

The Commercial-Grade Internet

Edge Systems and Services

January 2002



The HTRC Group, LLC

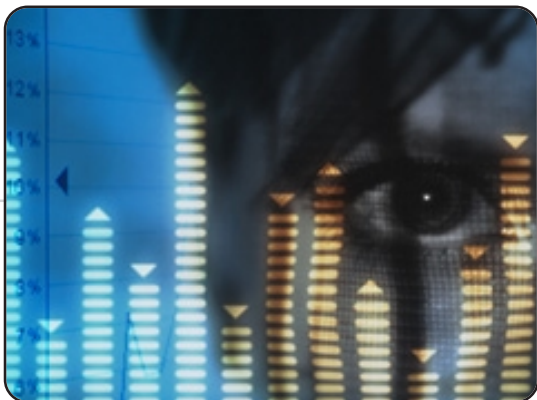
P.O. Box 2087

SAN ANDREAS, CA 95249

WWW.HTRCGROUP.COM

Table of Contents

Table of Contents	2
Introduction	3
Market Background	4
The Developing Edge	5
Tiered Services and Service Quality	6
Edge Systems: Required for a Commercial Grade Internet	7
Edge Services Market Forecast	9
Forecasts	10
Content Delivery Services	10
Streaming Media and Application Delivery Services	10
Storage Services for Web sites	10
The Customer Perspective: An Edge Services Business Case	11
Conclusion	15



Introduction

After the first Internet Gold Rush, spending on Internet infrastructure peaked in 2000. While much money was spent to build as quickly as possible, much was wasted in the haste. Fiscal sanity has hit Internet companies like a ton of bricks: all must soon deliver profits, merge or perish. The silver lining is that the restructuring will ultimately reduce capital waste and deliver a healthier Internet sector. But this will require a commercial-grade Internet capable of delivering new, revenue-generating services. And this, in turn, will require a new level of reliability and performance than is currently available in today's Internet.



In this paper, we introduce Internet Edge Service Providers (IESPs). Because of their location at the "edge" of the Internet, IESPs can align network, storage and computing resources inside networks or behind corporate firewalls in order to deliver upon the promise of the commercial-grade Internet. They are ideally positioned to deliver multiple, differentiated service levels and service options that precisely match customer needs, establishing a new, tiered service environment for increased revenues and profitability. IESPs can only guarantee performance on the networks they own and operate. The closer users are to content the better the chance for greater service quality. IESPs that offer Internet access directly to end users can maintain a higher level of service quality to connected users.

We will also examine the infrastructure required to deliver edge services. Edge services are becoming increasingly complex, as new applications and delivery processes continue to emerge and a greater variety of technical solutions take hold. However, the infrastructure that supports these services must be simple and low cost in order to be viable in edge locations. We'll explore these requirements and offer up our vision of the ideal edge platform.

Finally, we'll take a look at planning issues and the ROI of streaming applications and then forecast some IESP service market opportunities. By adopting edge services, service providers can generate more revenue, improve margins and grow and protect their customer base from aggressive competitors all at once.

Market Background

Two market trends are leading the build-out of the Internet's edge. First of all, rich data, streaming media and interactive applications are proliferating as a result of the high interest of consumers and enterprises for more compelling Web experiences. Because of their high bandwidth and often real-time delivery requirements, these applications are exposing the myriad bottlenecks found through the Internet's core. In order to support applications such as video-enriched e-commerce, corporate communications, distance learning, news delivery and online entertainment, enterprises and service providers are looking at ways of bypassing the Internet's core and moving content closer to end users. By doing so, they reduce network costs and also provide more compelling user experiences.

At the same time, the Internet service provider market is in flux as ISPs seek profitability. Even though profit margins on basic Internet access services are thin, many ISPs and carriers depend on them for large portions of their revenues. To combat these dwindling profit margins, service providers are reassessing their capacity to deliver value-added services, layered on top of basic bandwidth or access services, in order to increase their revenues per subscriber.



