

# **aCelera™**

## **Virtual Appliance for Application Acceleration**

### Architecture White Paper

July 2008

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## **aCelera™** Virtual Appliance for Application Acceleration

### Architecture White Paper

## **1.0 Introduction**

The advantages of consolidating servers through virtualization technologies are well known. More efficient use of hardware, greater deployment flexibility, and better management are just some of the benefits. These benefits stem largely from the economies of scale derived from leveraging common hardware infrastructure within an enterprise's centralized data centers. Increasingly, these economies are being further leveraged by moving servers out of branch offices and into virtualized data centers.

Unfortunately, this move toward consolidating servers and applications within the data center exacerbates performance problems experienced when more remote users access applications over the wide area network (WAN). Constraints of the intervening WAN, such as limited bandwidth and high latency, severely degrade application response time performance when accessed by remote users. The poor application performance remote users suffer can have a significant impact on an enterprise's overall operational efficiency and productivity.

This technical white paper describes the impact of the WAN on the performance of centralized virtual applications, as experienced by remote office users. It also introduces Certeon's *aCelera* Virtual Appliance (VA) for Application Acceleration software and describes its architecture, implementations, and deployment. Finally, it discusses how *aCelera* appliances enable the delivery of application acceleration as a service so that large enterprises and managed service providers can maximize their ROI (a return of more than \$12,000 per server over a period of 3 years. Source: VMware) from their virtualized application environments. *aCelera* is the perfect union of virtualization and acceleration, delivering flexibility, scalability, manageability, and cost reduction.

## **2.0 The Impact of Consolidation on the Remote Office**

Data center consolidation as driven by virtualized servers is already well under way within large enterprises. By the end of 2008, virtually all Fortune 100 companies will have deployed virtualization in production environments, and by 2009, the percentage of virtualized servers will reach 65 percent.<sup>1</sup> Clearly, the framework now exists for efficiently consolidating, managing, and rebalancing workloads in the data center. Virtualization enables IT managers to centralize data and applications that were once distributed among remote offices back into a consolidated central data center. This move enables businesses to decrease both fixed hardware costs and recurring IT maintenance expenses, while addressing security, compliance, manageability, and business continuity concerns.

### **2.1 WAN Issues**

As consolidation moves data and applications away from remote office users, one of the largest groups of consumers of these resources, those users must carry out their daily work by accessing these services remotely over the WAN. The negative effect of the WAN on application performance has long been recognized. Its roots lay in the generally inferior characteristics of these long-range networks, as compared to the 100 or 1,000 mbps LAN networks deployed locally within a corporate office or campus.

These poor WAN characteristics include:

- Limited bandwidth: less than 1 to 10's mbps
- Latency: 10's to 100's ms

Depending on the protocol or application running between the remote office and data center, the WAN can significantly impact performance. Some protocols, such as FTP or HTTP, suffer mainly from bandwidth limitations, especially when used to transfer large files. Chatterier protocols like CIFS, which provides file sharing services, are sensitive to both limited bandwidth and high latency on the WAN and suffer even poorer performance.

Increasingly, IT managers are addressing WAN issues by adopting acceleration appliances. These appliances traditionally are repackaged server computers containing proprietary software for acceleration. They are deployed in both the data center and remote office locations. These appliances work together to intercept traffic flows between remote office workers and data center servers and perform operations that accelerate these flows. They typically perform some or all of the following operations:

- Data compression and de-duplication
- Protocol optimization
- TCP optimization
- Traffic prioritization or shaping

If implemented correctly in the acceleration appliance, these techniques can mitigate the WAN effect and significantly improve the performance of consolidated applications accessed by remote office users.

