White Paper

Wholesale Content Delivery Networks: Unlocking New Revenue Streams and Content Relationships

What You Will Learn

As network operators seek to extend video services to new devices beyond the TV, they are increasingly turning to content delivery networks (CDNs). CDNs bridge the gap between the traditional closed pay TV infrastructures and the multiservice, multiprotocol, multiendpoint service capability that network operators need to deliver IP video services to their subscribers. However, CDNs can also serve as a platform for a new line of business: generating business-to-business (B2B) revenue by providing wholesale CDN services to content providers, aggregators, and other B2B customers.

This paper describes the attributes and requirements of a successful wholesale CDN solution and presents the business case for building an internal CDN versus outsourcing content delivery services. Finally, the paper discusses the Cisco Videoscape™ Distribution Suite for Internet Streaming (VDS-IS) solution and the unique advantages it provides to network operators developing a wholesale CDN capability.

A Growing Market for Content Delivery Networks

Network operators are seeing a proliferation of video traffic traversing their network infrastructures. The challenge is both to reduce the effects of this massive influx of online video traffic, as well as to take advantage of the market demand it represents by extending traditional TV services to new devices and screens. To address these growing needs, network operators are increasingly turning to CDNs.

A number of factors are accelerating CDN market growth, including:

- **Growing IP video traffic:** Consumer demand for video is seemingly insatiable, with video consumption over the Internet and mobile devices growing at unprecedented rates (Figure 1). The Cisco® Visual Networking Index forecasts that video will account for 90 percent of consumer IP traffic by 2015, and 66 percent of mobile traffic. At that time, 1 million minutes of video content will cross worldwide operator networks every second. However, viewers are not necessarily using online video as a replacement for traditional TV; rather, they often use it as a complement.
- **Billions of new video-capable devices:** Cisco VNI projects there will be two IP-connected devices for every man, woman, and child on the planet by 2015, many of which will be video-capable. Cisco VNI also forecasts that video traffic to tablets and smartphones will grow at a CAGR of 216 percent, and 144 percent respectively in the same time frame. According to a recent Nielsen survey, 143 million U.S. consumers watched video via the Internet on a computer in 2011, and 30 million watched video on their mobile phones. Nielsen also reports that the number of users watching video on their mobile phones grew by nearly 37 percent between 2010 and 2011.

- **New market entrants offering multiscreen video services:** "Over-the-top" (OTT) online video offerings from aggregators such as Netflix, Amazon, and Apple have become major players in the video landscape.

CDN Stakeholders

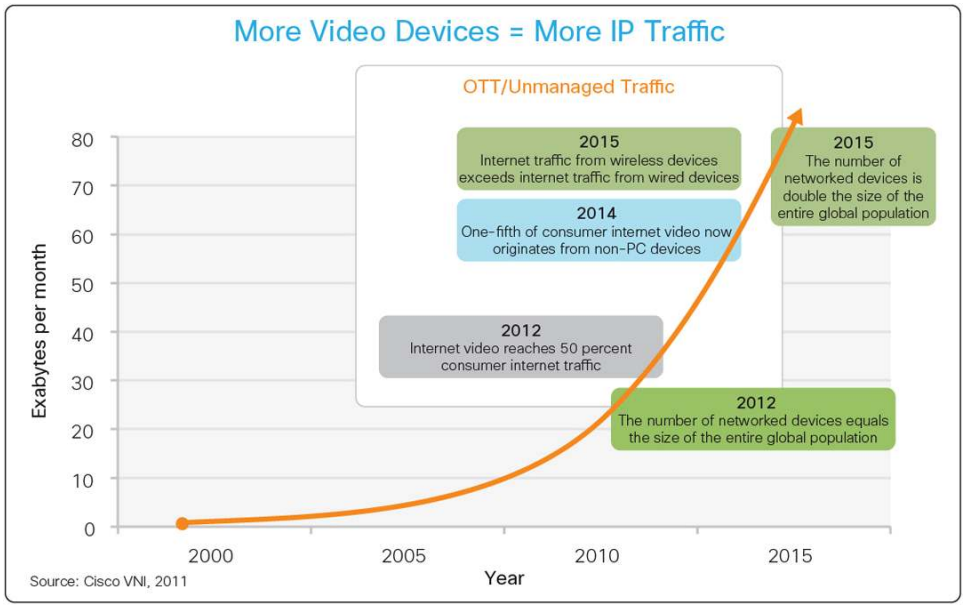
- **Network operator:** a telco, cable operator, or wireless provider such as Comcast, Rogers Cable, Telecom Italia, etc., that provides video services (linear, on-demand, etc.) to the home.
- **"Pure-play" CDN service provider:** a company that develops, deploys, and operates a CDN as its primary business, serving content provider customers. CDN service providers contract with network operators to deploy their CDN equipment within the operator's footprint, typically in peering and aggregation points. Examples include Akamai, Limelight, and EdgeCast.
- **Content provider:** a broadcaster, TV network, or other producer of video content for online viewing. Examples include HBO, BBC, Major League Baseball, etc., as well as online video aggregators such as Netflix or DailyMotion.

Services such as Netflix and DailyMotion today have millions of subscribers, with Netflix alone already accounting for 20 percent of downstream traffic in the United States at peak usage times. Independent content providers such as HBO and BBC have also launched online video services, and traditional pay TV providers are now launching multiscreen video offerings as well.

- **Changing consumer behavior:** Despite the extraordinary growth in IP video services and devices, consumers do not necessarily view online video as a replacement for traditional TV. Rather, IP video often complements the TV experience. According to a Nielsen Co. survey of 12,000 connected device owners, 70 percent of tablet owners and 68 percent of smartphone owners use their devices while watching TV. Tablet owners in particular seem unable to put down the iPad while flipping channels, with respondents saying that nearly a third of the time spent using their device is in front of the TV.

