Cisco UCS E-Series Servers

Performance Guide

March 2014

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Introduction

As customers move to lean branch-office architecture, they need to know which applications need to run at the branch location and what computing resources are required. Each application has its own unique behavior. Some applications may be memory intensive, and others may be storage intensive. Hence, as more applications co-reside on a sever in a virtualized environment, just calculating the CPU, memory, and disk space required for each application is not enough.

This document demonstrates the performance of the Cisco UCS® E-Series Servers running applications that are CPU, memory, and I/O intensive.

Cisco UCS E-Series Servers

Cisco UCS E-Series Servers are next-generation, power-optimized, x86, Intel® Xeon® 64-bit blade servers designed to be deployed in Cisco® Integrated Services Routers Generation 2 (ISR G2) and the Cisco 4451-X ISR. These price-to-performance-optimized single-socket blade servers balance simplicity, performance, reliability, and power efficiency. They are well suited for applications and infrastructure services typically deployed in small offices and branch offices.

Cisco UCS E-Series Servers are available in two form factors:

- Single-wide blade server powered by a high-performance yet power-efficient Intel Xeon processor E3 with four cores, up to 16 GB of RAM, and 2 terabytes (TB) of local storage
- Double-wide blade server powered by a high-performance Intel Xeon processor E5-2400 with up to six cores and support for up to 48 GB of RAM and 3 TB of local storage

Cisco is also releasing a newer version of the 4-core single-wide server module that includes an upgraded processor. The newer version of the single-wide module will be released toward the end of March 2014. These new Cisco UCS E140S M2 module blades will have the new, more powerful Intel Ivy Bridge processor with four cores clocked at 1.8 GHz. The tests reported in this document were conducted on the Cisco UCS E140S M1 module.

Figures 1 and 2 show the two form factors of the Cisco UCS E-Series.

Figure 1. Cisco UCS E140S M1 Module

Figure 2. Cisco UCS E160D M1 Module

Table 1 provides hardware information for the Cisco UCS E-Series Servers.

Table 1. Cisco UCS E-Series Specifications

Feature	Cisco UCS E140S M1 Single-Wide Server	Cisco UCS E140D M1 Double-Wide Server	Cisco UCS E160D M1 Double-Wide Server
Form factor	Single-wide server module	Double-wide server module	Double-wide server module
CPU	Intel Xeon processor E3-1105C V1	Intel Xeon processor E5-2428L	Intel Xeon processor E5-2418L
CPU cores	4 cores	4 cores	6 cores
DIMM slots	2 slots	3 slots	3 slots
RAM	8 to 16 GB Supports DDR3 1333 MHz very-low profile (VLP) unbuffered dual in-line memory module (UDIMM) at 1.5 volts (V) and 4 and 8 GB	8 to 48 GB Supports DDR3 1333 MHz registered DIMM (RDIMM) at 1.35V and 4, 8, and 16 GB	8 to 48 GB Supports DDR3 1333 MHz RDIMM at 1.35V and 4, 8, and 16 GB
RAID	RAID 0 and 1	RAID 0, 1, and 5	RAID 0, 1 and 5
Storage type	SATA, SAS, SSD, and SED	SATA, SAS, SSD, and SED	SATA, SAS, SSD, and SED
HDD	SAS 10,000-rpm, SATA 7200-rpm, and SAS SSD drives Supports 2 drives	SAS 10,000-rpm, SATA 7200-rpm, and SAS SSD drives Supports 3 drives	SAS 10,000-rpm, SATA 7200-rpm, and SAS SSD drives Supports 3 drives
Storage capacity	200 GB to 2 TB	200 GB to 3 TB	200 GB to 3 TB
Internal network interfaces	2 Gigabit Ethernet interfaces	2 Gigabit Ethernet interfaces	2 Gigabit Ethernet interfaces
External interfaces	1 USB Connector 1 RJ-45 Gigabit Ethernet connector 1 management port 1 keyboard, video, and mouse (KVM) port (supports VGA, 1 USB connector, and 1 DB9 serial connector)	2 USB connectors 2 RJ-45 Gigabit Ethernet connectors 1 management port 1 VGA port 1 DB9 serial connector	2 USB connectors 2 RJ-45 Gigabit Ethernet connectors 1 management port 1 VGA port 1 DB9 serial connector
Router platforms	Cisco 2911, 2921, 2951, 3925, 3925e, 3945, 3945e, and 4451-X ISRs	Cisco 2921, 2951, 3925, 3925e, 3945, 3945e, and 4451-X ISRs	Cisco 3925, 3925e, 3945, 3945e, and 4451-X ISRs

