Enhancing Desktop Virtualization Platforms with Configurable IP Cores

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Equipped with smart mobile devices, employees are increasingly taking their work outside of traditional cubicles and offices. With this growing trend toward mobility, not to mention workforce globalization, corporate IT departments are challenged to maintain safe, reliable access to corporate data assets. Desktop virtualization with virtualized servers represents an effective solution—users gain secure access to corporate data stores from their authorized, connected devices. To help optimize the performance of these virtualized platforms, IT teams are turning to configurable intellectual property (IP) cores.

Contents

Introduction

More and more, mobile workforces continue to demand secure access to corporate data assets through the cloud from their connected devices of choice. As a result, IT departments are turning to hosted virtual desktops (HVDs) on virtualized servers as a reliable and scalable means to deliver this data access. New service models utilizing such environments, such as IT as a service (ITaaS) or desktop as a service (DaaS), can increase IT productivity and efficiency while reducing total cost of ownership.

To make it easier to implement and maintain virtual desktops, IT teams often turn to server virtualization, which supports full utilization of datacenter server compute capacity for load balancing. Each virtual desktop can then be hosted on one isolated virtual machine (VM), each with a different guest OS. Virtualized environments have high demands on memory and storage in order to keep the virtual desktop sessions running for a large number of users. As such, virtualized server environments must be designed to accommodate requirements around bandwidth, memory, storage, power, and even video/image/audio processing. Specialized memory/storage, interface, and processor IP cores present a viable option to help design engineers enhance the performance of virtualized platforms.

Hosted Virtual Desktops a Growing Market

Globally, the HVD market is expected to grow at a CAGR of 65.7% from 2012-2016, according to TechNavio. In its July 2013 report, "Global Hosted Virtual Desktop Market 2012-2016," TechNavio's analysts noted that a key factor for this market growth is the increasing need to reduce desktop infrastructure costs. Other factors are the evolution of cloud computing and cloud-based services.

Even from the beginning, HVD has imposed demands on the interaction with end devices. Traditionally, the emphasis was on computation-intensive server applications such as databases, simulations, and scientific computations. Today, the number of virtual users is increasing exponentially, and the types of user input methods are changing. Webcams, touchscreens, voice- and gesture-controlled devices, and joysticks have joined the traditional keyboard, video, and mouse (KVM) user-interface combination.

In today's virtualized environment, it's common for the HVD agent on the server side to emulate the user interaction. The end user's personalized desktop environment and applications are run on a VM hosted by a virtualized compute server. The end user can then access the desktop environment from any client hardware platform that is connected to the corporate network or over the cloud. The GUI is projected to the client platform and rendered locally. Inputs from the end user are relayed back to the virtual desktop on the server to interact with applications. See Figure 1 for a depiction of this virtualized environment.

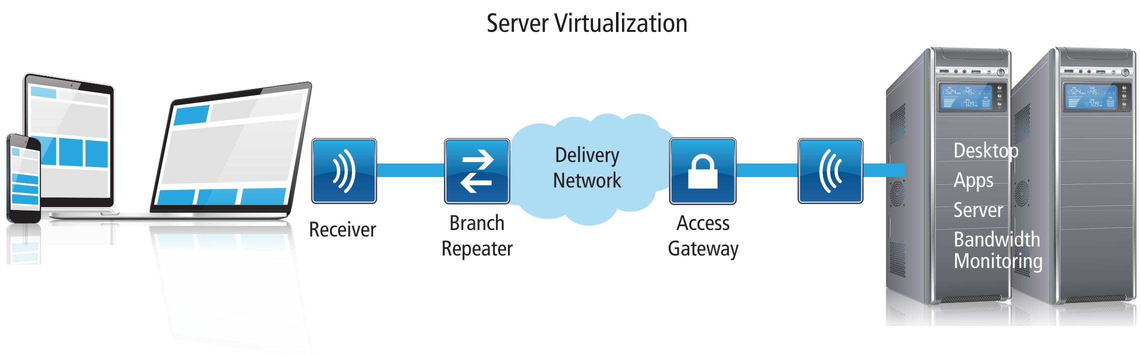

Figure 1: This diagram shows how a connected mobile device can access corporate data via a virtualized platform environment.