These trends are having a profound effect on network operator business and technology strategies. Rapidly proliferating growth in video traffic, especially from online aggregators such as Netflix and DailyMotion, places enormous strain on network operators' core networks. Compounding this problem, in today's online video ecosystem the financial relationships exist primarily between content providers and aggregators. As online video services generate more traffic on operator networks - requiring ever-greater infrastructure investment to support - network operators themselves have little opportunity to monetize them.

Figure 1. Growing IP Video Traffic



Network operators also face significant technical challenges as they seek to deliver content to new screens. In the past, video delivery typically meant serving one type of device (the TV set-top box [STB]) over a closed system that the network operator controlled end-to-end. Multiscreen video delivery means serving a dizzying array of managed and unmanaged IP devices, delivering content in a number of formats, over unmanaged networks (Wi-Fi in the home, cellular on the go) that are beyond the network operator's control.

The CDN Solution

CDNs can help network operators address all of these business and technical challenges. By distributing localized content caching and multiscreen streaming platforms out toward the edge of the network, network operators can radically reduce the bandwidth requirements for delivering IP video content, while giving subscribers the multiscreen media experience they crave. In addition to this business-to-consumer (B2C) or "retail" CDN model, however, network operators can also use their CDNs to support new B2B revenue models, offering wholesale CDN services to their content provider partners and other B2B customers.

Today, large content providers and aggregators such as Netflix, BBC, and others rely on "pure-play," dedicated CDN service providers to distribute their content to users. Many network operators, especially smaller cable TV providers, also contract with CDN service providers to support their multiscreen video offerings. However, as network operators build out their own CDN infrastructures and develop expertise in multiscreen content distribution, they can begin to offer these CDN services to content providers and other B2B customers as well. In the same way that a pure-play CDN service provider such as Akamai or Limelight contracts with TV networks and video aggregators to distribute their content, large network operators with their own CDNs can begin competing for this business. Smaller network operators serving a few thousand or tens of thousands of subscribers might not be able to compete with major CDN service providers, but large tier-1 operators with major regional, national, or international footprints can.

Network operators are well aware of these benefits, and multiple telcos and cable operators, especially in North America and Europe, have already launched CDN initiatives, including AT&T, Comcast, France Telecom, British Telecom, Deutche Telecom, and many others. Frost & Sullivan forecasts that these efforts will grow in the coming years and that network operators will increasingly partner with content owners to offer high-quality delivery of content and services. At the 2011 Content Delivery Summit, industry analyst Dan Rayburn of StreamingMedia.com projected that the video CDN market will grow to more than $1 billion in 2012 and grow at a 40-45 percent growth rate from 2012 to 2013.

The Network Operator's CDN Advantage

It is easy to understand why network operators would be interested in selling wholesale CDN services, but why would content providers, aggregators, and regional broadcasters buy them? Why would potential wholesale CDN customers choose a traditional network operator over a pure-play CDN service provider? In fact, network operators bring a number of valuable assets and advantages to CDN services. These include:

- **Access network:** Fundamentally, any pure-play CDN service provider does not own or control the transport network serving its customers' content. Rather, pure-play CDN service providers contract with network operators to deploy caching and streaming assets at various points in their infrastructures. CDN service providers therefore have inherent limitations in where and how they deploy CDN assets (typically only in peering or aggregation locations), and therefore, in the ultimate performance and efficiency of the CDN. Alternatively, network operators have total flexibility over the cache capacity, form factor (i.e., standalone appliance or integrated blade), and placement in the network. As a result, they can achieve more efficient CDN performance, and potentially a better experience for the end user.

- **Huge subscriber base and network footprint:** Large tier-one network operators might serve millions of customers and operate over vast geographic regions, with networks spanning multiple countries and continents. As a result, they can offer an enormous potential user base and unparalleled reach to content provider customers.
- **Wholesale relationships with Internet service provider (ISP) customers:** In addition to generating direct B2B revenues from CDN services to content providers, network operators can also sell wholesale CDN services to their ISP customers, just as they currently sell wholesale high-speed data services.
- **Longstanding content relationships:** Network operators have worked closely with broadcasters and content providers for many years, and have deep, longstanding relationships with them. Based on years of successfully working together, content providers will have complete confidence in a network operator's ability to protect content and deliver it with superior quality and reliability.

Because of all these built-in advantages, traditional network operators that develop the necessary CDN capabilities and expertise will be well-positioned to compete and thrive in the CDN services marketplace.

Understanding CDNs

At its core, a CDN performs two essential functions. First, it caches content at the edge of the network, closer to end users, to reduce the IP video traffic traversing the core network and, ideally, deliver a higher quality experience to viewers. At the same time, a CDN positions multiservice, multiprotocol content streaming capabilities at the network edge, allowing the operator to adapt video content for virtually any IP video device close to the user consuming it.

In the basic model, referred to as a B2C or retail CDN, the network operator uses the CDN to deliver multiscreen video content to its own subscribers. For example, Comcast or Telecom Italia can use a CDN to create a "TV Everywhere" service, and extend on-demand and linear TV content beyond the STB, to users' PCs, tablets, and smartphones, over the Internet.

In a wholesale CDN model, the network operator uses those same CDN assets and capabilities to offer B2B content delivery services to TV networks, local broadcasters, and other content providers seeking to deliver online video content to users. For example, Rogers Cable could partner with the National Hockey League (NHL) to support an online portal or smartphone/tablet app that streams NHL video content over the Internet. Or, a network operator such as British Telecom could offer CDN services to local ISP customers. Smaller, local ISPs already contract with BT to resell network access; purchasing CDN services from BT would allow these ISPs to support their subscribers more efficiently and bundle value-added online video offerings with their core high-speed data (HSD) service.