## **2.2 Virtual Appliances versus Physical Appliances**

For the most part, traditional WAN accelerators are specially configured “closed” servers, provisioned by the appliance vendor for this specific purpose, with no access in order to add other general purpose applications or system upgrades. These appliances are symmetrically deployed at both the data center and remote branch offices. In most cases, the start-up and maintenance costs of those deployments prevent many distributed enterprises from putting a WAN acceleration appliance in the branches that have either limited or no IT staff. Also, upgrading these appliances to higher-performing devices as technology evolves would require a forklift upgrade, which is expensive and disruptive to users. Underneath the hood of these appliances, there is very little difference between a WAN accelerator and a generalized server computer. In fact, given the economies of scale driving the server market, it is hard to justify using anything other than commodity server hardware for WAN acceleration.

### **2.2.1 Virtual Appliance for Application Acceleration**

VAs for application acceleration meet customers’ requirements for both consolidation through virtualization and application acceleration over the WAN. Deployed as software on industry-standard servers, VAs can be flexibly and cost-effectively deployed to multiple remote branch offices throughout the enterprise from a data center SAN or integrated storage device. Whereas the expense of the hardware and maintenance of single-purpose hardware WAN acceleration appliances can often make deployment to multiple branch offices cost prohibitive, a software-based VA is much more cost-effective to deploy to multiple branches. There are two aspects of application acceleration flexibility, manageability, and scalability that need to be considered: the data center and the remote office.

#### ***The Data Center***

In the data center, considerable investment in WAN acceleration infrastructure is likely. There are variations in load that follow daily, weekly, and seasonal trends. Few IT managers want to commit hardware resources to a service that may change with varying business conditions. With preset physical appliances, you are locked into system resource boundaries (i.e., CPU, memory, and storage), regardless of loads. Virtualizing WAN acceleration in a VA allows the hardware commitment to vary with the load. If more resources are required for application acceleration, you would need to swap out a physical appliance for a larger, more powerful model. VAs allow you to gradually upgrade CPU, memory, or storage as required. Moreover, a VA achieves acceleration from within the existing virtualized infrastructure rather unlike proprietary hardware appliances which reside external to the virtual machine (VM) environment. VAs can also be monitored and controlled with existing virtualized infrastructure management tools.

### The Remote Office

Physical appliances are often over provisioned for small offices. Remote offices are more likely to be decompressing rather than compressing traffic, and since decompression requires fewer processor cycles, there is less load. However, physical appliance vendors must define models that cover a broad range of use cases rather than address specific needs. These models often must reserve CPU and memory capacity for future growth, capacity that goes underutilized in the meantime. With VAs, you can provision application acceleration where you need it. VA performance can also scale as server system resources are upgraded (i.e., CPU, memory, and storage). VAs can be moved easily during their product lifetime onto hardware that is steadily improving in performance. The VA application response time performance is as good as a physical appliance's performance and has been demonstrated to use 50 percent less system resources (i.e., CPU and memory), so smaller, more affordable systems can be used at the branch office to support application acceleration. VAs in the branch offices also can be remotely managed from within a centralized virtualized management system, unlike physical appliances, which require separate management to be controlled and monitored.

### Application Acceleration as a Service

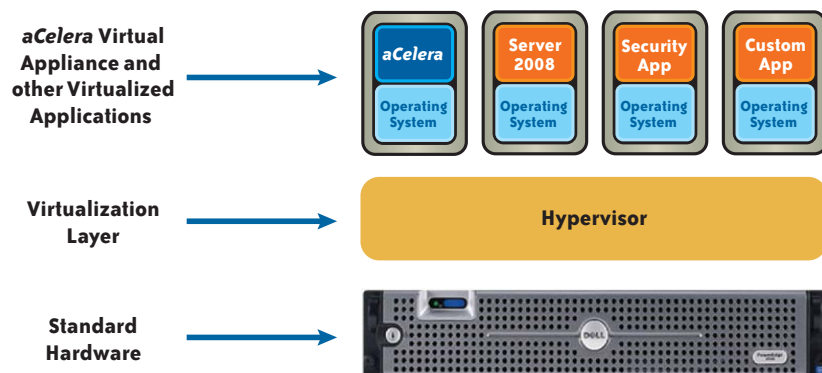
Because acceleration is now more accessible via virtualization, enterprises can afford to expand “acceleration as a service” to many more users who need it. Before, with a hardware-only solution, companies could not afford to address or even manage those end users’ performance expectations. VA software offers companies an inexpensive, flexible, and scalable solution for those remote users who were not able to benefit previously from application acceleration.

