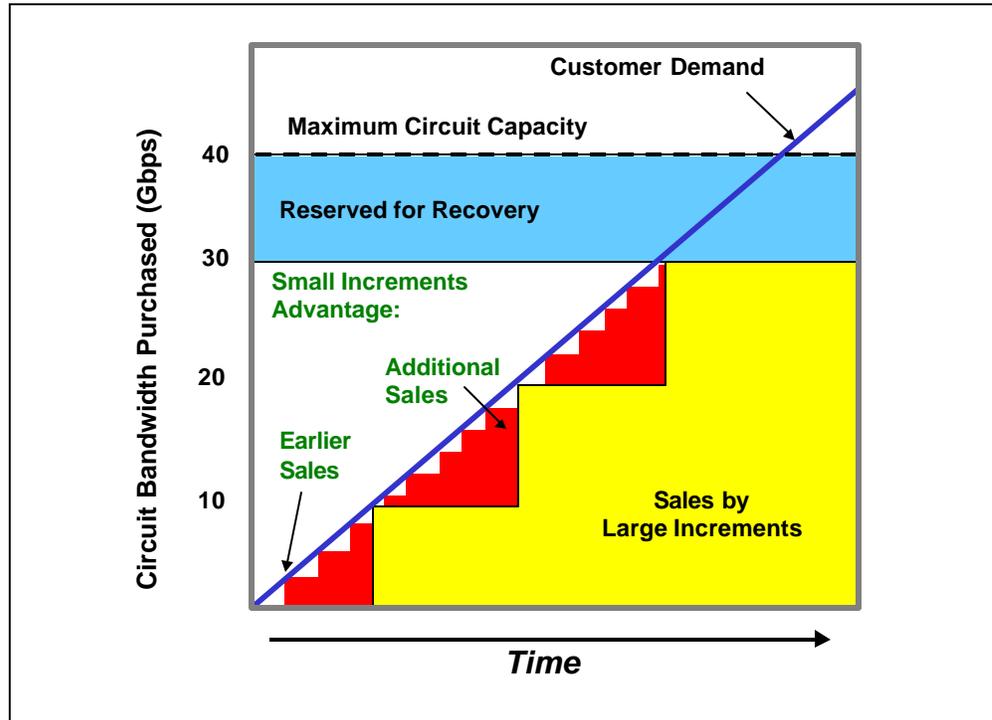


Figure 4 - Lost Revenue from Inflexible Bandwidth Packaging

Other types of service flexibility are also needed for backbone carriers to fully use available capacity and achieve the highest possible return on their fiber investment. In last-generation fiber networks, efficient use of available bandwidth was impossible because reserve capacity was needed for service restoration after equipment failure. There was no way to prioritize service restoration among customers with business-critical applications high priority, and others with lower priority. The flexibility to prioritize service restoral based on differentiated customer service levels, would allow more complete utilization of existing bandwidth and higher overall revenue.

***Business Benefits of Flexible Packaging***

Flexible bandwidth packaging, and faster order fulfillment make good business sense because capacity is used efficiently and revenue is maximized as a result. When backbone carriers sell bandwidth in increments that match customers’ needs, customers are more likely to buy and to do so sooner, rather than waiting to buy a “megameal.” Winning backbone carriers will offer bandwidth in increments that users need - a 100 to 1 dynamic range of bandwidth sales points.