Many carriers and ISPs are updating their networks or consolidating to achieve scale, increase transport capacity, lower production costs and/or expand their service portfolios. For example, storage services, rich media and content delivery are becoming natural extensions of their access services as promising ways to increase revenues and profit margins. And the delivery of these services from edge locations, closer to their customers, is the key to improving user experiences and increasing customer loyalty.



The Developing Edge

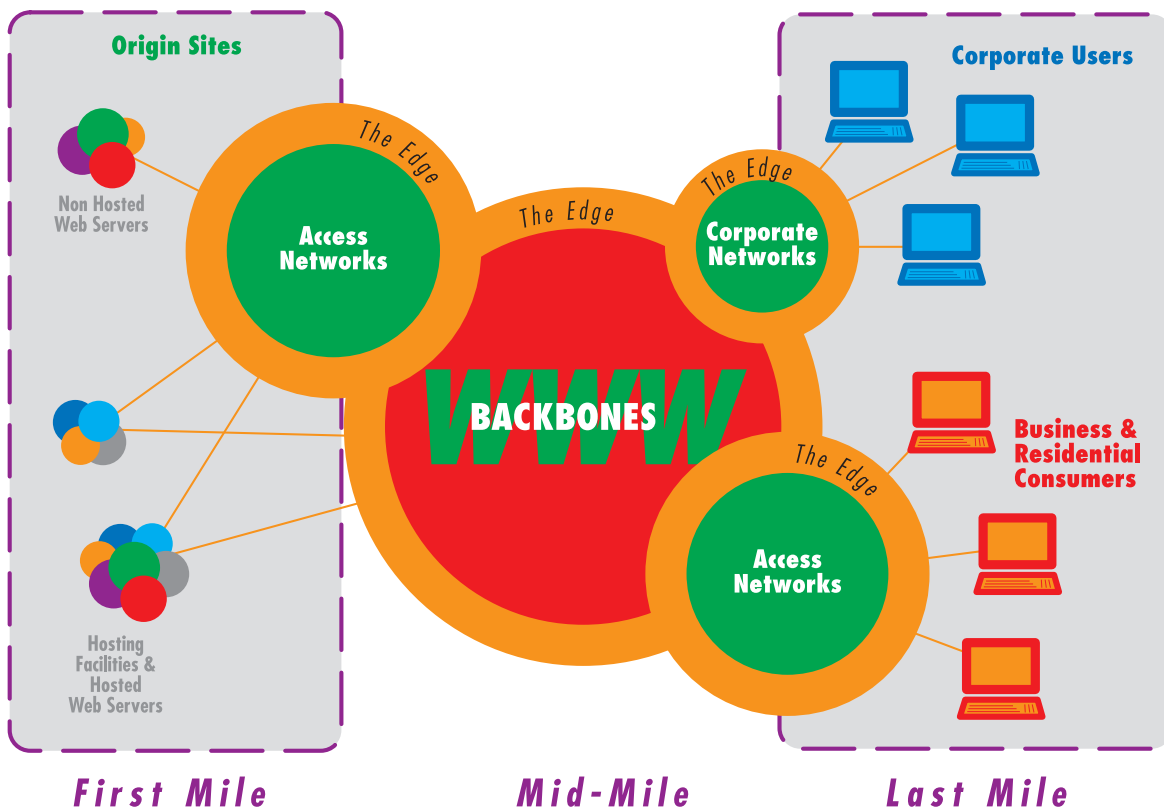
Service providers and enterprises are building out a new, multi-function edge, but how the edge is defined will vary. We see the Internet developing multiple edges.

Internet CDNs deliver content from the edge of the Internet, while eCDNs deliver content from the edge of the enterprise network. Figure 1 shows the three basic Internet edges. First, large backbone carriers, such as AT&T and UUNet, have an edge: the edge of their network interfaces with access networks and corporate networks. Access networks have an edge that interfaces with backbone carriers and corporate networks. Corporate networks, in turn, have an edge that interfaces with corporate users as well as access networks or backbone carriers.

