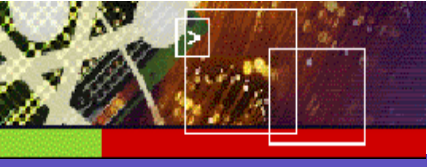
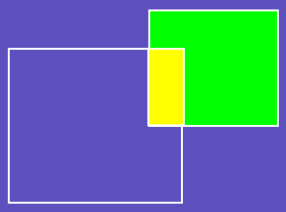


February 28, 2002



Route Control: Building Real Confidence in the Internet

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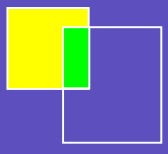

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Route Control: Building Real Confidence in the Internet

Although the unpredictable and lackluster performance of the Internet has not stopped enterprises from using it, they have real concerns and difficulty making decisions about when and where to use it. The end users feel an overwhelming lack of control over this gigantic mish-mash of networks for which no one entity has absolute responsibility and accountability. Lack of control drives enterprises to delay deployments, minimize their exposure by using the Internet for non-mission-critical applications only, or build overkill and expensive precautionary measures to protect themselves.

Fortunately, there is hope—and it's even better than hope. Route control has emerged to give users control over how they use the Internet and the performance they achieve. It is poised to build real confidence in the Internet.

Living with the Internet Today

The Internet has created unprecedented growth opportunities for businesses and service providers alike. The promise of ubiquitous any-to-any connectivity at affordable rates and the emergence of new IP-based applications has further spurred demand. With all its advantages, the Internet unfortunately has its share of problems—slow response times, downtime, unpredictable performance, and lack of end-to-end service guarantees.

A bigger Internet problem is not just the major network outages but the overall variability and unpredictability of network performance, sometimes referred to as "brownouts" or soft outages, caused by grossly excessive latency and/or loss. Internet customers are not expecting the same level of quality as private lines, but they do require adequate consistency to utilize their networks effectively. Much of this variability results from many factors that occur inside a service provider's network including the service provider's network design, traffic volumes, traffic patterns, number of customers, mix of applications, and time of day. For example, during peak business hours, potential customers attempting to buy products from an ecommerce website may experience lengthy response times. These customers may decide to buy later in the day in hopes for better response or make calls to the NOC or may completely abandon the transaction and look for an alternative vendor.

Despite many of these challenges, no direct fault should be placed on the Internet as it was designed for any-to-any connectivity, not necessarily performance. At the time of its inception, the key priorities were Internet connectivity and management of scarce bandwidth. BGP (Border Gateway Protocol), a key Internet routing protocol, emerged to ensure proper routing and routing policy. However, BGP primarily optimizes how the network delivers traffic from source to destination based on number of network hops. The route with the lowest number of hops does not necessarily offer the best performance as that path may have the lowest actual throughput, for example. In the event that multiple paths have the same hop count and all other BGP decision criteria is equivalent, the final tie-breaking scheme in BGP can often impede performance by selecting a route announced by routers with lowest IP address space, which typically exist in long-established ISP networks. Again, long-established ISP networks do not always provide the best performance. Furthermore, BGP cannot detect and avoid soft outages.

These performance challenges make enterprises feel out of control. There is little they can do—either tweak BGP, which is tedious, time-consuming, and costly, or switch service providers. Worse yet, some enterprises do not yet realize they have a problem. Most IT departments focus on avoiding or recovering from major outages. They are typically unaware of the persistent degradation of performance and inefficient utilization of network capacity that day in and day out cause increased network costs, increasing the vulnerability of their network and causing their applications to fall short of business goals. In fact, a typical 56Kbps user experiences web page downloads of 20 seconds or more[1] and only 47.3 percent of consumer users are satisfied with Internet performance.[2] Business users are also sharing the pain—citing network performance as the third (of 12) most important criteria in an Internet service (behind reliability and value for the price) but rating satisfaction with performance in ninth place.[3]

Businesses may not realize the magnitude of the problem of poorly served end users until sales slow down and the competition has stolen customers. Some may liken this situation to an undiagnosed, slow-growing tumor that later manifests itself with symptoms that someone can no longer ignore. Interestingly, service providers are not immune to these problems. Without providing enterprise users some level of control or confidence in the service, service providers may not realize that they too are slowly losing customers for lower-cost and/or better-performing services. Worse yet, they may lose revenue to inferior services because of BGP routing decisions outside of their direct control.

These Internet challenges fuel a growing trend in multi-homing, particularly for businesses wanting to take advantage of the ubiquitous connectivity and the lower prices of Internet-based services but also wanting to prevent or lower the impact of the Internet's inadequacies on their business. Enterprises use multi-homing to achieve better performance, have adequate bandwidth, and ensure high availability with the different ISP connections. Many enterprises primarily use multi-homing at larger locations that support mission-critical applications, larger volumes of traffic, and larger number of applications because multi-homing can be expensive. But some companies with mission-critical traffic on IP networks have begun multi-homing at smaller sites as well. Enterprises also multi-home for redundancy purposes. Although the Internet offers a cost-effective solution and multi-homing offers many benefits, having little-to-no visibility of Internet performance and control over route selections still results in sub-optimal performance and more expensive implementations.