All Cisco UCS E-Series Servers support the three major hypervisors. Table 2 lists the hypervisors supported on the blades.

Table 2. Hypervisors Supported

Hypervisor	Version
VMware ESXi	Releases 5.0 U1, 5.1, and 5.5
Microsoft Hyper-V	2008 and 2012
Citrix XenServer	Release 6.0 and later

In addition to supporting these hypervisors, the Cisco UCS E-Series supports bare-metal installations of Microsoft Windows and various versions of Linux. Table 3 lists the OS versions supported on the Cisco UCS E-Series.

Table 3. Operating Systems Supported

Operating System	Version
Microsoft Windows Server	2008 R2 Standard and Enterprise 64-bit
Microsoft Windows Server	2012 and 2012 R1
Red Hat Enterprise Linux	Release 6.2 and later
Oracle Enterprise Linux	Release 6.0 Update 2
SUSE Enterprise Linux	Release 11 SP2 and later

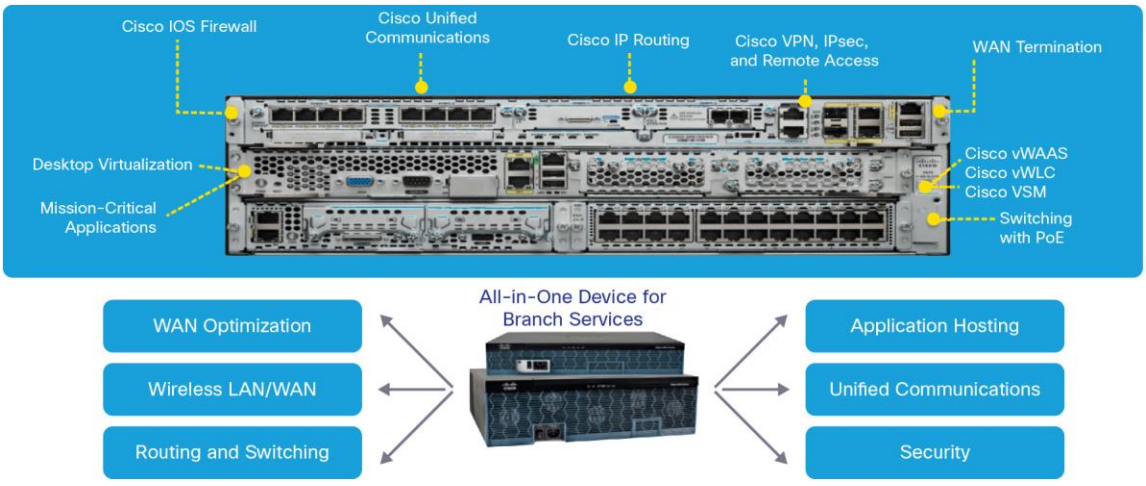
Cisco UCS E-Series in Retail and Remote Branch-Office Locations

Customers are attracted to the compact form factors of the Cisco UCS E-Series computing blades. The blade servers slide into a Cisco ISR G2, allowing retailers to save valuable floor space and to display more merchandise instead of servers and other appliances. With this converged infrastructure using the Cisco UCS E-Series, customers are eliminating dedicated appliances and choosing to run more applications virtually.