The deployment of streaming applications in the enterprise makes eCDNs a compelling solution for realizing performance and cost savings. These edge services are complementary to CDN services, as they provide performance enhancements by delivering rich media applications closer to end users.



Figure 1 below shows an illustration of the developing edge with last mile, mid-mile and first mile references.



Tiered Services and Service Quality

Many service providers have made a huge investment in network infrastructure. They must leverage it in order to maximize the value of the traffic and services they deliver. One way to increase the value of network traffic is to increase the performance of applications to consistently provide users with a quality experience. This increases the value of traffic to those who pay for it: origin sites, advertisers and companies. The best place to increase performance is from the edge.



Edge service providers can add guaranteed commercial-grade performance, consistency and reliability to Internet services and applications, efficiently delivering to customer SLAs.

However, the rule on today's general-purpose Internet is "best efforts": traffic is rarely prioritized. Revenue-generating applications often queue along with the bulk. Businesses have shown that pay-for-performance is necessary to maximize profitability. Airlines offer multiple service classes. Couriers offer same-day, next-day and other tiered service levels. What if service providers could consistently guarantee multi-tiered service levels, prioritized based on the revenue opportunity? Providers would be able to match customer requirements with service levels and could increase their revenues at minimal costs. Services that generate higher value and profit margins would get priority treatment. For example, live events, voice- and video-conferencing are highly time-sensitive: users are willing to pay a premium in order to get real-time delivery. Other services may be of lesser value to users and therefore cannot support a premium price.

However, tiered Internet services require effective service quality management. Service quality is the performance experience of end users and can be measured by examining latency, jitter, round trip time, and bandwidth throughput. Unlike the telephone network, the Internet is connectionless which creates challenges when managing end-to-end service quality. The final quality of content and application delivery depends on numerous variables, some of which are beyond the control of any particular entity. For example, Internet traffic passes through seventeen

routers on average. Therefore, Internet content and applications are more effectively delivered from the edge, closest to end-users, where service quality can be more tightly controlled. This in turn requires edge systems that are capable of differentiating classes of service based upon users, applications and data types, as well as delivering end-to-end service quality.

Serving applications and rich media logically closer to end users, as well as offloading origin Web site infrastructure, increases performance and reliability. Edge delivery platforms are able to serve content and applications faster than origin servers burdened with Web site traffic. Streaming media is a content type that is a latency-sensitive application, and significantly degrades with the number of router hops, jitter, and Internet congestion. Streaming media files are large compared to static Web site graphics. These large files also stress network capacity and origin Web site infrastructure with traffic. The need to deliver quality streaming media is driving the need for edge service delivery platforms.

Edge Systems: Required for a Commercial Grade Internet

The economic success of IESPs requires a new category of edge systems that combines rich feature sets with a cost structure that makes them economically viable to be deployed at multiple edge locations. That combination is difficult to attain with traditional caches, streaming servers, Web servers and file servers, which support a robust feature set but tend to be cost-prohibitive to deploy as a group. Additionally, IESPs may have exhausted the value of general purpose servers coupled with single service appliances because of the higher performance requirements placed on them by the coordination of components in Internet networks. Edge services require new architectures that are very powerful, yet very easy to deploy; compact, yet highly scalable.



