



EQUINIX



OPTIMIZING INTERNET APPLICATION PERFORMANCE

EQUINIX WHITEPAPER



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OPTIMIZING INTERNET APPLICATION PERFORMANCE

In today's digital economy, performance can be a strategic differentiator for your company. Whether you're a bank handling millions of clients online, a retailer dependent on your website to drive sales, or a cloud computing company powering enterprises, performance-related end user experience is one of the key criteria on which your company will be judged. There are numerous examples of how performance can impact revenue:

- **Amazon** — “Every 100ms delay costs 1% of sales”¹ — for 2009 that translates into \$245 million
- **Mozilla** shaved 2.2 seconds of load time off its landing pages and increased download conversions by 15.4%, translating into an additional 60 million downloads each year²
- **Microsoft** found that an increase of 500ms of delays on its page loads resulted in losing 1.2% in revenue per user³
- When **Shopzilla** reduced its page load time by 5 seconds, it saw an increase of 25% in page views and a 7-12% increase in revenue⁴
- 10ms latency could result in 10% less revenue for **U.S. brokerages**⁵

Performance isn't just about the speed of a site; availability and consistency are also important. Being able to deliver consistent, reliable service is fundamental to customer conversion and retention. From frustrated consumers trying to buy gifts for Christmas to multinational companies attempting to do computational modeling, all types of customers become frustrated when websites or cloud services aren't fast or pages fail to load. Being able to provide your customers a consistent experience, or in the case of the enterprise, to actually guarantee that performance and consistency with a Service Level Agreement (SLA), translates to increased revenue by improving the end user experience and reducing resistance from corporate buyers.

In this paper, we describe how leveraging Equinix as the foundation for your services can reduce latency by 15% globally, reduce downtime by up to 80%, and increase predictability, all without having to invest the time or incur the expense to change or redesign your application architecture.

1. <http://sites.google.com/site/glinden/Home/StanfordDataMining.2006-11-28.ppt>

2. <http://blog.mozilla.com/metrics/category/website-optimization/>

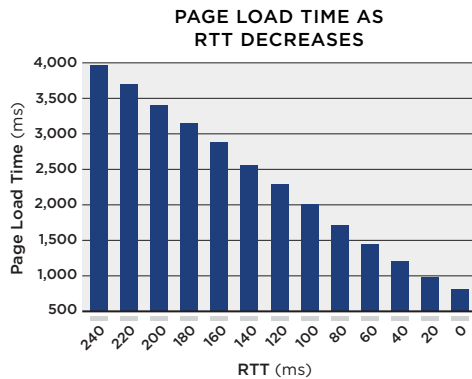
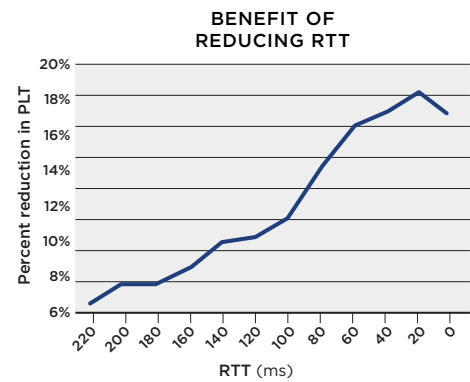
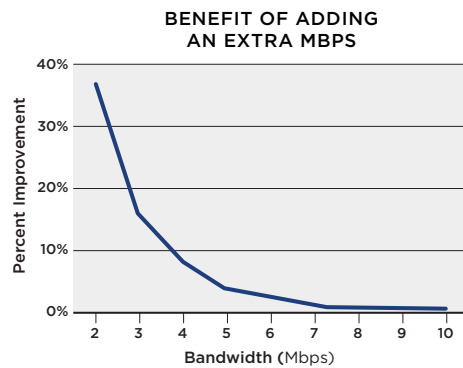
3. <http://en.oreilly.com/velocity2009/public/schedule/detail/8523>