To function in a conventional B2C or retail CDN deployment, the CDN must meet a number of core requirements. Supporting wholesale CDN services as well as retail content delivery to the network operator's own subscribers requires additional capabilities.

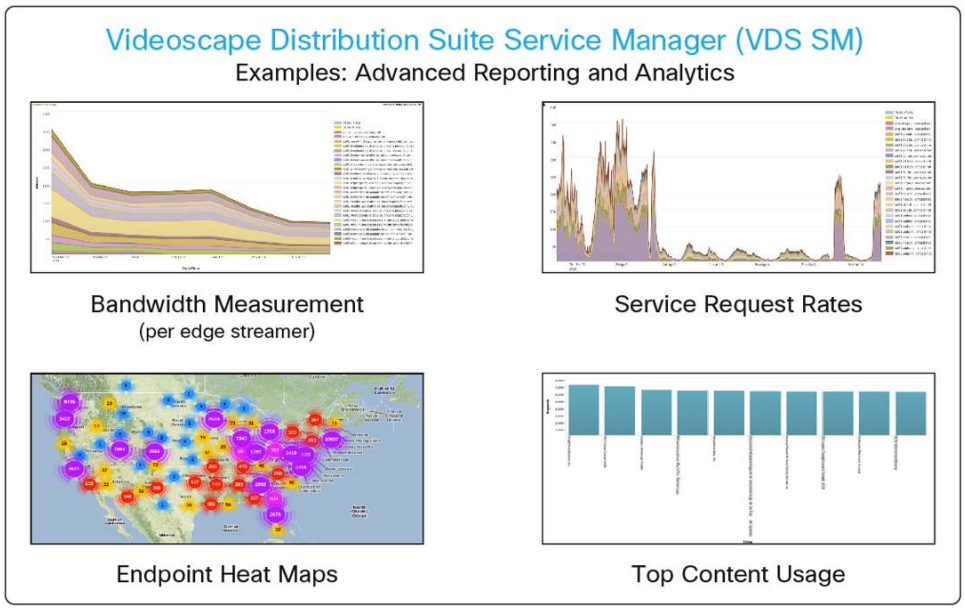
Retail CDN Requirements

An effective retail CDN solution provides:

- **Multiscreen media delivery:** By positioning streaming capabilities at the network edge, CDNs make it possible to serve a much larger variety of devices (with their associated screen sizes, formats, streaming protocols, etc.) than would be possible under the traditional model of using a dedicated headend/data center infrastructure for each distribution channel. The CDN must support:
  - Multiple content types (video-on-demand [VoD], linear, downloadable content, etc.)
  - Multiple device types, including PCs, tablets, mobile phones, game consoles, connected TVs, and more
  - Multiple protocols, including those used by major streaming video technologies from Apple, Microsoft, and Adobe
  - Delivery over multiple networks, supporting “on-net” delivery to managed STBs, as well as “off-net” delivery over Wi-Fi, 3G/4G cellular networks, etc.
- **Multi-bit-rate streaming:** The CDN must be able to optimize the video stream to provide an excellent experience when users are connecting over networks and endpoints that the operator does not control. The CDN should be able to identify the capabilities of the device and real-time conditions in the network to make intelligent decisions about the streaming bit rate. Typically, streaming media technologies accomplish this by encoding multiple versions of content at different bit rates, and communicating with the client player to select the optimal bit rate for that device at that time. Modern CDNs should support Hypertext Transport Protocol (HTTP) Adaptive Bit Rate (ABR) streaming, which allows them to continually shift the bit rate up or down within a session to deliver the best experience for the user.
- **Scalable content caching and distribution:** CDNs use distributed caches that store copies of content closer to subscribers, usually in edge and aggregation networks. When a client requests a piece of content, the network directs the request first to the cache to see if it can be filled from that location. If the cache contains that title, the content streams from that location. If not, the cache fills the request from the content source and then stores the title in the cache to fill subsequent requests. To provide the most efficient content distribution, the CDN should use “hierarchical” caches, employing multiple tiers of caches from the data center through aggregation and edge networks, with the intelligence to dynamically distribute the most popular content close to the edge.
- **Intelligent service request routing:** A CDN should use the most accurate possible service routing intelligence to achieve higher cache hit ratios - to fill more requests from caches rather than the content source. Better algorithms and routing technologies translate directly to more efficient CDN utilization and, ultimately, lower network infrastructure and operating costs. This intelligence can only come when the CDN application-layer intelligence is tightly linked with IP-layer intelligence in the network, so that the network can determine the optimal cache.
- **Strong content security:** No multiscreen video service can survive if content owners are not confident that it will protect their content rights, so any viable CDN solution must provide complete content security. Since a CDN inherently supports a wide range of devices, connections, and streaming protocols, this task becomes far more complex than in a traditional cable or IPTV video infrastructure. To provide the most flexibility and versatility, CDNs should support multiple digital rights management (DRM) technologies, encrypted connections, and session-based encryption.