Overcoming the Performance Nightmare

Enterprises can gain some control over the Internet performance challenges with route control. What is route control? Simply put, it is a network control solution that helps networking devices make forwarding decisions by intelligently choosing the best path selected based on the business or network criteria the end user configures. The next section, *Route Control: A New Category*, discusses the route control solution in more detail.

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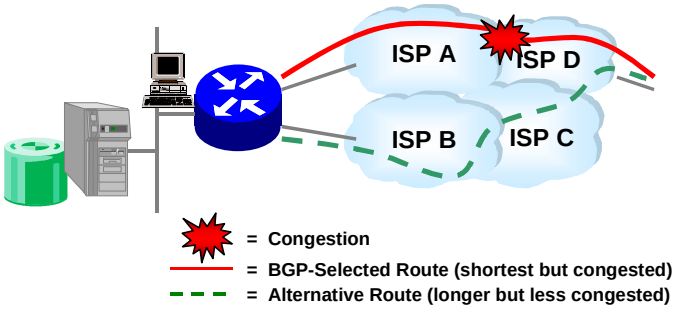
[1] Sevcik, Peter, and Bartlett, John, "Understanding Web Performance," NetForecast, Inc., January 2002.

[2] "Performance Metrics in Context," Gomez, Inc., July 2001.

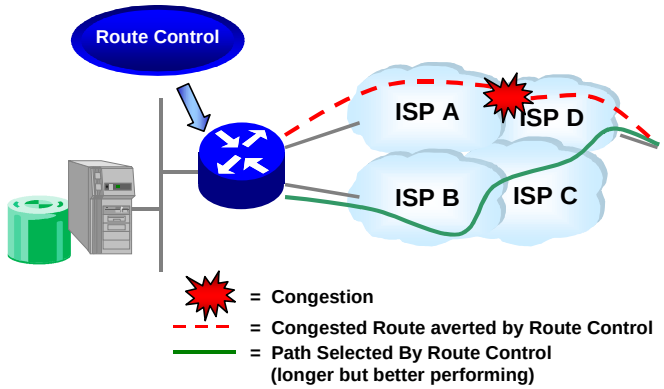
[3] Wetzel, Rebecca, "ISP Customer Satisfaction Survey," *eWeek*, September 2001.

A new class of vendor has emerged to offer route control solutions. The first implementations of route control solutions address the multi-homed IP environment and the inadequacies of BGP in ensuring high levels of performance and substantial cost savings. In these initial implementations, the route control solution continually (or periodically) determines the performance of the various links at a multi-homed location and updates the router's forwarding table accordingly with the information for the path that balances the best performance with low cost. The diagram below shows a typical implementation of route control.

Before Route Control



With Route Control



Route Control Applications

Some applications for today's route control solutions are as follows:

- **Hosted Applications.** A route control solution applies to multi-homed sites that host applications either at the enterprise premises or in an Internet Data Center, where it optimizes traffic to the end users and reduces response time for users accessing the applications. Route control solutions dynamically determine the performance from the hosted application source to each user. The cost of the bandwidth from the hosting site may also be a factor in the decision process. The route control solution then chooses the best-performing and/or least-cost path.

- **Virtual Private Networks (VPNs).** Site-to-site VPN denotes that the endpoints or sites are known. Route control in this environment works similar to the hosted applications environment in that it applies and can optimize traffic from any dual-home VPN location. Additionally, route control can improve performance for remote access VPN users connecting to a multi-homed site.

Enterprises can directly support these applications by deploying a route control solution. Additionally, service providers can address these applications through offering route control services to their customers or offering optimized bandwidth using route control.

The number of applications for which route control applies will increase in the future. Future developments in route control may include the following:

- Single-homed VPN locations seeking best-performing and/or least-cost path back to multi-homed central site
- Path selection between IP, frame relay, ATM, and other layer 2 or 3 access networks
- Other forwarding/routing protocols in addition to BGP

Enterprise Benefits

Route control solutions offer the enterprise many business and economic benefits, as outlined below:

- **Bandwidth Cost Savings.** Route control allows enterprises to save on bandwidth costs. Some of the ways enterprises can save money are as follows:

  ✓ **Routing Traffic over Lower-priced ISP Links.** The enterprises can direct more traffic to lower-priced service providers. Likewise for applications requiring higher network performance, route control can make decisions based on price/performance criteria, offloading some traffic from premium-price networks to aggressively priced carriers when performance is acceptable.

  ✓ **Leverage/Optimize Usage-based Billing Contracts.** Instead of paying for two full-time connections with flat rate monthly charges from a particular location, the user can subscribe to usage-based connections. Most usage-based pricing structures charge a flat monthly fee for a minimum bandwidth commitment and a variable charge based on the usage above and beyond the minimum, up to 95 percent of peak. Given the level of control over traffic volumes directed on each link with route control, enterprises can close the gap between actual bandwidth used and 95 percent of peak.