4. <http://assets.en.oreilly.com/1/event/29/Shopzilla%27s%20Site%20Redo%20-%20You%20Get%20What%20You%20Measure%20Presentation.ppt>

5. <http://www.tabbgroup.com/PublicationDetail.aspx?PublicationID=346>

SPEED

The speed of your site is judged on responsiveness to actions on the page (script requests, image renders, etc.) and on how quickly users can transition from page to page (loading a new page). The elements of speed can be further broken down: the network latency and bandwidth between your end users and your site, the performance of your server infrastructure in responding to a request, and how quickly the user's browser can render your site based on how the web page is coded. While there is a tremendous body of knowledge on how to increase bandwidth, optimize servers and code web pages, network latency is generally considered immutable. But new studies show that if you reduce latency, it will have a tremendous effect on page load times, even more so than bandwidth, with every 20ms of reduced network latency resulting in a 7-15% decrease in page load times.⁶



Conventional advice on reducing latency recommends using a third-party provider such as a Content-Delivery Network (CDN) to distribute content and leveraging their infrastructure to get geographically closer to the end user. While a CDN can help accelerate static content and effectively distribute video, the increasingly dynamic nature of the web (social media, real-time API access, etc.) reduces CDN effectiveness, and in a real-time cloud application may not be able to help at all. This study shows how it is possible to reduce network latency across the internet by housing application infrastructure in Equinix data centers and leveraging the unique network density located in them.

6. <http://www.belshe.com/2010/05/24/more-bandwidth-doesnt-matter-much/>

AVAILABILITY & CONSISTENCY

Availability of a website isn't solely dependent on how well you operate your infrastructure; it is also affected by the performance of your internet service provider (ISP) and other service providers. Disputes between carriers have sometimes resulted in a fragmented internet, with some end users unable to access content while others are unaffected.⁷ Likewise, achieving consistent site performance is based on an amalgamation of internal factors (e.g., proper capacity planning, load management) and external factors (e.g., internet performance, local traffic). Again, while the principles of optimizing the internal factors are well understood, how to optimize the external factors has seemed to be a secret held by only the largest content providers such as Google or Amazon. In this whitepaper we describe how these large content companies increase their control over external forces, and how your company can reproduce this easily and cost effectively. The picture becomes clearer when viewed in light of the expansion paths most favored by providers. 46% of respondents intended to expand primarily through partnerships, versus 28% planning to grow organically, and 14% through acquisitions.

7. <http://www.datacenterknowledge.com/archives/2008/03/18/cogent-telia-peering-dispute-widely-felt/>

