

The CDN Federation

Solutions for SPs and Content Providers To Scale a Great Customer Experience

Authors

Marc Latouche
Jaak Defour
Thomas Renger
Tony Verspecht
Francois Le Faucheur

October 2012



Cisco Internet Business Solutions Group (IBSG)

The CDN Federation

Solutions for SPs and Content Providers To Scale a Great Customer Experience

Introduction

The explosive demand for Internet content shows no signs of abating. Indeed, by 2015, Cisco projects a *quadrupling* of IP traffic,¹ more than 90 percent of which will be video. And while consumers were once satisfied with shorter YouTube-style “snacking,” today they expect a wide-ranging smorgasbord of higher-quality, long-form video, available on any device at any time.

The format of video consumption has become broader as well. Increasingly, on-demand and real-time live events (e.g., sports, music) are consumed over the Internet. The BBC, for example, recently cited that 14 percent of its iPlayer views were for live content.² This was driven by interest in the 2012 Olympics, but represents an overall trend.

The ongoing surge in content traffic, particularly video, has created great challenges for service providers (SPs). While their networks are strained to capacity from the rising demand, they have received little increase in revenue, since much of that content has come from over-the-top (OTT) providers who outsource their distribution to pure-play content delivery network (CDN) companies. Meanwhile, costs and maintenance issues continue to increase for SPs.

At the same time, OTT content providers see their online businesses maturing, after a period of experimentation. Increasingly, they offer higher-quality video and premium content through subscription or on-demand payment models. This emphasis on consumer quality of experience (QoE), they believe, is the key to maintaining customer brand loyalty and increasing their sales. Such quality has to be delivered irrespective of device type (e.g., connected TV, tablets, smartphones, PCs) or access method (e.g., mobile broadband, fixed broadband, Wi-Fi). Content providers recognize that this is something not always reachable with today’s commercially available CDN offers. They need something more robust and scalable.

In response to these trends, many SPs are deploying proprietary CDNs within their networks and have started to offer their CDN services to OTT content providers. This allows them to earn extra income from the content flowing over their networks, while providing a viable commercial alternative—or complement—to pure-play CDNs. SPs deploy caches and content streamers within their network, closer to the end-user connection, and have the capability to link their CDN to their own network, which is already enabled for quality of service (QoS).

¹ Cisco Visual Networking Index, 2012

² BBC, August 2012

A farther-reaching solution was first discussed in 2011, when Cisco began a three-phase exploration into the feasibility of CDN federations. Cisco defines CDN federations as *multi-footprint, open CDN capabilities built and shared by autonomous members*.

In short, separate SPs interconnect—and leverage—one another's CDN resources with the goal of benefiting all players in the value chain:

- **Consumers** enjoy an overall better quality of experience while watching content over the Internet. The closer the CDN cache is to the end user, the faster the response time. In addition, some video traffic can be given a premium QoS priority, ensuring better delivery in case of network congestion. And the more interconnected CDNs become available to content providers, the greater the variety of content that can be offered with a high-cache hit ratio, further enhancing the quality of experience.
- **SPs** can gain additional revenue by offering a better value proposition to content providers. Since the upsurge in traffic has had such a massive impact on their networks, pooling that data across separate, interconnected CDNs will benefit all SPs who participate. SPs can also sell their key differentiators (quality, scale) across multiple footprints, presenting one global “virtual CDN” to content providers. CDN federations also represent an opportunity to lessen the burden on SP networks by virtue of the traffic reduction that content caching brings.
- **Content providers** will be assured that their offerings—which are increasingly represented by paid content—are offered to their customers with guaranteed quality and made available to a much wider audience over both mobile and fixed Internet access. They will receive higher-quality online video/TV services, along with better analytics, reporting, and control of the overall end-to-end consumer experience.
- **Pure-play CDNs** will gain an opportunity to reduce CapEx and OpEx for content delivery by interconnecting and establishing a wholesale relationship with operator-owned CDNs. They will be able to experiment with new content-provider propositions, including sustained HD; larger-scale live events; better targeting; and optimized QoE to mobile devices. All of these will rely on the unique operator capabilities offered by a CDN federation (e.g., QoS, multicast, customer insight, mobile-delivery optimization). Being standardized, CDN interconnections will link to a variety of operator-owned CDNs without additional efforts.

In the first phase of the Cisco CDN federation pilot initiative, the concept was carefully studied, discussed, and developed, while a plan was formulated to spur sharing of ideas, technology, and standards among SPs. The second phase, which was carried out from December 2011 to June 2012, concentrated on proving the concept and moving it closer to reality.