In addition to saving space, customers spend less on power costs. The Cisco UCS E-Series saves up to 80 percent in power costs, resulting in significant savings in operating costs. The solution also reduces complexity, eliminating the need to run external cables. Taking advantage of the Cisco ISR G2 architecture, the Cisco UCS E-Series blade communicates with the router through the back-plane Layer 2 and Layer 3 interfaces, thus providing a complete cable-free, “branch-office in a box” deployment (Figure 3). Customers still can connect to the external Gigabit Ethernet interfaces on the modules if they want to run them independent of the routers and, essentially, rely on the routers only for the power supply.

Another main feature of the Cisco ISR G2 and Cisco UCS E-Series solution is the support structure. There is no support contract for the Cisco UCS E-Series. All components of the server - CPU, hard drives, memory, etc. - are automatically covered by the Cisco ISR G2 support contract. For customers with existing Cisco ISR G2 devices, their router support contracts will be extended to the server blades, thus resulting in lower total cost of ownership (TCO).

Figure 3. Office, Store, and Branch Office in a Box



Applications and Hardware Components

The Cisco UCS E-Series is deployed in multiple industry-specific markets, such as retail, financial, healthcare, and education markets. To support the vast number of use cases that it encompasses, the Cisco UCS E-Series hosts a number of Cisco and third-party applications. Table 4 lists some of the Cisco applications that run on the Cisco UCS E-Series.

Table 4. Cisco Applications Supported on the Cisco UCS E-Series

Applications	For More Information
Cisco Virtual Wide Area Application Services (vWAAS)	http://www.cisco.com/waas
Cisco Enterprise Content Delivery System (ECDS)	http://www.cisco.com/go/ecds
Cisco Video Surveillance Manager (VSM)	http://www.cisco.com/go/vsm
Cisco Wireless LAN Controller (WLC)	http://www.cisco.com/go/wireless
Cisco MediaSense (media recording)	http://www.cisco.com/go/mediasense
Cisco Unity® Connection	http://www.cisco.com/go/unityconnection
Cisco Unified Communications Manager	http://www.cisco.com/go/cucm

Numerous third-party applications are also supported as part of the Cisco Cloud Connector program. Cisco and application vendors have certified these applications to run on the Cisco UCS E-Series. More information and a complete list of applications supported on the Cisco UCS E-Series can be found at http://www.cisco.com/en/US/products/ps13054/Products_Sub_Category_Home.html#~products.

Performance tests were performed on the single-wide Cisco UCS E140S, the 4-core double-wide Cisco UCS E140D, and the 6-core double-wide Cisco UCS E160D. An appropriate Cisco ISR G2 platform was chosen for each module. Table 5 lists the server modules and the corresponding platforms that hosted them.

Table 5. Cisco UCS E-Series and Cisco ISR G2 Platforms

Cisco UCS E-Series	Cisco ISR G2
Cisco UCS E140S	Cisco 2911 ISR
Cisco UCS E140D	Cisco 2951 ISR
Cisco UCS E160D	Cisco 3945 ISR

Note: Router performance was not tested and is not within the scope of this document. In all cases, external network interface cards for the server were used to transport management and application traffic to and from the server.

Table 6 lists the applications that were run in the performance tests for each Cisco UCS E-Series blade.

Table 6. Applications Run in Cisco UCS E-Series Tests

Cisco UCS E-Series	Applications
Cisco UCS E140S	Point-of-sale, Cisco VSM, and WAN optimization (Cisco vWAAS) software
Cisco UCS E140D	Point-of-sale, Cisco VSM, WAN optimization (Cisco vWAAS), and Cisco ECDS software
Cisco UCS E160D	Point-of-sale, Cisco VSM, WAN optimization (Cisco vWAAS), and Cisco ECDS software

As stated earlier, each of these applications has unique properties that stress the Cisco UCS E-Series. Some of these applications are memory intensive, some are CPU intensive, and some are disk-write intensive. In each blade, both the type of applications run and the number of sessions for each application varied. For example, typically a Cisco 2911 ISR with a Cisco UCS E-Series Server is deployed in small to medium-sized businesses or branch offices or stores that host three or four applications. Applications such as WAN optimization would be deployed because such locations typically have slow WAN links. If a point-of-sale application is deployed, typically no more than three or four terminals are operational at such locations. Similarly, no more than five video surveillance cameras typically are deployed in these types of locations.