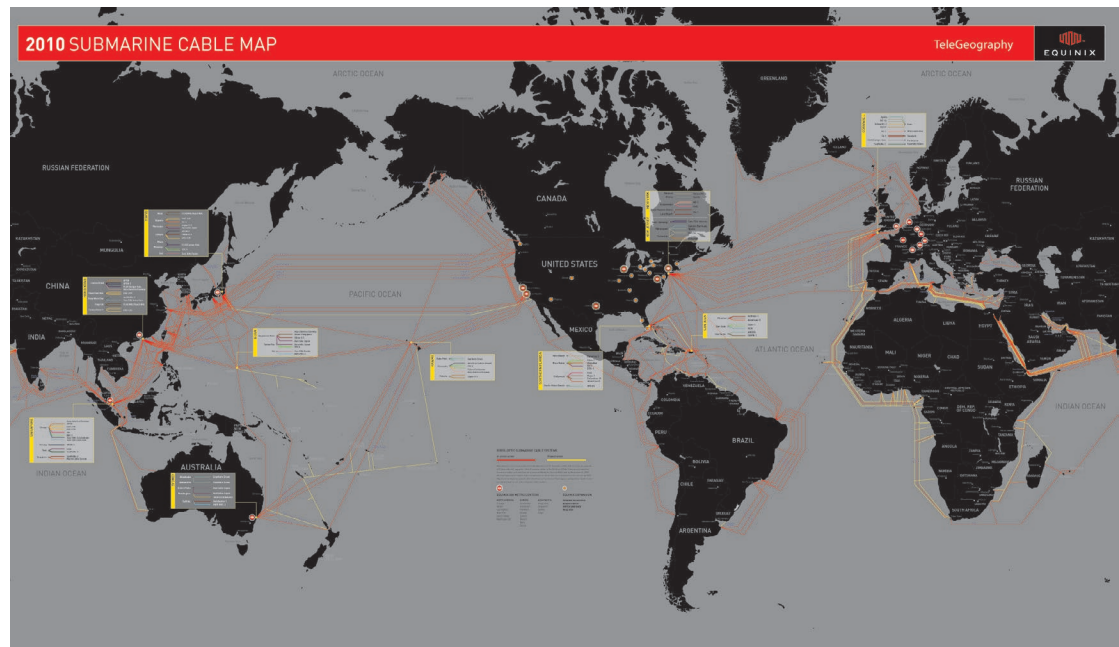
PLATFORM EQUINIX™

CDNs, content providers, and cloud providers choose Equinix as their data center services provider. Equinix provides some of the most reliable, secure facilities in the world, and our long track record of delivering excellent service has earned the trust of top companies' CTOs and CIOs who know application performance is mission critical. But equally important, Equinix data centers are situated in critical locations throughout the internet, which enables Equinix customers to optimize their end users' experience. To understand how, let's quickly review the structure of the internet.

To the general public, the internet is a "cloud" they can plug into anywhere, but the fundamental structure of the internet is actually drastically different. The internet is a vast series of interconnected networks that ride on the physical capacity of hundreds of telecom providers. These networks overlap geographically (some major cities have more than 50 networks), and they also share common characteristics.

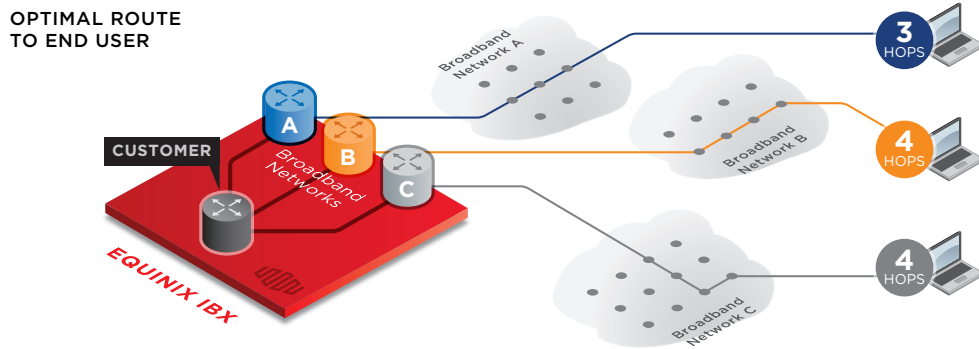
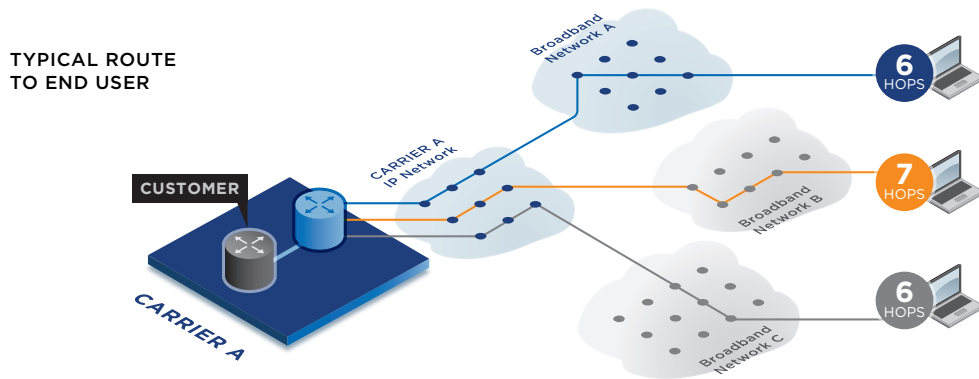
First, all ISPs architect their networks with backbone connections engineered as high-speed trunks between key network nodes. Since these backbones are responsible for carrying massive amounts of data and distributing them across the network, they are critical to each carrier. Therefore, carriers devote significant engineering and operational resources to ensure the backbone runs as quickly and with as little contention as possible. By contrast, the regional coverage or non-backbone networks built by that same ISP may have some degree of oversubscription, resulting in unpredictable behavior and network congestion.