The following table highlights what we believe are the critical requirements of edge systems:

Key Edge System Requirements

Multi-Application Delivery	Edge systems need to support a wide variety of data types and applications—such as streaming, storage and data delivery—all in one system. This maximizes IESP revenue opportunities and lowers overhead costs. The system should also integrate and interoperate with other platform components.
High Performance	Edge systems are often tasked with delivering high bandwidth data or numerous other edge applications and therefore must provide high levels of content delivery performance. Rich media and audio/video stream delivery is a growing opportunity for providers, and because stream performance is sensitive to latency, the best quality can only be delivered from the edge.
Management	Because edge systems may be used in environments with few IT resources (for example, central offices) they must be easy to install, manage and operate. Additionally, IESP customers need access to operations and management information. This includes service performance as response times to end-users directly impact the value of customer applications.
Storage	Storage is a critical resource at the edge for many services as high bandwidth applications such as streaming media require larger storage capabilities. It can also be sold as a straight service offering. Therefore, edge systems must be storage-rich.
Scalability	Edge systems must support a rapidly growing user base accessing ever-richer content and as a result must provide a high degree of scalability, both in bandwidth and storage capacity.



Reliability

Because edge systems are often used in lights-out environments, they must be extremely reliable with the ability to endure multiple levels of failure without impacting system operation.

Densely Integrated

Space and power are at a premium at the edge since most edge locations are cramped, crowded or difficult to alter or expand. Systems components must pack a lot of punch in small form factors.

Reporting

Reporting must match application performance metrics and customer requirements so they can be used for billing as well. The edge system should interface to billing and reporting systems and portal engines for customer and provider access via an Internet browser.

SLAs

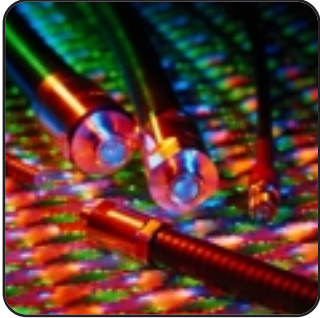
Quality of Service and tiered service levels are key to maximizing revenues and profitability. Therefore, edge systems must be service-level aware. They must make real-time decisions on service, application and content prioritization and deliver service levels based upon multiple user classes. For billing purposes, they must be able to track and monitor activities based upon the specified service levels.

Security

Security is a major issue, especially with recent high profile attacks against major Web sites. Edge systems must provide some degree of protection against these kinds of attacks.



Edge Services Market Forecast



How can providers best deploy edge delivery systems? We offer some suggestions below regarding how to plan for edge service deployments. Edge services offer Internet service and content providers ample opportunities for differentiation and high-margins. Providers of edge services can improve revenue and margins from existing customers and attract new ones as well. Edge services are at once instruments of market conquest and tools suitable for the preservation of existing customer relationships. Edge systems are capable of delivering numerous services such as streaming, content delivery, performance measurements, transaction processing and storage. Each service offers a significant market opportunity. In the interest of brevity, however, we only discuss streaming services, content delivery and storage below.

The forecasts below come from our content delivery, performance streaming, and storage research. One of the most significant factors influencing growth in our forecast is the increasing number of study respondents planning to use streaming applications and rich media in their current and future plans. We found significant increases in the number of respondents planning to incorporate live and on-demand streaming media in their Web sites.

We believe that the following market factors will influence IESP markets:

- The economic downturn of 2001 has influenced purchase decisions for CDN, streaming, and storage services.
- Enterprises will seek out services that reduce costs and lower capital expenditures.
- The adoption of streaming media in the enterprise will drive usage in the Internet services sector.
- The adoption of Web Services will drive the need for edge application services.
- Content-driven demand for bandwidth from origin sites increases by 6.8 percent a month.
- Content delivery services are price-sensitive and cost is the largest barrier to their adoption. The majority of content sites will choose the least expensive solution that yields acceptable performance.
- Customer education is a very important success factor since many customers are not yet fully capable of comparing different delivery service solutions.
- Site technology and IESPs will continue to support larger varieties of applications, content and data types, including dynamic content and streaming applications.
- Internet expertise does not scale with demand; sites will outsource the delivery of content and streams as well as site storage.
- In 2002 and 2003, the total number of new Web sites will continue to increase, but at a slower rate, as Internet infrastructure continues to develop around the world. However, the number of large Web sites will increase at a faster rate through 2004.
- The number of content bytes delivered per user increases over time.