### 3.0 aCelera Virtual Appliance Architecture

The aCelera software is the first and only application acceleration solution based on the same virtualization technologies (i.e., VMware ESX, ESXi, and Microsoft Hyper-V) that drive server consolidation and deliver the acceleration, flexibility, and manageability demanded by today’s virtualized enterprises.

Every aCelera application accelerator is packaged as a VA running within a virtualized environment. More specifically, aCelera runs on top of an industry-standard virtualization layer termed the “hypervisor.” This hypervisor provides aCelera with a flexible machine environment that is agnostic to the underlying hardware computing and storage infrastructures. This allows aCelera to run on a wide range of physical servers and utilize both internal disk drives and external SAN storage arrays in exactly the same way virtualized servers do. As a VA, aCelera can be deployed on dedicated hardware or added to an existing virtualized infrastructure. See Figure 1.

Figure 1. aCelera as a Virtual Appliance within a Virtual Machine

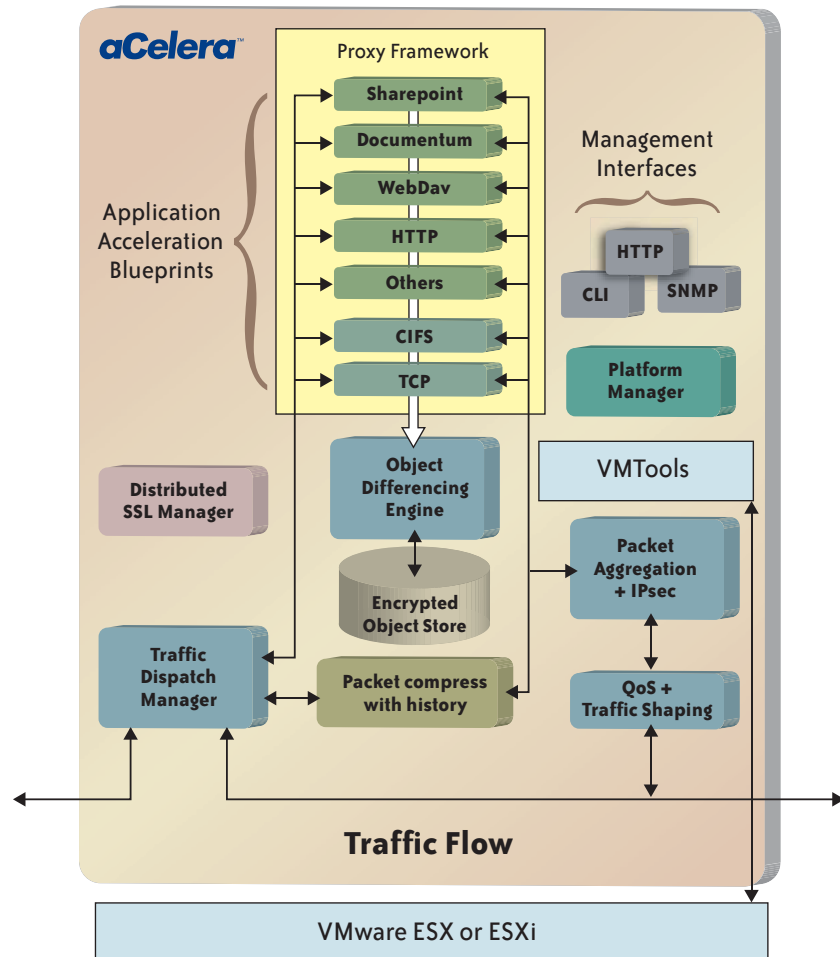


### 3.1 aCelera Software Components

Inside aCelera is a set of purpose-built software components that work together to accelerate traffic over the WAN. These components include VMTools, which enables aCelera to act as a VA under VMware ESX and ESXi hypervisors and to be managed via VMware’s VirtualCenter management system. Figure 2 illustrates the aCelera software architecture and its integration with VMware.

aCelera will also support Microsoft’s Hyper-V hypervisor and the management features incorporated within Microsoft’s System Center Virtual Machine Manager when production versions of these products become available.