- **In-depth reporting and analytics:** A successful CDN solution should give service providers a competitive edge by providing detailed information about how consumers are using the service and the content they value most. The best CDN platforms provide this intelligence through in-depth reporting and analytics (Figure 2), encompassing:
  - Traffic distribution to allow operators to allocate resources according to peaks and troughs in demand
  - Capacity utilization to enable better capacity planning
  - Asset popularity to configure the CDN to cache the content that subscribers watch most
  - Billing trends to help operators analyze consumption behavior and create the most attractive package offerings
  - Bandwidth consumption to monitor subscriber usage and provide alerts when they reach usage thresholds

Figure 2. Cisco Videoscape Distribution Suite Service Manager (VDS-SM)



For more details on retail CDNs, see the Cisco white paper “Retail Content Delivery Networks: Building a Profitable Multi-screen Experience” at http://www.cisco.com/en/US/partner/products/ps7127/index.html

Wholesale CDN Requirements

All of the previous attributes are essential for any retail CDN. For operators seeking to use the CDN to provide wholesale B2B services, however, the CDN must meet additional requirements. These include:

- **Multitenant integration:** A pure-play CDN service provider might support several thousand content provider customers. To provide a comparable B2B service, network operators must therefore deploy a CDN architecture designed to support hundreds or thousands of separate CDN services for content provider customers. In practice, this means that the CDN must go beyond the ability to cache and stream the network operator’s own content; it must provide the infrastructure to acquire, distribute, cache, and deliver content from each customer. The CDN should fully integrate with each content provider’s data center, including their unique content management systems (CMSs), workflows, encoding systems, origin servers, and storage, for both live and VoD content.

The network operator should not have to ask any content provider customer to change workflows or systems; rather, the CDN should support the full range of existing video technologies.

- **Multitenant service allocation, monitoring, and enforcement:** In addition to hosting content from multiple B2B customers, the network operator also needs to be able to manage and track CDN service delivery. The CDN must provide tools to allocate CDN resources to diverse content provider customers, monitor usage, and enforce contract terms (for example, limiting service or shifting to a higher billing tier if a content provider customer exceeds the agreed-upon service levels).
- **Reporting, analytics, logs, and billing:** The CDN should be designed to provide in-depth reporting and analytics about CDN usage for all content provider customers and their respective users. Network operators should be able to find detailed metrics about their CDN service, including sessions, streams, gigabytes delivered, and popularity of various titles. The CDN solution should also be able to provide daily and monthly records for billing purposes.
- **Scalability:** The CDN should be a carrier-class solution, capable of supporting thousands of content provider customers and serving millions of users across a network operator's regional, national, or international network footprint.
- **Flexible cache placement options:** To support the most efficient content delivery and offer a competitive edge over pure-play CDN services, the CDN should give network operators ample flexibility in where and how they deploy caching and streaming resources. Network operators should be able to deploy caches and streamers anywhere in the network infrastructure where those resources will be best utilized - not just in aggregation and peering locations. This capability allows network operators to invest in CDN infrastructure upgrades more organically, scaling video capabilities exactly where they are needed, as market demand grows, rather than having to scale the entire CDN infrastructure. The CDN should also give operators flexibility in caching/streaming form factor, with the option to use standalone appliances or deploy integrated CDN blades in existing network routers as they choose.
- **Integration with billing and operations systems:** To support a B2B business line, the CDN must integrate with the network operator's existing operational and business support systems (OSSs/BSSs). The CDN should operate as an open, standards-based solution, with application programming interfaces (APIs) that link CDN element management with existing OSS tools, and allow the CDN to export billing information.
- **Support for CDN Federation:** To provide the most efficient content delivery and support new business and revenue-sharing arrangements, the CDN should be designed to integrate with other network operators' CDNs as part of a large multinational or global CDN system. (See the section "National and Global CDN Federation" below for more details on CDN federations.)

Monetizing the CDN

An effective CDN gives operators a versatile platform for generating both B2C and B2B revenues, including:

- Delivering new B2C multiscreen video offerings to subscribers
- Selling wholesale CDN services to content providers and other B2B customers
- Providing national and global federated CDN services

Retail Multiscreen Video Offerings

Network operators can deploy multiscreen video services to support new B2C offerings targeting their own subscribers. These services can be employed to generate new revenue, to help drive subscribers to higher service tiers, to differentiate the network operator's offerings from others in the marketplace, or all of the above. Options include:

- **"TV Everywhere" services:** The most straightforward B2C revenue opportunity for a CDN is a "TV Everywhere" service - extending network operator-branded IP, VoD, and linear TV content to new screens, including both managed STBs and unmanaged IP-connected devices. With the ability to integrate all types of content into the service, network operators also have the ability to deliver content under multiple business models (i.e., subscription, rental, transactional sale, etc.).
- **Cloud-based digital video recorder (DVR):** CDNs offer operators the ability to converge time-shifting capabilities for linear TV, VoD services, and online video into a single multiscreen offering, integrated into the network and the cloud rather than in a traditional DVR in the subscriber's home. Well-positioned CDN elements can perform recording, storage, and efficient playback of multiple types of video content to multiple screens, with a uniform look and feel for the subscriber. This capability helps network operators differentiate their offerings and enables new revenue opportunities. For example, network operators can offer higher priced subscription tiers for larger amounts of cloud storage. Multiple cloud DVR offerings already exist in the marketplace. Cablevision launched its network DVR service in early 2011. Dutch IPTV provider KPN launched an nPVR service in July 2011 that allows subscribers to record up to 200 hours of programming from six linear channels concurrently.

CDN Services for Broadcasters, Aggregators, and Regional ISP Partners

As operators take advantage of their internal CDN to optimize their own networks and gain expertise in CDN operation, they can then sell those capabilities to regional broadcasters, TV networks, and content aggregators to generate B2B revenues. With potentially millions of subscribers and network reach extending across vast regions, countries, and even continents, large network operators can make a compelling offer to these content providers to provide wholesale delivery of multiscreen online video content across the network operator's footprint.

A CDN can also unlock new revenue models for large network operators that provide primarily high-speed data services, and for tier-1 operators that wholesale network services to regional ISPs. For a large high-speed data provider, a high-performance regional or national CDN provides a platform for forging new business relationships and revenue sharing arrangements with major content providers, and offering new online video services to subscribers. Large tier-1 operators can also sell these types of wholesale CDN services to smaller regional ISPs.