- Growth in broadband customers drives growth in demand for more high-bandwidth content, rich media and streaming applications.
- The need for Web sites to offer competitive differentiators also supports the deployment of rich content and streaming media.
- Sites, content and applications designed for high-bandwidth users all grow rapidly, increasing storage, content delivery and streaming needs as well as demand for IESP services.
- Competition and decreases in production costs will reduce the cost of IESP services over time, increasing both adoption rates and volume demand.

Forecasts

Content Delivery Services

We estimate that Web sites spent \$97 million on content delivery services in 2000 and that this will increase to \$1.3 billion by 2003. Our forecast includes dollars spent by Web sites for content delivery services and in-house product implementations. The forecast does not include service providers' own expenditures for content delivery products.

Streaming Media and Application Delivery Services.

We estimate that Web sites spent \$106 million on stream delivery services in 2000, increasing to \$1 billion by 2003. The revenue opportunity includes live and on-demand streaming services delivered to Internet users and corporate networks. Streaming services include dollars spent by Web sites for on-demand and live streaming services provided by IESPs. This forecast does not include investments in streaming servers and software.

The streaming media market is driven by several factors, including user familiarity with streaming media applications and their adoption by Web sites, broadband penetration in consumer and business markets, advances in encoding and streaming technologies, regulatory conditions and corporate needs. Streaming media files are often large, which can stress network capacity and peaks in demand for popular content may overwhelm origin sites.

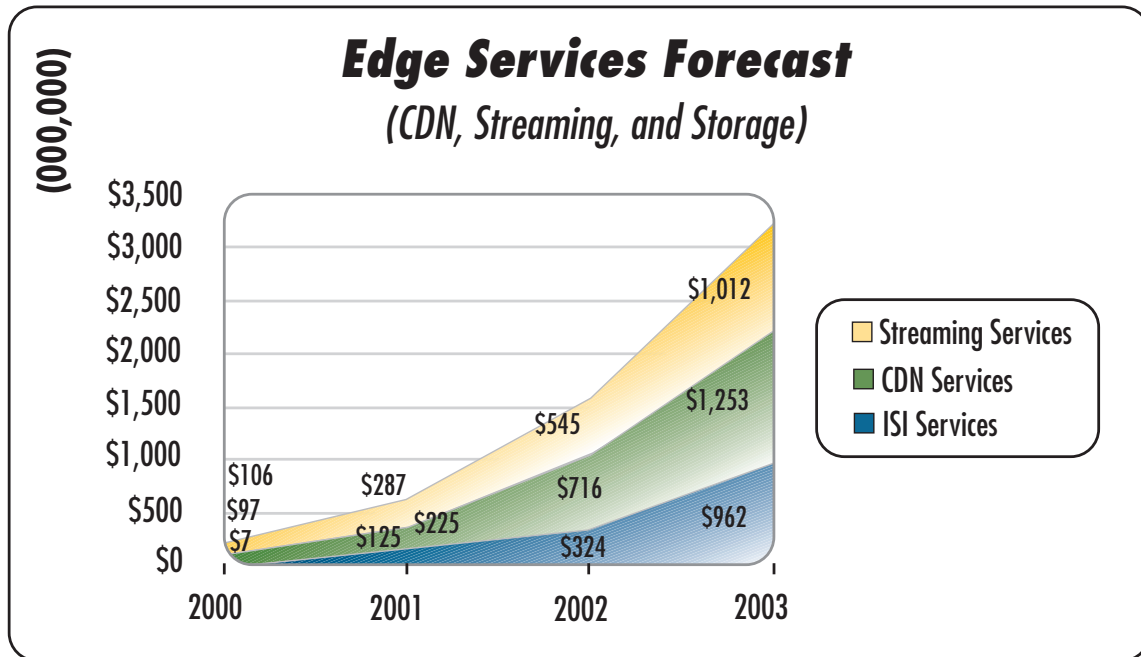
Storage Services for Web sites

The demand for Internet storage infrastructure services, estimated at \$7 million in 2000, is expected to grow to \$962 million in 2003. Our forecast includes storage services as purchased from IESPs, but does not include the bandwidth necessary to deliver files to users that they would buy from NSPs to deliver streams directly from their origin locations.

