

Data Center Tectonics

Tectonic shifts reverberating from the Data Center Core to the Network Edge



Expanding the focus to Edge Tectonics

Following several reports in the Data Center *Tectonics* series over the last year, we now expand our focus to Edge *Tectonics*. Edge *Tectonics* refers to significant changes taking place in the enterprise network edge (i.e. the corporate campus and branch office), as opposed to the data center. IT spending in the edge is greater than in the data center, and is undergoing similarly transformative and disruptive changes as a result of the shift to Cloud Computing.

Shifting to a “fat core, thin edge”

The move to Cloud Computing accelerates consolidation of IT assets and spending in the data center, but reduces spending in the network edge, as much of the IT equipment, software, and personnel historically located in the edge get consolidated in the core (data center).

Areas of decreased/lagging spend

Edge *Tectonics* is a headwind for technology that was traditionally deployed in campus and branch environments but is now consolidating in the data center – most notably PCs, servers, switches, routers, and endpoint security.

Areas of increased spend in newer networking and software technologies

Edge *Tectonics* is a tailwind for newer software and networking technologies that facilitate remote access from corporate campus and branch environments to data centers that are located thousands of miles away. These include desktop virtualization (VDI), software-as-a-service (SaaS), WAN optimization, content delivery networks (CDN), network security, wireless networking, and Unified Communications (UC).

Update to the GS Tectonics basket

We have updated our GS Tectonics basket (GSRHTECH) to better capture key stocks that should benefit from the shifts at the network edge. In addition to the existing 12 stocks, we are adding **Aruba Networks** (Buy), **Akamai** (Neutral), **Concur** (Neutral), **Riverbed** (Neutral), **salesforce.com** (Buy), **SuccessFactors** (Buy), and **Taleo** (Buy). We are removing HP, IBM, EMC, and NTAP, following our recent suspension of coverage. Since launching the basket on November 8, 2009, the basket is up 15.7% as compared to the S&P 500 up 2.4% and the Nasdaq Composite up 6.1%.

UPCOMING EVENTS

[Tectonics Roundtable: Shifts in the Network Edge](#)
Wednesday, July 14, 2010 | 10:00am ET

[Edge Tectonics Conference Call](#)
Thursday, July 15, 2010 | 11:00am ET
Dial-in: 973-528-0056 | code: 997401

[Save the Date: GS Tectonics Conference](#)
November 9, 2010

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PM Snapshot: *Tectonic* changes in the Network Edge create a new group of beneficiaries

For our view on the shifts in the data center, please see our November 8, 2009 report titled “A paradigm shift for IT: The Cloud”

The move to Cloud Computing accelerates consolidation of IT assets and spending in the data center, as detailed in our 11/8/2009 report on Data Center *Tectonics* titled “A paradigm shift for IT: The Cloud.” Conversely, we expect it to reduce spending in the Network Edge (defined as corporate campus and branch office environments) as much of the IT equipment, software, and personnel historically located in the edge gets consolidated in the core (i.e. data center). The shift to a “**fat core, thin edge**” architecture should be a headwind for systems vendors whose equipment has traditionally been distributed in campus and branch networks but is now being consolidated in the data center – most notably PCs, servers, switches, and routers. Conversely, the need to tap into content stored in a data center 3,000 miles away creates growth opportunities for newer software and networking technologies that facilitate such remote access, such as desktop virtualization, SaaS, WAN optimization, and content delivery networks:

	Areas of increased spend		Areas of decreased/lagging spend	
WAN is the new LAN	WAN optimization – Networking equipment that accelerates traffic from the campus/branch to the data center	Riverbed	Routers – Less spend on traditional routers, with some shift to feature-rich integrated service routers	Cisco
	Content delivery networks – Accelerate browser-based enterprise applications over the public internet	Akamai	Switches – Reduced spend in the network edge as servers/switches consolidate in the data center	Cisco
	IAM, Authentication, Network security vendors – Networking equipment and software that secures remote access to Cloud-based data	RSA (EMC), VeriSign (SYMC), Check Point, Juniper	Endpoint security – Pulling data and compute back to the data center, off of the physical endpoint	Symantec, McAfee
Rightsizing the Edge	Wireless Networking (WLAN) – Equipment that enables secure, reliable wireless access to corporate networks over WiFi	Aruba Networks	Servers – Reduced spend in the network edge as servers/switches consolidate in the data center	Dell, HP, IBM
	Unified Communications – Networking equipment and software that unifies voice, messaging and video communications and is location aware	Cisco	PCs – Elongated replacement cycles in traditional PCs and shift to thin clients as a result of the move to virtual desktops and SaaS	Acer, Dell, HP, Lenovo
Software	Virtual desktops (VDI) – Delivery of a desktop “image” on the user screen, while the desktop resides in the data center	Citrix, VMware		
	Software-as-a-Service – Enterprise software applications delivered over the Internet, and paid for, on demand	salesforce.com, SuccessFactors, Taleo, Concur		

Stock implications: Positive for software/networking vendors focused on the Network Edge

We continue to believe that investors can capitalize on the *Techtonics* theme over the next 1-4 years by owning names that (1) currently have strong footprints in the data center and are well positioned to benefit from data center consolidation and cloud build-outs; and (2) have disruptive technologies for the data center or the network edge that can drive IT consolidation and/or lower IT operating/maintenance expenses.

- **Data Center *Techtonics*** – Accenture, Brocade, Cisco, Citrix, F5 Networks, Juniper, Rackspace, VMware.
- **Network Edge *Techtonics*** – Aruba, Akamai, Concur, Riverbed, Salesforce.com, SuccessFactors, Taleo.

GS *Techtonics* Basket (Ticker: GSRHTECH)

We are updating the GS *Techtonics* basket to help investors gain exposure to opportunities created by the transition to Cloud Computing, including next-generation data center build-outs and the corresponding shifts at the Network Edge. As compared to the prior basket, which primarily focused on the data center and had a balance of disruptors and well positioned incumbents, the newly reconfigured basket is more broadly focused, capturing both the data center and the network edge. Moreover, the constituency of the new basket is weighted more to the best-of-breed, secular growth names, with a lower emphasis on integrated vertical solution providers.

The basket now includes the 15 stocks listed below. We are adding Aruba Networks, Akamai, Concur, Riverbed, salesforce.com, SuccessFactors and Taleo to the basket, to reflect growing opportunities for accelerating and delivering content to the Network Edge from internal or external Clouds. We are removing HP, IBM, NetApp and EMC following our recent suspension of coverage. All stocks are equal weighted in the basket except Rackspace, Concur, and Taleo which are 1/2 the weight of the all the other stocks in the basket due to liquidity constraints. New names in the basket are in bold.

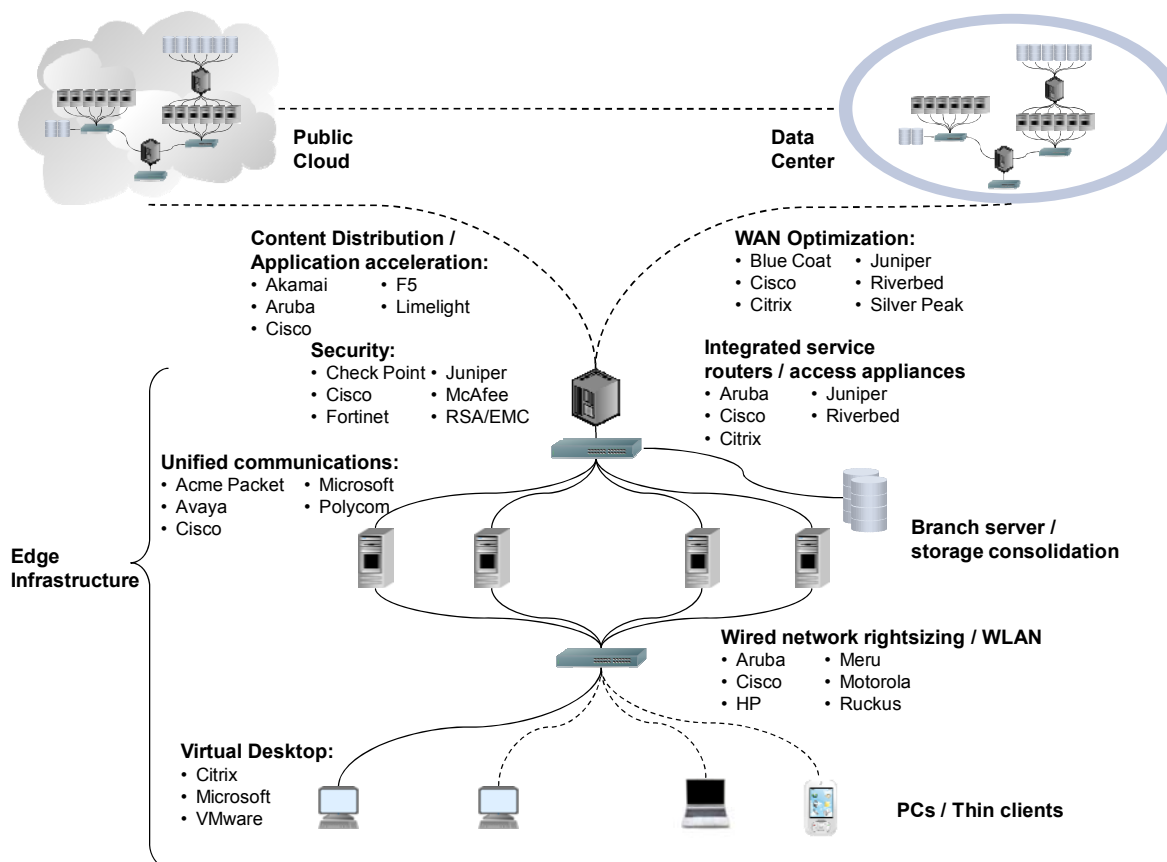
- Accenture (ACN, Buy)
- **Aruba Networks (ARUN, Buy)**
- **Akamai (AKAM, Neutral)**
- Brocade (BRCD, Neutral)
- Cisco (CSCO, Neutral)
- Citrix (CTXS, Buy)
- **Concur (CNQR, Neutral)**
- F5 Networks (FFIV, Neutral)
- Juniper (JNPR, Buy)
- Rackspace (RAX, Buy)
- **Riverbed (RVBD, Neutral)**
- **salesforce.com (CRM, Buy)**
- **SuccessFactors (SFSF, Buy)**
- **Taleo (TLEO, Buy)**
- VMware (VMW, Buy)

Note: The ability to trade this basket will depend upon market conditions, including liquidity and borrow constraints at the time of trade.

Technology Primer: Moving to a “fat core, thin edge”

Much of the focus throughout 2009 was on the increasing centralization of IT assets into data centers and the evolution to Cloud Computing. As these *Tectonic* shifts create “fat”, consolidated cores, we see corresponding architectural shifts outside the data center, creating a more optimized, “thin” Network Edge in campus and branch environments. Moreover, with further centralization, the distance between end users and their IT infrastructure continues to expand, with the Wide Area Network (WAN) increasingly serving as the new Local Area Network (LAN) in many deployments. We expect this trend to accelerate demand for new networking and software products to better secure and deliver content to the end user at the expense of traditional systems that were historically deployed in the Network Edge but are now being consolidated in the data center, such as servers, switches and routers. We show below the key elements of the evolving Network Edge ecosystem:

Exhibit 1: Infrastructure and vendors in the Network Edge



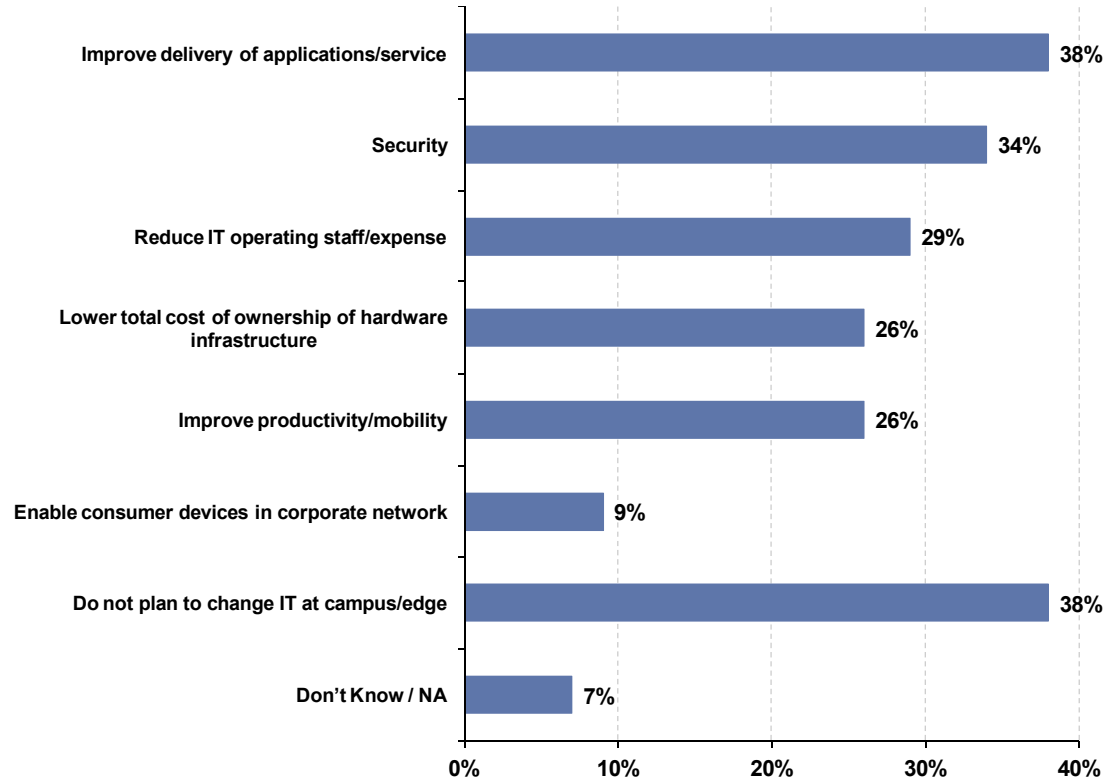
Source: Goldman Sachs Research.