  ✓ **Downsize and/or Reduce Number of Links.** Enterprises can subscribe to a minimum bandwidth that more closely aligns with bandwidth they actually use most of the time. Users can also subscribe to lower bandwidth commitments with higher-priced ISPs and use the lower-priced ISPs for “burst” or overflow traffic beyond the minimum since burst traffic above the minimum is typically charged at a higher rate. In some situations, enterprises can also reduce the number of links at the multi-homed site, not just downsize the minimum commitments. As an example, with route control, a location with three or four links may now achieve “acceptable” performance with just two.

  ✓ **Migration from Private Networks to the Internet.** As enterprises become more confident in the performance of the Internet using route control, they can slowly migrate applications from expensive private networks to the Internet.

- **Reduced Operations Cost.** With better management of network assets and better network performance, end users can reduce the cost of operating their network. Route control is cheaper, more reliable, timelier, and easier than manually changing routes. The number of trouble tickets due to degradation of service and/or outages also decreases. By automatically managing routes, network engineers can focus on other network issues.

- **Increased Revenues.** Improved productivity due to improved network performance can have a significant impact on increasing corporate revenues. More visibly, with ecommerce sites, route control can help increase customer satisfaction and reduce customer abandonment with better response times.

- **Increased Visibility and Control.** Traditional BGP routing limits the ability of the enterprise to view and control the end-to-end network performance. With route control, enterprises have the flexibility to have has much or as little control of their networks as they desire. They can configure different parameters that the route control solution will use for path selection. Improved levels of control give users greater confidence in putting mission-critical applications and/or latency-sensitive applications over the Internet. Route control also allows enterprises to better manage their ISPs, configure the control parameters themselves, and design their networks in a fashion they choose. Increased visibility also allows enterprises to manage and negotiate contracts and validate enforcement of SLAs with their ISPs.

Route Control: A New Category

Several solutions in the market today help to overcome the performance problems of the Internet, but not all solutions are route control solutions. What defines route control? Three key criteria embody route control: Path monitoring and evaluation, automated changes to forwarding tables, and application of business logic to ensure network performance aligns with business objectives.

- **Path Monitoring and Evaluation.** All route control solutions go through a process of path monitoring and evaluation, and vendors have various implementations of this process. The process may vary in the paths monitored, when monitoring occurs, when evaluation occurs, and the evaluation method. The table below depicts the variances at a high level. Please contact the specific vendors to obtain more detailed and more technical information about their unique implementations, as well as the their pros and cons and applicability to different networking environments.

Criteria	Description
What is monitored?	• **User-Selected Paths.** The network administrator on the enterprise IT staff, the service provider, or the remote user identifies/triggers specific flows, paths, nodes, and/or networks to monitor. • **All Paths at Multi-Homed Location.** The route control solution monitors all paths across all networks at the multi-homed location automatically. • **Paths to Key Points on the Internet.** Some vendors monitor the health of the Internet through sampling routes at key locations across the Internet as a whole (or subsets of known customer networks). This compilation of Internet paths and health statistics is sometimes referred to as an Internet Health Map.

Criteria	Description
When is it monitored?	• **User-Initiated Monitoring.** Monitoring of paths occurs when a remote user establishes a connection to a multi-homed site, such as a website. • **Continuous Monitoring.** The route control solution continuously monitors, at specific intervals, the state and performance of the paths.
When are alternate paths evaluated?	• **Event-Triggered Evaluation.** A network event that results in the primary BGP path exceeding performance and/or cost thresholds triggers the route control solution to evaluate alternative paths. • **Continuous Evaluation.** The route control solution continuously evaluates the best-performing/least-cost paths.
Where are alternate paths evaluated?	• **At Customer Premises.** Computation of best paths happens at the customer data center or multi-homed office. • **At Vendor Data Center.** Computation of best paths happens at vendor data center. Allows customer to control most configuration options but outsources the computation, storage, and management to the vendor.
How are alternate paths evaluated?	• **Evaluate Against Internet Health Map.** Some vendors evaluate and determine the best paths based on the Internet Health Map. The solution chooses the path that avoids the areas of congestion and/or loss derived from the Internet Health Map. Cost parameters are taken into consideration in evaluating the paths as well. • **Compare the Alternate Paths at the Multi-homed Location.** Other vendors evaluate and choose the best path by comparing the performance/cost on each of the alternative paths at the multi-homed location. • **Hybrid Evaluation.** Some vendors leverage both the Internet Health Map view as well as taking measurements from the customer location.

The enterprise determines which monitoring technique is most appropriate by balancing the desired coverage (number of hosts/networks monitored), time intervals at which routes are measured, and the required resources (i.e., processing power of the solution, amount of inline bandwidth needed, and cost of the solution).