How Custom ASICs Can Enhance Virtual Servers

As an example, let's consider how one global networking company enhanced its virtualized server platform to support HVD-type applications. Taking a traditional physical server environment, the company developed enhancements to improve scalability in the areas of memory capacity and bandwidth of the converged network/storage network.

To support these enhancements, the company applied memory extender and fabric extender technologies. The memory extender technology increases the DDR memory capacity on each server blade. The fabric extender technology assigns virtual converged networking interface card (CNIC) ports directly to VMs, allowing VM migration through the top-of-rack (ToR) fabric interconnect without disconnection.

Custom ASICs can also be used to enhance virtualized server platforms. In the example of the global networking company, its IT team accommodated the physical partition of the servers by implementing capability enhancements in ASIC chipsets, instead of in a single device. To expand memory capacity, they applied physical-to-logical mapping, inserting a specialized ASIC between the CPU and the memory DIMMs to increase the total DDR memory capacity of the virtual server by 4X.

To expand converged network/storage connectivity, the team implemented a converged network adapter (CNA) ASIC to provide multiple physical ports of 10G Ethernet/Fibre Channel connectivity, as well as multiple virtualized network adaptors to virtual servers. The CNA is a mezzanine card that the team inserted into its server platform using a 10G-KR-based backplane, as Ethernet technology eases the process of building connectivity.

Indeed, for Ethernet applications, 10G-KR is emerging for the backplane, while 40G-KR can be a future replacement. To support 10G-KR, Cadence offers interface IP with very low active power (per lane and per Gbps) and high-performance long-reach channel with >31dB insertion loss and bifurcation support for multi-lane configuration.

The Role of IP in Enhancing Virtualized Environments

When hosting feature-rich desktop OSs on the servers, emulation of all possible user interface devices turns into quite a challenging software task. Fortunately, user-interface devices are converging to a standard-based USB interface on client systems. As shown in Figure 2, an IP sub-system consisting of USB 3.x xHCI host controller and device controller IP can support a virtual USB device emulation scenario. Using USB hardware in a custom ASIC is another way to achieve virtual USB device emulation. The virtual USB devices are software proxy agents running on the server representing client-side USB devices. The enumeration is performed through a hardware-based USB bus hierarchy embedded in the ASIC.