Performance, security, and cost are primary drivers behind changes at the Network Edge

We see three primary drivers for the technology shifts underway in the Network Edge (Exhibit 2):

- ◆ **Performance** – IT Centralization creates unique new challenges for enterprises: while their workforce is increasingly distributed (mobile workers, telecommuters, global offices), their IT infrastructure is increasingly consolidated (in internal and third party data centers). Thus, applications and data have to be delivered reliably across much longer distances.
- ◆ **Security** – The proliferation of access devices into corporate networks (iPhones, tablets, notebooks, netbooks) and the consumerization of IT (consumer devices, social networks) have created unique new challenges that require enterprises to more intelligently attach security measures to the user and the network, rather than to the individual access device.
- ◆ **Cost** – The Network Edge accounts for a larger proportion of IT spending than the data center. For example, nearly 2/3 of capital spending on switching equipment is for the campus or SMB environments vs. 1/4 of spending in the data center.

Exhibit 2: If you plan to re-architect aspects for your campus/edge, what are the primary factors driving the change? Please select all that apply.

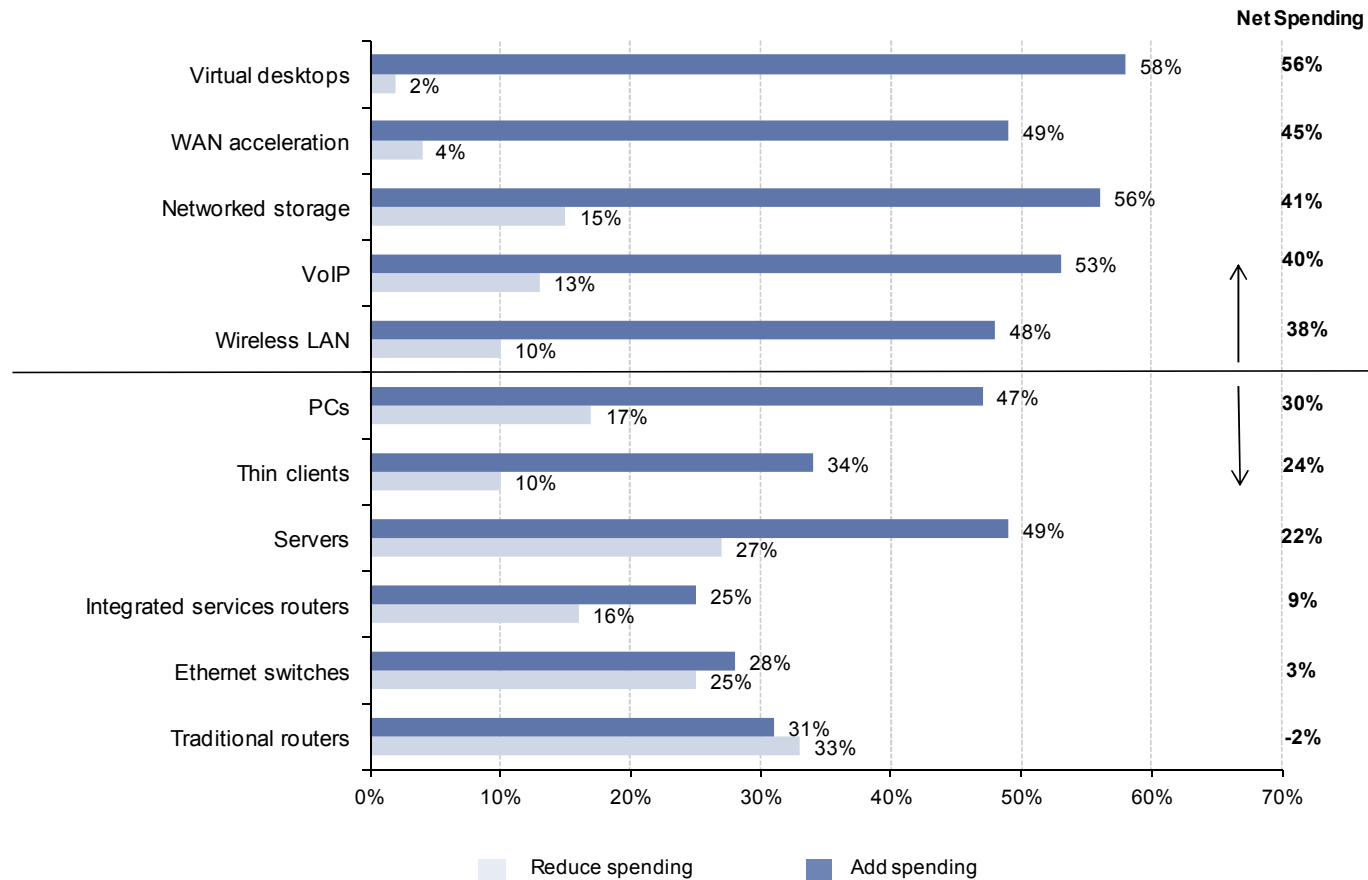


Source: Goldman Sachs IT Spending Survey, April 2010.

Network Edge shifts: Virtual desktops and WAN acceleration lead, switches and routers lag

The shift to a “fat core, thin edge” architecture has a profound impact on various categories of IT spending (Exhibit 3). As discussed in more detail below, the general trend is that new software and networking technologies that enable secure, reliable remote access to corporate applications and data are on the rise, while legacy systems (servers, switches, routers) currently deployed in corporate campuses and branch offices are likely to lag as they are consolidated in data centers.

Exhibit 3: Do you expect to increase or decrease your spending on any of the following product categories for the campus/edge? Answer all that apply.



Source: Goldman Sachs IT Spending Survey.

Areas of increased spend:

- **Virtual desktops** - Among our survey respondents, desktop virtualization leads as the category of highest incremental spend on the network edge, with 58% of our survey respondents expecting to increase their spending in this category vs. only 2% of respondents looking to reduce their spend. The increasing penetration for virtual desktops is most positive for software vendors that have a specific focus on these deployments, such as Citrix and VMware, though we expect some networking and thin client vendors to benefit from the trend as well. On the client side, higher penetration of virtual desktops should become a headwind to legacy PC vendors' growth over time due to the higher mix of stripped down PCs and thin clients, as well as from extended replacement cycles for fully configured PCs. Moreover, increasing virtual desktop penetration is expected to have a dampening effect on spend for traditional networking equipment on campus and branch locations, with some of the spend shifting to the data center.
- **WAN acceleration** - 49% of respondents (45% net) in our more recent survey expect to increase spending on WAN acceleration/optimization. We think the WAN optimization segment is among the best positioned to benefit from the ongoing secular trend of IT centralization, as increasing consolidation in the core and the shift to the Cloud will require better traffic optimization to the edge.
- **Networked storage** - 56% of our survey respondents expect to increase spending on networked storage at the edge while 15% expect a decrease. The results are consistent with broader storage spending trends, though we think further streamlining of infrastructure at the edge will shift more storage spending to the data center.
- **Voice over IP** - Our respondents also noted VoIP as a key area of incremental spend, with 53% of the respondents expecting to increase spending vs. 13% looking to decrease spend in the area.
- **Wireless LAN** - 48% of our survey respondents expect to increase their spending on wireless networks, while only 10% expect to see a decrease. We think this result, combined with the spending expectations for traditional wired Ethernet switching (see below), suggests that incremental spending on edge networks will be biased to wireless deployments.

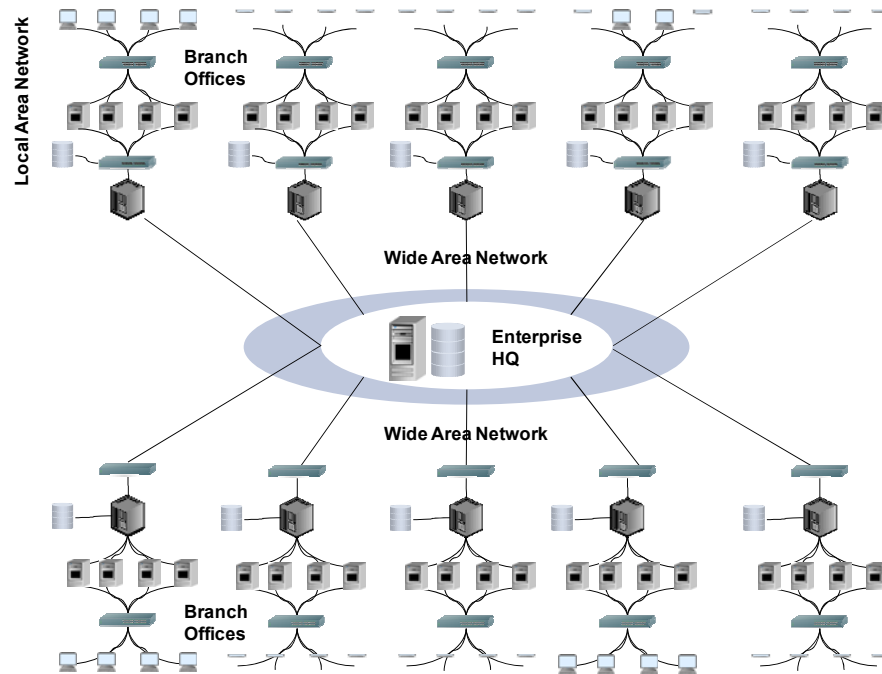
Areas of decreased/lagging spend:

- **Switches and routers** - For traditional switching and routing, the number of respondents expected to increase spending was offset by a similar number of respondents expecting to reduce spend in those categories, largely due to the consolidation into data centers. The only growth category was integrated services routers (e.g. Cisco's ISR G2), which consolidate branch office requirements such as routing, WAN optimization, security, switching, compute, storage, and unified communications.
- **Servers** – Server spending intentions for the edge also lag, largely as a result of the consolidation into data centers.
- **PCs/thin clients** – PC growth is likely to be impacted by the reduced PC hardware requirements in Cloud Computing, as more of the compute loads take place in the corporate data center (in the virtual desktop use case) or the cloud provider's data center (in the SaaS use case).

The WAN is the new LAN

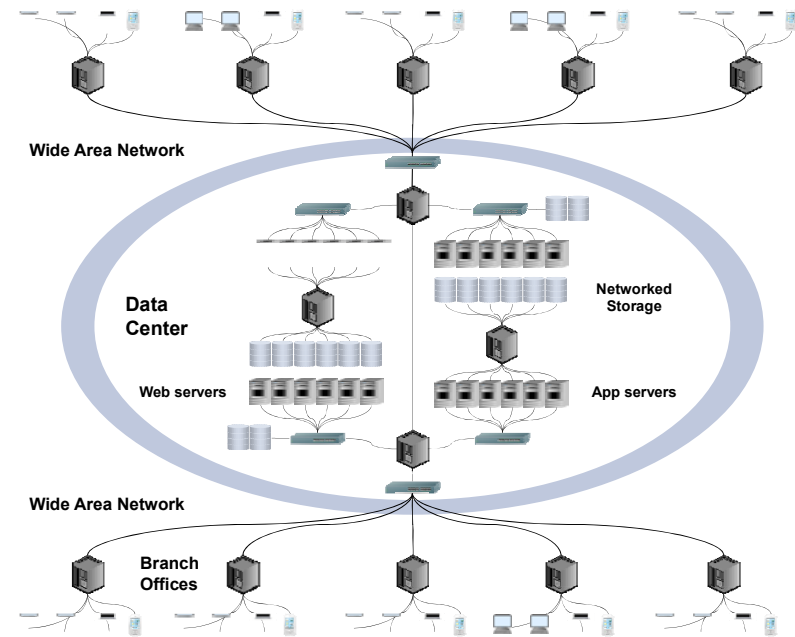
The Wide Area Network (WAN) is increasingly serving as the primary access network as end users perform more tasks over the WAN due to the centralization of IT. As enterprises shift from distributed models – where campuses and branch environments maintain their own footprint of servers, storage, networking, and software – to consolidated data centers, the distance between end users and their applications/data increases, causing network latency and less than optimal system performance, as traditional applications and networking protocols were designed to function over short distances and not optimized for the WAN. As such, as enterprises centralize IT assets into large data centers and shift to Cloud Computing, we expect a corresponding increase for new services, such as WAN optimization and content delivery, to maintain adequate performance at the edge.

Exhibit 4: Current architecture: “fat edge, thin core”



Source: Goldman Sachs Research.

Exhibit 5: Future architecture: “fat core, thin edge”



Source: Goldman Sachs Research.

WAN optimization: Mitigates expanding distances between end users and IT

We expect strong growth in the WAN optimization market over the intermediate term driven by increasing centralization of IT and the need to deliver content effectively to the network edge. We think the market will experience compounded annual growth in excess of 17% over the next 3 years, as more end users embrace the technology as a means to improve productivity and offset bandwidth requirements. Moreover, we expect current share leaders, Riverbed, Cisco, and BlueCoat to see outsized benefits from the strong secular growth in the market.

What it is: WAN optimization accelerates application performance and the delivery of content over the wide area network, with the goal of optimizing response times and reducing bandwidth costs. Given that most applications and file system protocols were designed to work over local area networks (LAN), expanding the physical distance between end users and IT causes significant degradation of system performance. WAN optimization resolves these issues by using a number of different techniques, including caching, data compression, deduplication, and protocol optimization, among others, to push content over the WAN at LAN-like speeds. WAN optimization is a symmetric technology, with appliances at both ends of the WAN link.

Adoption drivers: WAN optimization goes hand-in-hand with trends in IT centralization and the shift to the cloud, as it resolves a key CIO dilemma of needing to centralize IT (for higher utilization, ease of management, control, compliance, et al.), while providing adequate performance to end-users at the network edge. While WAN optimization adds another layer to the network stack, we think the fast ROI, driven by lower bandwidth requirements and improved productivity is compelling in nearly all economic environments and we anticipate higher adoption of the technology to drive growth in the market. In addition to new customer adds, we also see significant near term opportunities within the existing installed base of WAN optimization customers as penetration remains relatively low. Riverbed, one the leading vendors in the market, notes that penetration within its installed base is around 20%, suggesting solid opportunities for growth even if the pace of new customer acquisitions slows due to macro factors.