- **Automated Change to the Forwarding Table.** Once the monitoring/detection process identifies the state of the network and possible paths, the solution automatically updates the forwarding table with information about the best route selected based on the business parameters the user configured. This feature sets route control apart from other solutions that simply monitor and/or advise users to trigger manual changes. Regardless of which mechanism enacts the BGP change (typically IBGP "whispering" to border router), the router does not advertise the update to the Internet as a whole and does not create risk of propagating a routing table explosion. In fact, the change is localized to the multi-homed site.

- **Applies Business Parameters.** The solution makes changes based on a set of business parameters or policies that the enterprise or service provider sets on behalf of the user. The business parameter options for choosing the best path vary depending on the route control vendor. Today's solutions primarily use performance parameters such as latency, jitter, and packet loss as well as link cost.

Another difference between the vendor implementations is the set of parameters that determine when, where, and for what the solution invokes the changes.

Some of these parameters are as follows:

- ✓ **Time of Day/Day of Month.** Network pricing may vary by time of day, such as those pricing plans with peak and off-peak rates. An end user may also want to apply different performance parameters to different applications based on time of day or day of month. This example employs the combination of time of month and type of application parameters (described below).

- ✓ **Type of Application.** The end user can optimize based on the type of application. For example, a company may want the route control to optimize its media conferencing application based on link performance, particularly latency, and its web browsing applications based on link cost.

- ✓ **Premium Customers.** Service providers offering route control as part of their connectivity service can provide premium service and offer a higher level of performance and/or guaranteed end-to-end SLAs (Service Level Agreements). The service provider can designate the premium customers using specific IP addresses or subnets.

Additional features common to today's route control solutions include non-intrusive networking implementations and robust reporting capabilities. Route control solutions are non-intrusive in that they do not sit within the data path; they enact changes to the network but are not themselves a part of the network. For example, a route control solution will modify the forwarding table of an IP router, but unlike the router, traffic does not flow through the route control solution.

Some of the reports offered include network availability; performance measurements for latency, jitter, and packet loss; average throughput; burst rates; and comparisons of BGP-selected routes vs. routes selected by vendor. Companies can use these reports for further optimization and planning, as well as managing their service providers to ensure they meet the SLAs.

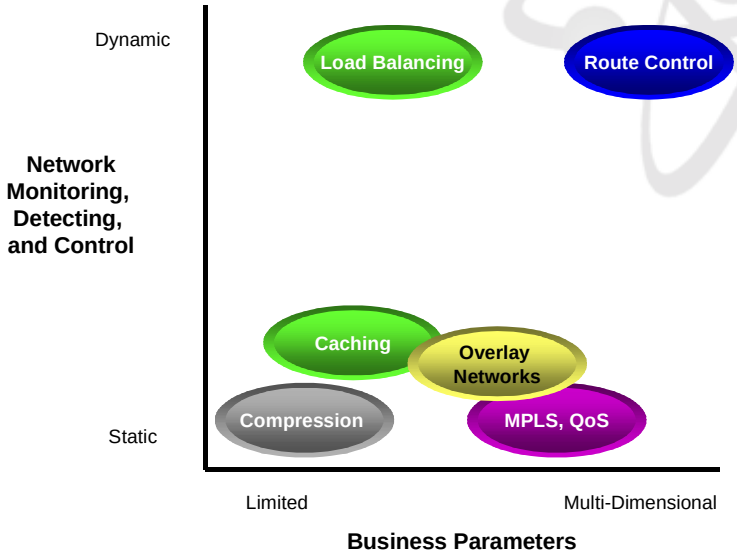
While it is important to understand what route control is, it is equally important to understand what it is not. Route control does not address routing modifications within the service providers' networks—it primarily gives the "first push" down the selected service provider link, constituting the first hop in the end-to-end path. Although route control solutions improve Internet performance for mission-critical business applications, they are not intended to address security concerns. However, route control solutions do not compromise security; enhanced network performance can improve network security through fewer password timeouts, dropped key exchanges, etc.

Additionally, route control is not the only solution for improving the overall Internet user experience. There are several alternative solutions and techniques to route control which impact network transport to application performance.

A few of these options are profiled on the following page.