Second, the physical cables forming these backbone networks generally converge on certain locations due to population density and geographic limitations. In addition, sub-sea cables that connect the world's continents reach the shore at very distinct locations based on geographic characteristics (away from shipping lanes to prevent cable cuts, but still near major cities), resulting in placement similar or identical to where ISPs locate their backbone networks.



Map of Undersea Fiber Optic Cables

Third, ISPs must have commercial agreements with each other to pass traffic, and physically connect backbones with each other to accomplish this. The locations where the backbones tie together, also known as peering points, are the bridge between carriers. Thus, a route between two computers connected to different carriers might not be the shortest possible route: data sent from a computer in Boston to a computer in Maine may go through a peering point in New York. The implications become even greater in Asia, where a PC in Singapore trying to reach Sydney may be routed through Los Angeles, transiting the Pacific Ocean twice. These types of routing inefficiencies can have devastating consequences on performance.



Equinix's data centers were built to act as the major peering points for ISPs, and our founding principle is to serve as a neutral location for carriers and their customers to meet and efficiently exchange traffic. Equinix is the only global provider of carrier-neutral data center services. More than 650 carriers connect with each other in our facilities around the world, and the carrier connections to our facilities are their backbone links that expedite internet traffic.

Equinix customers choose to build their infrastructure inside our data centers to ensure reliability and security, while connecting to the carriers they choose in order to leverage the world's most reliable and efficient network routes. This allows businesses to mitigate the unpredictability of the internet by connecting directly to the ISPs their end users use most often, whether a large cable broadband provider in the U.S., a French ISP, or a wireless provider for smartphones. Because the physical speed limitations caused by geographical distances can also be a factor, Equinix has built data centers all around the world, enabling our customers to locate their infrastructure as close to their end users as possible. We call our combination of reliable data centers, located around the world, which contain dynamic ecosystems of customers and networks "Platform Equinix."

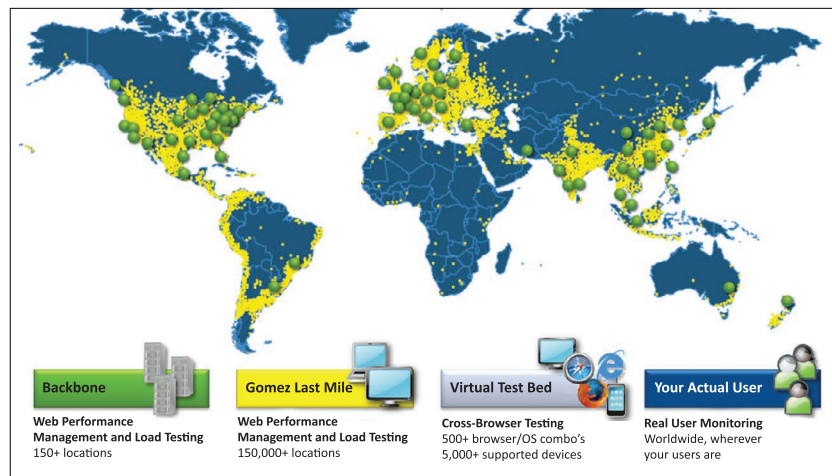
HOW DO WE TEST APPLICATION PERFORMANCE?