Tables 7 through 9 classify the applications deployed and the scale for each type of deployment.

Table 7. Applications in a Small Branch Location

Deployment Type	Cisco ISR G2 and Cisco UCS E-Series	Application	Scale	Resources
Small branch office or store	Cisco 2911 with Cisco UCS E140S	Point-of-sale application	3 registers running constantly	4 virtual CPUs (vCPUs), 6 GB of RAM, and 250 GB of storage
		Cisco vWAAS	50 Mbps of traffic	2 vCPUs, 6 GB of RAM, and 300 GB of storage
		Cisco VSM	5 cameras streaming and recording	2 vCPUs, 3.5 GB of RAM, and 350 GB of storage

Table 8. Applications in a Medium-Sized Branch Location

Deployment Type	Cisco ISR G2 and Cisco UCS E-Series	Application	Scale	Resources
Medium-sized branch office or store	Cisco 2951 with Cisco UCS E140D	Point-of-sale application	6 registers running constantly	6 vCPUs, 10 GB of RAM, and 250 GB of storage
		Cisco vWAAS	50 Mbps of traffic	4 vCPUs, 8 GB of RAM, and 400 GB of storage
		Cisco VSM	15 cameras streaming and recording plus 3 additional cameras streaming to Cisco Security Desktop	4 vCPUs, 12 GB of RAM, and 500 GB of storage
		Cisco ECDS	6 video streams played to clients	2 vCPUs, 4 GB of RAM, and 250 GB of storage

Table 9. Applications in a Large Branch Location

Deployment Type	Cisco ISR G2 and Cisco UCS E-Series	Application	Scale	Resources
Large branch office or store	Cisco 3945 with Cisco UCS E160D	Point-of-sale application	6 registers running constantly	6 vCPUs, 10 GB of RAM, and 250 GB of storage
		Cisco vWAAS	50 Mbps of traffic	4 vCPUs, 8 GB of RAM, and 400 GB of storage
		Cisco VSM	15 cameras streaming and recording plus 3 additional cameras streaming to Cisco Security Desktop	4 vCPUs, 12 GB of RAM, and 500 GB of storage
		Cisco ECDS	6 video streams played to clients	2 vCPUs, 4 GB of RAM, and 250 GB of storage

Each of these applications targets a specific component on the Cisco UCS E-Series. Table 10 summarizes the target characteristics of each of the applications.

Table 10. Application Characteristics

Application	CPU Access	Memory Access	Read Access	Write Access
Cisco VSM	X			X
Cisco ECDS			X	
Cisco vWAAS	X			X
Third-party point-of-sale application		X		

These applications help characterize the performance of the Cisco UCS E-Series computing blades.

Test Methodology and Results

Each of the profiles in Table 10 was tested with the appropriate Cisco ISR G2 and Cisco UCS E-Series platform combination. This section presents the test results for each of the profiles.

Small Branch-Office or Store Deployment

The Cisco 2911 ISR G2 was running Cisco IOS® Software Release 15.3(3)M1. The Cisco UCS E140S was configured with 16 GB of RAM and two 1-TB 7200-rpm SATA HDDs. The hard drives used RAID 1. VMware ESXi 5.1 was the OS installed on the blade.

