Evaluation of HP 20GbE Adapters and Cisco 40GbE Adapters

Evaluation report prepared under contract with HP

Introduction

For blade servers, 10Gb Ethernet (10GbE) has been available as a networking interconnect speed for several years. Today, 10GbE is widely utilized in blade servers and has become the de facto standard for blade server network interconnects. However, with the increased processing power available in the current generation of servers, along with the expanding use of server virtualization and the growing amounts of data to be processed, many IT shops require more bandwidth than a single 10GbE connection can provide.

In 2014, HP introduced its 20GbE adapter technology for the HP BladeSystem environment. This HP 20GbE technology is compatible with today's 10GbE and 40GbE technology, and is supported in existing HP BladeSystem enclosures.

In this second evaluation of HP's 20GbE technology, HP commissioned Demartek to perform additional performance tests using its 20GbE technology with its BladeSystem platform and compare it to existing 10GbE and 40GbE technology available today in the HP BladeSystem and Cisco UCS blade server environments. For these tests, we performed file transfers between blade servers within the same blade chassis and a database data warehousing workload involving a blade server and an all-flash storage array.

Key Findings

The HP 20GbE technology performed better in our file transfer tests that involved the server and networking resources, showing higher performance than the equivalent Cisco 40GbE technology. And in an industry standard database test, the HP 20GbE technology completed the database data warehousing workload 7.5% faster than the equivalent Cisco 40GbE technology, using server, network and storage resources. In both sets of tests, two ports of each technology were used, so the HP servers had 40Gbps of available bandwidth while the Cisco servers had 80Gbps of available bandwidth.

20GbE Explained

In order to develop and deploy 20GbE, HP took the existing IEEE 802.3ba specification for 40GbE and simply divided the 40Gb connection into two independent 20GbE connections. To explain how this works, we first need to provide some background on today's 10GbE.

10Gb Per Lane – Ethernet Today

The fastest Ethernet connection in a single lane today is 10Gbps in one direction. 10GbE transmits at 10.3125 Giga-transfers/second and uses 64b/66b encoding to transmit data over the wire (copper or fiber optic).

In order to get 40GbE today, four lanes of 10GbE are bundled together to form a single 40Gb connection. For 100GbE today, a similar process is used to bundle ten lanes of 10GbE together. These technologies transmit at the same 10.3125 Gbps rate and use the same encoding scheme as 10GbE, but simply bundle multiple lanes together to achieve the desired aggregate throughput.

20GbE per Lane

HP developed 20GbE for the HP c-Class BladeSystem platforms in order to provide higher bandwidth to meet today's increasing requirements in converged and virtualized environments. This 20GbE technology is contained entirely within the HP c-Class BladeSystem components, communicating internally at 20Gb.

Using the standard four-lane mode used by 40GbE, HP follows the same standard but uses only the first two lanes for one 20Gb connection. The second pair of lanes is used as an independent 20Gb connection. The same advanced features provided by 40GbE are available to be used by 20GbE. HP follows IEEE 802.3ba with only minor changes to a few clauses of the specification to support 20GbE while providing interoperability with 10Gb and 40Gb link partners.

HP enables two ports of 20Gb (full duplex) per FlexibleLOM Blade (FLB) on its Gen 8 (or newer) blade servers. The 20Gb of bandwidth in each of these ports can be used entirely for Ethernet traffic, or the bandwidth can be divided between FCoE and Ethernet. These adapters also support fully offloaded iSCSI traffic. Similar to HP's Flex-10 and 10Gb FlexFabric technologies, the new adapters use Flex-20 technology and can be divided into four connections per port with dynamic, precisely assigned bandwidth allocations for each.

To obtain 20Gb performance, the new HP FlexFabric 630 Series adapters must be connected to the new HP Virtual Connect FlexFabric-20/40 F8 module. This combination is compatible with any industry-standard Ethernet or Fibre Channel technology. This HP Virtual Connect fabric connects seamlessly to any external 10GbE and 40GbE infrastructure.

Speed Sensing and Investment Protection

The HP 20Gb 630 Series adapters also support multiple speeds and allow for a smooth transition to higher bandwidth, while auto-negotiating the speed with the switching infrastructure. If these new adapters are installed in a blade server connected to a 10GbE switching infrastructure then these adapters will operate at 10GbE. If the switch infrastructure is upgraded to 20GbE technology such as the HP Virtual Connect FlexFabric-20/40 F8 module, or if the blade server is moved to a different chassis that has the 20GbE infrastructure, then these adapters will automatically run at the higher 20GbE speed.

Each port of the HP 20Gb 630 Series adapter operates at the full rated speed of 20Gbps (full duplex). This is not to be confused with load balancing across two 10GbE ports, where two 10GbE ports share the load and could, in some situations, achieve 20Gbps across both ports together.

The HP 20Gb 630 Series adapters and HP Virtual Connect FlexFabric-20/40 F8 modules are supported in existing HP BladeSystem enclosures today. These 20GbE adapters provide investment protection by allowing the adapters and switching infrastructure to be upgraded independently.

Additional information for HP Virtual Connect is available at www.hp.com/go/virtualconnect.

Optimizing MAC Addresses and Host Ports

Because a 20GbE adapter provides twice the available bandwidth of a 10GbE adapter, fewer 20GbE adapters are required to achieve a specific bandwidth level. This means that during the initial MAC address-learning phase of transmissions, fewer broadcast floods are issued than would be issued with a higher number of slower 10GbE adapters.