Alternative	*Advantages*	*Key Considerations*	*Application*
Overlay Networks	Provides a wholly separate network design to provide premium bandwidth to support mission-critical and latency/jitter-sensitive applications	Premium pricetag Not ubiquitous – only available in areas where overlay provider has its own network facilities and/or peering agreements	Wholesale network providers offering enhanced services Enterprises requiring premium bandwidth to known endpoints
Over-Provisioning	Designed to support peak traffic volumes and sometimes even overflow traffic Provides redundancy Bandwidth readily available when traffic volumes increase	Not efficient use of bandwidth Can be extremely expensive	Current practice for entities requiring large Internet pipes and redundancy Service providers multi-homed with other service providers at peering points
Compression	Reduces traffic volume for more efficient use of links	Does not address network congestion	Bandwidth-constrained networks Third-world or developing countries that have very low-speed connections
Caching	Enterprises reduce traffic over network access Service providers reduce traffic over core	Does not address network congestion Not all content can be cached effectively such as real-time, interactive applications	Distributed websites Caching at the premises of content designed for external distribution
Server/LAN Load-Balancing	Ensures that specific device and LAN segment resources are not overutilized or congested Ensures that all applications are not affected, in case of link failure	Nearly all implementations are for LAN connections on the customer premises or within a data center Can be an expensive solution Does not address network link or network congestion	Distributing traffic to application, content, or database servers on a LAN Disaster recovery and back-up plans
Network Link Load-Balancing	Access network load balancers equally distribute the load between multiple links Ensures that specific device and link resources are not overutilized or congested	Typically results in an overprovisioned design Can be an expensive solution Does not address network congestion	Managing access redundancy Distributing traffic over multiple access links to optimize access bandwidth utilization Handling bursty traffic over fixed
Monitoring	Detailed historical, current, predictive information on network health assists network managers to maintain networks efficiently	Requires user to analyze reports and determine action required Requires manual intervention to enact changes	Enterprises and service providers that need status about their networks, particularly large networks or networks undergoing rapid changes Ideal for service providers and enterprises that offer SLA reporting Helpful to entities with legacy networks in addition to IP
QoS/Rate Limiting	Specific applications and types of traffic managed with appropriate level of service or priority	Does not address network congestion	Utilized when multiple applications with different tolerance for latency, jitter, and performance compete for bandwidth Support for multimedia applications

How does route control compare with these alternatives? The graphic at right depicts the advantages of route control along two axes: The mechanical elements of dynamic network monitoring, detection and control, and multi-dimensional business parameters used in assessing the best-performing and/or least-cost path.



While this mapping indicates that route control is superior based on the axes' criteria, it does not imply that route control offers the best solution in all cases. In fact, these alternative solutions are often complementary to route control, rather than a direct replacement or competing solution. In many situations, enterprises can achieve their goals best by leveraging the benefits of route control and one or more of these complementary solutions.

Route Control Vendor Business Models

Each route control vendor offers its solution in a unique manner, but there are essentially two distinct business models today. Vendors offer a technology product or they sell route control as a service.

Technology Product Model

With the technology product model, the product may be a device/appliance or software that customers can implement on the hardware platform of their choice. Vendors leveraging this business model target the DIY (Do-It-Yourself) market, i.e., enterprises that have the internal IT resources/expertise and the capital/expense budget to support the solution and do not want to outsource any part of their solution. The enterprise has full control and responsibility over the installation, configuration, maintenance, and ongoing management of the route control solution, as well as ownership of the device. The vendor may offer maintenance packages and upgrades for the product itself. Service providers that want to offer route control as part of their managed services offering may select this option as well.

Service Model

With the service model, enterprises have the flexibility to control as little or as much of their solution as they want, leaving the balance of support and technology upgrade issues to the service provider. If the customer so desires, it can fully outsource the planning, design, implementation, configuration, maintenance, and management to the service provider. The service provider will work interactively with the customer to ensure that the solution meets the company's business and financial objectives on an ongoing basis. The provider delivers service typically in one of two ways: As a network service (intelligence in the network) or as outsourced management of a route control product.

These vendors target the DIY enterprises and service providers as well as customers that typically subscribe to managed services and do not have the budget to purchase the equipment and/or software upfront. They may also target enterprises that do not want to own the assets or do not have the resources to fully support the solution themselves. Customers typically elect to control configuration and parameter settings and rely on the service to provide them with real-time reports on building congestion, inefficient link utilization, etc.

Some vendors will leverage both of these models, allowing customers to select from a service, a product, or both.

Impact and Implications

Route control has the potential to make a huge impact not only on the enterprise market as discussed previously but also on the service providers, the networking vendors, and the networking industry as a whole—all evidence that it may be a disruptive technology.

Networking Industry

Route control will have some positive growth implications on the industry, as outlined below.

- Increase confidence and comfort levels with the Internet and other public networks
- Increase traffic on the Internet
- Speed adoption of other IP applications and the emergence of new applications
- Create an environment with a higher level of confidence in the Internet as a means of conducting business
- More capital available for public networking and Internet-related investment opportunities

Route control will also help speed up the migration from legacy technologies such as frame relay and ATM to IP. Although an all-out migration to IP will not happen overnight, growth of layer 2 networks may very well plateau as a result of increased confidence in IP networks. While end users may not touch existing frame relay and ATM locations initially, IP may get the lion's share for the new locations. Legacy technologies and IP will then co-exist using interworking technologies.

Service Providers

Route control can provide an advantage to lower-cost ISPs (typically smaller providers) over premium-priced ISPs (typically large, incumbent providers). Although BGP tends to choose the big, higher-priced providers since they typically have the least number of network hops, route control gives lower-cost ISPs (with potentially more network hops but as good overall performance) a bigger share of the traffic. Lower-cost ISPs offering equal performance will thrive, challenging the premium-priced ISPs.