**Figure 2. aCelera Software Components and Integration with VMware**



### 3.1.1 aCelera Application Acceleration Components

The following section describes how a*Celera*'s application acceleration components operate to significantly reduce application response time through various compression and data object reduction techniques.

In delivering application acceleration, a*Celera* internally performs a host of operations that together reduce traffic over the WAN, mitigate the effects of network latency, manage network bandwidth, and handle security. These are:

- Data compression and de-duplication
- Protocol optimization
- Traffic prioritization and shaping
- Packet aggregation
- SSL session proxy
- Virtual private networking (VPN)

The a*Celera* components that perform these operations are described below.

#### High-Performance Proxy

Traffic flows between clients and servers are intercepted by the a*Celera* appliance for processing by this high-performance proxy. It is here that related components (described below) carry out a range of acceleration functions, such as data compression, de-duplication, and protocol optimization.

##### • Object Differencing Engine

This core component performs advanced data compression and de-duplication functions on traffic flows and their embedded data objects. Utilizing a persistent history store that is managed within a virtualized storage environment, the Object Differencing Engine learns transmitted data and uses it for subsequent de-duplication. In this way, the amount of traffic sent over the WAN can be reduced by up to 99 percent.

##### • Application Acceleration Blueprints

A unique part of the a*Celera* architecture, Blueprints decode traffic flows to uncover specific application data objects hidden inside. This "application knowledge" is conveyed to the Object Differencing Engine, enabling it to perform enhanced compression and de-duplication operations, thereby further improving the acceleration achieved for business-critical applications. Importantly, Blueprints also perform protocol specific optimizations that mitigate the effects of high-latency WAN environments. Spoofing, read-ahead, and write-behind operations are some examples.

##### • Traffic Dispatch Manager

This component manages traffic flows entering and leaving the a*Celera* VA. It performs a number of packet-level operations that impact the performance or security of traffic flowing over the WAN. These include:

- Packet aggregation: reduces IP header overhead, saving WAN bandwidth
- QoS and traffic shaping: ensures that scarce WAN bandwidth is allocated appropriately to applications according to defined policies
- IPsec: provides industry-standard security over the WAN

- **Distributed SSL Manager**

This unique component allows the transparent acceleration of encrypted traffic between clients and servers. More important, it does so without the need for special *aCeler*a certificates and without compromising the security of native server private keys. Secure acceleration is achieved without added management overhead and without compromising overall system security.

- **Platform Manager**

The brains of the *aCeler*a appliance, the Platform Manager provides external management interfaces for configuration and performance monitoring. It also manages the coordination of configuration and acceleration between *aCeler*a appliances.

## 3.2 VMware Infrastructure Integration

Certeon's *aCeler*a was developed to be integrated as a VA within a virtual machine (VM) architecture. The first VM operating system that *aCeler*a has been certified on is VMware Infrastructure 3 for hypervisors ESX and ESXi.



To accomplish this tight level of integration and certification, *aCeler*a was developed to incorporate VMTools as one of *aCeler*a's management interfaces. *aCeler*a VA software ships with VMTools. To date, no other application acceleration or WAN optimization vendor has taken those steps to become a part of the VMware infrastructure and obtain VMware-certified validation as a VA.

### Benefits of *aCeler*a and VMware Integration

The VMware integration enables *aCeler*a to take advantage of many of the VMware components and deliver benefits that cannot be achieved by physical appliances that sit outside of the VMware infrastructure.