Storage growth reflects the increased Internet requirements of organizations across all industries. Growth drivers include distributed data, rich media, database-driven applications and e-commerce and the storage of dynamic Web pages. Only a small percentage of Web sites start out with significant storage requirements; however, storage requirements increase over time for the vast majority of sites.



The aggregate market opportunity for the three IESP services examined is expected to grow from \$210 million in 2000 to \$3.2 billion in 2003. The value of the market opportunity for all three services combined could pass the billion-dollar mark by 2002.



The Customer Perspective: An Edge Services Business Case

Business models and value propositions for edge services will change over time, picking up new functions and features. Successful providers are implementing flexible business and technical infrastructure that accommodate the changing market. Edge services present a significant opportunity for service providers and new revenue models are continually being developed and tested in the market.

What follows is a sample business model of a corporation who's considering using the Internet to reduce costs associated with training and communication programs. The assumptions used in the creation of the following model were the result of feedback from service providers, public pricing information, streaming providers, product manufacturers and extrapolations based on industry trends. This model is only intended to be used as a high-level guideline. Actual costs and revenue will vary.

The fictitious XYZ Corp, a thriving \$250m manufacturing business, is trying to conserve capital while it expands. Quarterly, XYZ launches a new product line and conducts an off-site training event to educate its sales force. XYZ employs 250 sales reps: 200 in 25 US locations, 15 in 3 Canadian offices and 35 in 3 locations in Europe and Asia.

Traditionally, off-site sales training events at XYZ involve the following steps:

- Coordinate a training event, secure a facility and verify that all participants can attend. Project coordination and location rental fees bring the cost of coordination to \$10,650.
- Create student materials (\$3,400). Evaluate students and trainers (\$5,875).
- Dispatch the entire sales force plus 10 marketers and trainers (260 people total) off-site for 2 days. Salaries cost \$258,750; travel, hospitality & entertainment are \$279,920.
- All told, including \$558,595 in direct and \$121,574 in hidden costs, each off-site event is a \$680,169 affair. With an event each quarter, the total annual bill exceeds \$2.72m, which is steep for a quarter-billion dollar company.

XYZ would like to use video for employee training: although conceptually, video is a logical solution, the use of videotapes is not. Tapes must be produced in multiple formats to accommodate local video standards (for example, VHS in North America, PAL in Europe), require significant storage space, wear out, or can be easily damaged. Tapes lack content flexibility, provide no protection against unauthorized viewing and offer no integrated way to measure learning progress. The CEO has asked the CIO to determine the most cost-effective means to provide streaming video.

Given the desire to minimize upfront capital expenditures and decrease time to market with edge services, the CIO decides to outsource operations to an IESP.

The CIO receives a green light as he presents the benefits of the IESP plan:

- Cut workflow disruption & travel time (at least 1 day per attendee per quarter). 260 man-days saved, times 4 sales training events, is \$500,000 per year at minimum. Eliminate travel expenses. At \$279,920 per session, savings approach \$1.2m a year.
- Film superior-quality videos with outsourced production crews, encode and deliver to the sales force worldwide via the Internet –cost is \$241,727 per training event (\$920,000/year).
- Computers will handle paperwork, tests and evaluations; processing costs increase by about \$17,400 a year.
- Training repetition costs come down from \$1,600 to \$586 per repeat –and new hires can receive the same training as other sales reps. Missed profit opportunities drop from about \$296,000 per year to less than \$4,000: add \$292,000 to yearly pre-tax profits.
- Current budget per year is \$2.72 million: total projected costs to use an IESP are under \$1.1m. Net savings are at least 61% (or above \$1.6 million per year), with no additional staff or investment.