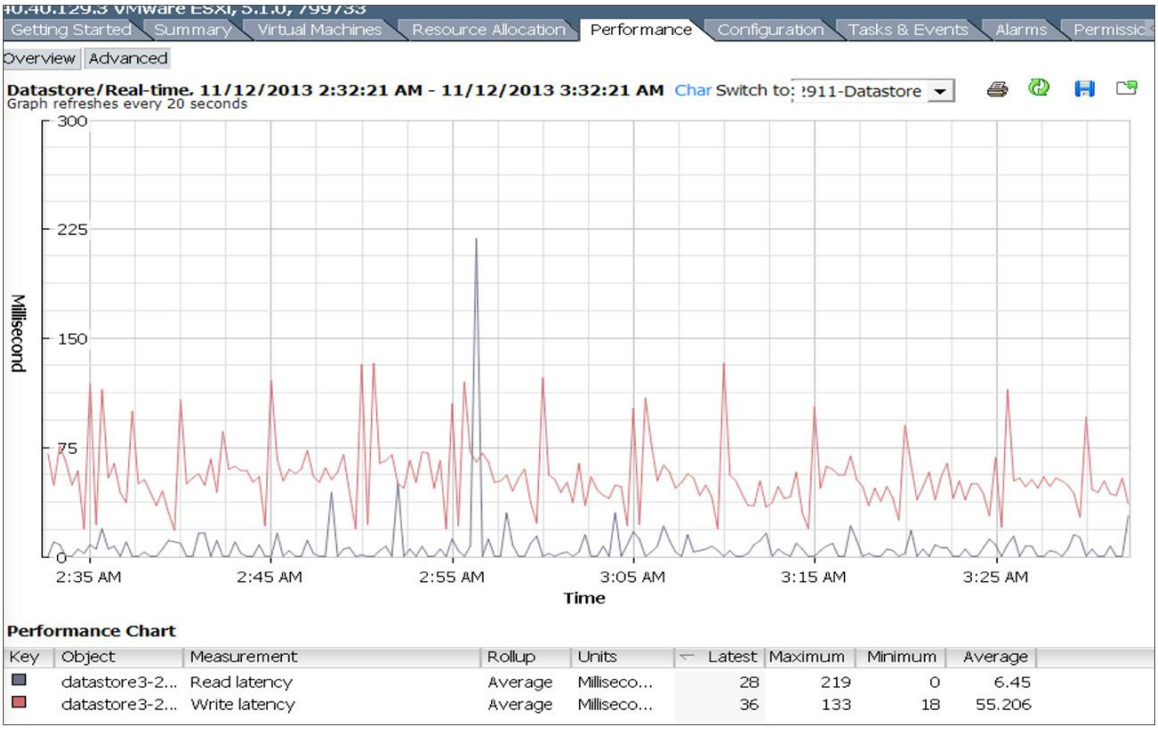
Note: All applications, except Cisco WAAS, running on the Cisco UCS E-Series in this profile used the external Ethernet interface on the module. Cisco WAAS took advantage of the internal back-plane connections with the Cisco ISR G2 and used these to intercept and redirect WAN traffic.

Cisco VSM 7.2 was deployed, which monitored and recorded streams from five physical security cameras. Three point-of-sale registers were deployed, which accessed data from the point-of-sale server running on the Cisco UCS E-Series. Cisco vWAAS was deployed for 1300 sessions on the Cisco UCS E-Series and was set to continuously optimize 50 Mbps of HTTP traffic. With all these applications running concurrently, the average CPU utilization was about 32 percent, with the peak CPU utilization reaching 44 percent. Figure 4 shows the overall CPU utilization.

Figure 4. Overall CPU Utilization of the Cisco UCS E140S

The testing also revealed relatively overall low read and write latency for the various applications installed, with the average write latency at 55 milliseconds (ms). Figure 5 shows that the maximum read latency reached 219 ms, and the average read latency was 6.5 ms.

Figure 5. Read and Write Latency of the Cisco UCS E140S



As shown by the preceding test results, even with these applications, the maximum threshold of the Cisco UCS E140S was not reached, and there still was room to deploy additional applications. Core Microsoft Windows applications such as the Domain Host Configuration Protocol (DHCP) server, domain controller, Microsoft Active Directory, and Domain Name System (DNS) server typically are deployed on the Cisco UCS E-Series, and this platform is an excellent fit for deploying these services.