Core areas of focus included in-depth reviews of business models along with lab-level interconnections among far-reaching networks while utilizing different streaming protocols. The impact and opportunities provided by the ongoing surge in mobile video was another key trend under study.

This paper will further explain the market context driving the need for CDN federations; make the case for federations and the ways in which they will benefit multiple players along the web-video value chain; and expound on the results and conclusions of the second phase of Cisco's CDN federation pilot.

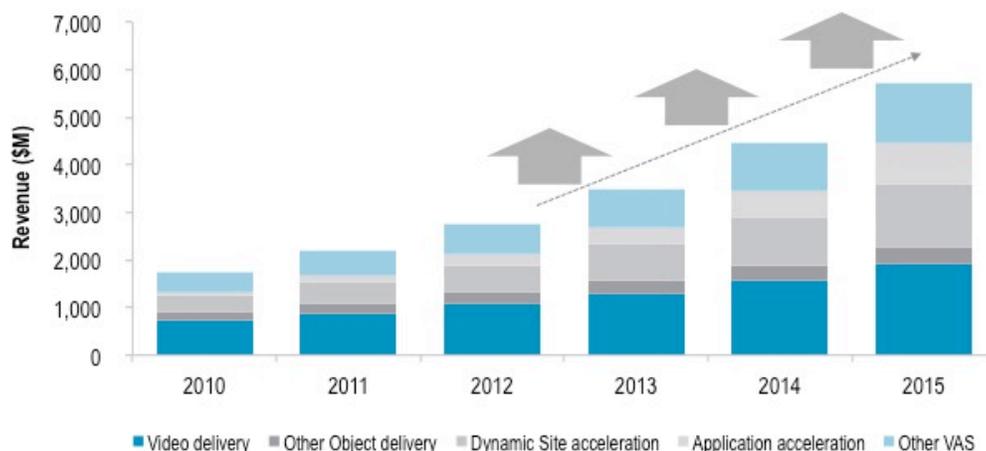
Pain Points Along the Web Video Value Chain

As we have seen, shifting consumer behavior is driving soaring demand for Internet video. The numbers are eye-opening and reflect a major transformation in the CDN market.

At peak times, Netflix alone represents 32.7 percent of all downstream Internet traffic in North America.³ New business models like Hulu Plus—expected to account for more than half of Hulu’s revenue in 2012, according to Hulu CEO Jason Kilar⁴—illustrate the rapidly developing market potential for Internet streaming. Interactive offerings, such as SkySport and many others, are taking advantage of the explosive proliferation of mobile devices.

CDNs have seen strong growth along with these trends. A \$2 billion industry in 2011, it is projected to reach \$6 billion by 2015.⁵ Cisco believes that this growth will gain additional momentum as CDN federations mature, enabling higher-definition content to be delivered over the Internet and enticing content providers to sell and distribute premium content online.

Figure 1. CDN Market Is Experiencing Strong Growth.



- Increase in higher-definition content
- SPs build On-Net CDNs delivering better quality; more video is consumed
- Content providers move premium content to benefit from this guaranteed quality
- SP CDN federations scale On-Net differentiators
- DIY CDNs become less attractive for content providers

Sources: Frost & Sullivan, Cisco VNI, Akamai, Limelight, Cisco IBSG, 2012

Meanwhile, as content providers mature, the demand for higher-quality presentation of their video offerings is rising sharply. Today’s premium services are a far cry from user-generated content. And when consumers are paying, slow response times and questionable quality of service are not acceptable. As a result, the need for CDNs with content caches closer to the customer has become painfully apparent. SPs can fill this void.

³ Sandvine, Inc., fall 2011

⁴ Hulu Blog, Jan. 12, 2012

⁵ Frost & Sullivan, Cisco VNI, Akamai, Limelight, Cisco IBSG, 2012

As part of a CDN federation, On-Net CDNs could benefit from multiple differentiated service-level agreements:

- Availability SLAs combine “CDN availability” and “Internet access availability SLA” to provide end-to-end availability commitments to content providers.
- Performance SLAs provide guaranteed throughput SLAs (complemented with delay, bufferization, loss, and jitter) and premium delivery services for content that inflicts a heavy payload on the network, adding to congestion.

Content providers (e.g., Netflix, HBO, ESPN) are also seeking wider audiences in far-reaching regions. But they fear the complexity of contracts, billing, and negotiations across a complex network of pure-play CDNs and SPs, potentially spanning countries and continents.