National and Global Federated CDNs

As an extension to this B2B business model, large network operators can also act as global CDN service providers by interconnecting, or "federating," their CDNs with those of other large operators. Effectively, a CDN federation provides a multifootprint CDN capability, built from CDN resources owned and operated by autonomous network operator members.

Consider a hypothetical example: a subscriber in Argentina requests video content originating in the United States. Under the traditional service delivery model, that request - and the subsequent video stream filling it - traverses a large number of network hops, with little or no traffic optimization from one operator network to another. If the network operator in Argentina and a network operator in the United States are part of a CDN federation, however, that request can be filled much more efficiently, utilizing the most frequently viewed content in each provider's network, covering a larger footprint of content.

The same hierarchical caching intelligence that extends across an individual network operator's network can extend across both network operator domains (as well as any participating network operators between them), even as all CDNs in the federation are still owned and operated entirely autonomously. Indeed, a CDN federation architecture complements existing IP transit and peering arrangements that network operators already employ.

In a CDN federation, participating network operators can access end-to-end analytics and reporting, and assure a high-quality consumer experience over a much larger footprint, even as they maintain complete control over their own network and CDN. Network operators in the federation can cross-bill each other for CDN services. But, they can also compete with major third-party CDN service providers by offering content providers and aggregators a CDN service with global distribution. Additionally, CDN federation can extend the service footprint of each network operator's "TV Everywhere" service - allowing customers to access the service from the network of any provider in the federation.

Recognizing the potential of this capability, the Internet Engineering Task Force (IETF) is today developing CDN interconnection standards to enable the efficient interconnection of network operators operating autonomous CDNs, even when using CDN technology from different vendors. There is good reason for this industry effort and enthusiasm. Frost & Sullivan projects that CDN federation will actually double the size of the content delivery market from $6 billion to $12 billion by 2015.

Building Versus Buying CDN Services

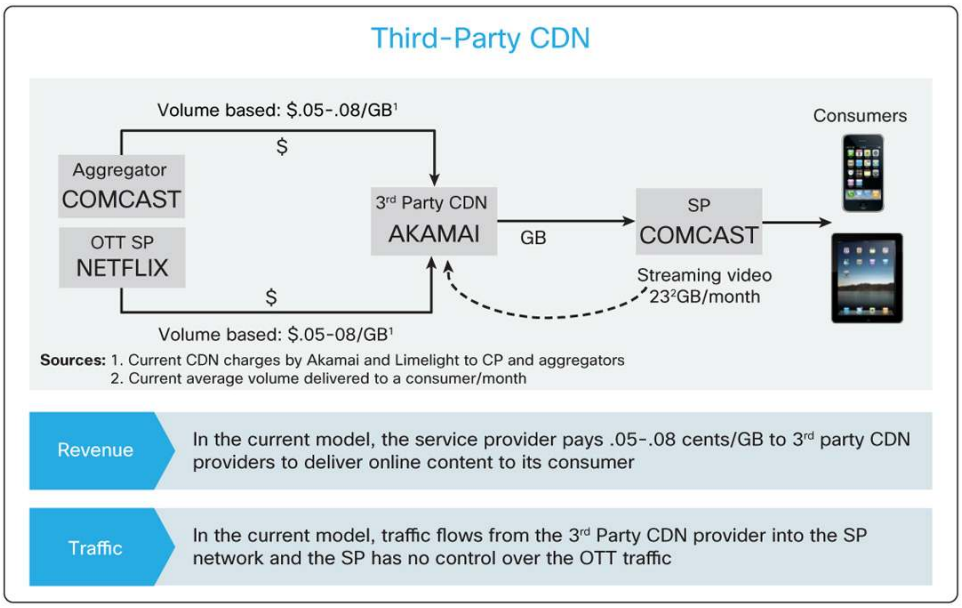
Most of the CDN discussion in this paper assumes that a large network operator will build and operate its own CDN infrastructure to support new retail and wholesale CDN services. However, a network operator could theoretically purchase CDN services from a third-party, or pure-play, CDN service provider, just as content providers and aggregators do. Why would large network operators choose to build their own CDNs instead of leasing CDN services? Cisco has developed an extensive total cost of ownership (TCO) model comparing these two use cases, and the results are clear: for a large network operator, building an internal CDN yields lower TCO, improved network efficiency, and greater business flexibility.

The "Buy" Model: Leasing Third-Party CDN Services

Under the "buy" model, the network operator contracts with the CDN service provider to provide premium multiscreen video services to the network operator's paying subscribers, and to help deliver online video content more efficiently. To accomplish this, the CDN service provider deploys content caching and streaming assets at various points in the network operator's infrastructure, and takes on the role of adapting the network operator's licenses content for the broad range of IP devices.

Network operators pay a recurring fee for these services, typically calculated based on the volume of traffic delivered on a per-gigabyte basis. Under this model, the CDN operates over the network operator's edge and access infrastructures, but it functions as an overlay network. The position, form factor, and operation of caching and streaming resources are managed almost entirely by the CDN service provider. Figure 3 illustrates the revenue and traffic flow of the CDN overlay, or "buy" model.