Model assumptions:

XYZ Corp. employs 2,500 employees in 43 locations worldwide (2,100 in factories, 250 in sales), paid \$23,166 a year each on average. Annual company revenues are \$250m at 10% profit before tax. Internet stream delivery assumes sufficient bandwidth in XYZ Corp.'s network and usage of an Internet streaming service for delivery. Cost to train an additional participant is brought to delivering the same training content and experience to all students, which may be impossible to do with the traditional solution. Cost estimates are based on current market value of each component. All costs are for a single training event.



Streaming ROI - XYZ Corp.

 Sales Training		
	Off-site event	Stream Delivery (internet)	Cost Savings
DIRECT COSTS	\$558,595	\$241,727	\$316,868
Sub-totals:			
Event coordination & facility	\$10,650	\$3,325	\$7,325
Travel & expenses	\$279,920	\$3,328	\$276,592
Event materials	\$3,400	\$3,400	-
Workflow disruption & salaries	\$258,750	\$101,400	\$157,350
Streaming content -production, storage, bandwidth & delivery	N/A	\$120,049	\$(120,049)
Event wrap-up, tests, record-keeping	\$5,875	\$10,225	\$(4,350)
HIDDEN COSTS	\$121,574	\$25,097	\$96,477
Sub-totals:			
Training did not go through for all the first time. 25 reps need repeats	\$7,500	\$6,592	\$908
New hire training (25/year)	\$40,000	\$17,579	\$22,421
Opportunity cost (lost profits on missed sales)	\$74,074	\$926	\$73,148
TOTAL COSTS	\$680,169	\$266,824	\$413,346
Total cost per sales rep (250 reps)	\$2,721	\$1,067	\$1,653
Cost per additional participant			
Cost to train an additional participant (new hires and retrains).	\$1,600	\$586	\$1,014

Adjusted costs per training unit delivered	Per employee-day	Per employee-hour
Traditional	\$1,360.34	\$170.04
IESP	\$533.65	\$66.71

Adjusted cost of operations	Per annum	3-year
Traditional	\$2,720,676	\$8,162,029
IESP	\$1,067,294	\$3,201,882

The true measure of cost for XYZ is cost per training hour delivered. As shown in the example above, it is much more cost effective to use a fully outsourced IESP solution than traditional training methods. Additionally, it requires no upfront investment from XYZ and little effort and expenses to manage and support it.

Beyond cost, there are many other excellent reasons to use streaming media in the enterprise. Training can be delivered on-demand to all participants on their own schedule, as many times as necessary, from any location, and at minimal cost per head. Students can pause, rewind and repeat at will—each can learn at their own pace. In addition, new hires can be directed to streaming videos, saving the precious time of experienced staff and minimizing disruption. For all online training, automated tests can verify that content was learned and provide program tracking and student evaluations. IESPs can offer complete outsourced packages to implement distance learning, greatly simplifying the task of their clients and creating additional revenue streams.





Conclusion

The Internet is a fantastic tool that facilitates business and person-to-person communications, information, commerce and entertainment all over the world. It offers an abundance of always-on information, data and entertainment services. About 200 million people worldwide already enjoy the flexibility of on-demand Internet services. Millions of additional businesses and consumers will come online during the next few years.

The last five years have laid the foundation of a fertile Internet ecosystem. Currently, the Internet industry is adjusting to attain fiscal sanity. The edge of the Internet is the feeder system that can provide the rich realm of compelling application services that users want.

The world needs an improved, commercial-grade Internet. This means it needs to be managed, flexible, predictable and highly reliable, matched to the needs of users and profitable for its providers. It needs to reflect tiered service values, supporting differentiated customer options and prioritized features that will generate more revenue and profits. Fortunately, the emergence of edge systems will enable this commercial-grade Internet.

Rich media, streaming video, broadband and interactive distributed data applications are driving the Internet into a new era. IESPs are strategically positioned to take the network to commercial-grade reliability. Exciting things are happening at the edge.