In collaboration with Compuware/Gomez, Equinix created a dedicated test platform to quantify the application performance enabled by Platform Equinix. By building a “beacon server” connected to multiple carriers, Equinix simulated the effects of different application routing scenarios—connected to only one carrier or connected to a multitude of carriers—using the same hardware, software and physical location to remove as many variables as possible. In addition, to represent the impact of geographic diversity, Equinix replicated the beacon server at sites on the East Coast (Ashburn, Va.) and West Coast (Silicon Valley, Calif.). The beacon server was initially configured to represent a typical server deployment with a connection to a single ISP in one location. The configuration was then connected with up to five carriers across multiple sites.

Gomez, the web performance division of Compuware, provides the industry’s leading solution for testing the performance, availability, and quality of web and mobile applications. The Gomez platform integrates web load testing, web performance management, web cross-browser testing, and web performance business analysis, enabling organizations to test from the “outside-in” across all users, browsers, devices, geographies, and data centers. Gomez has created a unique monitoring solution that aligns with our attempt at representing real performance across the internet. Its Active Last Mile capability provides on-demand active monitoring from more than 150,000 real, consumer-grade computers connected to over 2,500 local ISPs and wireless carriers in more than 168 countries around the globe.

Gomez is the only solution able to provide an accurate view into the end user experience from anywhere on the internet, anywhere in the world, on any carrier. In addition, the Gomez platform is extensible and flexible enough for Equinix to capture standard data, such as end-to-end connection time and availability, and also create custom traceroute scripts to provide visibility into actual network paths taken, by performing scripted routines using their last-mile network. The resulting data was parsed by removing outlying data (the bottom and top 2.5% of results for all tests), sorted by region and statistically analyzed to calculate variance (which translates into predictability).

Equinix tested three key parameters: roundtrip time, traceroute, and availability. Roundtrip time represents the time it takes to establish an initial connection to a server. This minimizes any differences in page rendering time, as well as any potential concerns about database or back-end access. Differentials in roundtrip times can then be isolated to correlate with network speed. The traceroute test counts how many network hops exist between the last-mile test node and the beacon servers. Finally, availability data was collected from all global locations, which factors in the reliability of the internet as a whole .



The Gomez Network:
World's Largest and Most Comprehensive Performance Monitoring and Testing Network

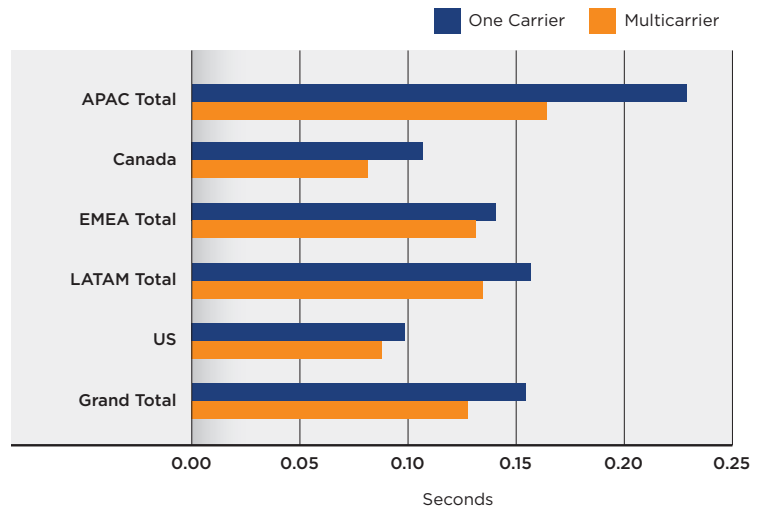
Source: <http://www.gomez.com/products-solutions/technology/the-gomez-network/>

RESULTS

When compared to a typical deployment, roundtrip time, traceroutes, and availability were all materially better in the multi-carrier, multi-node solution. In addition, predictability was improved across all three factors.