Medium-Sized Branch Office or Store Deployment

The medium-sized branch office or store deployment used the Cisco 2951 ISR G2 running Cisco IOS Software Release 15.3(3) M1 with the Cisco UCS E140D. This 4-core double-wide blade was installed with 48 GB of RAM and three 1-TB HDDs in RAID 5 mode. Effective hard drive capacity was about 1.8 TB. CPU oversubscription was enabled, and hence up to 12 vCPUs were used on an 8-vCPU blade. The test results show CPU oversubscription on the Cisco UCS E140D.

Note: All applications, except Cisco WAAS, running on the Cisco UCS E-Series in this profile used the external Ethernet interface on the module. Cisco WAAS took advantage of the internal back-plane connections of the Cisco ISR G2 and used these to intercept and redirect WAN traffic.

In this deployment, the number of cameras controlled by Cisco VSM was increased to 15, and streams from all 15 cameras were recorded on the Cisco UCS E140D. Simultaneous HTTP traffic of 2500 Mbps was constantly being optimized by the Cisco vWAAS application. Six point-of-sale registers were constantly active, accessing data from the point-of-sale server, and six video streams were constantly being played by the Cisco ECDS application to six client endpoints on the LAN.

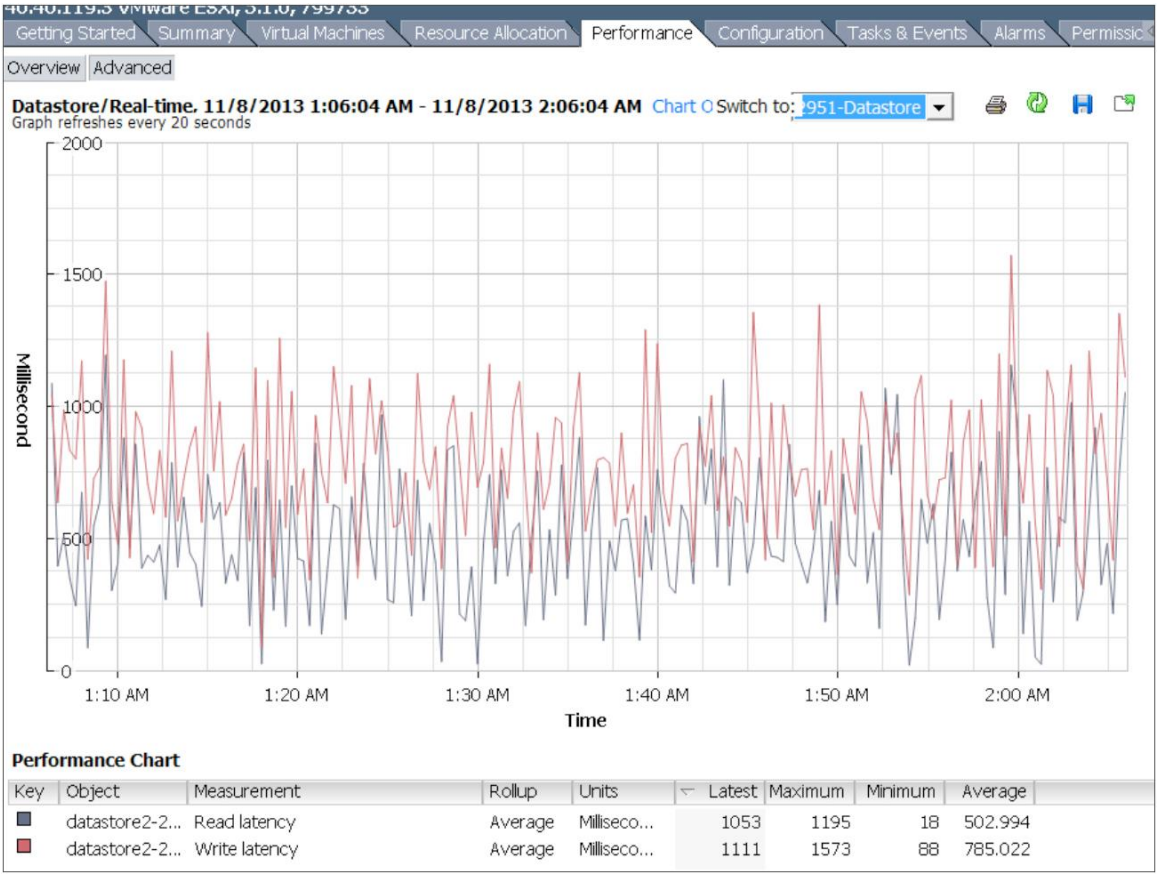
The average CPU utilization under this load was under 29 percent, and the peak CPU utilization was 36 percent. Figure 6 shows the CPU utilization of the Cisco UCS E140D.