In addition, one 20GbE adapter could replace two 10GbE adapters, freeing up precious blade server mezzanine card locations and making them available for other types of adapters, or enabling servers with additional 20GbE adapters for demanding workload connections.

The Importance of Ethernet Adapter Offloads

Today's Ethernet adapters designed for servers can improve the overall performance of network traffic by offloading many of the Ethernet network functions into the adapter. This can improve performance over the network and reduce host CPU utilization. These features are frequently found in Ethernet adapters designed for servers, while many of these features are not typically available for Ethernet adapters designed for desktop or laptop computers.

Several specific features are available to help improve this performance. The table below provides a partial list of key features available in the Ethernet adapters in the HP BladeSystem environment and the Cisco UCS Blade server environment.

There are settings in HP OneView and Cisco UCS Manager for adjusting some of these features at the blade chassis level, but in the case of Cisco UCS Manager, these settings do not necessarily carry down to the operating system running on each blade server. The table below is based on the output of several Windows PowerShell commands that retrieve the network adapter settings. A complete list of the PowerShell output from the blade servers is available in **Appendix B – Network Adapter Information**

Ethernet Adapter Feature	HP BladeSystem & HP 20Gb 630 Series adapter	Cisco UCS Blade Server & Cisco VIC 1240 adapter
Link Speed	10 Gbps, 20 Gbps (1x20) Full duplex	40 Gbps (4x10) Full duplex
Checksum Offload TCP	Yes – Rx and Tx	No
Checksum Offload UDP	Yes – Rx and Tx	No
Large Send Offload (LSO)	Yes	No
Receive Segment Coalescing	Yes	No
Receive Side Scaling (RSS)	Yes – Receive Queues Default=8, adjustable to 16	Yes – Receive Queues Default=8, not adjustable
TCP Connection Offload	Yes	No
Virtual Machine Queues (VMQ)	Yes – 29 queues per port	Yes – 63 queues per port

These features, or the lack of them in some cases, contributed to the performance results identified in this report.

20GbE Performance Results

We performed two sets of tests that demonstrate the performance capabilities of the HP 20Gb 630 Series adapters. These tests demonstrate different capabilities of these adapters.

- File transfer tests over TCP/IP and Ethernet between two servers
- Database data warehousing workload using FCoE between server and storage

File Transfer Tests over TCP/IP and Ethernet Between Two Servers

The goal of these tests was to send real-world network traffic between two blade servers within the same blade chassis. We performed a series of file transfer tests using native file copy commands. Windows Server 2012 R2 was installed on each blade server, and a series of ROBOCOPY commands were issued to copy files from one blade server to another blade server within the same blade chassis. RAM disks were used as the source and target locations within each server. The target servers were comprised of 46 virtual machines (VMs) in order to maximize the available bandwidth.

Load Balancing Using SMB 3

Load balancing for the network traffic was achieved by using the native SMB 3.0 functions provided by the operating system. This avoided the necessity to specifically define NIC teaming.

SMB has no knowledge of the external switching (outside the blade chassis) used in these configurations and can choose any path for the Ethernet traffic. One side effect of using SMB 3.0 for load balancing was that on occasion, SMB might choose a path that required the Cisco system to send traffic across fabrics, using the external uplink connections. Because the HP system does not require hard definitions of "fabrics" for Ethernet traffic, it does not require the equivalent of the external uplink that the Cisco system requires for "cross-fabric" Ethernet traffic.

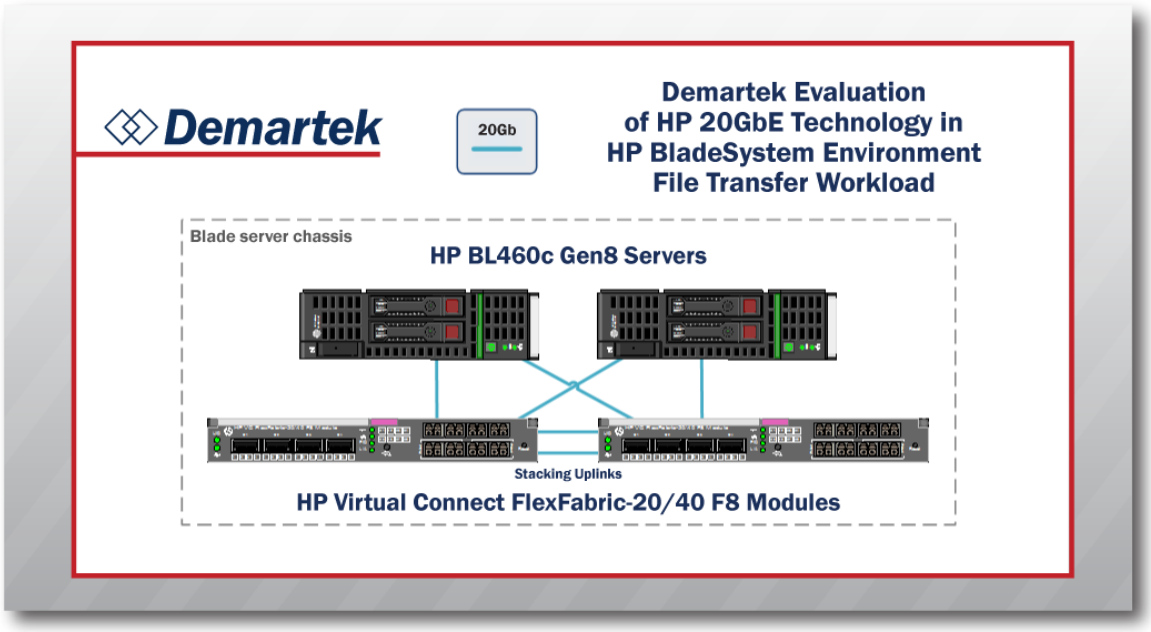
Jumbo Frames

Jumbo frames (9014 bytes) were used for all components of file transfer tests.