#### VirtualCenter — Centralized Management

- *aCeler*a can be managed and provisioned via an established standardized set of virtualization monitoring and control tools – specifically VMware VirtualCenter.
- Increased ease of provisioning and deployment of *aCeler*a appliances anywhere within the VMware infrastructure is provided through the management interface. Includes setup, configuration, performance parameters, resource allocation, and other benefits.
- *aCeler*a software can reside on any data center SAN and be deployed throughout the VMware infrastructure on any VMware VM.

#### VMotion — Ease of Maintenance

- VMotion gives system managers the ability to move a running process (i.e., *aCeler*a VA) from one virtual machine to another without restarting the system. This provides ease of maintenance and configuration without losing connections to any other devices.

#### Dynamic Resource Scheduling (DRS) — Enhanced Resource Allocation and Scalability

DRS gives system managers the ability to manage CPU and memory resource allocation across multiple VMs. This allows the system manager the ability to reduce or increase CPU allocation, clock cycles, and memory that the *aCeler*a VA requires to meet overall system and performance requirements. System managers will be able to maintain performance and maximize system resources (i.e., CPU allocation, clock cycles, and memory) across all the VMs and their applications, including the *aCeler*a VAs.

Because of DRS, VMware can over commit the system memory to support multiple applications and still achieve optimal performance. This allows system managers to maximize the number of applications that can be supported by a VM, including the *aCelera* VA. If more performance is required from *aCelera*, they can start another instance of the *aCelera* VA on any VM in the infrastructure.

#### **Virtual Machine File System (VMFS) — Agnostic Storage Device Support**

- VMFS lets system managers deploy *aCelera* VA software on any storage device within the VMware infrastructure, no matter where it is or what type of device it is (e.g., SCSI, iSCSI, FC SAN, SATA, etc.). These devices can be external (networked) or internal (directly attached) to the system.

#### **VMware High Availability (HA)**

- *aCelera* takes advantage of the VMware HA features so that if the virtual machine that has *aCelera* software running on it dies, VMware migrates the *aCelera* VA and all other applications to a designated backup system. An HA environment can be set up within branches and data centers, so if a VM fails, another VM system takes over.
- If the *aCelera* VA stops working, then VMware automatically restarts the *aCelera* VA instance.
- Because *aCelera* is part of the VMware environment, it participates in whatever business continuance/disaster recovery (BC/DR) application VMware supports (e.g., Site Recovery and Consolidated Backup or other third-party tools). You can have a fully featured BC/DR environment for half the cost of traditional BC/DR environments because of the way VMware manages and scales the VM resources using DRS.

### **3.3 Microsoft Hyper-V Integration**

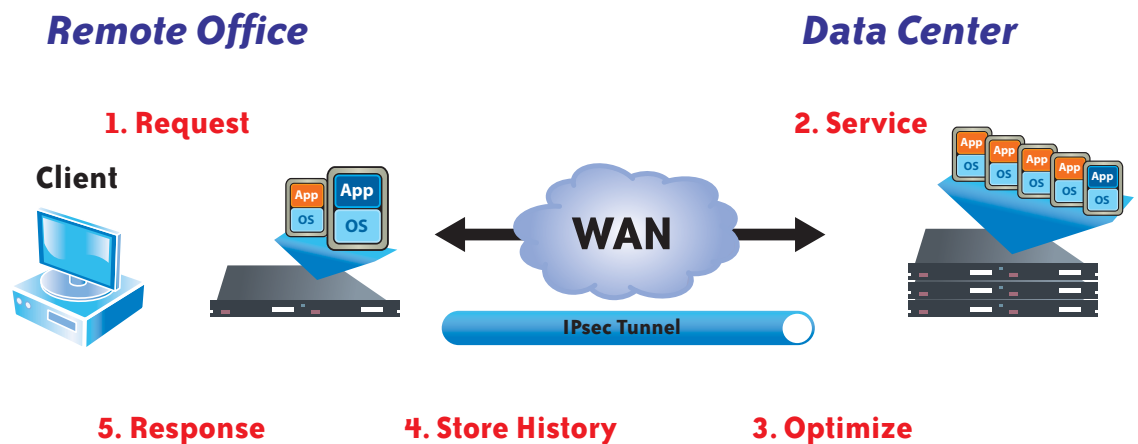
As a worldwide leader in enterprise software solutions, Microsoft will be entering the virtualization marketplace later this year with its much-anticipated Hyper-V product. Hyper-V is Microsoft's own hypervisor technology, which runs as part of its latest server operating system, Windows Server 2008. In addition, Microsoft will be enhancing its System Center Virtual Machine Manager specifically to take advantage of the capabilities of Hyper-V.