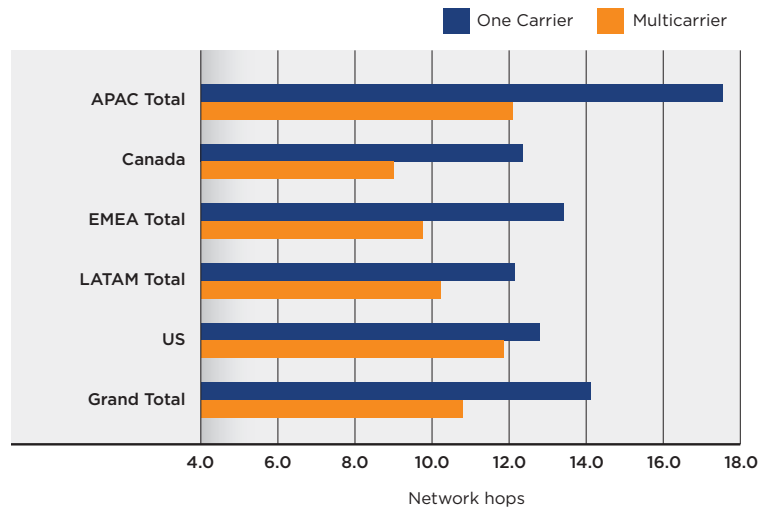
Round Trip Time

Roundtrip time was reduced 17% globally, in Asia-Pacific (APAC) by a striking 29% (65ms), Canada by 24% (25ms), Latin America (LATAM) by 14% (22ms), U.S. by 11% (11ms), and Europe Middle East/Africa (EMEA) by 7% (9ms). Using the modeling done in other research⁸, with a 20ms improvement representing a 7-15% drop in page load times, we can extrapolate the dramatic improvements in performance possible.



Traceroutes

Traceroutes depict how many different routers a packet must traverse on its way to the final destination. A more direct route means fewer points in the path for congestion, failure, or variability. By leveraging direct access to multiple carriers in one Equinix facility, the number of hops to the beacon server is dramatically reduced. Globally network hops decreased by 24%, APAC decreased by 31%, EMEA by 27%, Canada by 21%, LATAM by 16%, and the U.S. by 7%. This translates into more direct connectivity from your end users to your servers.