HP Blade Server and Network Architecture

Each server is connected to two network fabrics. When network traffic flows out of one server, it can take any of several paths to get to the other server.

The HP architecture has the concept of two network fabrics for communicating between the servers. The HP Virtual Connect FlexFabric modules support stacking uplinks, so that traffic destined for servers within the same blade chassis can be passed across fabrics, if necessary.

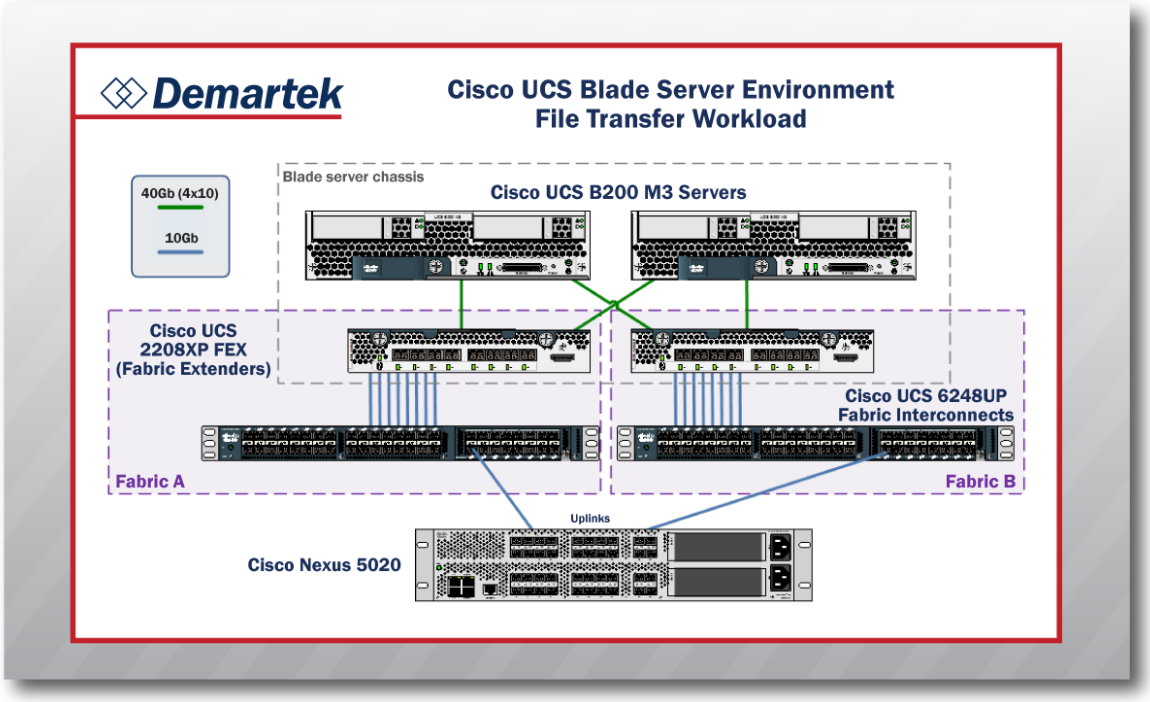


Cisco Blade Server and Network Architecture

Each server is connected to two network fabrics. When network traffic flows out of one server, it can take any of several paths to get to the other server.

The Cisco architecture requires separate network fabrics that do not allow data traffic to flow across the fabrics. The Cisco blade chassis architecture has no equivalent to the stacking uplinks found in the HP architecture. The external switch is necessary to accommodate the possibility that some traffic may need to flow across the two network fabrics in order to complete the path from one server to the other.

The Cisco architecture requires considerably more equipment than the HP architecture to accomplish the task of sending network traffic between the two blade servers within the same blade chassis.



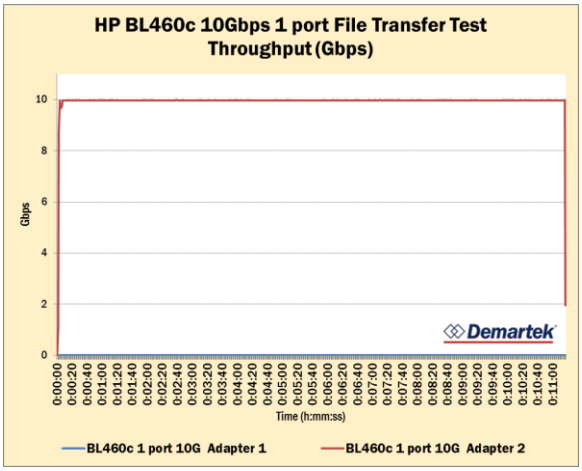
Comparisons were made of the following configurations:

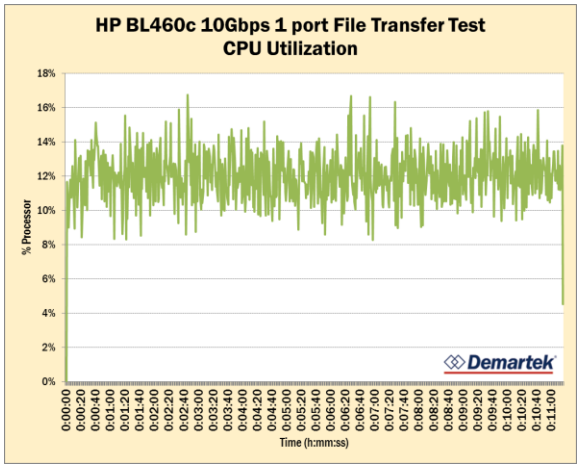
- 10GbE single port – HP BL460c
- 20GbE single port – HP BL460c
- 10GbE dual port vs. 20GbE dual port – HP BL460C
- 20GbE Dual-Port HP BL460c vs. 40GbE Dual-Port Cisco UCS B200

We noticed that for all of the file transfer tests, the single-port performance was very steady, regardless of the rated speed of the adapter or port. The dual-port performance generally had slightly more variability in the performance.

10GbE Single Port – HP BL460c

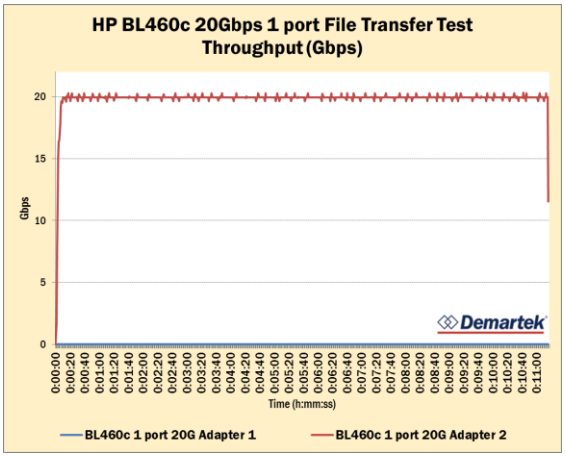
For the single-port 10GbE test, the HP BL460c was able to achieve a sustained rate of 10Gbps and consumed an average of approximately 12% CPU utilization using the HP FlexFabric 534FLB adapter.

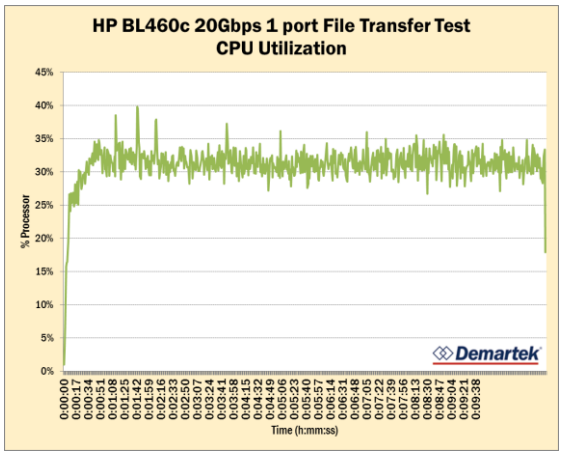




20GbE Single Port – HP BL460c

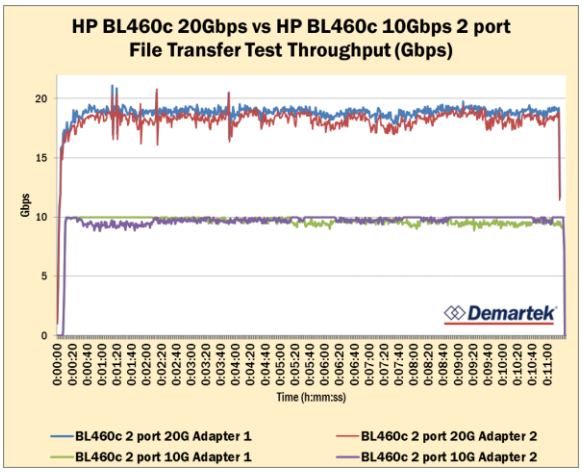
For the single-port 20GbE test, the HP BL460c was able to achieve a sustained rate of 20Gbps and consumed an average of approximately 32% CPU utilization using the HP FlexFabric 630FLB adapter.