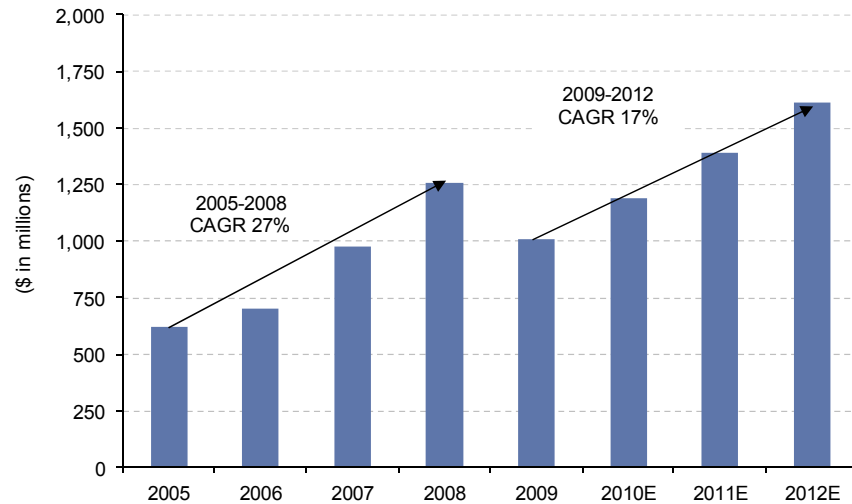
New software-based virtual WAN optimization controllers should expand the total addressable market and make WAN optimization even more relevant in the shift to the cloud. Specifically, a software-based controller will enable end customers to deploy WAN optimization into cloud environments where they may not have access to the physical infrastructure. Although the introduction of software-based controllers increases the risk of cannibalization and may impact revenue growth (as vendors lose the hardware component of the sale, though margins would move higher), we think pricing of the virtual appliances and the ease of the hardware appliances should limit the potential impact from substitution. Also, beyond the core-to-edge acceleration, WAN optimization is also gaining increasing traction for data center- to- data center connectivity for back-up and disaster recovery, providing another pool of incremental revenue.

Market size and growth: We think the WAN optimization market will grow from about \$1bn in 2009 to roughly \$1.6bn by 2012, with the bias to the upside. Given the sheer number of branch offices where WAN optimization technology can be deployed (estimated at about 6-8 million globally) as well as the potential sales into the data center and cloud deployments, we see significant room for industry growth over the long run driven by IT centralization and the need to deliver content effectively to the end user.

From 2005 to 2008, industry revenue grew at a compounded annual rate of nearly 27%. Although the market pulled back in 2009 due to cutbacks in overall IT spending, WAN optimization remained a priority in the downturn and performed well relative to other segments in technology due to its low cost of deployment and strong ROI case. In fact, Riverbed's WAN optimization product revenue grew in calendar 2009 despite the overall decline in IT spend. We expect the market to see a solid recovery in 2010 and

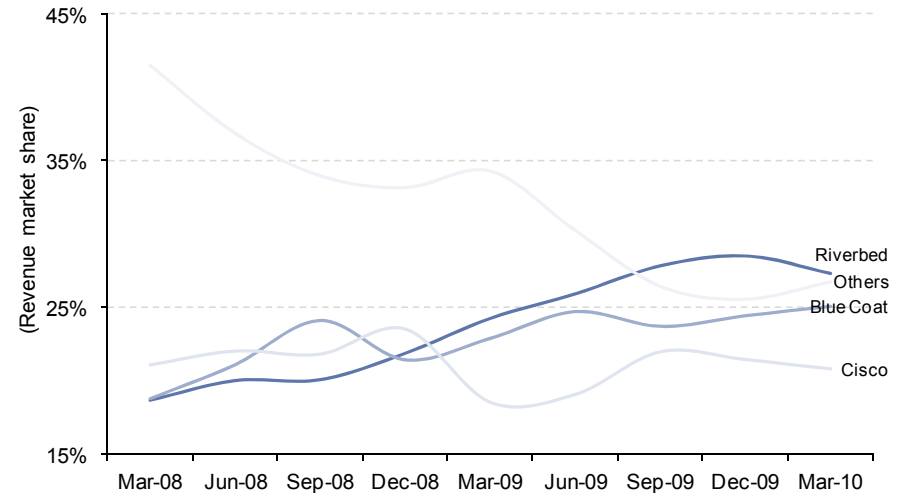
deliver strong growth over the intermediate term, though the 17% compounded growth rate we are forecasting reflects a more tempered pace than in the earlier years of the technology.

Exhibit 6: WAN optimization market should see solid growth over the next few years



Source: Gartner and Goldman Sachs Research.

Exhibit 7: Riverbed, Cisco, and Blue Coat account for more than 70% of the WAN optimization market



Source: Gartner and Goldman Sachs Research.

Key competitors: Riverbed, Cisco, and Blue Coat continue to dominate the WAN optimization market, accounting for more than 73% of total share (Exhibit 7), from about 58% two years earlier. Although we think the market will remain competitive, particularly for greenfield projects and more nascent segments in WAN optimization (such as the data center-to-data center for back-up and disaster recovery), the symmetric architecture of WAN optimization provides a significant advantage to the incumbents given their installed base at the core and we expect Riverbed, Cisco, and Bluecoat to see outsized benefits.

We think Riverbed (RVBD, Neutral) should benefit from its solid position amid strong market growth. Riverbed's solid market position, including a large, underpenetrated installed base, combined with a strong product portfolio that captures all the key end markets for WAN optimization (data center to edge, virtual appliance for the cloud, and higher performance products for data center-to-data center connectivity), should enable the company to outpace the growth in the broader market. Moreover, the company's strong roadmap, including its cloud-based storage offering and its upcoming platform to virtualize the edge, should enable the company to gain further traction with customers. Although the stock's valuation, at 3.6X our calendar 2011 revenue estimate of \$605.0 mn, appears high on an absolute basis, we think (1) the company's growth prospects and expected margin expansion warrant premium valuation, and (2) on a relative basis the stock trades at a discount to other fast growing, pure play networking vendors.

Content delivery networks: “Hardware-free” way to accelerate web-based and SaaS apps

We expect growing usage of content delivery networks as a cloud-based way to accelerate application delivery. Akamai is currently the leader, leveraging its broad network footprint and leading capabilities in delivering dynamic (non-cacheable) content. We currently see the acceleration of SaaS applications as fastest growing opportunity for application delivery networks (ADNs), though the opportunity could expand more substantively to internal applications as web-based apps become more pervasive and enterprises become more comfortable deploying corporate apps over the public internet.

What it is: On a private WAN enterprises can use a WAN acceleration/optimization solution to optimize application performance. For application traffic over the public internet, organizations can use acceleration and optimization services provided by content delivery networks (CDNs) such as Akamai to carry out a similar role. Features of an application delivery network (ADN) include:

- **Edge server network** – User requests for secure application content are sent to an optimal edge server situated close to the end user.
- **Routing algorithms** – The edge server selects the optimum path back to the origin through routing algorithms, ensuring application availability even if certain parts of the internet are suffering from congestion or outages.
- **Improved transfer protocols** – The edge server situated close to the user uses optimized transfer protocols to communicate with a server close to the origin. Other acceleration techniques such as compression, caching, and pre-fetching can be utilized to improve application performance.
- **Symmetric architecture** – Unlike application delivery controllers (ADCs) which are situated only in the origin datacenter and are thus asymmetric, an application delivery network includes servers near the origin and at the network edge to create a symmetric architecture which helps to identify packet loss and network anomalies.
- **Security** – The ADN’s servers can act as the first line of defense to protect data in the data center from malicious attacks, as they are the first point of contact for hackers in the public internet.
- **Analytics** – An ADN can also provide network monitoring solutions which provide visibility into network performance, traffic, and end users.

Adoption drivers: The need to access applications outside of the dedicated enterprise WAN is a key adoption driver for application delivery networks. Web-based and SaaS applications offer a way to do this as organizations expand geographically and IT infrastructure becomes centralized. Enterprise apps are also often accessed by supply chain partners and customers via the public internet. While an ADC at the data center can help maximize web server performance through load balancing, off-loading computationally intensive tasks, and caching frequently accessed content at the origin, an ADC cannot address performance bottlenecks on the internet or WAN, nor can it optimize in-bound traffic.

Market size and growth: We view the ADC and WOC markets (expected to grow at a CAGR of ~15%) as a proxy for the market opportunity for CDN-based application acceleration. Given its relative newness, we would expect ADN revenues to grow in excess of these more mature, appliance-based markets. Given SaaS-based applications are a key driver of application delivery networks, we also look at expected growth in the SaaS market as a guide (expected to grow at a 2009-2012 CAGR of 16%) (Exhibit 10).

Exhibit 8: Comparison between CDN, ADC, and WAN optimization controller-based (WOC) application acceleration solutions

	CDN	ADC	WOC
Nature of solution	Symmetric – Edge servers close to the origin and end user.	Asymmetric – ADC appliance is placed behind the firewall at the origin data center.	Symmetric – WOC appliances are placed at both the origin and each of the end points.
Location of accelerating device	No servers located on-premise. Edge servers usually located at first hop on the internet.	ADC appliances are located on-premise at the origin data center.	WOC appliance located on-premise at the origin and end user location.
Acceleration over the public internet	Can accelerate “browser-based” applications over the content delivery network using routing algorithms, protocol optimizations.	Helps maximize server performance at the origin data center through load balancing, SSL offloading, accelerating XML applications.	Cannot accelerate applications over the public internet.
Acceleration over WAN	Has limitations on the kind of content it can accelerate and hence use case is limited on the WAN.	Similar performance improvement as above.	Can accelerate traffic over a WAN but impact is limited to users on the WAN.
Adoption drivers	<ol style="list-style-type: none"> 1. Growing SaaS traffic. 2. Difficulty in placing a WOC appliance at every end point. 	<ol style="list-style-type: none"> 1. Centralization of IT infrastructure. 2. Improving existing server utilization. 	<ol style="list-style-type: none"> 1. Centralization of IT infrastructure. 2. Geographically dispersed branch offices.
Major players	<ol style="list-style-type: none"> 1. Akamai 2. CDNetworks 3. Cotendo 	<ol style="list-style-type: none"> 1. F5 2. Cisco 3. Citrix 	<ol style="list-style-type: none"> 1. Riverbed 2. Blue Coat 3. Cisco

Source: Gartner and Goldman Sachs Research.

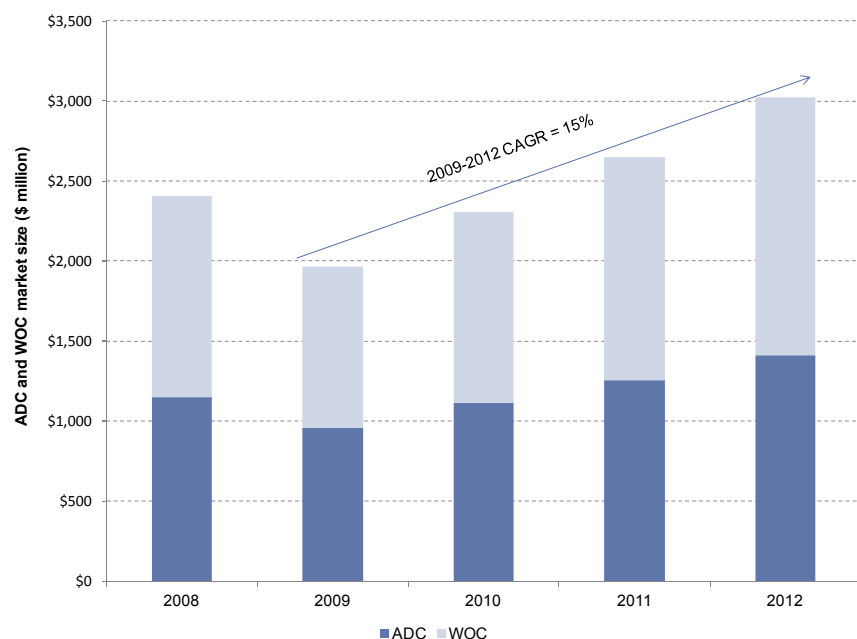
Key Competitors: Akamai is the market leader for web-based application acceleration solutions, though other vendors such as CDNetworks and Cotendo have recently launched similar services. In 2009, we estimate that Akamai’s application acceleration revenues were in the range of \$60-65 mn, growing faster than the company’s overall growth rate.

Akamai’s application performance solution (APS) is focused on accelerating browser-based enterprise applications over the public internet. While Akamai’s acceleration solution can also be deployed on a WAN, most customers prefer using a WAN optimization solution that can accelerate all traffic on the network, not just web traffic. However, there are instances when customers may use a combination of different acceleration technologies for particular application scenarios.

For enterprise customers, Akamai’s application acceleration solution is ideally suited for those with customers, supply chain partners, or remote employees accessing browser-based applications over the public internet. It is also used to connect highly distributed branch offices where a WAN optimization appliance at every end point is prohibitive for cost and management reasons.

We believe that, more recently, growth in the SaaS application market has been the larger driver of adoption for Akamai’s application acceleration solution. SaaS vendors are able to improve customer experience, improve performance of existing IT infrastructure, and expand their geographic footprint without incurring the additional expense of building out new data centers. By implementing Akamai’s APS as a part of their standard offering, some SaaS vendors have been able to reduce support costs as a result of increased customer satisfaction, providing them with a quick ROI.

Exhibit 9: We believe the ADC and WOC markets are fair proxies for the market opportunity for CDN-based application acceleration services
ADC and WOC market size, \$ millions



Source: Gartner, and Goldman Sachs Research estimates.