## 4.0 How aCelera Works

aCelera VAs are deployed in both the data center and remote offices. The data center and remote office appliances work together to accelerate application traffic flows between remote office clients and data center servers. By employing the internal components described above, these transactions are carried out faster and with significant savings in bandwidth. This improves overall application performance and thus end-user productivity.

A simple example of this acceleration is shown below in Figure 3.

**Figure 3. How aCelera Works**



**1. Client Request:** The aCelera appliance in the remote office intercepts and then parses, compresses, and forwards the request to the data center aCelera appliance. The data center aCelera appliance decompresses and forwards the request to the server. Both aCelera appliances prepare to accelerate the server response. In addition, both aCelera appliances optimize the protocol by eliminating unnecessary request-response transactions.

**2. Service:** The server validates the client request as normal, ensuring that content is fresh and served only to an authenticated user. The server sends its response.

**3. Optimize:** The data center aCelera appliance performs compression and de-duplication of the server response by utilizing its history store. Data over the WAN can be reduced by up to 99 percent.

**4. Store History:** Both aCelera appliances update their history stores by adding new data contained in the response. In this way, they learn data patterns and objects over time, further improving performance.

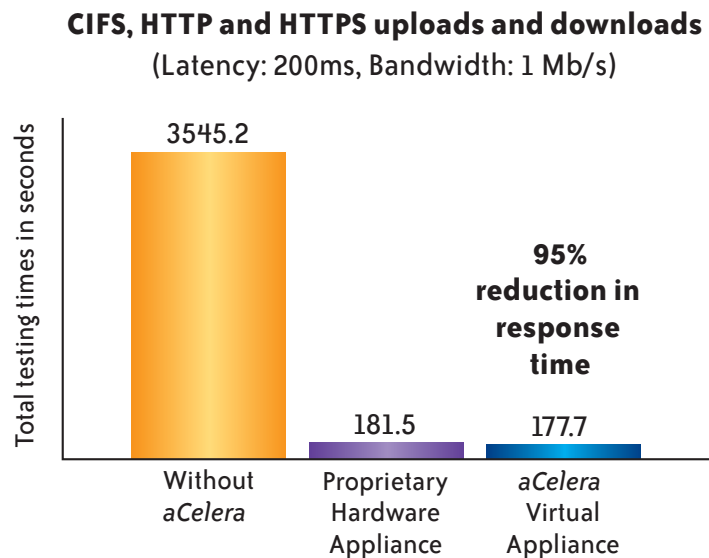
**5. Response:** The remote office aCelera appliance reconstructs the server response and sends it on to the client. This completes the transaction in less time, improving overall application performance.

## 4.1 Performance Metrics

aCelera's impact on application performance in real-world environments is illustrated in the graph in Figure 4. As shown, the time to deliver files over the WAN is drastically reduced with aCelera. aCelera's unique data de-duplication accelerates files as well as proprietary hardware appliances, reducing transmission times by more than 95 percent. Rendering times for pages in Web-based applications are also reduced significantly because

of *aCeler*'s Private Cache Acceleration (PCA), a protocol optimization feature. As previously mentioned, *aCeler* VAs deliver the same reduction in application response time as physical appliances, using 50 percent of the system resource capacity.