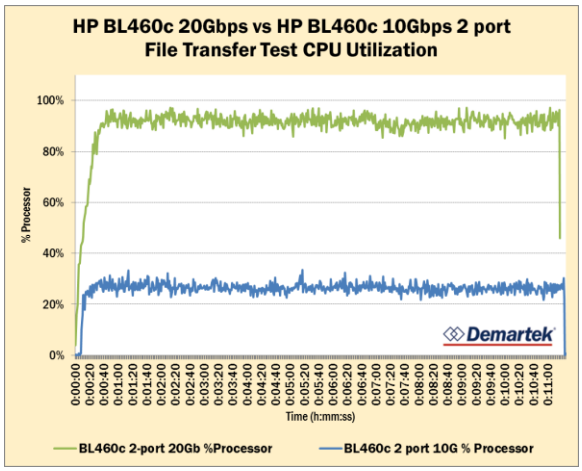




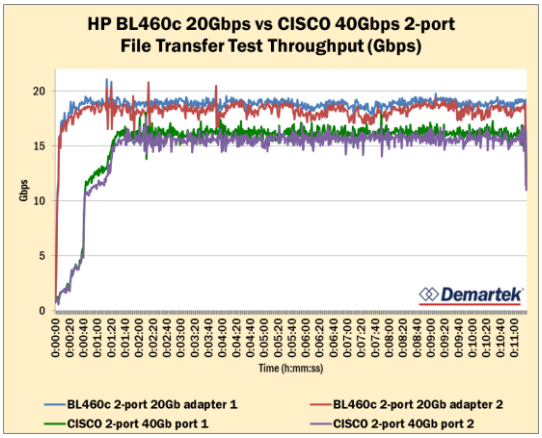
10GbE Dual-Port vs. 20GbE Dual-Port – HP BL460c

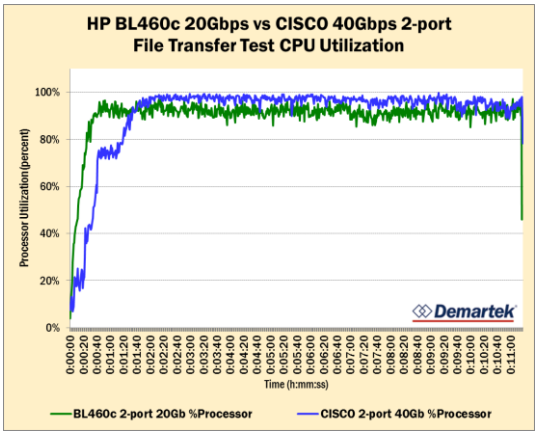
In the charts below, we compare the dual-port performance of the 10GbE technology with the dual-port performance of the 20GbE technology.





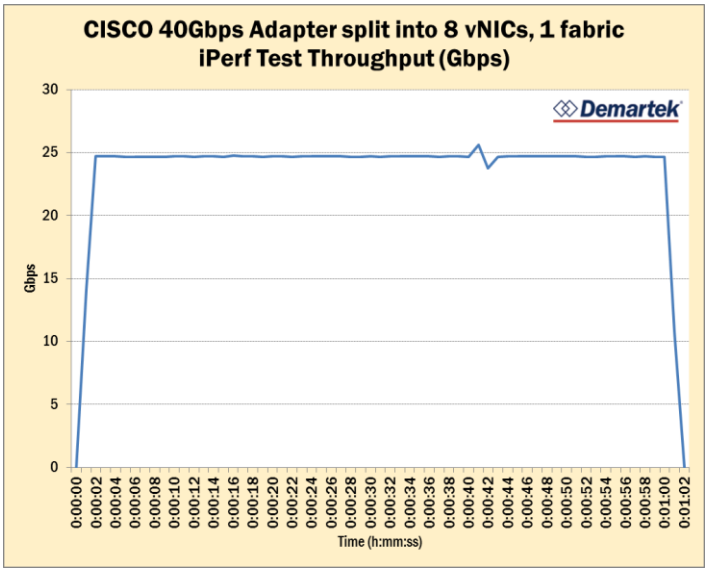
20GbE Dual-Port HP BL460c vs. 40GbE Dual-Port Cisco UCS B200





We observed that the HP BL460c dual-port FlexFabric 630FLB 20Gb adapters achieved higher aggregate bandwidth than the Cisco UCS B200 M3 dual-port 40Gb adapters in the same file transfer test.

This initially surprised us, because we expected higher performance from the 40Gb adapter in the Cisco server. Therefore, we decided to run a simple, synthetic benchmark test (iPerf) on a single port of the Cisco 40Gb adapter, and achieved a sustained rate of 25Gbps using the 40Gb adapter. We concluded that this 40Gb adapter is not capable of providing 40Gbps in this environment.



Database Data Warehousing Workloads

For the database workloads, we connected the blade servers to the storage system using FCoE technology. These database workloads deployed in these tests used a real database (Microsoft SQL Server) with database tables, indexes, etc., performing actual database instructions and I/O. When using real database workloads, I/O rate will vary as the workload progresses because the database performs operations that consume varying amounts of CPU and memory resources in addition to I/O resources. These results more closely resemble a real customer environment.

For Fibre Channel over Ethernet (FCoE) traffic, different adapter speeds yield different storage network bandwidth rates.

FCoE Adapter Speed	FCoE Storage Networking Bandwidth
10 Gbps	1150 MBps
20 Gbps	2300 MBps
40 Gbps	4600 MBps

For native Fibre Channel (FC) traffic, different adapter speeds yield different storage network bandwidth rates.