This content-delivery portfolio can be enriched by other valued services, including content management, encoding, and preparation for the multiple devices connected to the Internet. Overall, this will allow content providers to focus on their core business while delegating other activities.

The Case for CDN Federation

If a service provider deploys its own CDN, improvements in performance result, but there are also inherent limitations. For starters, the distribution of content is subject to the footprint of that particular network. If, for example, an SP in Spain wants to attract Spanish-speaking viewers in the Americas, that broader audience is not easily reached.

Once that SP is part of a CDN federation, however, the overall process is streamlined, allowing the SP to access a wider audience much more easily. Transport costs are lowered once CDN resources are pooled, and billing is simplified.

From an SP perspective, the federation concept is obvious—especially considering that in the area of mobile voice communications, there is a long tradition of standardization and interconnections. An AT&T user, after all, has no trouble calling a friend on the Verizon network.

This last point is important since it is unlikely that SPs and CDN providers around the world will all select a unique hardware and software vendor to build their CDN; one global, vertical mono-vendor CDN federation is very unlikely. As a result, standards enabling heterogeneous CDNs to interconnect at low cost while maintaining a high level of functionality are essential. A key value of the Cisco CDN federation pilot is to ensure that its developments and findings nurture the standardization effort already being driven by the IETF CDN Interconnect Working Group.

In a federation of CDNs, content caches would be that much closer to end users, thereby lessening the strain on SP networks while also offering better quality of service to consumers. SPs will gain a wider footprint for their own content offerings as well. In addition, the interconnect model already complements IP transit and peering.

As we have seen, SPs are also longing to gain revenue from the abundance of video traffic coursing across their networks. Through a federation, members have an increased opportunity to sell Internet-wide delivery services. In presenting their value proposition to content providers, SPs can offer improvements in QoS to customers as a prime selling point.

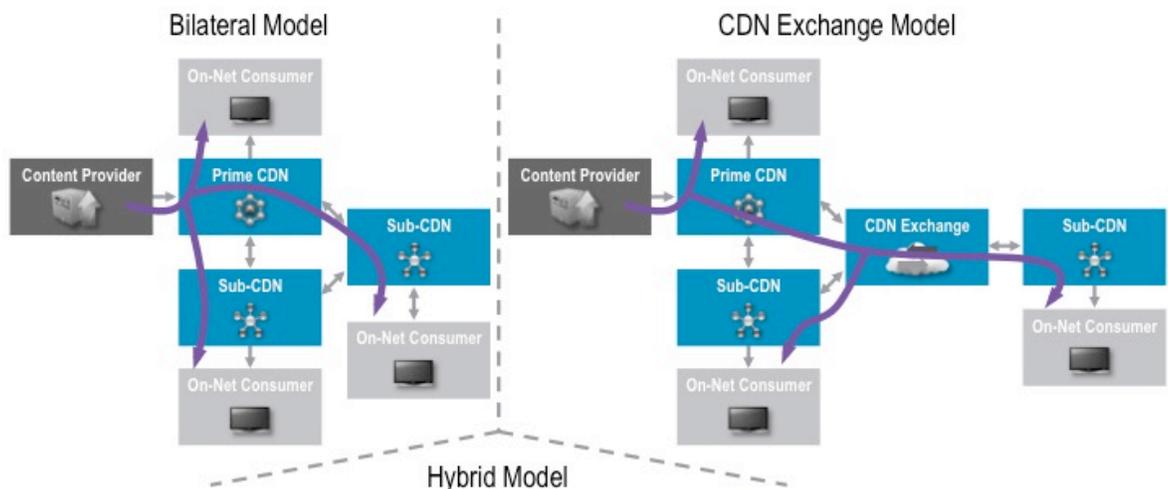
Customers want fast, reliable access to their content, especially when they pay for it. Cached content that is stored in CDNs closer to the end users—as part of a CDN federation—is the way to do it.

An additional selling point for content providers is simplicity. Instead of complex relationships with multiple SPs and CDNs, content providers could reach a much wider, potentially global audience by dealing with one prime CDN. That CDN would be entrusted to act on behalf of many others. Thus, by negotiating business and technical arrangements with just one CDN, a content provider could extend its footprint across regions, countries, and continents while ensuring fast, reliable service for its customers. Those content providers could continue to work with pure-play CDNs (e.g., Limelight, Akamai) for certain requirements. But they would gain new flexibility and additional viewers through SPs participating in a CDN federation.