Exhibit 10: Adoption of SaaS applications are a key driver of growth for CDN-based application acceleration
Market size, \$ millions

Market size (\$ mn)	2008	2009	2010	2011	2012
ADC	\$1,151	\$958	\$1,115	\$1,258	\$1,410
WOC	1,256	1,009	1,192	1,389	1,614
SaaS	6,410	7,486	8,543	9,961	11,620
% growth					
ADC	6%	-17%	16%	13%	12%
WOC	29%	-20%	18%	16%	16%
SaaS	27%	17%	14%	17%	17%

Source: Gartner, and Goldman Sachs Research estimates.

Security: Spend shifts toward Data Protection and Identity and Access Management

In a world evolving to more data center and cloud-based solutions, the need for security does not abate, but we expect to see shifts in the approach to securing corporate data. While we do not expect that endpoints will be left largely unsecured anytime soon, we expect IT departments to prioritize different kinds of security spending, with incremental growth moving toward security tools that help manage identities, control access, and protect data as it moves more over networks (back and forth to a data center and the cloud, as well as out to mobile devices).

What is it: Evolutionary shift in the way IT departments approach security will drive incremental demand away from traditional endpoint security.

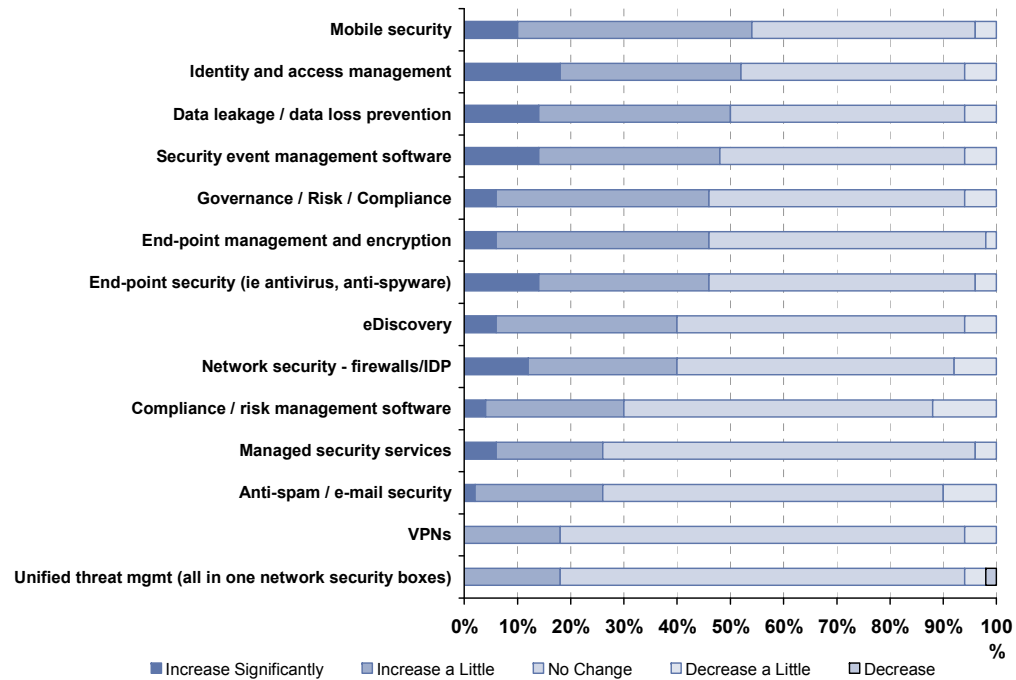
Implications: We expect a slow evolution from the traditional security stack, which has been focused on securing the points of attack, with a very large weight to the physical endpoint (anti-virus, anti-malware, etc), and more traditional firewall/VPN solutions. However, protecting data through its life-cycle and managing access takes on increased importance in a more cloud-based world. Therefore, we expect incremental dollars will be spent more on: (1) Identity and Access Management, as managing access and controls becomes increasingly important the more users are separated from physical devices; (2) data protection and encryption to secure data on the move; (3) security and vulnerability monitoring, which collates security events into a single pane of glass for monitoring purposes; and, (4) security to protect the network, as data is increasingly moving over it. Exhibit 11 summarizes the responses from our most recent security survey, which pegs Mobile Security, Identity and Access Management, Data Loss Prevention, and Security Event Management software as top spending priorities among enterprise chief information security officers.

We also flag Symantec's recent acquisitions of PGP and Guardian Edge, who provide email and data encryption technology, and VeriSign's SSL cert business, which provides identity and authentication technology, as indicators that these areas of security represent where growth in the security market is headed.

Market size and growth: We expect security spending growth in the mid-to-high single digits from 2010-2013, more or less tracking software spending generally, which tends to outpace IT spend by a couple percentage points. However, we anticipate a shift in types of security spend, with incremental growth leaning toward security that helps protect data through its lifecycle and manage/monitor the access to that data, as security focused on physical endpoints becomes more mature. Specific pockets of security where *Tectonic* shifts create opportunity include:

- **Identity & Access Management (IAM):** IAM helps to identify users including employees, customers, partners, etc. and allows appropriate users access to data and applications, using established rights and restrictions. Examples include authentication, single-sign-on, user provisioning, entitlement management, etc. We expect a 7-9% growth rate in IAM through 2013.
- **Data protection and encryption:** These products are used to encrypt and protect data wherever it resides, increasingly hosted in data centers, the Cloud, and on mobile devices. We anticipate growth in the 7-9% range in this subsector as well.
- **Security and vulnerability monitoring:** This segment includes products used to monitor and enforce security policy. These products enable users to consolidate security logs and events from disparate security products into a single pane of glass, as well as monitor and report instances of data loss (Data Loss Protection- DLP) . In this subsector, we expect 10-12% growth over the coming three years.

Exhibit 11: Where applicable, please indicate how you expect your spending to change for each product area over the next 12 months, relative to current levels. Please indicate all that apply.

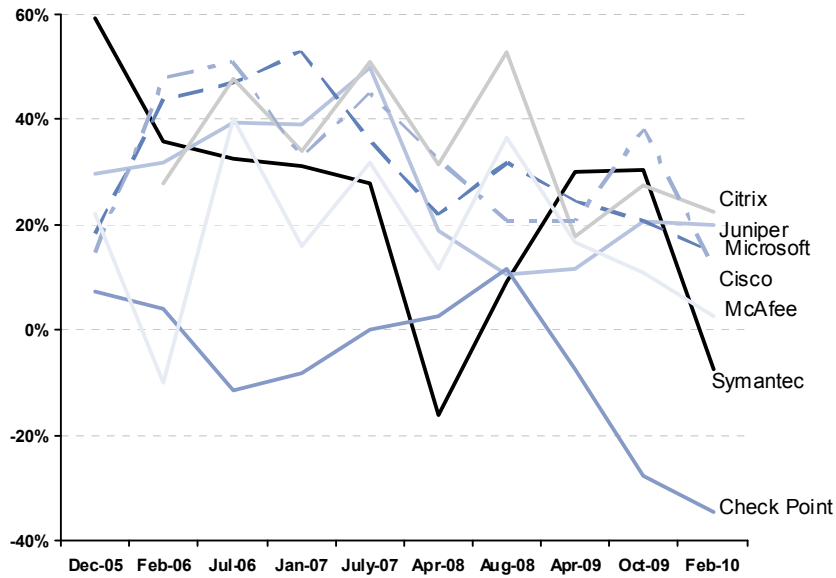


Source: Goldman Sachs Security Spending Survey, March 2010.

Key Competitors: From a vendor perspective, we expect a continued slow shift of incremental dollars from the more classic endpoint security providers in a number of directions: (1) toward vendors more focused on identity and access management, (2) to those protecting the data itself, wherever it resides or moves; (3) to those securing the network that data is increasingly moving across; and (4) to the virtualization providers themselves. Exhibits 12 and 13 show the traction of a broad base of security vendors from our latest security survey. We highlight the increasing traction of virtualization providers (VMware, Citrix), IAM vendors (EMC/RSA, Microsoft), and network focused vendors (Cisco, Juniper), while traditional vendors (Symantec, McAfee, Check Point) seem to slip.

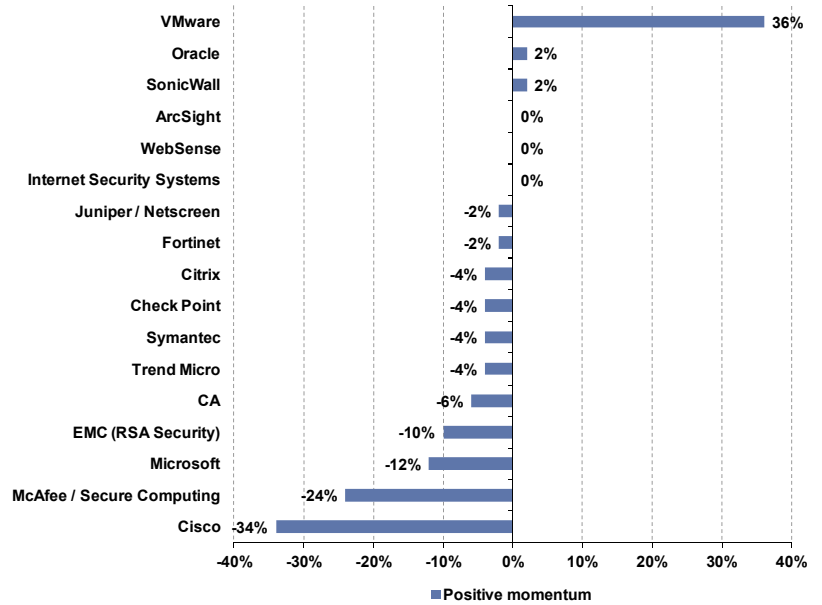
Exhibit 12: Cisco, Juniper and Citrix clear net share gainers reported in our most recent security survey

Net of respondents reporting % gains vs. declines by vendor over our survey history



Source: Goldman Sachs Security Spending Survey, March, 2010.

Exhibit 13: Who do you view as your top strategic security vendors today? Who do you expect to be most strategic in a more cloud-based computing world? Please select top 3.



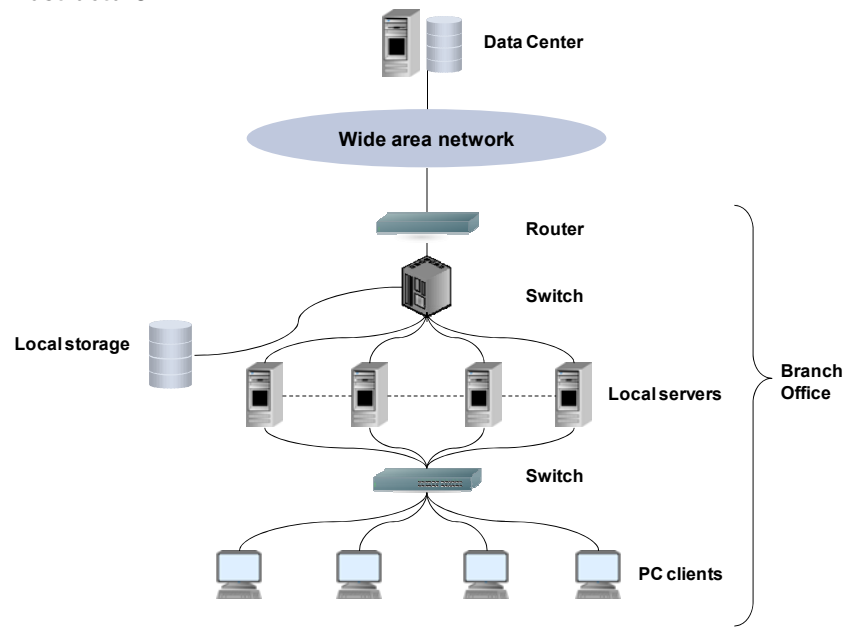
Source: Goldman Sachs Security Spending Survey, March, 2010.

Rightsizing the Edge

As enterprises centralize and streamline their infrastructure in the data center, we expect corresponding shifts at the edge of the network, driven by the need for easier deployment and lower cost of operations. Similar to the collapse of traditional network tiering architectures in the data center, we think branch office IT footprints will likely see consolidation of the stack, with many branches moving away from local servers/storage and reducing networking equipment at the edge. In lieu of the traditional stack of hardware and software, we expect increasing demand for newer product categories, such as integrated branch solutions (including virtual gateways), unified communications, and enterprise wireless networks.

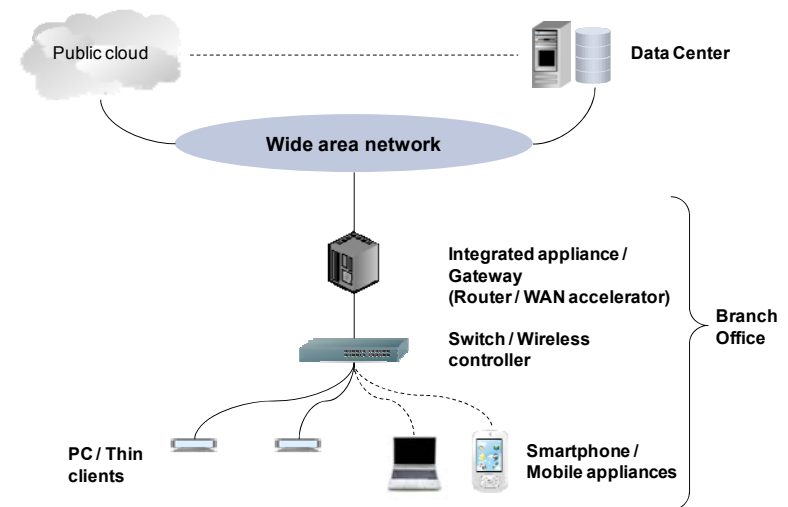
As illustrated in the exhibits below, we think traditional IT footprints at the edge are beginning to evolve from fully configured operations with traditional networking, security, servers, storage, and PCs to those with streamlined, integrated solutions. We think the consolidated scenario will drive lower capital costs, reduce operating expenses (in lower equipment maintenance costs and smaller branch IT staff), improve performance and security, and allow CIOs to better manage the transition to Cloud Computing. Moreover, we expect the edge network will need to be more adaptive – for access and security – as more consumer appliances are pulled into the enterprise.