Route control exposes the performance deficiencies between some service providers—it chooses the networks (big or small) that have the most extensive and well-provisioned interconnections with other networks over more "insular," less interconnected networks. The level, quality, and size of the peering connections between the ISP networks also has a significant impact on which path gets chosen.

As some service providers have done already, they may use route control as a differentiator—leveraging performance optimization to make their services better. They may also offer it as a premium service or as a managed service. With route control, service providers can finally offer an end-to-end performance SLA regardless of whether the traffic traverses another service provider's network. In the future, route control can potentially become a baseline requirement for service providers to compete. However, since some enterprises do not realize they have a problem until something bad happens and/or they see how much better it could be, route control may be positioned as a value-added service targeting a few enterprises in the short term.

As route control has the potential to have significant impact on IP traffic growth, it can impact where and when service providers deploy/light fiber, buy and install equipment, and launch new services.

Networking Vendors

The route control vendors are already achieving success in strides. TeleChoice believes their successes will continue as more customers recognize the problems and understand how route control can solve them. There should also be a positive impact on other networking vendors. IP routing and switching vendors, for example, will benefit as more users cram more IP traffic into the network, increasing the need for more IP routers and switches. Vendors in cutting-edge IP application spaces such as VoIP (Voice over IP), CDN (Content Distribution Networks), etc., benefit as route control improves the customers' confidence in IP networks with predictable network performance.

Some traditional networking vendors may want to integrate route control into their products either by developing a route control solution themselves or developing OEM relationships with existing route control players. Historically, these traditional networking vendors prefer to acquire technology rather than build in-house, particularly when the new technology falls outside their core competencies or if it would take a long time to develop the technology themselves. Mergers and acquisitions, joint development, joint sales and marketing, and licensing will most likely occur between the traditional networking vendors and the route control players.

In the future, the demand from enterprises and the service providers may command the need for standards from standards bodies such as a route control forum, the IETF, etc. Standards will ensure interoperability between different route control vendor solutions.

Summary and Conclusions

Route control has emerged to solve the enterprises' persistent problems with the Internet's unpredictable performance. Route control is a network control solution that helps networking devices make forwarding decisions by providing information about the best path selected based on the business or network criteria the end user configures. Initial implementations of route control apply to multi-homed IP locations.

Route control can be used for hosted applications and site-to-site VPNs. Some of the benefits enterprises can achieve with route control include bandwidth cost savings, reduced operations expenses, increased revenues, and increased control. They also gain more predictability and consistency for their IP traffic.

Three key criteria define route control: Flow monitoring and anomaly detection, automated changes to forwarding tables, and application of business logic to ensure network performance aligns with business objectives. Other solutions, such as overlay networks, overprovisioning, compression, caching, load balancing, monitoring, and QoS/rate limiting, that also help to solve specific Internet problems complement route control. Enterprises can sometimes achieve their goals best with a combination of route control and other complementary solutions.

Route control players either provide route control as a technology product, as a service, or both. Vendors offering a technology product target the enterprises that have the internal resources to support the solution and have the budget for the upfront investment of owning or leasing a device or software solution. The vendors utilizing a service model target enterprises and service providers that are DIY and/or prefer to pay a monthly subscription fee for route control. They may want to outsource some or all of the route control functions to a service provider while still maintaining control of their specific configuration.

Route control is poised to have a significant impact on the industry, enterprise users, service providers, and networking vendors. Improved confidence in the Internet ultimately translates into more business opportunities for everyone.

About TeleChoice

TeleChoice assists companies in creating new markets around innovative business models, technologies, products, services, and applications. As the strategic catalyst™ for the telecom industry, TeleChoice helps start or greatly accelerate the process of crystallizing a business or market strategy, value proposition, or differentiated position. Playing a strategic role, TeleChoice enables clients to launch new businesses, new markets, and new products and services rapidly and successfully.

Supporting service providers and the technology vendors that serve them, TeleChoice focuses on leading-edge public network technologies. Since being founded in 1985, we have been differentiated by our proven ability to transform new technologies into successful products and services. Our portfolio of offerings helps clients conceptualize, launch, market, and capitalize on innovations in networking—faster, more efficiently, and more profitably.

Appendix: Route Control Vendor Profiles

The following section profiles some leading route control vendors that offer commercially available solutions today. The vendors profiled in this section include:

- netVmg
- Opnix
- Proficient Networks
- RouteScience
- Sockeye Networks

(vendor profiles appear alphabetically)

netVmg Overview

netVmg's software solution, the Flow Control Platform™ (FCP), enables businesses to take full advantage of the Internet's ubiquity while improving performance, increasing visibility, reducing operational pain, and lowering costs.

Target Customers

netVmg markets the FCP to enterprises and Internet Data Centers (IDCs) with multiple Internet connections. Beneficiaries of netVmg's technology are companies that would like to take advantage of the path diversity of multi-homing to gain consistent, predictable Internet performance while significantly lowering network costs. Equinix (Nasdaq: EQIX), the leading provider of core Internet exchange services, has selected the FCP as the platform for its Managed Intelligent Routing Service.