Figure 6. Overall CPU Utilization of the Cisco UCS E140D

Even with the Cisco ECDS application running on the blade and constantly accessing data on the Cisco UCS E-Series, the overall read and write latency times continued to remain low. The average read latency was measured to be about 500 ms, and the average write latency was measured to be about 785 ms (Figure 7).

Note that the type of disk is an important factor in latency. SAS hard drives provide significant improvement, and SSDs perform the best. You should use one of these disk types if your application requires very low latency. Also note the RAID configuration. Generally, RAID 5 performance is lower than RAID 1 performance. The test scenarios used SATA HDDs and RAID 5.

Figure 7. Read and Write Latency of the Cisco UCS E140D



Large Branch-Office or Store Deployment

The tests run for the large branch-office deployment were similar to those run for the medium-sized branch-office deployment. The blade used in this deployment was the Cisco UCS E160D, which has two more cores than the Cisco UCS E140D; however, the clocking speed of the Cisco UCS E140D is slightly higher than that of the Cisco UCS E160D. The Cisco ISR G2 used in this deployment was the Cisco 3945 with Cisco IOS Software Release 15.3(3) M1. Six video surveillance cameras were deployed with Cisco VSM and were constantly recording streams to the hard drives. The hard drives consisted of three 1-TB SATA disks using RAID 5. Six video content streams were sent to local clients through the Cisco ECDS application. Fifteen point-of-sale terminals were accessing the point-of-sale data from the Cisco UCS E-Series, and Cisco vWAAS was set to optimize 2500-Gbps HTTP traffic. No CPU oversubscription was enabled or required in this deployment.