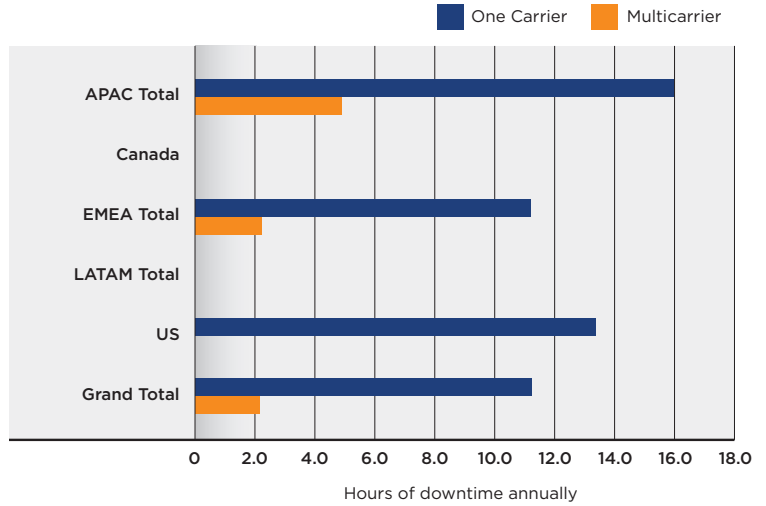


8. <http://www.belshe.com/2010/05/24/more-bandwidth-doesnt-matter-much/>

Availability

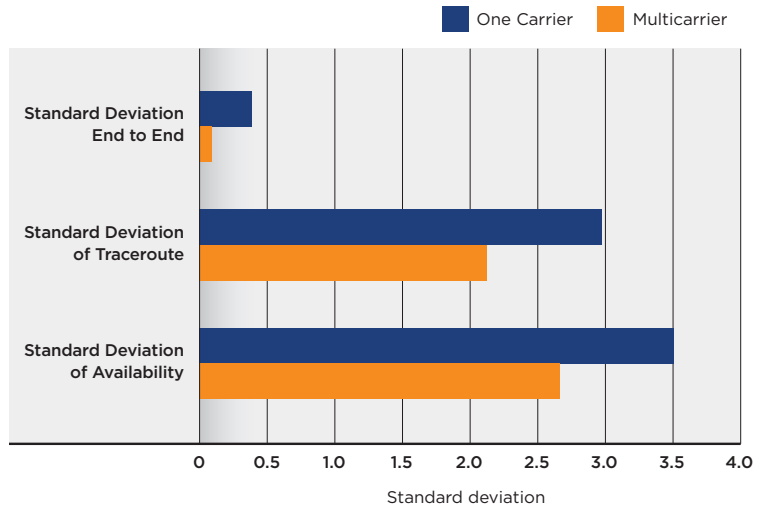
Availability improvements achieved an 81% reduction in downtime globally, translating into a drop from 11 to two hours of downtime in a year. Typically, availability measurements simply show whether or not your site infrastructure is up and whether or not it is reachable from a single test node. By using Gomez's Active Last Mile monitoring, we gain visibility into site availability from the end user's perspective, factoring in whatever connectivity or availability issues their internet connection might be introducing.

This provides a more holistic view of site availability. By deploying in our optimized fashion, downtime in Hong Kong went from 50 to 0 hours, in UAE from 120 to 0 hours, and in the U.S. from 13 to 0 hours. For end users, this represents the difference between failing to access your application and the assurance they can access them reliably every time.



Predictability

By taking the standard deviations from all the source data, we find 77% less variability in connection time, 28% less variability in traceroute hops, and 23% less variability in availability. Not only is performance improved across the board, but predictability of that performance is also increased dramatically.



TAKEAWAYS

How difficult is it to implement the architecture we tested? Amazingly simple. As this study clearly demonstrates, where you locate your infrastructure plays a huge role in how well your site or application performs. Without any software or server optimization, we were able to obtain significant improvements in performance by leveraging Equinix as a global interconnection hub. This represents a tremendous ROI compared to expensive software engineering efforts or infrastructure overhauls. By leveraging Platform Equinix, you can increase the performance of your site by 15-20% and increase availability and predictability without having to redo any software or hardware.

As studies have shown, performance is critical to the end user experience. A recent survey by Equation Research showed many consumers will abandon a website or company application that performs slowly⁹:

- Nearly one-third (32%) of consumers will start abandoning slow sites after one and five seconds.
- 39% of consumers say speed is more important than functionality for most websites, while only one in five ranked site functionality as more important.
- More than one-third (37%) of consumers said they would not return to a slow site, and 27 percent would likely jump to a competitor's site.

Simply by colocating at the right data centers and being able to directly access multiple ISPs' backbones, you can achieve the significant performance benefits that allow companies like Google or Microsoft to be fast for all users independent of their location. These performance improvements translate into measurable business benefits:

- Increased revenue for retailers
- More page views (and ad views) for content companies
- More satisfied customers for any type of site or application

Whether your customers are regional or global, Equinix has data center services in the right locations to help you dramatically improve application performance to end users.



9. <http://www.gomez.com/wp-content/downloads/GomezWebSpeedSurvey.pdf>



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About Equinix

Equinix, Inc. (Nasdaq: EQIX), connects more than 4,000 companies directly to their customers and partners inside the world's most networked data centers. Today, enterprise, cloud, networking, digital media and financial services companies leverage the Equinix interconnection platform in 31 strategic markets across the Americas, EMEA and Asia-Pacific.

By connecting directly to their strategic partners and end users, customers are forming dynamic ecosystems inside Equinix. These interconnected ecosystems enable companies to optimize the performance of their content and applications and protect their vital digital assets.