Still another benefit for content providers would be the detailed analytics, reporting, and control over the consumer experience that only an SP, with its sweeping view of the network, could provide.

To further solidify all of the interactions along the CDN federation value chain, Cisco IBSG sees a role for a neutral, trusted intermediary. This CDN Exchange, as we call it, could take over settlement while maintaining a detailed database for each CDN, capturing their capabilities, the prices they charge, the area they cover, and so on. This role is optional. As CDN federations expand their scope and gain multiple members, however, such a role could grow in importance. A CDN Exchange could, for example, provide important information to a prime CDN or content provider about a sub-CDN while overseeing billing among all players. (The service provider industry already has similar entities acting as clearinghouses for information and billing among SPs.)

Figure 2. CDN Federation: Deployment Models and Topology.



Multiple CDN federations: e.g., international players could build a CDN federation among their own affiliates, in-country federations

Source: Cisco IBSG, 2012

In short, here are some overall objectives of the CDN federation:

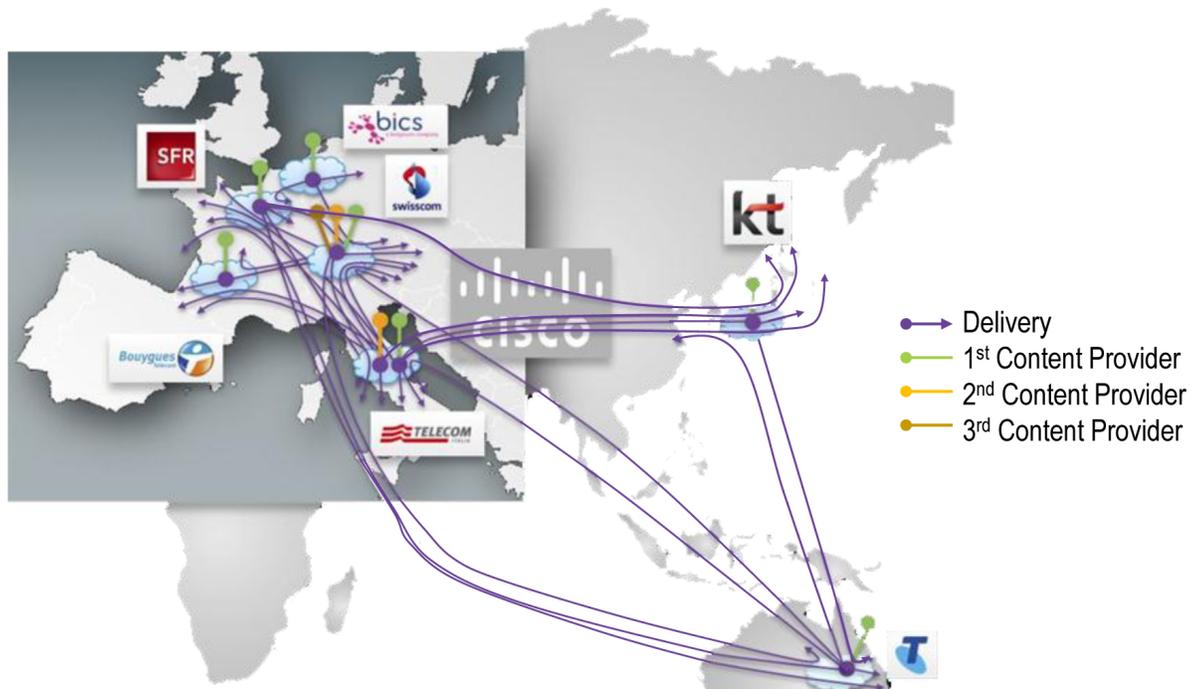
- Allow individual CDN federation members to sell delivery services across the Internet that reach consumers worldwide
- Simplify business and technical arrangements with content providers
- Provide a new interconnection model between OTTs and SPs that offers caches closer to end users
- Provide a wider platform for valued-added and SP retail services

Testing the Concept in a Real-World Setting: CDN Federation Pilot

For the CDN federation pilot, the Cisco® Internet Business Solutions Group (IBSG) is bringing together informal groups of service providers willing to collaborate. The main goal is to move the SP industry from considering a great idea to creating a market reality that can deliver clear benefits to SPs, provide a better experience for consumers, and offer media companies and OTT content providers differentiated online-delivery capabilities.