FC Adapter Speed	FC Storage Networking Bandwidth
4 Gbps	400 MBps
8 Gbps	800 MBps
16 Gbps	1600 MBps

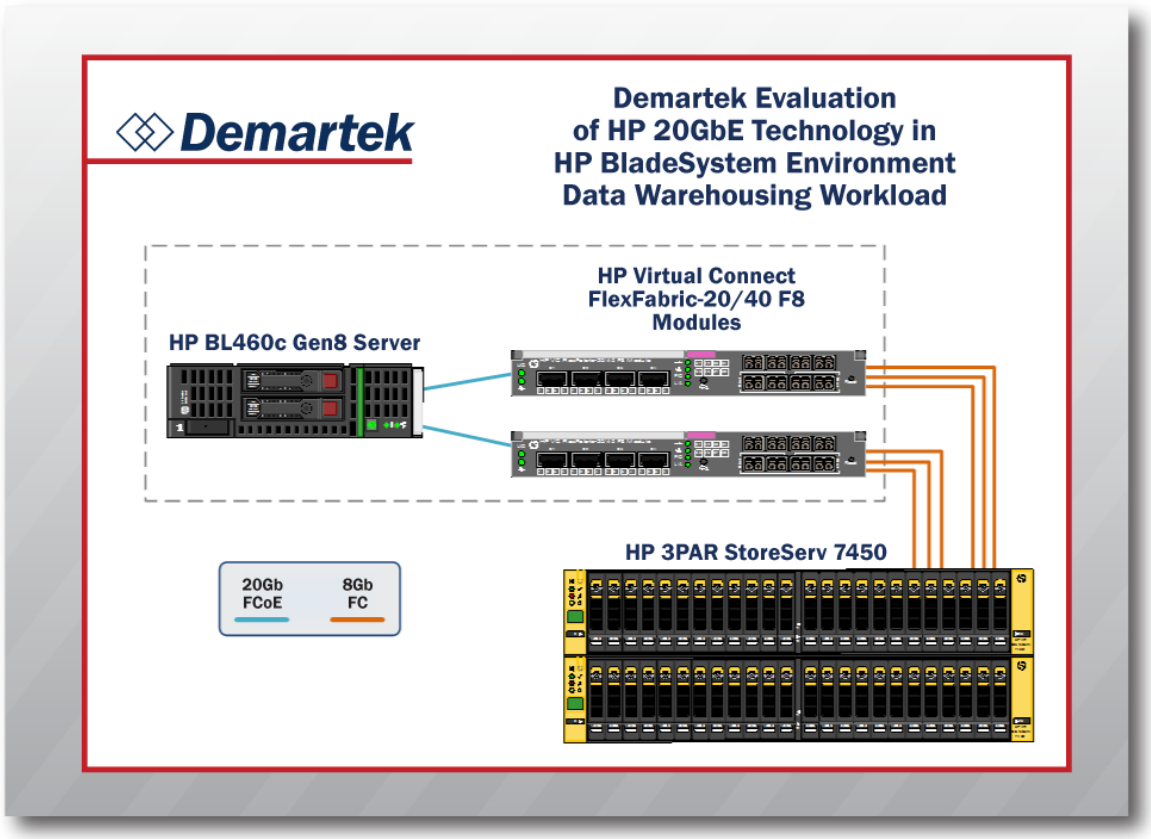
Bits per Second vs. Bytes per Second – Networking and Storage

Transfer rates, or speeds, are generally expressed differently for network interfaces and storage devices. Network interface speeds are generally expressed in bits per second, with units such as gigabits per second (Gbps) or megabits per second (Mbps). Storage device transfer rates are generally expressed in bytes per second, such as gigabytes per second (GBps) or megabytes per second (MBps). The use of a capital "B" in these abbreviations generally means bytes, which refers to storage device transfer rates.

HP BL460c 20Gb Adapter Data Warehousing Performance

The configuration of the HP server and storage for this set of tests is shown below. Two HP FlexFabric 630FLB 20Gb adapters from the server were connected to the FlexFabric-20/40 F8 I/O modules, providing up to 4600 MBps (2 x 2300 MBps) of available bandwidth from the server. These two HP FlexFabric 630FLB 20Gb adapters used FCoE to carry the storage traffic. These I/O modules were connected directly to six 8Gb Fibre Channel host interfaces on the all-flash storage array, providing up to 4800 MBps (6 x 800 MBps) of available bandwidth to the storage system. The FlexFabric-20/40 F8 module supports converged fabrics thus reducing the need for specialized interconnects. It supports Ethernet, FCoE, iSCSI, and FC protocols on the uplink ports, and Ethernet (including iSCSI) and FCoE protocols on the downlink ports.

It should be noted that in addition to the Flexible LOM used in these tests, the HP BL460c supports an additional two dual-port 20Gb mezzanine cards, so the server could support as much as 13,800 MBps (6 x 2300 MBps) of FCoE bandwidth. We did not need the extra mezzanine cards for this test.