Exhibit 14: Existing branch office networks often duplicate the data center infrastructure.



Source: Goldman Sachs Research.

Exhibit 15: Optimized edge networks collapse the stack of hardware at the branch and campus environments.



Source: Goldman Sachs Research.

Integrated branch solutions: Reducing IT footprints at the edge

As more enterprises deliver applications and content directly from the data center, IT requirements outside the core are significantly reduced. As a result, we expect “branch office in a box” solutions with small footprints to displace traditional infrastructure at the edge.

What it is: A branch office router or appliance that integrates numerous services typically found on a fully configured IT stack, including routing, security, compute, storage, telephony, and networking onto a single piece of hardware. Alternatively, we think secured gateway appliances that access and accelerate content from the corporate data center could also displace traditional branch infrastructure, particularly for smaller branches.

Adoption drivers: The increasing centralization of IT and improving WAN performance should result in more enterprises delivering applications and content directly from the data center (and the cloud moving forward) to end users, reducing IT requirements outside the core and rendering obsolete the distributed IT model that necessitates fully configured stacks of on-premise hardware and software at the network edge. We expect that as IT managers seek to further streamline edge deployments, integrated service routers as well as appliance-based solutions will gain significant share in lieu of traditional infrastructure.

Implications: IT infrastructures at the edge have experienced some level of consolidation – with many enterprises shifting from traditional deployments that often resemble scaled down versions of their enterprise headquarters into more elegant models with virtualized servers, networked storage, and in some cases with integrated services appliances. We expect this evolution to continue, with more radical shifts coinciding with the changes in the data center and the shift to the cloud. Specifically, we think the infrastructure at the edge can be collapsed further, possibly with a single hardware appliance (using virtualized and cloud-based services, including routing, security, application/WAN acceleration, compute, and wire/wireless network access) handling all the requirements outside the core. For now concerns around IT survivability, e.g. what happens when the WAN connection goes down, remain a key pain point, keeping the pace of change more measured; however, as WAN links become more reliable and local compute and services become virtualized on stand alone appliances, the pace of adoption should accelerate. As this trend moves along, and enterprises reduce their IT footprint at the edge, the corollary is that the following products will experience declining demand:

- **Traditional routers** – While routing will remain a critical element in broader network, the emergence of new integrated routers that provide additional functions/services, as well as virtual routing appliances, that run on lower cost industry standard hardware, will likely reduce demand for traditional branch office routers.
- **Security** – As vendors continue to pull more security features into network infrastructure, and as security becomes a service offered from the cloud, we expect to see lower demand for dedicated security devices at the edge.
- **Branch servers** – We expect IT managers will continue to reduce server footprints at the edge as increasing centralization of IT will shift compute workloads to data centers and the cloud. Although edge networks will likely require some compute capacity to run mission critical branch applications and on-premise services (e.g., print, DNS, et al.), as more appliances offer virtualized compute capacity, there will likely be corresponding reduction in demand for dedicated branch servers.
- **On premise storage** – Similar to that of servers, as more content and data are served out of centralized infrastructure, we expect spending for on-premise storage will decline.

- **Wired network switching** – We think wired network connectivity will be an important element for the network edge for some time; however, with wireless connectivity becoming more secure and reliable, we expect spending on wired networking at the edge (which is already driven primarily by product refresh) to decline going forward. Please see our thoughts on WLANs below.

Key competitors: Cisco’s strong presence in branch office routing and early moves to consolidate the network edge with its Integrated Service Router (ISR) platform provides it with a strong position, though we think the opportunity for Cisco is more about retention of its installed base rather than growth. We expect alternative platforms, such as the Riverbed Services Platform, which consolidates branch requirement onto its WAN optimization appliance, and Aruba’s Virtual Branch Office (VBO), which provides a secured gateway into the corporate infrastructure, to see increasing traction as this market develops further. Citrix’s Branch Repeater consolidates components of a Windows stack (such as file, DNS, Print, DHCP, and authentication) in a special purpose offering optimized for delivering the company’s virtual desktop offerings (e.g., ICA-based traffic).

Exhibit 16: Highlights of key integrated access solutions

	Traditional Deployment	Cisco Integrated Service Router (ISR) G2	Riverbed Riverbed Services Platform (RSP)	Aruba Virtual Branch Office (VBN)
Solution	Distributed branch office deployment	Consolidate branch office requirements by integrating services on routing infrastructure. Deploy additional services on demand	Consolidate branch office hardware on Riverbed's Steelhead WAN Optimization appliance to reduce IT footprint and simplify operations	Mostly for small branch offices; consolidate branch IT into a single Remote Access Point; serves as a gateway to corporate infrastructure
Routing	Traditional hardware router	Embedded	Virtual appliance (Vyatta)	Embedded
Acceleration	WAN accelerator appliance	WAN optimization capability	Core WAN optimization appliance with bandwidth utilization, compression, QoS, TCP optimization, et al	Application Acceleration Service (AAS) -- Cloud-based protocol optimization and compression to accelerate content delivery to the edge
Security	Hardware based VPN/firewall	Firewall, hardware based VPN acceleration, intrusion prevention, content filtering	Software-based security futures (partnerships with Check Point, Websense, and others)	Integrated firewall/VPN
Compute	Local compute to serve applications and services	Compute capability via service module upgrades	Virtualized compute partition (VMware) on Steelhead appliance; add up to five services/applications for local compute, eliminating need for most local servers	Not applicable
Storage	Direct attach / premise-based network storage	Up to 1TB of local storage via service modules upgrades	Support for local iSCSI storage targets; data delivery over the WAN	Not applicable
Switching	Wired Ethernet switching	LAN switch ports embedded	Required	Embedded fixed ports and WiFi
Communications	Traditional routing / PBX	Unified communications and video-based collaboration	Routing capability via partnership	Wired ports for voice connectivity
Other	Benefit from best of breed technologies, though higher expenses can be prohibitive and compliance/back up/disaster recovery more difficult	Customization available via service module upgrades.	Plug and play deployment	Zero touch deployment model (appliance configured at home office and sent to the branch) requires minimal IT staff support at the edge

Source: Company data and Goldman Sachs Research.

WLAN: Enterprise wireless moving from “nice to have” to replacing wired networks

The market for enterprise WiFi networks (WLAN) should continue to ramp as network managers seek to provide more mobility while “right-sizing” their wired infrastructure at the edge. We think the 802.11n standard, which provides wireless performance that matches traditional campus networks, as well as the proliferation of mobile appliances, will increase demand for wireless connectivity. The technology has already gained significant traction in key verticals that require heightened mobility and we expect higher adoption from general enterprise given improving performance and security.

What it is: Wireless LANs (WLANs) provide WiFi networks in campus and branch environments to improve mobility and reduce costs associated with traditional wired infrastructure. WiFi networks were initially deployed in the enterprise as overlay networks, providing secondary access, often for guest and in conference rooms. However, with improving performance and security of WLANs, as well as the increasing penetration of the mobile appliances in the enterprise, we see WLANs becoming a more vital part of the overall enterprise network, with increasing instances of WLANs as the primary means of access into the corporate network.

Adoption drivers: The efforts of network managers to “right-size” their wired infrastructure – reducing the number of fixed ports per user and their associated maintenance cost – should drive higher adoption of WLANs. Moreover, the proliferation of mobile appliances, such as notebooks and smartphones, should increase demand for wireless networks, driving the WLAN market growth well ahead of overall IT spend. We expect improving network and endpoint security, as well as higher end features, such as location aware technology (defined areas have different access privileges) should mitigate security concerns, while the 802.11n standard (with data rates of 300Mbps as compared to wired Fast Ethernet at 100Mbps), eliminates a key performance hurdle for WLAN adoption.

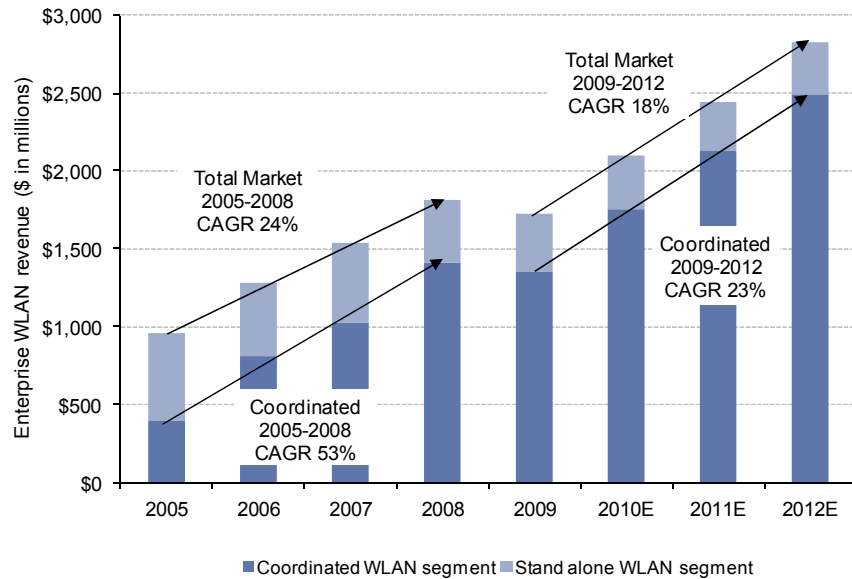
Implications: The technology has already gained significant traction in key verticals that require heightened mobility, such as healthcare, education and retail, and we expect higher adoption from general enterprise customers given the products’ improving performance and security. Requirements for mobility and lower costs should enable WLANs to continue to take share in the \$10bn edge switching market. While certain elements in the enterprise (e.g., power users in mission critical seats) will require wired connectivity going forward, often leading to hybrid wired/wireless solutions, we see WLANs taking incremental share in the broader enterprise network.

In traditional wired network architecture, enterprises deploy two to three fixed ports per seat for the PC, VoIP, and for redundancy, with many ports running at very low utilization despite high maintenance costs. We think WLANs can enable network managers to “right-size” their wired networks and reduce the number of fixed ports required to support the end user. In a recent deployment by Aruba Networks for an education customer, the network manager noted that prior to migrating to WLANs, over 40% of its fixed Ethernet ports were unused, and the customer was able to eliminate those ports during a network refresh, reducing significant service and maintenance fees. In greenfield deployments, WLANs provide the same level of efficiency while also lowering cabling costs (moving from two to four ports per seat to one port per access point that can service multiple users). As WLAN technologies continue to improve and move up the stack (already application aware and soon expected to take VoIP wirelessly), WLAN penetration in the enterprise should rise dramatically.

Market size and growth: From 2005 to 2008, the market for enterprise WLANs grew at a compounded annual growth rate of 24%. In the coordinated WLAN segment (which excludes legacy, stand-alone access points), the market grew 53% during the same period. We expect growth in the WLAN market to reaccelerate over the intermediate term as higher penetration of notebooks and smartphones in the enterprise increases demand for wireless connectivity and as more enterprises substitute traditional wired

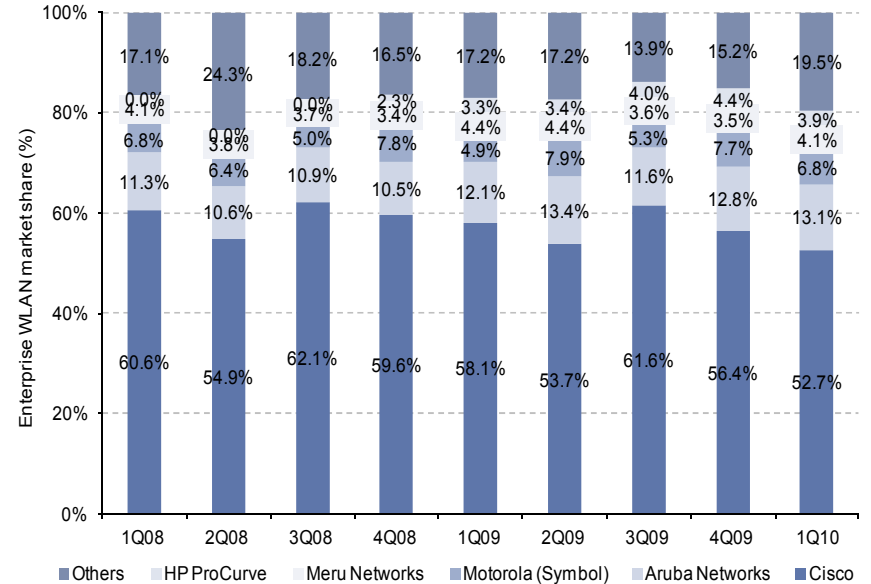
infrastructure with WLAN networks. While revenue growth for the market is unlikely to reach historical levels given the higher revenue base, we expect strong growth in excess of 18% per year for the overall market in the next three years. In the coordinated segment, we expect compounded annual growth of 23% over the same period.

Exhibit 17: The overall WLAN market should grow 18% CAGR over the next three years, though the coordinated segment should see a 23% CAGR



Source: Gartner and Goldman Sachs Research.

Exhibit 18: Cisco has leading market share, though is seeing some challenge by smaller, best-of-breed vendors



Source: Gartner and Goldman Sachs Research.

Key competitors: Cisco is the clear share leader in the enterprise WLAN segment with over 50% of the market, followed by Aruba Networks and Motorola, each with less than 10% market share. Behind the top three competitors the market is fairly fragmented, with the rest of the vendors accounting for less than 30% of the networking share, though we see more aggressive competition coming from the likes of HP (via acquisitions of Colubris and 3Com) and Meru Networks.