Figure 3. CDN “Buy” Model Revenue and Traffic Flow



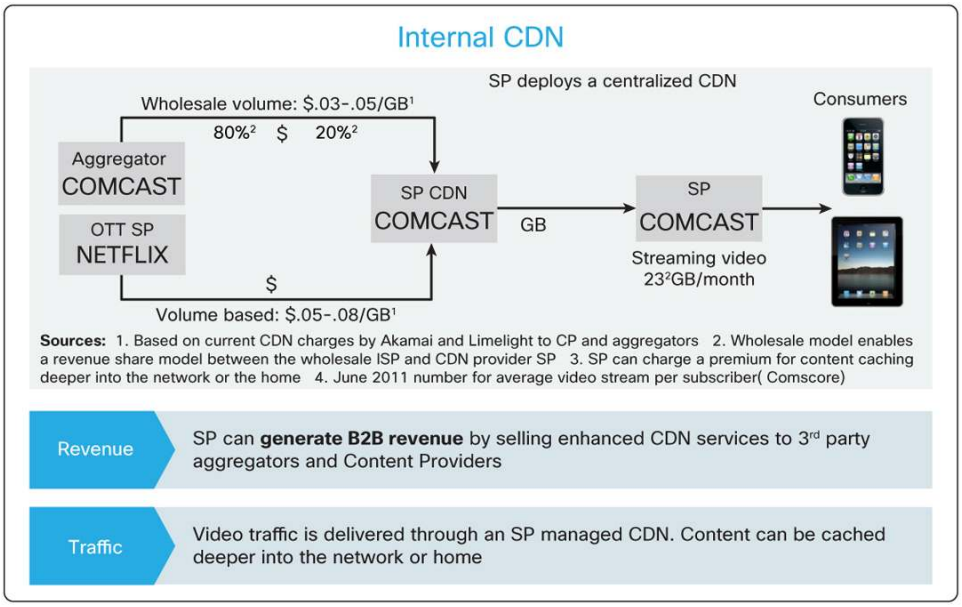
*Note: Companies listed in figure are illustrative only. They do not represent real-world implementations.

The “Build” Model: Using an Internally Owned and Operated CDN

Under the CDN “build” model, local caching and streaming resources are once again distributed throughout the network operator’s infrastructure. Unlike the “buy” CDN model, however, the network operator determines the position and form factor of all caching and streaming resources, and manages the CDN itself. Under this model, the network operator also has the ability to generate B2B revenue by acting as a CDN service provider itself.

Figure 4 illustrates the revenue and traffic flow of an operator-owned CDN.

Figure 4. “Build” Model Revenue and Traffic Flow



*Note: Companies listed in figure are illustrative only. They do not represent real-world implementations.

Business Model Comparison

Now, let's examine the TCO for the "build" versus "buy" CDN models over a six-year period. This model is based on a hypothetical large network operator with the following characteristics:

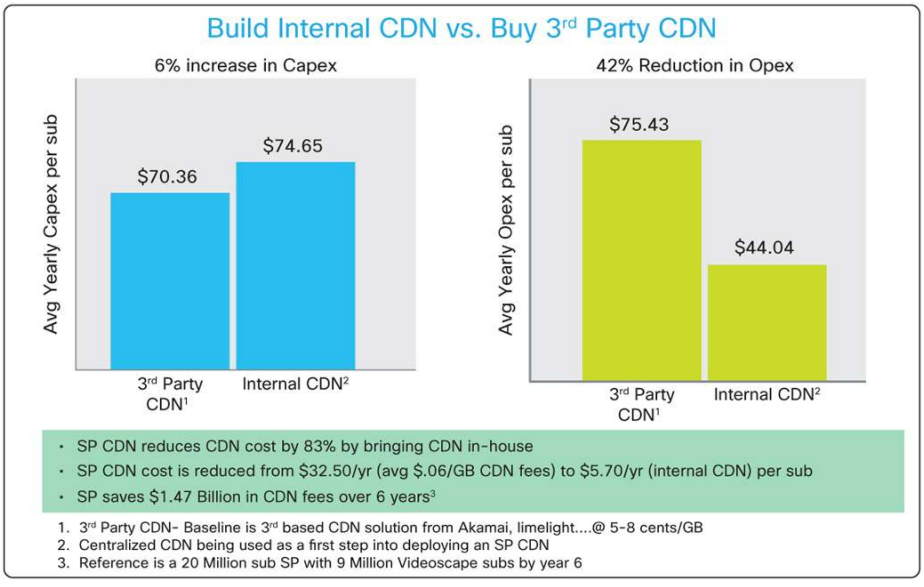
- The network operator serves 20 million subscribers.
- The network encompasses two national data centers/headends, serving 20 regional data centers, each of which serves 200 local hubs.
- The network operator has video penetration of 55 percent of its subscriber base in year 1, growing to 62 percent by year 6.
- The network operator introduces a multiscreen video service year 1, with uptake by 9 million customers by year 6.

Third-party CDN fees are calculated at 6 cents per gigabyte of video traffic delivered, which is consistent with standard industry rates from CDN service providers. To provide comparable CDN capabilities internally, the "build" model assumes a cost to purchase and support internal CDN hardware of $5.70 per subscriber per year over the six-year period (also consistent with average industry rates for CDN hardware and support costs). (It should be noted, however, that in the "build" model, these costs can be offset by new B2B revenue gained from contracting with online video aggregators and content providers for CDN delivery.)

- **CDN "buy" model:** At a rate of 6 cents per gigabyte, the network operator pays fees of $32.85 per subscriber per year to the CDN service provider. In total, the network operator pays $1.8 billion in CDN fees over the six-year period.
- **CDN "build" model:** At the rate of $5.70 per subscriber described above for CDN hardware, the network operator has a total capital expenditure of $51 million over a six-year period.

By building an internal CDN capability, the network operator realizes savings of $27.15 per subscriber per year in total CDN cost. This represents a cumulative savings of **$1.47 billion** over six years. Or, for every dollar invested in the CDN capability, the network operator saves $4.75 in total cost. Figure 5 illustrates the TCO comparison of the two models.

Figure 5. Total Cost of Ownership of "Build" Versus "Buy" CDN Models



As Figure 5 shows, investing in building an internal CDN represents a 6 percent increase in average yearly capital expenditure per subscriber. However, the savings in fees paid to the CDN service provider represents a 34 percent reduction in operational expenses over the same period. In all, the “build” CDN model for the large network operator illustrated in this comparison generates a 19 percent reduction in TCO of CDN services.