Phase Two of the pilot program included European service providers Telecom Italia, BICS, SFR, Bouygues Telecom, and Swisscom, as well as Korea Telecom in Asia and Telstra in Australia. The pilot comprised both a business track and a technical/lab track, with the aim of giving participants a practical experience. Core areas of focus included in-depth tests of interconnections among different networks, along with compatibilities of various on-demand and live streaming protocols.

Figure 3. Example of CDN Labs Interconnection Meshing During Phase 2.



Source: Cisco, 2012

In particular, three key business-related goals emerged:

1. Clarify the value proposition that CDN federations would bring to content providers and pure-play CDNs, and establish how their own pain points could be alleviated within the context of a CDN federation.
2. Explore some of the complexity and challenges from an operations standpoint—particularly identifying the need and requirements for a CDN Exchange, an entity that could act as an intermediary along the federation value chain.
3. Develop a better understanding of the implications of mobile video for SPs, especially considering the rise of the smartphone and the tablet—and their impact on the mobile network.

Of equal importance, participating SPs in Europe, Australia, and Asia collaborated in lab trials to test the technical feasibility of interconnecting across continents and with various streaming protocols. They also sought to prove the interconnection capabilities for request routing, content distribution, billing, reporting, and analytics.

Cisco IBSG believes that the best way to ensure the success of CDN federations is to employ an open, standards-based approach. Therefore, Cisco and the pilot members are contributing findings from all three phases of the pilot to the industry's standards bodies, including the IETF and its CDN Interconnect (CDNI) Working Group, co-chaired by experts from Comcast and Cisco.

Findings and Results of the CDN Federation Pilot

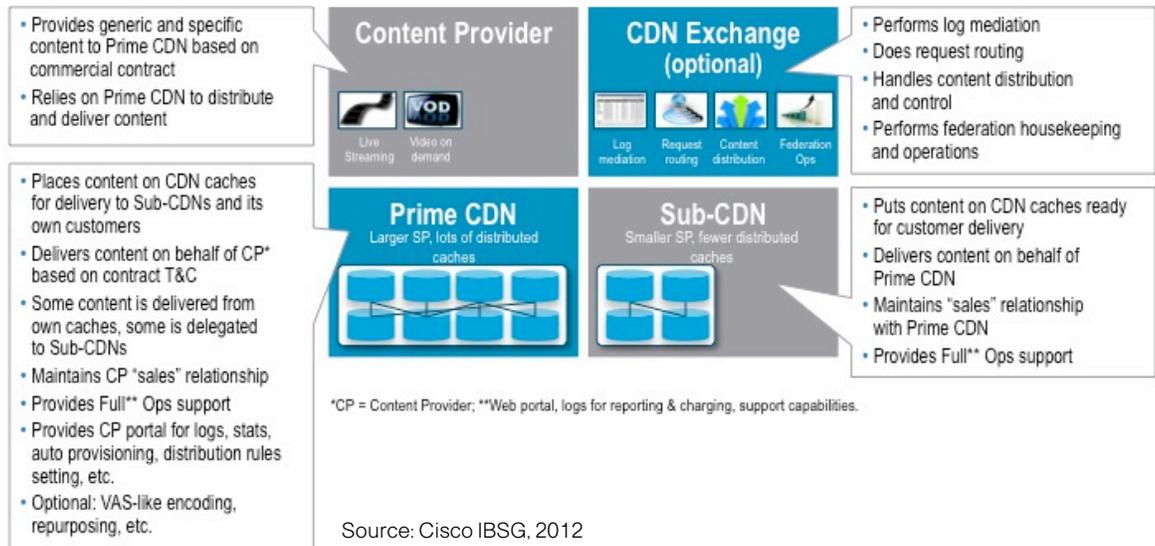
The CDN federation pilot took great strides forward in its second phase. Many of the ideas and concepts explored in the first phase are now proven and moving much closer to reality.

Phase Two proved that participating SPs are in a position to offer a robust alternative to pure-play CDNs, while creating new revenues and network cost savings. The pilot explored multiple CDN federation use cases, including domestic, international, SP internal, and SP group.

Specific roles were identified to match the skills of each potential player:

- **Prime CDN role**—Position retail offers to content providers, including all delivery and value-added services. They must speak to the content providers in their own languages and understand their needs.
- **Sub-CDN role**—Provide wholesale services to prime CDNs, without needing to be involved in commercial and sales aspects of negotiations with content providers.
- **Exchange role**—Act as a neutral, trusted intermediary and perform common functions on behalf of prime and sub-CDNs (e.g., accounting, billing, maintaining a database). This role is optional, but can vary with different use cases, from a basic role (e.g., log mediation) to an advanced role (e.g., complete Off-Net delivery offer for a prime CDN).