As the leading pure play WLAN vendor, we think Aruba Networks is best positioned to benefit from the secular growth in WLAN. Even through the recent downturn, Aruba steadily increased its market presence, with no yoy revenue contraction in any quarter. Moreover, the lack of an incumbents' dilemma enables Aruba to aggressively pursue network rightsizing engagements (in contrast to the market share leader, which needs to defend its installed base of traditional wired networks). The combination of the company's leading product portfolio, including its Airwave management suite (which is able to manage heterogeneous WLAN and application aware access points (which can recognize and accelerate application specific packets and maintain QoS), combined with its 10,000+ installed base of customers, provides a solid foundation for further growth.

Unified Communications: From the telephone to the cloud

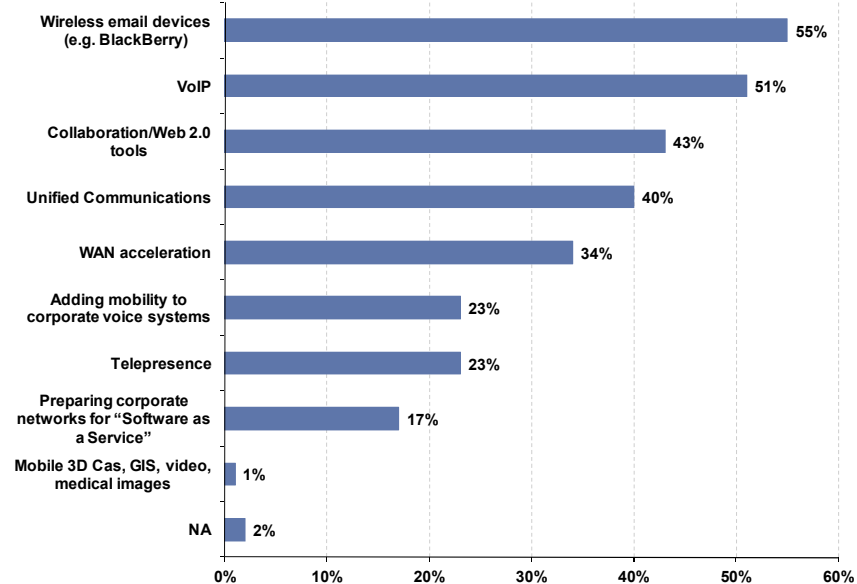
We see Unified Communications as one of the emerging areas of robust growth and innovation in the areas of software and networking, as a result of the confluence of several trends. These include higher VoIP penetration, rising interest for videoconferencing solutions, a more distributed and mobile workforce, and the drive toward increased productivity. We see this area as a significant tailwind for market leader Cisco, as well as niche infrastructure vendors such as Acme Packet.

What it is: Unified Communications is an emerging set of technologies at the intersection of traditional communication tools (e.g. email, voicemail, instant messaging, mobile phones) and desktop-based software applications (e.g. Internet, SharePoint, Office, business applications). UC is typically offered as a suite of hardware equipment, software, and services that enables integrated and ubiquitous connectivity for corporate users across applications. As defined by Gartner, there are six UC components:

- Voice and telephony – fixed and mobile telephony, soft telephony (e.g., VoIP on the PC) and video telephony
- Conferencing – voice, video and Web conferencing
- Messaging – email, voicemail, and unified messaging
- Presence and instant messaging – the ability to show the location and availability of the user
- Clients – software on a PC, mobile device, or in a browser that allows unified access to various communications channels
- Communications applications – applications that integrate communications capabilities (e.g., for contact centers)

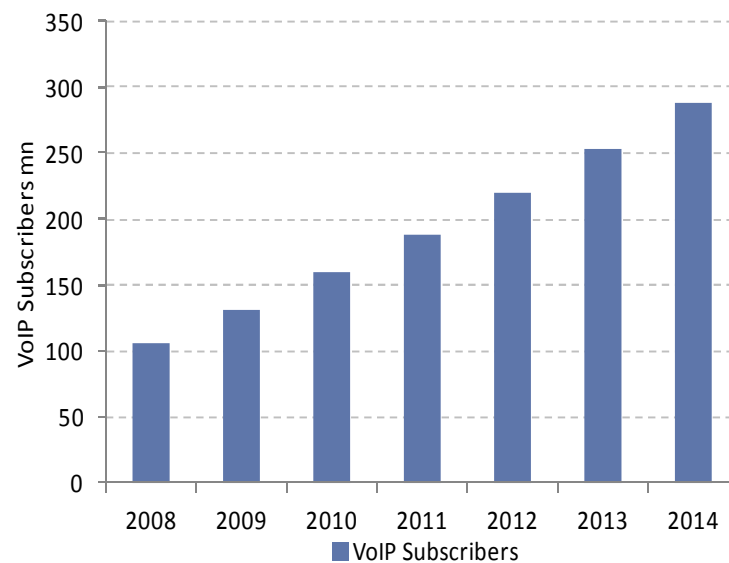
Adoption drivers: The primary adoption driver of UC is **increased productivity**, as employees are able to collaborate more efficiently through the use of tools such as web conferencing, SharePoint, instant messaging, unified voicemail across fixed and mobile lines, and others. Our recent IT surveys suggest that UC has now moved up the priority list for CIOs this year (Exhibit 19). The fundamental enabler of UC is the move of voice from legacy switched networks to IP (**VoIP**), as voice can now be handled as just another application on the IP network. Over 80% of US enterprises now have VoIP (IDC). According to a recent IDC Survey, about 30% of enterprises have already adopted UC, with a similar proportion planning to adopt in the next year.

Exhibit 19: What networking technologies are you investing in to enhance employee productivity and collaboration in 2010? Answer all that apply.



Source: Goldman Sachs IT Spending Survey.

Exhibit 20: VoIP market set for a solid period of expansion



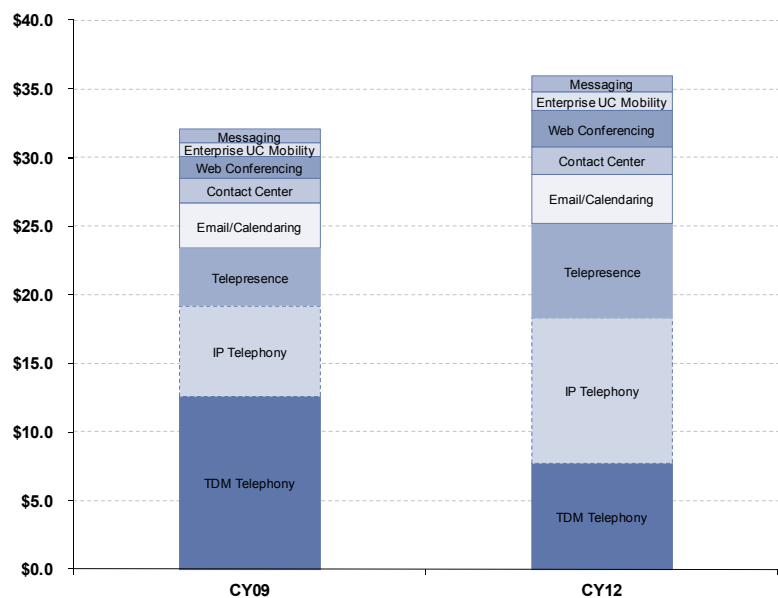
Source: Infonetics, Goldman Sachs Research estimates.

Implications: We expect UC adoption to disrupt the technology landscape in the enterprise campus/branch office/SMB environment, with reduced sales of telephony hardware and related infrastructure such as PBX equipment (where Cisco, Avaya, and Nortel have the leading share), and increased adoption of video conferencing (e.g. Cisco TelePresence/Tandberg), web conferencing (e.g. Cisco WebEx), collaboration (e.g. Microsoft SharePoint), or hosted UC (e.g. from AT&T or Verizon).

Market size and growth: The Unified Communications market is a \$36bn opportunity, with the main components including enterprise mobility, web conferencing, contact center, email/calendaring, messaging, telepresence, IP telephony, and TDM telephony. We expect overall market growth in the single digits, as growth in emerging software-based applications and services offsets declines in traditional equipment-based telephony.

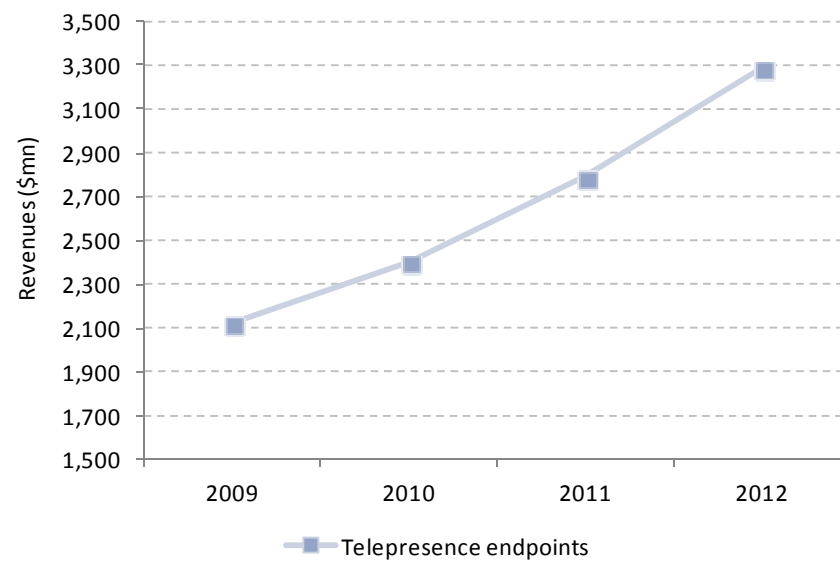
Key competitors: The largest vendors in Unified Communications are Cisco and Microsoft, though each is approaching the market from its traditional vantage point of networking and PC applications, respectively. We estimate that UC will drive \$2.8bn, or 7%, of Cisco's CY10 sales, and about \$1bn, or 2%, of Microsoft's CY10 sales. Other key vendors include Avaya (IP telephony), Polycom (video conferencing), Acme Packet (VoIP infrastructure), and Genband (VoIP infrastructure, through the acquisition of Nortel's voice assets).

Exhibit 21: Unified Collaboration is a \$36bn + market opportunity



Source: Gartner, and Goldman Sachs Research estimates.

Exhibit 22: Telepresence endpoint revenue is expected to grow at a 16% CAGR through 2012

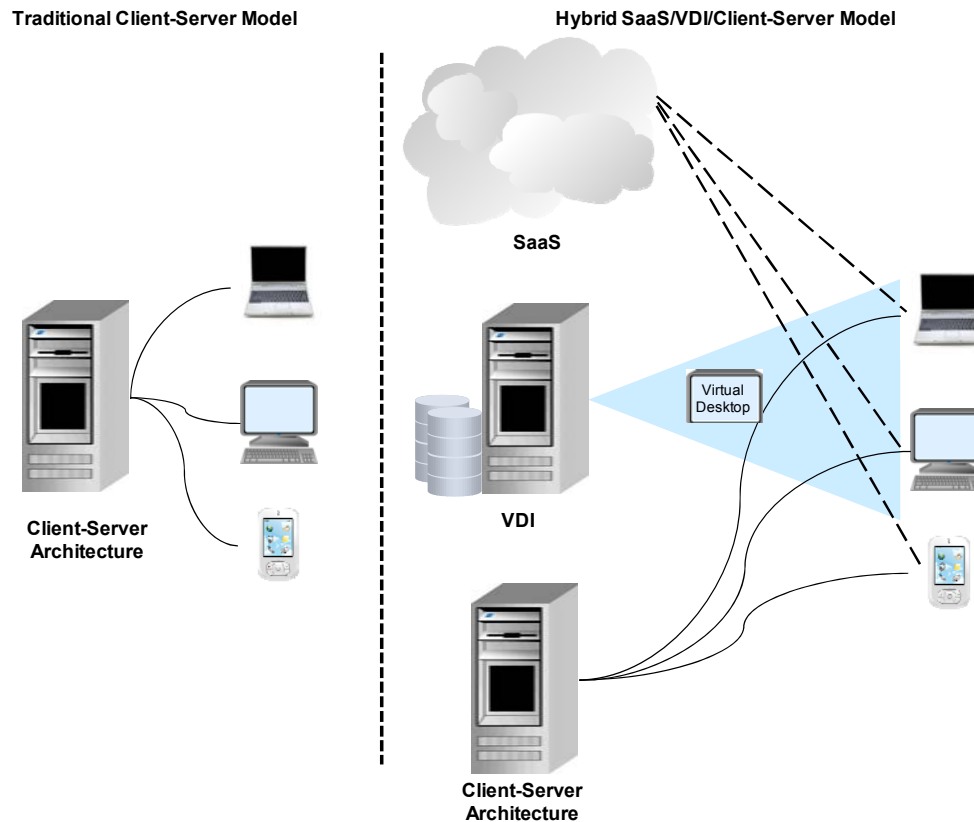


Source: Gartner.

Software delivery shifting from straight client-server architecture to a hybrid of client-server, SaaS, and VDI

Software is shifting away from the traditional client-server architecture to a hybrid of Client-Server, SaaS, and VDI. The prevalence of service-oriented architectures to standardize many of the building blocks of software, as well as the advent of virtualization technologies and increased network bandwidth have enabled new models for software that change the way it is consumed, deployed, and delivered, while also changing the physical compute required by end users. New technologies have shifted the client-server architecture to more of a hybrid, where certain applications still run on a traditional client-server build, but others are delivered from the Cloud (SaaS) or are hosted within the company firewall from a centralized data center.

Exhibit 1: SaaS and desktop virtualization are two key trends in software driving the shift to Cloud Computing



Source: Goldman Sachs Research.