Benefits

netVmg's solution grants enterprises and IDCs visibility and control of how their traffic is routed and directs flows in near real-time to lower-cost paths adhering to customer-specific performance objectives. This enables multi-homed businesses to get consistent, predictable quality over the Internet while reducing their network costs. Adam Joffe, director of technical operations for Sony Online Entertainment, was recently quoted in the *Wall Street Journal* saying that the netVmg software has saved him 20 to 40% by routing traffic to the lowest cost provider.

The FCP also allows for aggressive end-to-end performance management and billing verification through internal reporting, which can be invaluable in negotiating and managing service provider contracts. Lastly, the FCP is non-intrusive and can optimize both web and corporate traffic.

Product Description

The FCP is comprised of a set of tightly integrated software modules running on general-purpose hardware. These modules include:

FlowCollector. Continuously monitors traffic flows to identify destination networks and measures actual traffic performance to these destination networks, as well as measured traffic performance to these networks across each of the customer's ISPs.

FlowDirector. Directs network traffic based on customer-specific objectives, including performance and cost. The FlowDirector leverages the FlowCollector's statistics to determine whether the enterprise-defined performance and transit cost policies are being met and makes route changes in accordance with these policies.

FlowView. Provides up-to-the-minute reports on customer-specific transit provider bandwidth usage and cost, route change activity, and traffic delivery performance to select destinations. The FlowPreview feature allows potential customers to preview projected route changes and traffic delivery performance without actually making any routing changes to traffic flows.

Opnix Overview

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Orbit Routing Intelligence System

The Orbit Routing Intelligence System utilizes two components: the Orbit 1000 CPE, and the Opnix CORE (Central Optimizing Route Engine). The two components continually work together to provide a system of Internet intelligence and dynamic Internet-wide routing knowledge allowing all Orbit 1000 customers to automatically avail their networks of the best routes possible given varying Internet conditions.

Orbit 1000, attached as a BGP peer to the customer's router not in the stream of data, gathers Internet performance metrics from the perspective of the client network through active probing of all available routes in IPv4 space (configurable by the customer). The metrics currently gathered include packet loss, latency, network access points (NAPs), and layer-3 hops. Orbit 1000 then sends this actively gathered data to the Opnix CORE for analysis.

The CORE takes the data gathered by all remote ORBIT systems and calculates the best routes based on customer-defined weights associated with both cost and performance. At a configurable interval (typically 15-30 minutes), the ORBIT CPE requests the optimized route map from the CORE and creates new IPv4 routes in its internal BGP4 server. It sets the next-hop gateway appropriately according to the customized route map. Through the traditional BGP4 peering session with the client routers, this optimized route map is then propagated to the client routers. The client routers are configured to set a local preference for routes received from the ORBIT CPE, such that it will prefer to use the ORBIT system's routes over routes received from the routers' other peers.

Pricing Information

Opnix provides a plug-and-play solution, consisting of hardware, software, and services. The Orbit 1000 CPE retails for $20K one-time charge. The CORE monthly usage service fee is $1K per month, per carrier for each Orbit 1000 CPE. To avoid monthly service fees, CORE can also be purchased for install at a customer data center starting at $100K.

Distinguishing Characteristics

- FLEXIBILITY in purchase. Customers who want the least upfront cost can choose the Opnix monthly service. Those who want to own the technology can buy the entire product to install in their data centers.
- ACTIVE PROBING of IPv4 routes to every network, across all available carriers on the entire global Internet on an ongoing basis.
- CUSTOMER PORTAL access, which enables generation of hourly and weekly graphs of network performance of Orbit vs. BGP based on latency, packet loss, layer-3hops, and congestion.
- VPN capability at minimal expense. Due to low cost of CPE, Orbit can be installed at every VPN location at minimal expense.
- SCALABILITY because data collection occurs at central CORE, not on customer site.
- 1u CPE device is low impact on data center space.

Proficient Networks Overview

Proficient Networks, Inc. provides the most comprehensive network optimization solution for enterprises to align network policy to business objectives. The Proficient Network Policy Engine bridges the gap between what businesses want to do versus what their networks are capable of doing by tuning traffic for business requirements and managing network resources for both cost and capacity.

Headquartered in San Francisco, Proficient Networks is privately held, funded by Canaan Partners, El Dorado Ventures, and individual investors, including Ed Kozel. For more information on Proficient Networks, visit www.proficient.net.

Proficient Network Policy Engine™

Delivered as a stand-alone, self-contained appliance rather than as a hosted service, the NPE1010A™ is seamlessly deployed within the timeframe of a few hours, using Internet standard protocols rather than requiring vendor-specific commands or hardware-specific features. By operating inside enterprise networks to monitor and guide traffic more efficiently, the NPE1010A works in collaboration with routers running BGP to collect network traffic information, test route paths, and apply updated routes to meet business objectives. With this approach, Proficient Networks delivers a rapidly deployed solution, scalable and solid technology, and a compelling Return On Investment (ROI).