Distributing the Internal CDN

The business cases described above were based on a CDN using standalone caching/streaming appliances. However, when a network operator builds an internal CDN, it also has the option of distributing CDN functions into edge routing platforms via CDN caching/streaming modules or blades integrated into edge routers.

By taking this step, network operators can reduce the capital costs of investing in CDN technology by 2 percent over the six-year period (based on standard industry costs-per-gigabyte of CDN router blades versus standalone CDN caching/streaming engines). However, with the ability to operate the CDN as part of the edge router, rather than as a standalone solution, network operators realize a 14 percent operational expense savings - $8.92 per subscriber per year. In all, this operational savings results in $425 million savings over the six-year period, or a 60 percent TCO savings for the CDN.

Lowering TCO, Improving Flexibility

Looking at the business case for a hypothetical large network operator, it becomes clear that, over the long term, building an internal CDN yields lower TCO, improved network efficiency, and greater flexibility to further augment CDN capabilities. While a third-party CDN “buy” model represents a lower cost per subscriber during the first year, the fees paid to the third-party CDN service provider scale with increased customer uptake of video and multiscreen services. Ultimately, the network operator building an internal CDN in this illustration sees a yearly per-subscriber savings of $27.15 on upfront capital costs and ongoing support costs, compared to the ongoing operational costs associated with a growing third-party CDN implementation.

Cisco Videoscape Distribution Suite

Recognizing all of the potential advantages of wholesale CDN capabilities, as well as the diverse requirements necessary to support B2B CDN services, Cisco has created an ideal wholesale CDN platform based on the Cisco Videoscape Distribution Suite for Internet Streaming (VDS-IS) solution. Cisco VDS-IS applications and content delivery engines provide all of the capabilities that a successful multiscreen video offering requires, combined with one of the industry’s most powerful CDN analytics and reporting platforms. (For more details, see the Cisco white paper “Retail Content Delivery Networks: Building a Profitable Multi-screen Experience” at http://www.cisco.com/en/US/partner/products/ps7127/index.html.) Cisco also provides a CDN platform with native support for advanced multitenant CDN services to give network operators ample flexibility to unlock new business models and revenue streams. And, Cisco is playing a major role in the development of worldwide CDN federations.

The Cisco Difference: Advanced Multitenant Capabilities

Supporting hundreds of content provider customers is a core requirement for any B2B CDN service. Cisco VDS-IS provides advanced tools to manage multiple CDN customers with “virtual CDN” capabilities. Conceptually, virtual CDNs operate in a similar manner as virtual LANs (VLANs). They allow network operators to segment a single physical CDN implementation into multiple virtual CDNs, and manage each B2B customer as if it were running over its own dedicated CDN infrastructure.

Cisco VDS-IS virtual CDN tools allow network operators to allocate session and bandwidth quotas on a per-customer basis, monitor each customer's CDN utilization, and enforce quotas using the CDN server router. As a result, network operators can not only support hundreds of separate B2B CDN customers more easily, they can create and enforce CDN service-level agreements for all customers.

In a Cisco VDS-IS architecture, all tenants, as well as the network operator itself, share hardware and software resources in a common CDN. As with a conventional retail CDN, when clients request video content, the service router directs the request to the appropriate cache. However, with a Cisco VDS-IS architecture, the service router also associates each content request with the appropriate virtual CDN, and monitors the sessions, streams, and cumulative bandwidth for each B2B customer. This allows the network operator to define SLA terms with content provider customers, and set rates for a certain number of streams and a certain amount of bandwidth. The network then monitors usage, and if that customer exceeds the allocated session quota or bandwidth quota on its virtual CDN, the network can either block subsequent requests or track and bill for them at a higher rate.

The Cisco Difference: Advanced Reporting, Analytics, and Billing

Complementing virtual CDN capabilities, Cisco VDS-IS also provides sophisticated multitenant reporting, logging, and billing capabilities through the Cisco Videoscape Distribution Suite Service Manager (VDS-SM) application. In a conventional retail CDN implementation, Cisco Videoscape Distribution Suite Service Manager (VDS-SM) provides centralized element management capabilities and APIs to integrate with the network operator's OSS/BSS systems. In a multitenant CDN environment, Cisco Videoscape Distribution Suite Service Manager (VDS-SM) provides additional monitoring and analytics capabilities to support a B2B service.

Cisco Videoscape Distribution Suite Service Manager (VDS-SM) provides an intuitive GUI to provide in-depth analytics about CDN content delivery, including sessions, streams, gigabytes delivered, and content popularity. In a multitenant environment, however, Cisco Videoscape Distribution Suite Service Manager (VDS-SM) also allows the network operator to collect this information on a per-content provider basis, and generate per-customer delivery analytics.

This information allows the network operator to appropriately bill for its B2B CDN services, but it also empowers the network operator's CDN customers. Cisco Videoscape Distribution Suite Service Manager (VDS-SM) provides a cloud-hosted analytics portal, allowing all content provider customers to securely log in and access their own content analytics, as well as integrate this information with their own internal OSS/BSS environments. As a result, network operators can help content providers better understand viewer behavior and make more informed business decisions about their content and services.

The Cisco Difference: CDN Federation Leadership

The previous section "National and Global Federated CDNs" described how a CDN federation among multiple network operators will work, and the benefits it can provide. To realize these benefits, however, a CDN federation must be fundamentally open and standardized.

In the early days of the Internet, network operators recognized the need to allow users worldwide to freely communicate, regardless of which network operator's infrastructure they were connected with or the network technologies used in that infrastructure. To enable this free, transparent communication, network operators, vendors, and standards bodies developed open, standardized peering technologies to interconnect different operators' networks. Today, the industry is developing the same types of technologies for CDNs. By defining an open, standardized set of business and technical interfaces between CDNs, network operators will be able to exchange content data, exchange service routing information, and perform billing and settlement across CDNs.