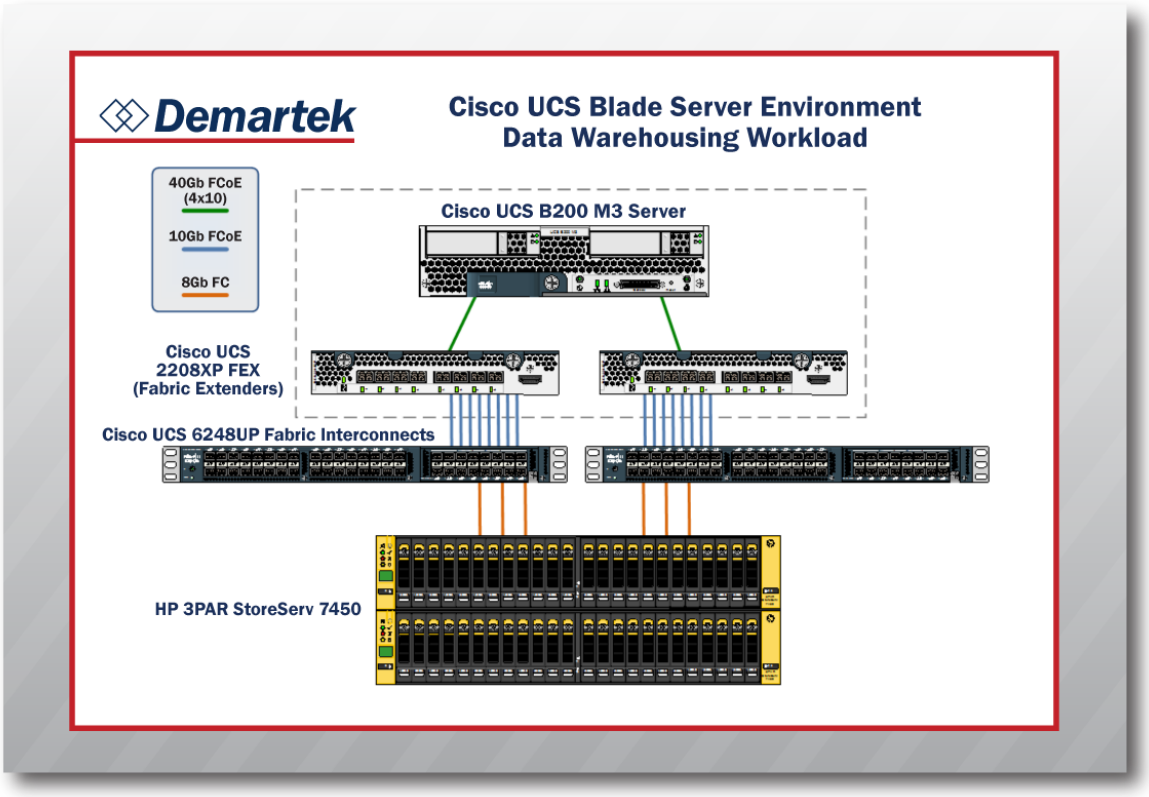


Cisco UCS B200 M3 40Gb Adapter Data Warehousing Performance

The equivalent tests for the Cisco UCS blade server environment required fabric interconnects to complete the networking configuration.

Each of the two 40Gb interfaces from the server was connected to a Cisco UCS 2208XP fabric extender (FEX) module, providing up to a total of 9200 MBps (2 x 4600 MBps) of theoretical available bandwidth from the server. These two 40Gb interfaces used FCoE to carry the storage traffic. Each FEX module was connected to a Cisco UCS 6248UP Fabric Interconnect (FI), via eight 10Gb connections from each FEX, providing up to 9200 MBps (8 x 1150 MBps) of available bandwidth between each FEX and its respective FI. The Chassis/FEX Discovery Policy in UCS was set to port channel, 8-link, to maximize the use of these connections. Each FI was connected to three 8Gb Fibre Channel host interfaces on the all-flash storage array, providing up to 4800 MBps (6 x 800 MBps) of available bandwidth to the storage system.

A QoS Policy for FCoE was created, which used the Fibre Channel Priority. Fibre Channel was given a QoS of 6 and weight of 10, while all other Priorities were disabled except "Best Effort" that was given no weight. This gave Fibre Channel 100% Weight.



Configuration Notes

	Number of Cables Required
Cisco configuration	22
HP configuration	6

Storage Direct Connect

It should be noted that both HP and Cisco are expanding the number of storage arrays that can be directly connected to their blade system infrastructure. Without this "direct connect" feature, additional Fibre Channel switches, with the appropriate Fibre Channel zoning, would need to be added to the configurations. Local zoning was required and enabled in the Cisco Fabric Interconnects for this configuration, which disables uplinks to an external Cisco Fibre Channel switch.

Fibre Channel Zoning

Zoning is a service in Fibre Channel storage area networks (SANs) that logically groups together servers and storage that need to communicate with each other. Elements of a zone can only communicate with other elements within the same zone. This prevents unauthorized access of storage. Servers and storage can be members of multiple zones at the same time. This has some similarities with the concept of VLANs in Ethernet networks.

Switch Port Licensing

Licensing for the ports in the switching infrastructure is another item that needs to be considered. For the HP configuration, all the ports are licensed at the time of purchase of the equipment. For the Cisco UCS 6248UP Fabric Interconnects, pre-installed licenses for the first twelve unified ports are enabled in Cisco UCS Manager. Expansion modules come with eight licenses that can be used on the expansion module or the base module. If additional ports are required, then additional licenses must be purchased.