**Figure 4. *aCeler* Performance versus Proprietary Appliances**



## 5.0 *aCeler* Solutions

*aCeler* is available for deployment in both existing virtualized environments and environments where virtualization is not present. For instance, in data centers that already have an installed base of virtualized server computers and shared storage, *aCeler* can be purchased and deployed purely as software. In sites that are not yet virtualized, such as remote or branch offices, *aCeler* can be purchased and deployed in a plug-and-play appliance package. This solution includes not only the *aCeler* software, but also an embedded hypervisor and server hardware with integrated storage.

### 5.1 *aCeler* Virtual Appliance Software

For the growing number of enterprises that have already adopted virtualization as a key component of their overall consolidation strategy, adding application acceleration via *aCeler* VA software follows the same practices as any other VA on a virtual system. *aCeler* software can be flexibly configured, utilizing CPU cores, memory, and disk storage according to the throughput and user loads required. Machine cloning, migration, and high-availability features available from the virtualized environment are fully supported by *aCeler*.

*aCeler* VA software is available on CD media or can be downloaded over the Web from Certeon or its partners.

### 5.2 *aCeler* Physical Appliance

For those customers or sites without a virtualized infrastructure in place, *aCeler* VA software is also available in a plug-and-play physical appliance package. Along with *aCeler* VA software, the *aCeler* Physical Appliance (PA) also includes an industry standard VMware ESXi hypervisor and server hardware. The *aCeler* PA is a standard Dell server platform with integrated SCSI storage. The entire package is preconfigured and ready for installation. No explicit management of the ESXi hypervisor or VM environment is necessary.

The aCelera PA provides the same deployment characteristics as any conventional hardware acceleration appliance, but with one important difference: because it contains an industry standard hypervisor, the platform can be leveraged over time by the addition of other VA or server solutions, such as BC/DR, security, and Server 2008. This is especially important for branch offices where other localized services are required. For instance, print or directory services can be added, cost-effectively utilizing the same hypervisor and hardware as aCelera.

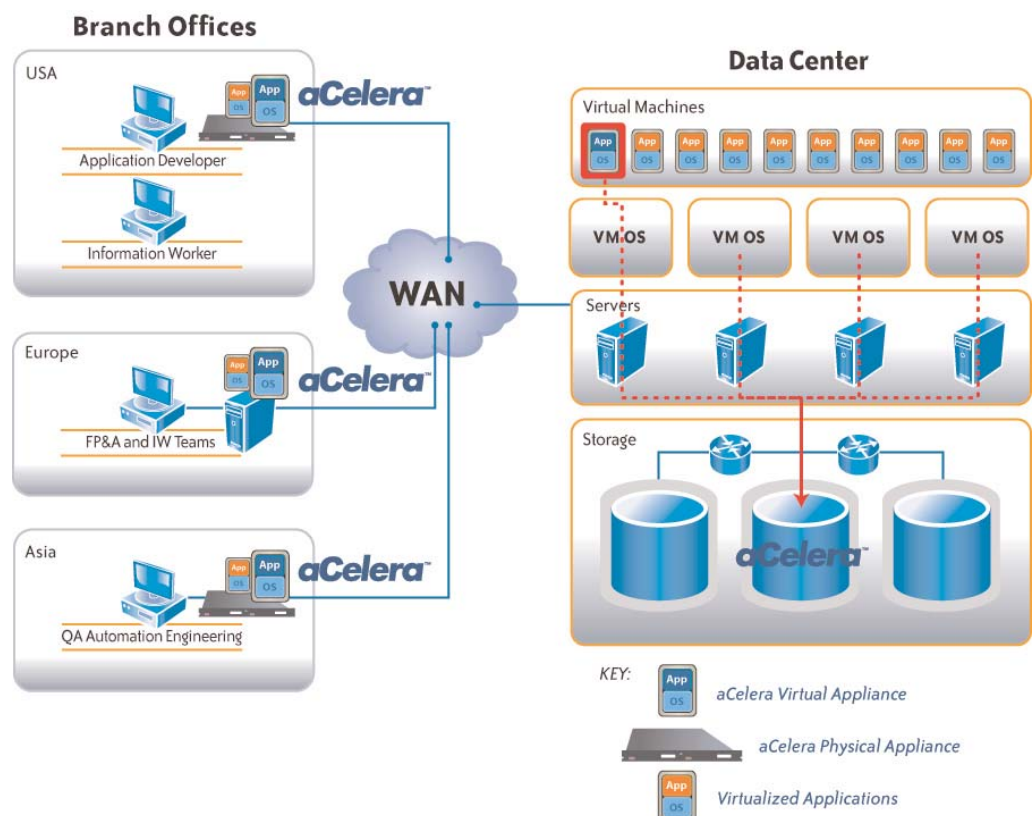
The underlying hardware is currently available in a range of standard Dell 1 RU server platforms.