The NPE1010A provides a comprehensive set of traffic engineering capabilities including:

- Load Sharing – Distribute load across diverse providers
- Metrics Engineering – User-specified performance tests
- Explicit Engineering – Deterministic traffic routing

In addition, a scheduling option allows businesses to apply the combination of traffic engineering capabilities when they make the most sense.

Benefits

Proficient Networks enables customer to achieve their business objectives by:

- Providing a technology solution that drives measurable business value
- Improving connectivity across the enterprise and with business partners to enhance overall customer experience
- Building a solid, scalable solution for today and tomorrow

RouteScience Overview

Founded in December 1999 by a trio of Cisco Systems executives, RouteScience is the leading provider of route control solutions. The company is fully funded, having raised $56 million in equity financing from leading venture capital firms including Benchmark Capital, Sequoia Capital, Sevin Rosen Funds, and Foundation Capital. Its first product, RouteScience PathControl, became generally available in October 2001 and the company announced its first revenue-generating customer, FreeMarkets Inc., in January 2002.

About PathControl

A stand-alone hardware solution, PathControl allows an organization to control its Internet connectivity at the network edge to achieve specific business objectives. PathControl optimizes an organization's Internet connectivity in real time using a four-step process:

1. **Measurement.** PathControl offers both user-initiated and continuous monitoring options to measure an organization's end-to-end application performance to its own end users over all available ISP links in real time.

2. **Analysis and Decision-making.** PathControl's CLI and web-based GUI allow the organization to easily define its routing preferences. These preferences are then compared against performance metrics to determine the best ISP path.

3. **Automatic Route Updates.** PathControl sends BGP route updates to the organization's edge routers in real time as conditions on the Internet change. The device can also operate in a "reporting only" mode if the organization so chooses.

4. **Reporting.** PathControl generates a detailed "audit trail" of ISP performance by Internet prefix, which can be used by the organization to better manage its ISP connectivity. The device can create both standard-format and custom reports.

Benefits

As a stand-alone route control solution, PathControl provides an organization with the greatest degree of control over its Internet routing. The control can be used to achieve specific business objectives:

- **Reduce WAN Costs.** Organizations can reduce WAN costs by using PathControl to steer traffic to low-cost ISP links. Over time, the company can transition from so-called "premium ISPs" to low-cost ISPs without sacrificing performance.

- **Improve WAN Performance.** PathControl's ability to detect and route around Internet congestion in real time allows the organization to provide reliable connectivity, avoiding "brownouts" that result from excessive latency and loss.

- **Facilitates the Migration to IP Connectivity.** PathControl's ability to optimize connectivity in real time is essential to providing the predictability of performance necessary to migrate from Frame/ATM to IP for mission-critical applications.

Sockeye Networks Overview

Immediate ROI and Proactive Route Optimization

Sockeye Networks was founded in January 2001 by Akamai Technologies. The Sockeye Networks GlobalRoute service is built upon a foundation of technologies that have been operationally proven for years. Enterprises and service providers rely on GlobalRoute to proactively optimize multi-homed Internet connectivity for VPN and web applications. GlobalRoute improves performance dramatically, lowers costs by 10 to 40%, and provides unprecedented insight into current and historical network conditions.

GlobalRoute Combines Global and Edge Measurement Technologies

By uniquely combining global measurement and edge measurement technologies, GlobalRoute creates detailed, customer-specific views on how traffic conditions affect current and alternate routes.

Exclusively licensed from Akamai Technologies, a global Internet measurement and mapping platform provides GlobalRoute customers with real-time performance data for the entire Internet.

Leveraging this global intelligence, a GlobalRoute measurement device, which resides outside the data path at customers' multi-homed locations, performs customer-specific edge measurements and enforces customer-controlled performance and cost policies.

Sockeye Networks Offers Its Customers Unique Capabilities

GlobalRoute is a comprehensive ***service*** providing 7x24x365 support by engineers with extensive operational and networking expertise.

Extensive web-based reporting and configuration access to all performance, cost, and comprehensive routing policies ensures GlobalRoute customers maintain ***total control***.

GlobalRoute delivers impressive ***performance and cost benefits*** as demonstrated by customers and by extensive testing utilizing third-party testing services.

Paths are evaluated automatically at each multi-homed location and specific policies may be configured for ***premium customers***.

GlobalRoute addresses all applications and protocols, including both enterprise ***VPN and Web*** solutions.

GlobalRoute is ***non-intrusive***, requiring no ongoing modifications of websites or mirrors and imposing no dependencies on website application developers.

GlobalRoute measurement and mapping technologies are ***proven*** after years of operation as part of the Akamai content distribution service.

With GlobalRoute, congestion is detected, alternate routes tested, and new routes are asserted ***proactively***. Alternate routes are tested before traffic is rerouted.

For more information, please visit our website at www.sockeye.com.