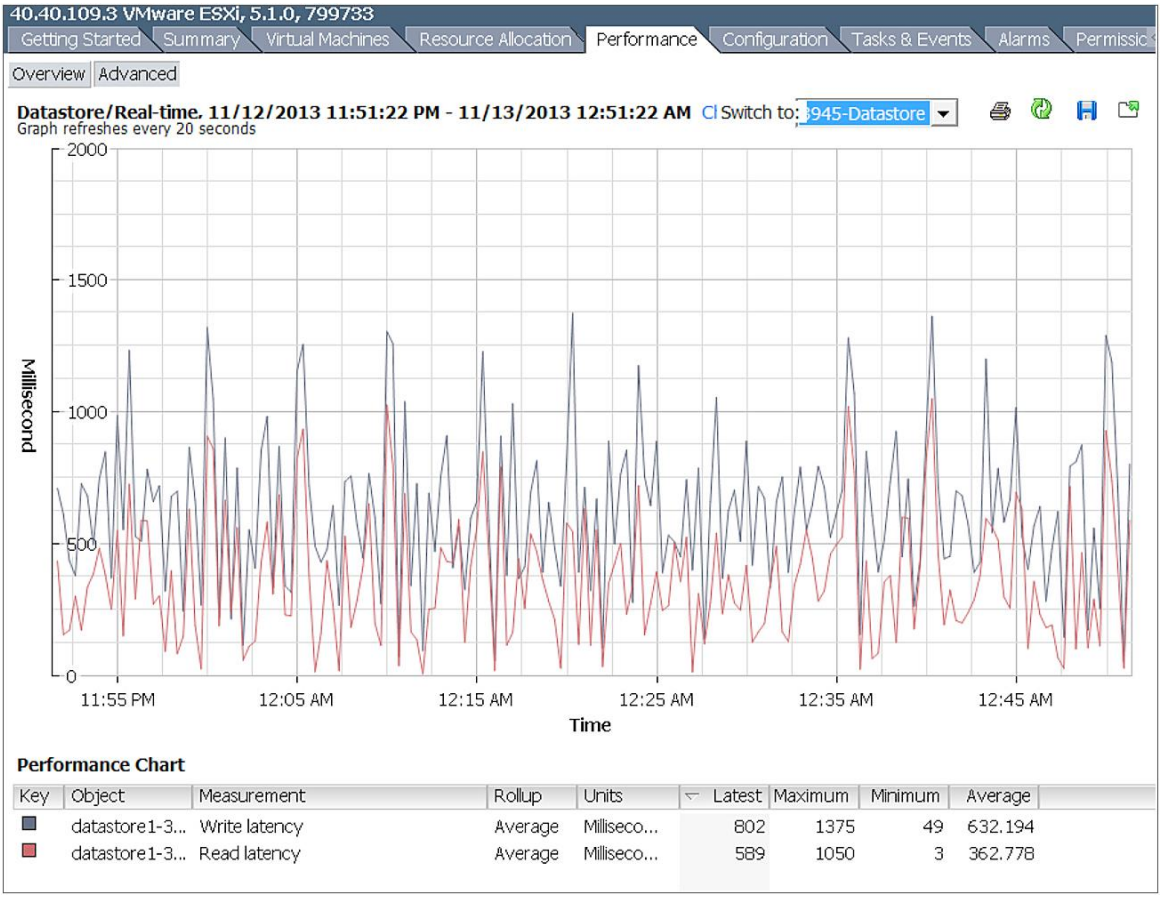
Note: All applications, except Cisco WAAS, running on the Cisco UCS E-Series in this profile used the external Ethernet interface on the module. Cisco WAAS took advantage of the internal back-plane connections of the Cisco ISR G2 and used these to intercept and redirect WAN traffic.

The average CPU utilization was only 22 percent, and the peak utilization reached was only 26 percent, thus leaving significant room to add more applications (Figure 8).

Figure 8. Overall CPU Utilization of the Cisco UCS E160D

The average read latency was 363 ms, and the average write latency was 635 ms. As expected, Cisco VSM had the highest write latency, at 800 ms, and Cisco ECDS had the highest read latency, at 400 ms. Figure 9 shows the average read and write latency times.

Figure 9. Read and Write Latency of the Cisco UCS E140D



Conclusion

Even with significant workloads and applications, all three models of the Cisco UCS E-Series - Cisco UCS E140S, E140D, and E160D - were able to operate smoothly with relatively low CPU and memory utilization. On all models of the Cisco UCS E-Series, memory utilization was found to be low, in part because of the ample memory available on the blades for the various applications. However, as demonstrated in the medium-sized deployment profile, significant computing power is still available if a customer wants CPU or memory oversubscription to be enabled.

Using the test results, customers can determine the size of the computing blade they require. They should classify their applications into four categories - CPU access, memory access, read access, and write access - and use this document to understand the impact of their applications on the Cisco UCS E-Series and accordingly choose the right model, amount of memory, type of hard disk, and size of storage.

These tests show that these blades are capable of handling multiple commonly deployed applications for a wide variety of industry-specific use cases while not compromising performance.

For More Information

For more information about the Cisco UCS E-Series, see http://www.cisco.com/go/ucse.

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