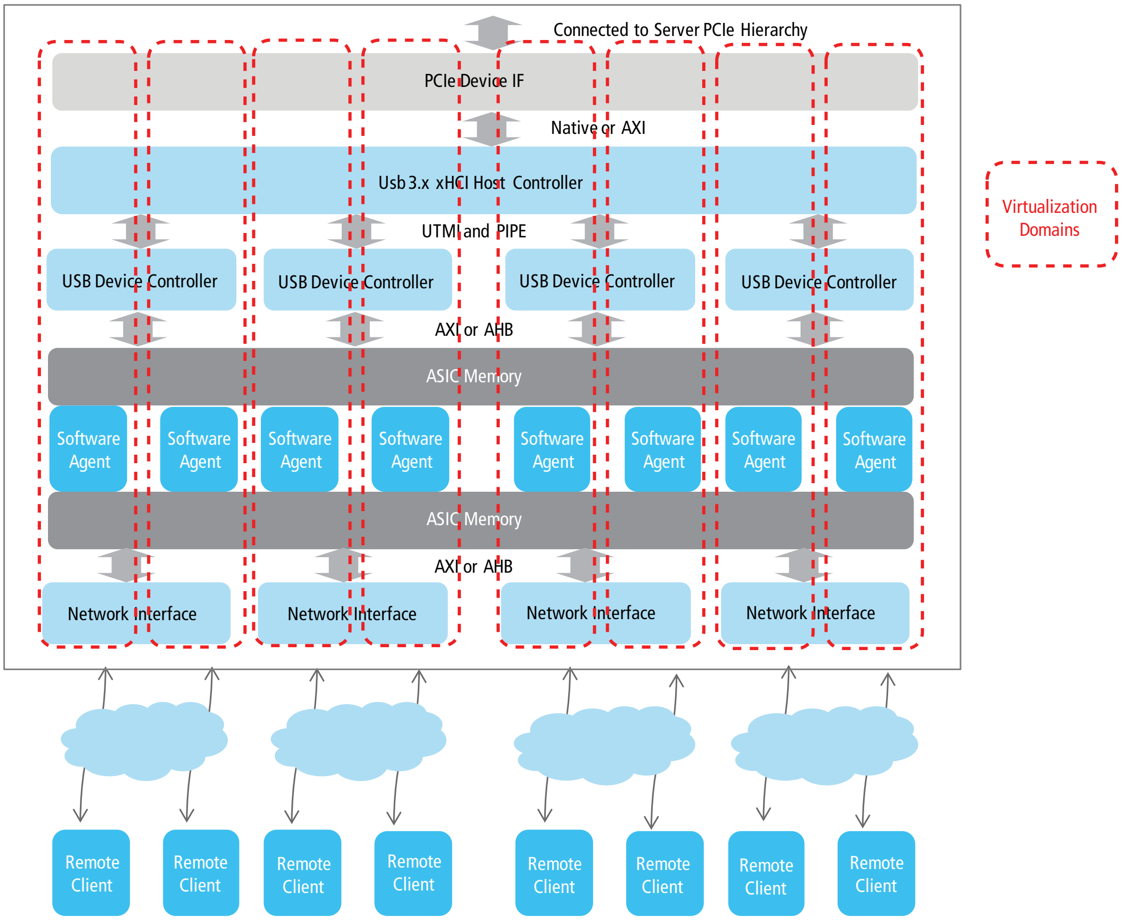

Figure 2: IP subsystem for USB device emulation

IP cores can support the implementation of custom ASICs to enhance virtualized environments. The IP can both ease the development process and also provide the functionality needed. For example, for server applications, capacity, performance, and reliability are the most important attributes that require a lot of memory capacity. Servers have long relied on dual inline memory module (DIMM) technology to increase system memory capacity via a large array of memory devices. DIMM technology is now evolving from UDIMM to RDIMM and LRDIMM. UDIMM doesn't provide any registering or buffering of DDR interface signals, so speed and signal integrity decrease as more memory devices are added to increase capacity. Both RDIMM and LRDIMM register and buffer the DDR interface signals, so memory capacity significantly increases with more memory devices and the interface speed increases to deliver higher performance.

For high-performance computing on a multi-core physical server that is hosting many independently operating VMs, memory utilization can be significantly improved with advanced DDR memory controller IP. For data reliability, end-to-end error correction code (ECC) protects data read/write from/to memory. Memory built-in self-test (MBIST) detects runtime defects of memory. These features minimize undetectable data corruption in the high-density computing environment of datacenters. In addition, these features improve the manageability and observability of server applications such as HVD.

There are other areas of a virtualized environment where IP can help. In the area of USB device emulation, USB host controller and device controller IP cores can address performance, power, and area (PPA) requirements. A scalable USB controller with support for I/O virtualization through virtualized PCI Express (PCIe) interface IP cores presents another beneficial scenario. Given the type of user-interface devices now common in desktop virtualization environments, image and video processing as well as digital signal processing (DSP) capabilities are also important. Here, configurable IP cores can support high-quality video streaming and sharp photo displays, while DSP cores can support the audio, voice, and speed functionality that's critical for new applications such as teleconferencing and workforce virtual collaboration.

Cadence offers a broad IP portfolio with functionality that can help streamline the development of components for virtualized environments. IP cores such as DDR controllers and PHY provide silicon-proven support for RDIMM and LRDIMM for DDR3/DDR4 memory devices. The company's DDR4/DDR3 controller and PHY IPs support ECC and enhanced MBIST. The company's Denali® DDR controller supports advanced quality of service (QoS) features such as multi-level arbitration (placement queue) and intelligence traffic scheduling of memory transactions across multiple data ports. Cadence also offers USB IP that supports USB 2.0 and USB 3.0 specifications, with controller, PHY, software stack, verification IP, and an application platform that can lower design risks and speed time to market. In addition, the company's configurable Tensilica® HiFi audio, voice, and speech DSP cores and its IVP for image and video processing cores are efficient, high performance, and ideal for data-intensive tasks.

Summary

As the "bring your own device" way of working becomes more entrenched in the modern world, IT departments will continue to seek efficient ways to optimize desktop virtualization environments. Configurable, customizable memory and storage IP cores provide one avenue toward easing the development process and enhancing the performance of these virtual platforms.

For Further Information

Learn more about Cadence's IP portfolio at http://ip.cadence.com/