Desktop virtualization: Interest and momentum for software vendors; long-term headwind for PCs

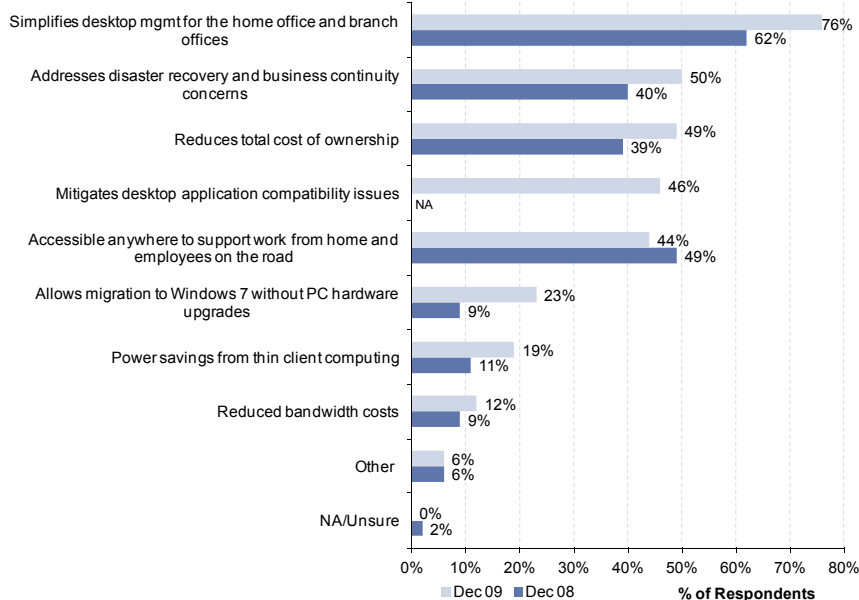
Momentum for virtual desktop deployments continues to build in 2010, driven by advantages of centralized management, security, improved disaster planning, and leveraging employee-owned hardware in some cases. We expect adoption to accelerate as vendor offerings mature, licensing complexity ebbs, and customers find greater comfort with the TCO story. Our estimates anticipate a total addressable virtual desktop infrastructure (VDI) market of \$1.9 bn by 2013, growing at a 4-year CAGR of about 100% from 2009.

What it is: VDI (Virtual Desktop Infrastructure) is currently the leading implementation of desktop virtualization, which consolidates desktop instances onto a centralized server architecture in the data center, and typically delivers the desktop to end users via a display protocol over the LAN or WAN.

Adoption drivers: We expect advantages of manageability, security, and flexibility to drive increased penetration of desktop virtualization. Key reasons why organizations are likely to embrace desktop virtualization include:

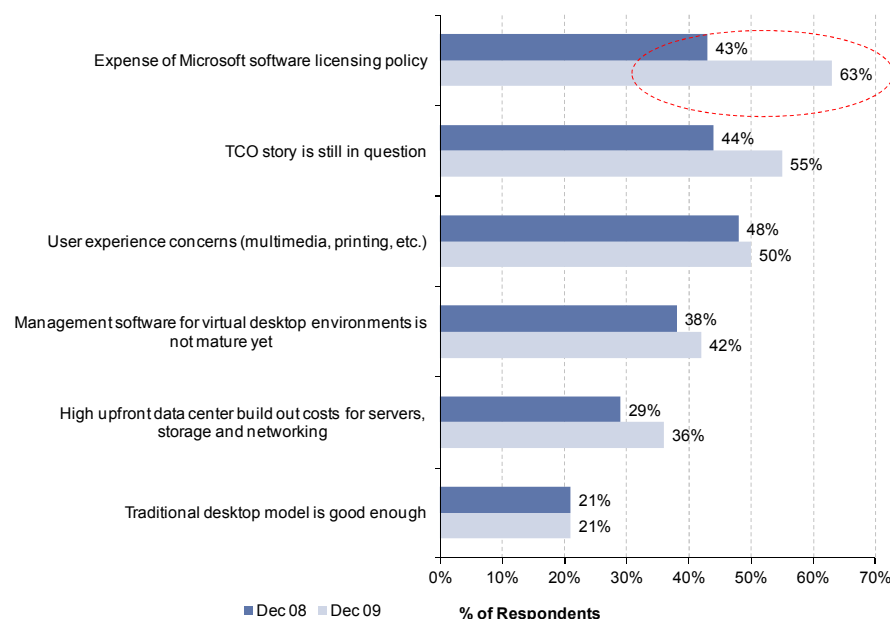
- **Centralized management.** Desktop virtualization enables the IT organization to manage a pool of desktops centrally in the data center. This is especially useful to organizations with multiple locations or with remote workers logging in from the road. Over time, management continues to gain importance as IT environments become more complex which is a positive for VDI adoption. In our January IT Spending Survey, 76% of respondents highlighted simplified desktop management as an important benefit of VDI (Exhibit 23).
- **Increased security.** Virtualized desktops tend to be considerably more secure than their traditional counterparts by either keeping sensitive corporate data in the data center or by sandboxing desktop workloads to disallow access via desktop peripherals.
- **Eases disaster recovery planning.** Virtualized desktops make it easy for employees to have access to their complete workspaces from their homes, or any external location, in the event of an emergency. Disaster recovery benefits now ranks as the second most important driver with 50% of respondents in our survey looking to virtual desktops in planning for extraordinary events, an increase from 40% a year prior (Exhibit 23).
- **Organizations are better able to leverage employee-owned hardware while still providing secure access to corporate systems.** Virtual desktops can be OS-independent and isolate the corporate system from anything running directly on the user's PC at home, including malware.
- **One of the key hurdles to VDI adoption is being addressed; new Microsoft licensing could accelerate VDI adoption.** Our market conversations and survey work have pointed to Microsoft licensing complexity as the top hurdle to adoption (Exhibit 24). However, as of July 1, Microsoft no longer charges incremental license fees for VDI instances, although customers are still required to be on Software Assurance. We view the recent change as an important step in the right direction.
- **We expect the next round of products from Citrix and VMware to accelerate adoption** by improving feature functionality and bringing the fully loaded costs of a virtual desktop closer to parity with the traditional PC model in 2010 and beyond. Today, user experience remains one of the key hurdles to adoption (Exhibit 24). However, as Citrix and VMware continue introducing additional products and functionality we expect these concerns to be alleviated.

Exhibit 23: In your opinion, what are the most important benefits of desktop virtualization vs. traditional desktop solutions? Answer all that apply.



Source: Goldman Sachs IT Spending Survey, January 2010.

Exhibit 24: In your opinion, what are the most important hurdles to adoption of desktop virtualization? Answer all that apply.



Source: Goldman Sachs IT Spending Survey, January 2010.

Implications: Hardware vendors could experience headwinds in the long run from virtual desktop deployments due to a mix shift to lower ASP thin clients and extending lifecycles of fully configured PCs. Likewise, for networking vendors we expect higher penetration of virtualized desktops to reduce the requirement for switching equipment at the edge because most networking tasks will be completed in the data center. As shown in the charts below, customer interest in VDI continues to increase due to compelling solution

Market size and growth: The Goldman Sachs software team estimates that the desktop virtualization opportunity for software vendors alone could reach \$1.9 billion by 2013.

- Moving from pilots to sizable deployments.** Our latest industry checks continue to indicate that customer interest is very high, and activity is moving beyond the pilot phase to deals of meaningful size. While most deals are still not large, we are hearing of more multi-thousand-seat deployments—government in particular appears to be shifting up a gear. As deals continue to move from pilots to deployments, the overall market should become more educated on VDI. This should help customers better understand the TCO story, which is highlighted as a key hurdle in our January 2010 IT Survey (Exhibit 24) and in our industry conversations.
- Our survey respondents cited VDI as the leading category of incremental spend on the network edge,** even ahead of other high growth areas such as WAN acceleration. In our May survey, 58% of respondents are expecting to increase their spending in this category versus only 2% of the respondents looking to reduce their spend (Exhibit 3).

Exhibit 25: The GS VDI model suggests a \$1.9bn opportunity by 2013

Market size (\$ mn), 2008-2013E

	Calendar Years						CAGR 09-'13
	2008	2009	2010E	2011E	2012E	2013E	
Commercial PC installed base (mn)	446	473	501	533	576	622	7%
<i>yoy growth</i>	8.6%	6.0%	5.9%	6.4%	8.0%	8.0%	
ASP - new license	\$50	\$55	\$60	\$70	\$75	\$80	10%
ASP - annual maintenance	\$11	\$12	\$14	\$16	\$17	\$18	
% of license value	21%	22%	23%	23%	23%	23%	
Units shipped (mn)	0.58	1.76	4.40	8.58	12.01	15.62	73%
<i>yoy growth</i>	165%	204%	150%	95%	40%	30%	
VDI installed base (mn)	0.99	2.75	7.15	15.73	27.74	43.36	99%
% of installed base virtualized	0.2%	0.6%	1.4%	3.0%	4.8%	7.0%	
License revenue	\$29	\$96	\$264	\$601	\$901	\$1,249	
% of total revenue	80%	81%	79%	77%	71%	66%	
Maintenance revenue	\$7	\$22	\$68	\$184	\$370	\$641	
% of total revenue	20%	19%	21%	23%	29%	34%	
VDI market (\$ mn)	\$36	\$118	\$332	\$785	\$1,271	\$1,890	100%
<i>y/y growth</i>	164%	226%	181%	136%	62%	49%	

Source: Company data, Goldman Sachs Research estimates.

Exhibit 26: Market share shifting to Citrix, by VMware remains a key vendor

Estimated revenue by vendor and market share, 2008-2013E

	Calendar Years					
	2008	2009	2010E	2011E	2012E	2013E
Revenue by vendor (estimated)						
Citrix	9	49	\$163	\$400	\$636	\$945
VMware	25	60	136	314	496	737
Others	2	9	33	71	140	208
Total	\$36	\$118	\$332	\$785	\$1,271	\$1,890
Implied market share						
Citrix	26%	42%	49%	51%	50%	50%
VMware	69%	51%	41%	40%	39%	39%
Others	6%	7%	10%	9%	11%	11%
Total	100%	100%	100%	100%	100%	100%
Growth (y/y)						
Citrix	NM	426%	233%	146%	59%	49%
VMware	90%	142%	126%	130%	58%	49%
Others	150%	325%	291%	113%	98%	49%
Total market	164%	226%	181%	136%	62%	49%

Source: Company data, Goldman Sachs Research estimates.

Key competitors: We believe VDI market share is currently shifting towards Citrix, but VMware remains a key vendor owing to their early entry into the space and dominance in server virtualization, which carries positive derivative benefits of customer perception and reach. We see Citrix and VMware dominating the market with the two vendors taking close to 90% market share for the foreseeable future. Citrix's historic expertise and installed base of customers already committed to server-based computing on the desktop, as well as a close relationship with Microsoft, gives Citrix an important edge, in our view. Our latest market feedback has been consistent with this view, with more signs of Citrix winning head-to-head, particularly in larger deployments. That said, both Citrix and VMware are focused on garnering customer mindshare in a critical stage of the market, which should help to drive innovation and education in the market. Others such as Quest Software, Red Hat, and other private vendors are also investing in VDI technologies, helping to help foster innovation.

Virtual Desktops should be a near-term positive, but a longer-term negative for PCs

Desktop virtualization remains in its infancy and will likely have minimal impact on the overall PC market in the near term.

The GS Software team estimates that less than 1% of the total commercial PC installed base (including PCs in corporations, governments, and education) had been virtualized before the end of 2009, although security, stability, and ease-of-support in virtualized desktop environments should drive penetration higher to 7% by end of 2013. For corporate PCs, we estimate that roughly 27 mn units could be virtualized by end of 2013 vs. less than 2 mn units exiting 2009.

Exhibit 27: We estimate that roughly 7% of corporate PCs could be virtualized by 2013.

	2007E	2008E	2009E	2010E	2011E	2012E	2013E
Corporate PC installed base	250,965	274,485	299,774	316,757	336,568	360,128	385,337
Penetration level, % cumulative	0.1%	0.2%	0.6%	1.4%	3.0%	4.8%	7.0%
Corporate PCs virtualized	324	629	1,760	4,561	9,929	17,340	26,877
Incremental PCs virtualized	324	305	1,131	2,802	5,367	7,411	9,537

Source: IDC, Goldman Sachs Research estimates.

New thin clients purchased for desktop virtualization deployments should lead to incremental PC units shipped in the near term, although longer life cycles will likely weigh on the overall PC unit growth longer term. Assuming that roughly half of the desktop virtualization demand will be satisfied with new desktop purchases over the next two years (slightly higher than our assumptions for the outer years considering that corporate customers have already stretched their replacement cycle by a year to roughly 4.5 years) and that a higher percentage of desktops in branch offices will be virtualized vs. PCs in main offices, we estimate that there could be an incremental uplift of roughly 0.9 million and 1.2 million new corporate PC unit shipments in 2010 and 2011, respectively. We expect branch offices will account for almost half of new corporate PCs deployed for desktop virtualization. However, in the intermediate to longer term, the elongated replacement cycle for these virtualized desktops (we estimate 6 years vs. less than 4 years for typical corporate desktops) will reduce the total number of replacement PC units and more than offset these incremental units, serving as a deflationary trend for the overall PC market.

Exhibit 28: Desktop virtualization's impact on overall PC units should be a net positive in the next few years

	2007E	2008E	2009E	2010E	2011E	2012E	2013E
Corporate PC installed base: remote offices	72,780	79,601	86,935	95,027	100,971	108,038	115,601
Penetration level, % cumulative	0.2%	0.3%	0.8%	2.0%	4.0%	8.0%	12.8%
Corporate remote office PCs virtualized	146	239	695	1,901	4,039	8,643	14,739
Incremental PCs virtualized	146	93	457	1,205	2,138	4,604	6,096
% virtualized through using old units	--	--	--	60.0%	70.0%	80.0%	90.0%
Incremental new PCs purchased for DT virtualization	--	--	--	482	641	921	610
# of units not replaced due to DT virtualization, remote offices	--	--	--	102	174	239	276
Net impact				380	468	682	334
Corporate PC installed base: main offices	178,185	194,884	212,840	221,730	235,598	252,090	269,736
Penetration level, % cumulative	0.1%	0.2%	0.5%	1.2%	2.5%	3.5%	4.5%
Corporate main office PCs virtualized	178	390	1,064	2,661	5,890	8,697	12,138
Incremental PCs virtualized	178	212	674	1,597	3,229	2,807	3,441
% virtualized through using old units	--	--	--	60.0%	70.0%	80.0%	90.0%
Incremental new PCs purchased for DT virtualization	--	--	--	639	969	561	344
# of units not replaced due to DT virtualization, main offices	--	--	--	125	242	390	481
Net impact				514	727	172	(137)
Corporate PC installed base	250,965	274,485	299,774	316,757	336,568	360,128	385,337
Penetration level, % cumulative	0.1%	0.2%	0.6%	1.4%	3.0%	4.8%	7.0%
Corporate PCs virtualized	324	629	1,760	4,561	9,929	17,340	26,877
Incremental PCs virtualized	324	305	1,131	2,802	5,367	7,411	9,537
% virtualized through using old units	--	--	--	60.0%	70.0%	80.0%	90.0%
Incremental new PCs purchased for DT virtualization	--	--	--	1,121	1,610	1,482	954
# of units not replaced due to DT virtualization	--	--	--	227	415	629	757
Net impact				894	1,195	854	196

Source: IDC, Goldman Sachs Research estimates.