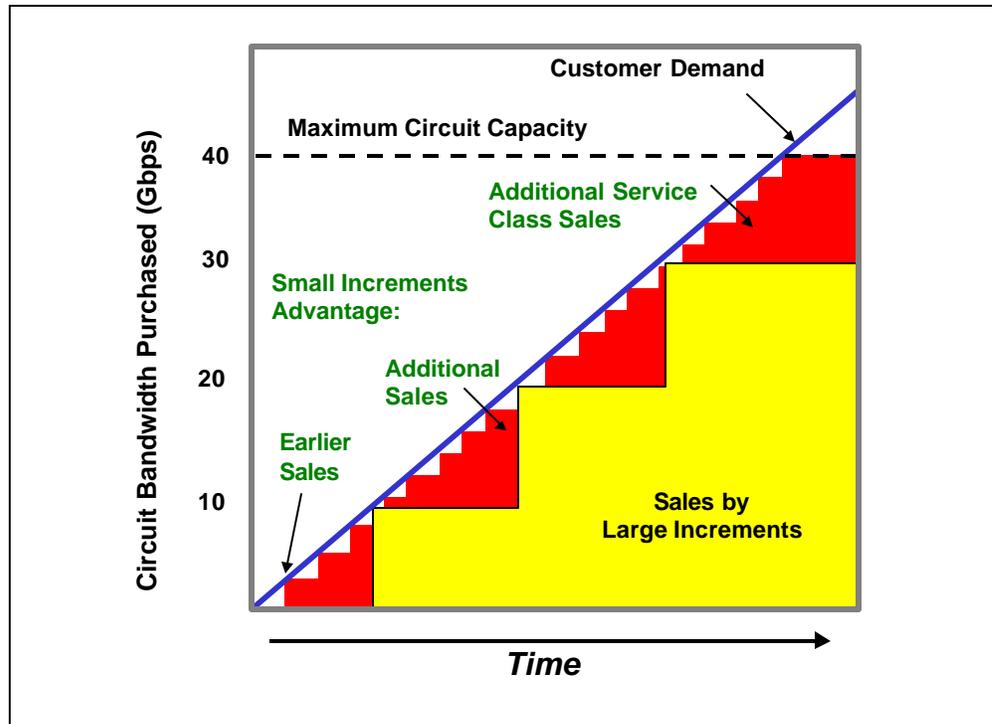


Figure 5 - Increased Capacity Use from Flexible Bandwidth Packaging

When customers can buy service in the increments they need, carriers will realize revenue sooner and revenue will grow larger over time. In addition, when customers can order bandwidth on the fly to meet dynamic needs, they will buy more bandwidth instead of making do with less and suffering performance problems during peak periods. Adding restoral prioritization to the service flexibility mix expands revenue even further, by increasing the amount of total capacity that can be sold (See Figure 5).

For a backbone carrier that expands single wavelength capacity to 40 Gbps, business benefits resulting from flexible packaging will quadruple. Higher overall capacity will

allow the carrier to remain well ahead of the demand curve and maintain a competitive advantage. It will also permit offering a wider range of bandwidth solutions that are so critical in an uncertain marketplace. Backbones based on a 40 Gbps trunking rate can offer a 100-to-1 realistic bandwidth range to its customers. This is a dramatically better solution than the 4-to-1 range offered by traditional approaches.

The long-term effect of flexible bandwidth is the ability to manage the yield from the fiber and transmission investment in a much more efficient manner. For example, the advantage of selling services that more closely match user demand growth is shown in Figure 6. The figure shows a normalized bandwidth sales model across a wide range of customer demand requirements.

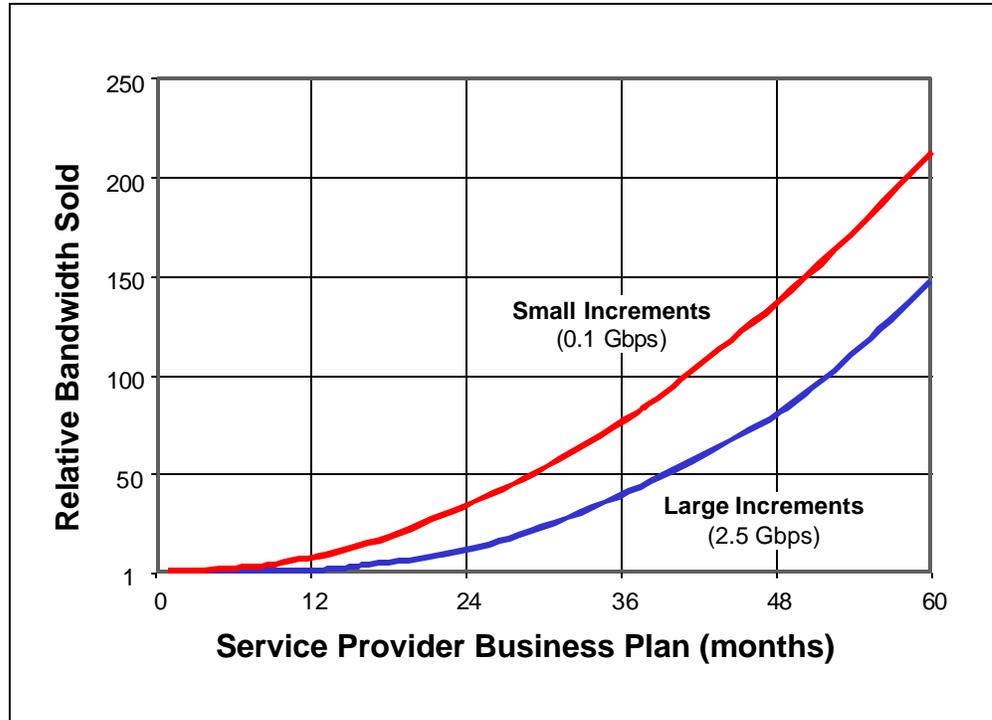


Figure 6 - Bandwidth Sold by Small Increments Relative to Large Increments

The curves show the effective overall revenue lead a service provider can expect when selling in smaller increments that more closely match customer demand growth. The advantage is dramatic. By the end of the first year of operation, the smaller increment carrier has a 10-fold bandwidth sales lead over the traditional carrier. Even in the fifth year the lead is 55 percent more sales over the large increments carrier. Flexible bandwidth sales are a clear competitive advantage.

## Conclusions

Savvy backbone carriers will be well served to implement technology that enables flexible services. Flexible bandwidth in the Internet backbone will increase carriers' revenues and make the most efficient use of available capacity. This will help backbone carriers to survive the challenging times ahead. ☐

NetForecast, Inc., helps leading service providers, enterprises, and vendors navigate the changing competitive landscape of the Internet economy. The firm specializes in developing return on investment (ROI) models to determine the business value of new Internet technologies.

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