### 5.3 Deployment Options for aCelera

Logically, the aCelera VA sits in the data path of communication between remote offices and the data center. Traffic may either be intercepted by aCelera directly in an in-line deployment or redirected to aCelera by routers employing Web Cache Communication Protocol (WCCP) or Policy Based Routing (PBR). In a virtualized environment, even the routers themselves may be VAs.

aCelera appliances can be deployed throughout a distributed enterprise in a number of ways, as shown in Figure 5. Centrally provisioned from a virtualized data center, aCelera VA software can be deployed onto industry-standard servers throughout data centers and remote branch offices from a corporate SAN or integrated storage devices. aCelera appliances can be deployed to branch offices where application acceleration is needed, but virtualization is not present. The aCelera PAs enable remote branch offices to cost-effectively gain both virtualization flexibility and application acceleration performance, as well as run support standard applications as required.

**Figure 5. aCelera within a Distributed Enterprise**



## 6.0 aCelera's Differentiation

There are many advantages of an aCelera VA solution in delivering application acceleration throughout the distributed enterprise, including:

- **Performance:** aCelera delivers more than 95 percent reduction in application response time over the WAN, using 50 percent less system resources.
- **Ease of Deployment:** aCelera can be downloaded as software and deployed without installing and wiring specialized hardware.
- **Operational Efficiency:** aCelera utilizes existing hardware infrastructure, saving space and power and reducing complexity.
- **Scalability:** As a virtual machine, aCelera can grow with increased demand, without the need to add additional hardware appliances, and application acceleration can be allocated to make the best use of system resources when needed.
- **Flexibility:** aCelera can be tailored to fit the specific demands of application acceleration as they vary from site to site or change over time. aCelera offers application acceleration as a service to a variety of distributed enterprise environments.
- **Manageability:** aCelera's intuitive management system is integrated with existing management tools, such as VMware's Virtual Center, and is able to take advantage of a number of virtualization management features and benefits.
- **Security:** As a leader in secure application acceleration, Certeon delivers aCelera with industry-leading features that enable the acceleration of applications with end-to-end security.

## 7.0 Summary

Certeon's aCelera VA software is the industry's first and only VA to deliver acceleration, virtualization, and manageability when remotely accessing applications throughout a distributed enterprise. aCelera was architected to integrate its unique application acceleration components within a VM infrastructure such as VMware or Microsoft Hyper-V. This tight integration enables aCelera to take advantage of many scalability, reliability, and manageability features within a VM infrastructure. aCelera VAs reduce application response time over the WAN by more than 95 percent, while using 50 percent less system resources than proprietary hardware appliances. As a VA, aCelera is flexible and easy to deploy within a distributed enterprise, enabling system managers and managed service providers to offer their users *application acceleration as a service*. aCelera enables businesses to meet cost-saving consolidation objectives faster while increasing overall user productivity through high-performance access to virtualized applications.