We expect blended ASPs for corporate PCs to be negatively impacted as more corporations begin to deploy thin clients in their virtualized environments. Although we estimate that the incremental thin client units shipped driven by desktop virtualization projects will be only 1% of total corporate PCs shipped over the next 4 years, thin clients, which typically have ASPs much lower than average corporate PCs (we assume \$200 in our analysis versus \$830 for a corporate PC in 2009), should add pressure to blended ASPs for corporate PCs. Our analysis suggests that a growing percentage of thin client units shipped will impact the overall corporate PC ASP by roughly one percentage point per year. However, incremental corporate PCs purchased for new desktop virtualization projects should offset the ASP headwinds in the near term, adding roughly \$150 million - \$200 million net revenue.

Exhibit 29: We estimate that overall ASP impact from virtualized desktops will be a minor negative in the corporate segment

	2007E	2008E	2009E	2010E	2011E	2012E	2013E
ASPs (\$)							
Average corporate PCs	970	935	830	739	665	598	538
Virtualized desktops	200	200	200	200	200	200	200
Blended average corporate PCs	--	--	--	732	657	593	536
% difference vs. avg. corporate PCs	--	--	--	(0.9%)	(1.1%)	(0.9%)	(0.5%)

Source: IDC, Goldman Sachs Research estimates.

Software-as-a-Service (SaaS): Shifting compute from internal data centers to the Cloud

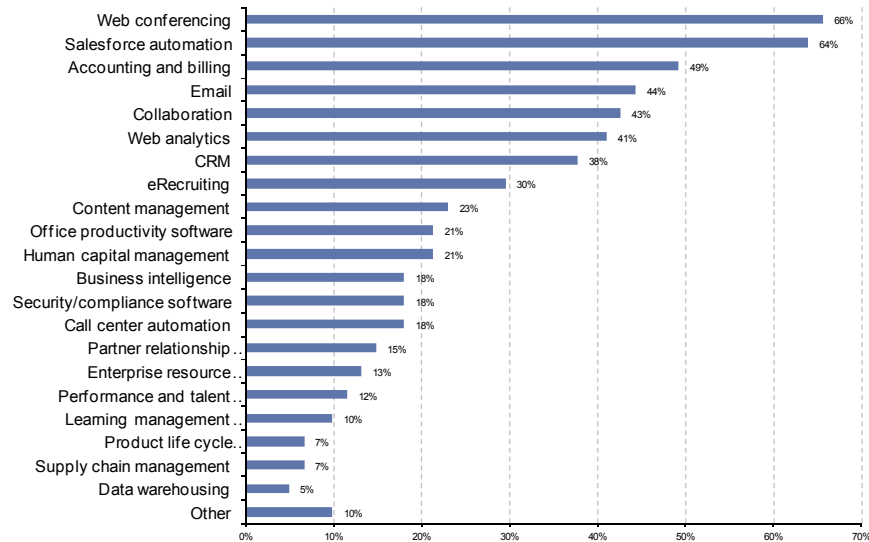
Just as VDI shifts hardware requirements from the endpoint to the internal data center, SaaS implementations shift the requirements to an external data center, as applications are increasingly deployed and accessed off-premise.

What is it: SaaS describes a delivery method whereby an application is hosted, supported, and maintained by the application vendor and accessed through the internet by users. Eleven years after the launch of salesforce.com, SaaS has become an accepted model and we expect incremental growth in software to be weighted toward SaaS.

Adoption drivers: The main drivers of SaaS adoption include: (1) ease of deployment; (2) limited upfront implementation costs; (3) decreased need for IT infrastructure; and (4) a price tag that affords smaller businesses access to more sophisticated applications than they could typically afford. Adoption of Software-as-a-Service hit an inflection point in large enterprise coming out of the economic downturn as IT departments focused on trimming costs and cutting capital budgets. SaaS is typically paid out of operating budgets and does not incur the large upfront implementation costs of a typical on-premise application deployment.

Exhibit 30: SMB usage patterns: Web conferencing and salesforce automation top of list but accounting and billing notable

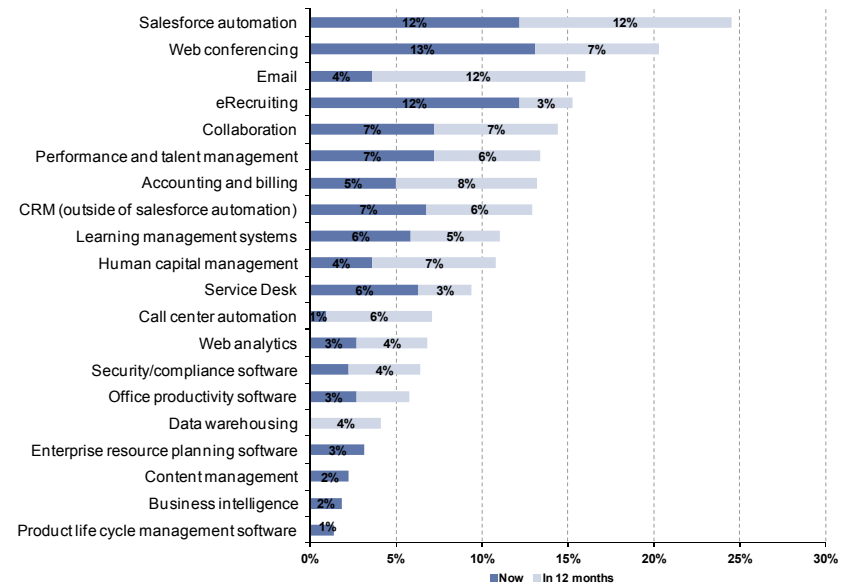
In what areas do you currently implement SaaS?



Source: Goldman Sachs SaaS Spending Survey, February 2010.

Exhibit 31: Fortune 100 usage patterns: Quite similar despite different technology requirements

What applications do you currently use on a SaaS model and which ones are you planning to roll out, if any, over the next 12 months?



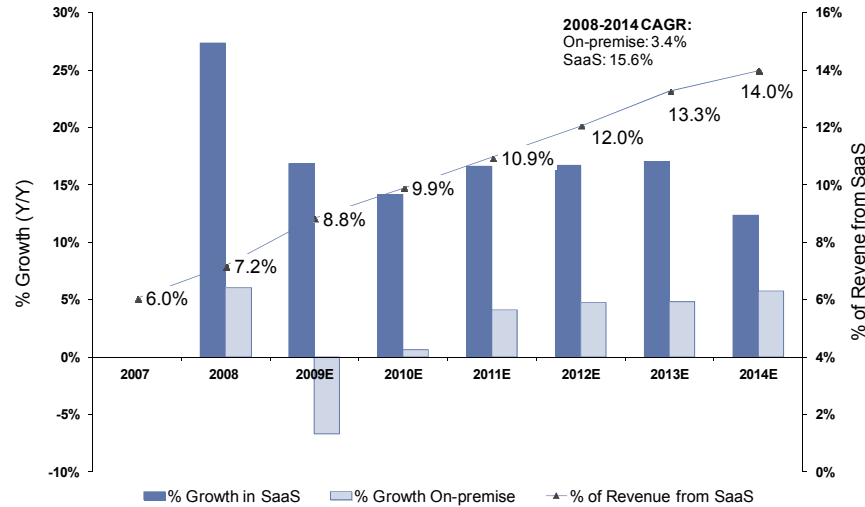
Source: Goldman Sachs SaaS Survey, February 2010.

Implications: As software is increasingly delivered over the internet, from a vendor data center, as opposed to hosted on-premise, IT departments will require less on-premise hardware on which to run those applications. Network speed, capacity and security become increasingly important as secure data is sent to and from vendor databases.

Market size and growth: Software-as-a-Service (SaaS) ushers in a new era to the software industry and we expect incremental growth in the enterprise software market to be weighted toward SaaS. On-premise applications still garner most share, but the growth is coming from SaaS. In the market for enterprise applications, only about 9%-10% of spending currently goes to SaaS application. Gartner estimates a 15.3% CAGR in spending on SaaS applications over the 2009-2014 time frame, versus 3.4% for on-premise enterprise apps.

Exhibit 32: SaaS should outpace traditional on-premise growth...

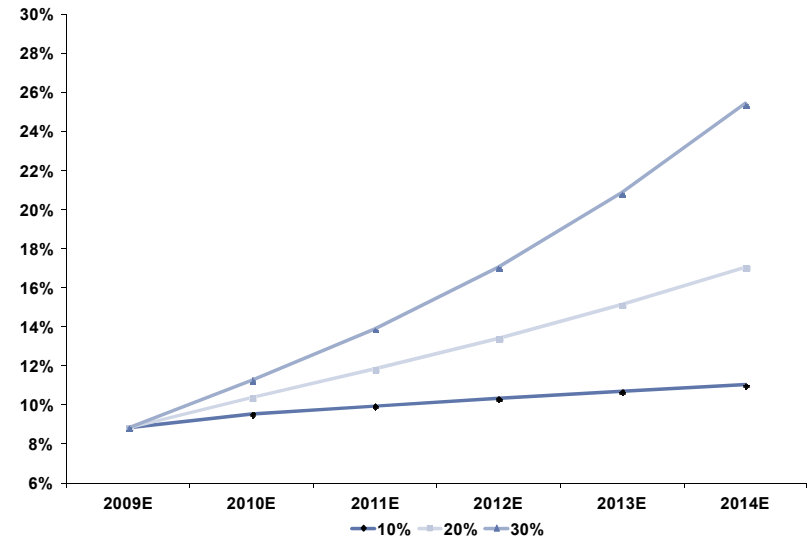
Growth in SaaS vs. on-premise enterprise applications and SaaS as a % of total



Source: Gartner.

Exhibit 33: but remains underpenetrated, with plenty of runway

SaaS as a % of total enterprise applications at various growth rates



Source: Gartner, Goldman Sachs Research estimates.

Key Competitors: Key beneficiaries of the shift to SaaS are the pure-play SaaS vendors, including salesforce.com, SuccessFactors, Taleo, Concur, and NetSuite in our coverage. Software incumbents, such as Oracle, SAP, Microsoft are working on competitive SaaS offerings, but have met limited traction thus far, given cultural challenges of selling on-premise software and SaaS under one roof.

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Please hit control and click with mouse to directly access the following research on GS360.

1. Global: Technology: The rise of the iPad and tablets: Assessing winners and losers in the global TMT ecosystem- Covello, Schneider, Friar, King, Takayama, Fassler, Mitchell, Schafer. <https://360.gs.com/gs/portal/?st=1&action=action.binary&d=9345921&fn=/document.pdf> Published July 12, 2010
2. US Technology Strategy: IT Spending Survey: Current results positive, but macro concerns keep our new 2011 outlook tempered- Friar, Bingham, Covello, Hettenbach, Jankowski, Quinteros, Cavenaghi. <https://360.gs.com/gs/portal/?st=1&action=action.binary&d=9309822&fn=/document.pdf> Published July 1, 2010
3. Americas: Technology: Software: SaaS Savvy: New coverage of Taleo (Buy), Concur, NetSuite; updating our views on SaaS- Withers, Friar, Stoichev. <https://360.gs.com/gs/portal/?st=1&action=action.binary&d=8925662&fn=/document.pdf> Published April 20, 2010
4. Americas: Technology: Software Security Spending Survey: Moderate optimism in 2010; Cloud posing new challenges. Friar, Withers, Stoichev. <https://360.gs.com/gs/portal/?st=1&action=action.binary&d=8675758&fn=/document.pdf> Published March 1, 2010
5. Americas: Technology: Software: Techtonics: Unstoppable shift to SaaS continues- buy SFSF; CTXS and ADBE also benefit- Friar, Withers, Stoichev. <https://360.gs.com/gs/portal/?st=1&action=action.binary&d=8565526&fn=/document.pdf> Published February 9, 2010
6. Americas: Technology: TMT Desktop: Back to macro, but fundamentals keep us positive; focusing on *Techtonics* and M&A- Covello, Friar, Mitchell, Armstrong. <https://360.gs.com/gs/portal/?st=1&action=action.binary&d=8623189&fn=/document.pdf> Published February 19, 2010
7. Americas: Technology: Data Center *Techtonics* Conference highlights a paradigm shift to cloud- Jankowski, Bailey, Friar, Park, Bingham, Hettenbach, Len, Quinteros. <https://360.gs.com/gs/portal/?st=1&action=action.binary&d=8129249&fn=/document.pdf> Published November 12, 2009
8. Americas: Technology: A paradigm shift for IT: The Cloud- Jankowski, Bailey, Friar, Lee, Park, Quinteros, Len, Bingham. <https://360.gs.com/gs/portal/?st=1&action=action.binary&d=8102053&fn=/document.pdf> Published November 8, 2009
9. Americas Technology: TMT opportunities created by shifts in the data center- Jankowski, Bailey, Park, Armstrong, Bingham, Covello, Friar, Lee, Len, Mitchell. <https://360.gs.com/gs/portal/?st=1&action=action.binary&d=7093024&fn=/document.pdf> Published April 30, 2009

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