Recognizing the potential of CDN federations, some pure-play CDN service providers now claim that they too support CDN federation. From the network operator's perspective, however, this is not really the case. Typically, a pure-play CDN service provider's "CDN federation" consists of its own content caching and streaming assets, deployed in multiple network operator infrastructures. But each network operator still has little or no control over the CDN. In a true CDN federation, each network operator can design, build, and operate its own CDN based on the best available class of equipment and software, and can exchange content and have settlement with multiple operators across the federation.

Cisco is working with other technology vendors, network operators, and standards bodies worldwide to develop the standards environment to support truly open CDN federations. As a result, network operators will have maximum flexibility and choice in worldwide CDN services, without being tied to any single CDN provider.

Cisco CDS Spotlight: British Telecom

BT Wholesale is Europe's largest communications wholesaler, contributing £4.5bn to BT Group's annual revenue. It provides traditional and next-generation network services and managed solutions to over 1,300 mobile and fixed-line operators, ISPs, broadcasters, and resellers in the United Kingdom.

Challenge

BT Wholesale recognized the growing market demand for a sustainable delivery model for linear and on-demand video content over broadband. The company launched its Content Connect service to support this emerging hybrid IPTV model, and enable efficient content delivery to both managed and unmanaged IP devices. BT Wholesale envisioned a solution that would allow service providers and ISPs to collaborate to deliver a superior user experience and drive more value. To make this vision a reality, the company needed a partner that could offer advanced CDN technologies such as multiscreen delivery, multiformat ABR streaming, and support for syndicated media.

Solution

After consulting with longtime partner Cisco, BT Wholesale chose a solution based on the Cisco VDS-IS solution. Using Cisco VDS-IS, BT Wholesale built a high-performance multitier caching system to bring content closer to end users, and enable regional multiprotocol content storage for scalable end-to-end distribution with guaranteed quality of service (QoS). The company is using Cisco VDS-IS to provide wholesale delivery services to its ISP and content service provider customers. The Content Connect platform caches content deep in the broadband network, delivering it much closer to the end user and avoiding congested areas of the network. This, in turn, allows broadcasters to provide video content with an assured level of service all the way to the viewer, providing uninterrupted access even at peak times.

Results

With the help of the Cisco VDS-IS solution, BT Wholesale is providing a wide variety of business benefits for wholesale customers, content service providers and end users alike. The Content Connect service supports a mix of commercial models, and provides ISPs and content providers with the ability to differentiate themselves in the market. Perhaps most important, the service empowers ISPs to participate in the online video value chain by charging content providers for content delivery and value-added services such as targeted advertising, multiscreen delivery, and ABR streaming.

Conclusion

As network operators strive to optimize their networks, compete with new and traditional video competitors, and extend new revenue-generating services to their subscribers, CDNs have become an important business tool. CDNs can provide vital strategic capabilities to extend media services to new screens and devices, both on-net and off. And increasingly, CDNs can also provide a platform for new revenues and business models, allowing network operators to sell wholesale content delivery services to content providers, aggregators, and other B2B partners. All of these capabilities help network operators strengthen their core value proposition in the video ecosystem. Effectively, they can transition from a business model focused on delivering video to STBs in their own footprint, to one focused on delivering all forms of video, for a variety of B2B and B2C customers, to any screen, anywhere.

Cisco understands the diverse requirements of emerging wholesale CDN services. With the Cisco VDS-IS solution, Cisco can provide all of the multitenant CDN management capabilities, advanced analytics and reporting, scalability, and flexibility that service providers need to capitalize on B2B CDN capabilities. Cisco VDS-IS provides:

- **A comprehensive solution for multiscreen media delivery:** Cisco VDS-IS supports concurrent delivery of all video formats and applications from the same server, to any network. This includes the full range of media services, streaming video protocols, and connected endpoints, as well as advanced adaptive streaming intelligence to optimize delivery over any managed or unmanaged network.
- **Platform flexibility:** Cisco VDS-IS gives service providers a variety of options in hardware platforms and cache storage options. Options include:
  - High-performance Cisco CDE-250 content delivery engines with both solid-state and hard disk cache options and 10-gigabit per second (Gbps) connectivity
  - Flexible rack-mount server options with the Cisco UCS® platform
  - Integrated caching/streaming capabilities with a Cisco CDS integrated services module (ISM) for the Cisco ASR 9000 Aggregation Services Router
- **Scalability:** Cisco CDE content delivery engines scale to thousands of live channels and hundreds of thousands of VoD hours to support the largest national and global video networks. Cisco VDS-IS also supports advanced service routing intelligence to provide optimal cache efficiency with global and local load-balancing.
- **Investment protection:** An open platform, Cisco VDS-IS allows service providers to rapidly adapt their CDN to support new protocols and changing market demands. The solution's software-based architecture also means that operators can take advantage of Moore's Law to continually upgrade performance at a lower cost - something that is not possible with purpose-built CDN hardware. Cisco VDS-IS also provides optimal business flexibility, with the ability to support both retail and wholesale CDN applications with a single infrastructure, and to participate in CDN federations in the future.

For More Information

To learn more about the Cisco VDS-IS solution, contact your local Cisco account representative, or visit: http://www.cisco.com/en/US/partner/products/ps7127/index.html

For more details about Cisco CDE 250 content delivery engines, including models, specifications, and ordering information, visit: http://www.cisco.com/en/US/prod/collateral/video/ps7191/ps7126/data_sheet_c78-635849.html

For more information on the software elements of the Cisco VDS-IS solution, visit: http://www.cisco.com/en/US/partner/products/ps7127/index.html

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