Figure 4. CDN Federation Operational Blueprint: Roles and Responsibilities.



In addition, Cisco IBSG explored, from a business viewpoint, ways in which mobile operators can monetize the explosion in online data. Lower delivery costs via a CDN federation were seen as a driver to generate new revenues and improve the user experience on the mobile video front. In addition, a new business model was formulated around guaranteed delivery and sender-pay models.

On the technical track, Phase Two proved enhanced CDN federation functionality for video on-demand, live video, and web delivery. It also validated a wide range of technical requirements that would be essential to establishing a CDN federation:

- Delivery of content simultaneously on multiple federated CDNs in arbitrary CDN topology/meshing, including cascaded CDNs
- Hierarchical dynamic acquisition of content across CDNs
- Transparency to content provider
- Manually triggered inter-CDN content purge
- Single-vendor and dual-vendor operations
- Exchange of transaction logs in bilateral mode or via CDN Exchange
- Scalable provisioning
- Support for common HTTP-based VoD streaming, including adaptive streaming
- HTTP-based live adaptive streaming (Microsoft Smooth, Apple HLS, Adobe Zeri/HDS)
- Time-shifting video services
- Global as well as in-country/domestic federations
- Content with special delivery requirements
- Dense meshing with many-to-many simultaneous delivery
- Support for HTTP-based and DNS-based inter-CDN redirection
- Fine-grain access control policy via URI-signing
- High performance gain of CDN federation

Conclusion

Phase Two of the CDN federation pilot proved a success on all fronts—business and technical. Cooperation among SPs reached a high level, and practical solutions were found for a multitude of problems.

A number of core conclusions and key trends emerged from Phase Two:

- SPs have an opportunity to deliver rich content services to media and broadcasters as more end users demand premium video content and have higher expectations.
- CDN federations are gaining momentum as a way for SPs to generate revenues, lower costs, and more generally contribute to the content-delivery value chain.
- Several innovative SPs are working with Cisco to validate key concepts and fundamentals required to make CDN federations a reality.
- Results of the CDN federation pilot are being leveraged to accelerate standardization of CDN interconnection and to create an industry roadmap.
- Open standardized solutions are essential to CDN federation success.

Phase Three of Cisco's CDN federation pilot, scheduled to begin by November 2012, will focus on more advanced functionalities, such as flexible CDN selection, integration between fixed and mobile networks, in-depth monitoring and analysis, and scaling. Another core goal is to draw in a broader set of ecosystem players, including pure-play CDNs and content providers.

Meanwhile, interest in the overall CDN federation concept is gaining momentum. In South Korea, for example, a government initiative is driving creation of an experimental domestic CDN federation.

This could be a model for the future growth of CDN federations as domestic trials solidify their markets, leading them to seek interconnections with other federations to extend their reach. This could give them access across wider, international regions as demand and business opportunities dictate.

For now, pain points across the web-content ecosystem have been clearly identified. And the CDN federation—with its open standards and potential for new revenues and global reach—is a proven concept and an essential solution for all players: SPs, content providers, and consumers.

More Information

Cisco IBSG (Internet Business Solutions Group) drives market value creation for our customers by delivering industry-shaping thought leadership, CXO-level consulting services, and innovative solution design and incubation. By connecting strategy, process, and technology, Cisco IBSG acts as a trusted adviser to help customers make transformative decisions that turn great ideas into value realized.

For further information about IBSG, visit <http://www.cisco.com/ibsg>



Americas Headquarters
Cisco Systems, Inc.
San Jose, CA

Asia Pacific Headquarters
Cisco Systems (USA) Pte. Ltd.
Singapore

Europe Headquarters
Cisco Systems International BV Amsterdam,
The Netherlands

Cisco has more than 200 offices worldwide. Addresses, phone numbers, and fax numbers are listed on the Cisco Website at www.cisco.com/go/offices.

Cisco and the Cisco logo are trademarks or registered trademarks of Cisco and/or its affiliates in the U.S. and other countries. To view a list of Cisco trademarks, go to this URL: www.cisco.com/go/trademarks. Third party trademarks mentioned are the property of their respective owners. The use of the word partner does not imply a partnership relationship between Cisco and any other company. (1110R)