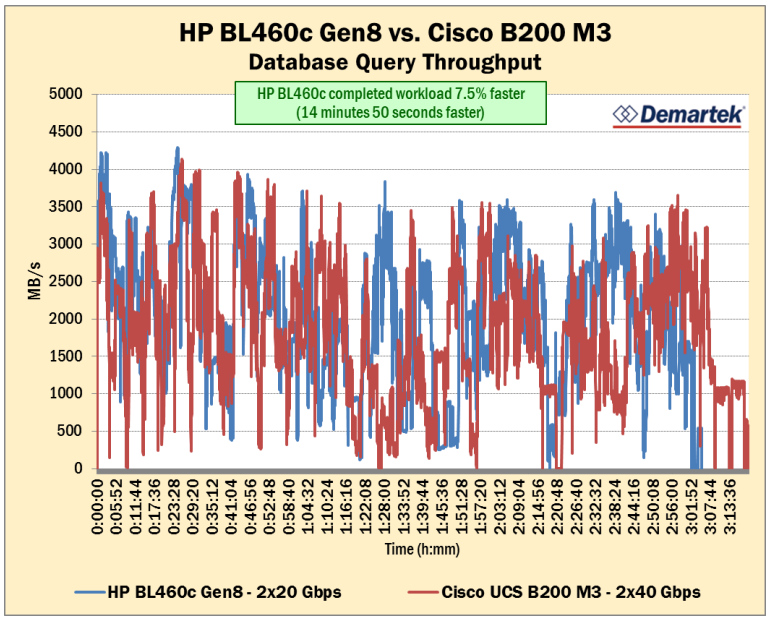
SQL Server RAM

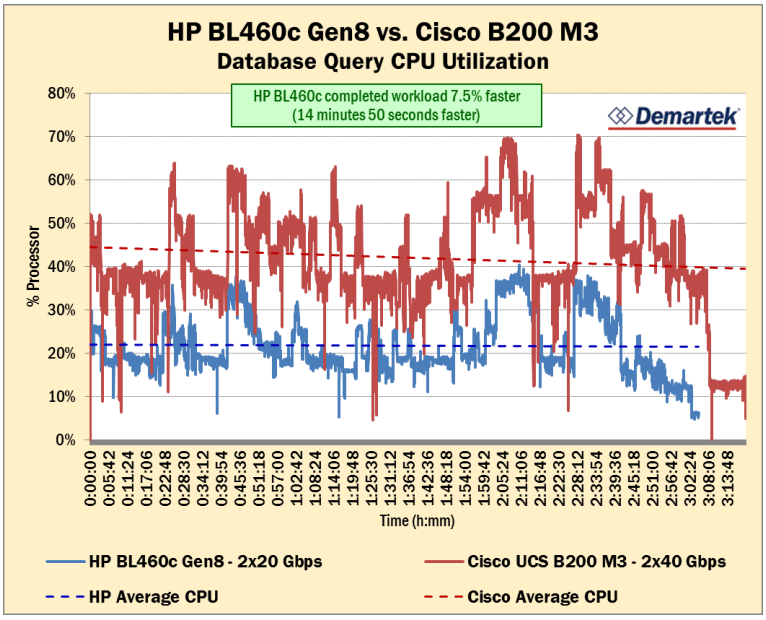
For the data warehousing tests, the RAM was limited to 16GB in SQL Server in order to force more I/O to the back-end storage system.

Performance Results

This database workload performs a fixed set of 22 large database queries that are representative of a data warehousing workload. Because this is a fixed set of work, a faster configuration will complete the work in less time.

In these tests, the HP BL460c with its FlexFabric 630FLB 20Gb adapters completed the work in 7.5% less time (14:50 minutes) than the Cisco UCS B200 M3 server with its 40GbE ports. The HP configuration also completed the work with approximately 20% lower CPU utilization.





Conclusion

HP's 20GbE technology is an excellent choice for customers currently using HP's 10GbE technology in their blade systems. It provides double the performance for less than double the price.

We also found that HP's 20GbE technology outperformed Cisco's 40GbE technology in equivalent tests involving blade servers and networking, and in equivalent tests involving blade servers, networking with external storage systems. For the storage tests, the HP 20GbE technology completed the database data warehousing workload 7.5% faster than the equivalent Cisco 40GbE technology, with approximately 20% lower CPU utilization, using equivalent blade servers and the same all-flash storage array for both configurations.

In both sets of tests two ports of each technology were used, so the HP servers had 40Gbps of available bandwidth while the Cisco servers had 80Gbps of available bandwidth.

Appendix A – Test Configuration Details

Blade Servers

HP BL460c Gen8

- 2x: Intel Xeon E5-2670 v2, 2.7 GHz, 20 total cores, 40 total logical processors
- 384GB RAM
- BIOS setting: Maximum Performance & Static High Performance
- HP 10Gb and HP 20Gb adapters
  - Transmit: HP FlexFabric 536FLB based on 57810 network adapters from QLogic
  - Receive: HP FlexFabric 554FLB based on network adapters from Emulex
  - HP FlexFabric 630FLB based on 57840 network adapters from QLogic

Cisco UCS B200 M3

- 2x: Intel Xeon E5-2670 v2, 2.7 GHz, 20 total cores, 40 total logical processors
- 384GB RAM
- BIOS policy included:
  - Memory RAS configuration: maximum-performance
  - LV DDR mode: performance-mode
- Cisco UCS VIC 1240 adapter and Cisco UCS Port Expander Card

Blade Chassis Network Modules

HP Virtual Connect FlexFabric-20/40 G8 Module, firmware service pack for ProLiant 2014.06.0, included with HP OneView 1.10

Cisco UCS 2208XP FEX, firmware version 2.2(2c)
Cisco UCS 6248UP Fabric Interconnect, firmware version 2.2(2c)

Storage System

HP 3PAR StoreServ 7450 All-flash array

Appendix B – Network Adapter Information

This appendix provides the output of various Windows PowerShell commands that display features and settings of the network adapters.

In order to accommodate all of the PowerShell output, the following pages use landscape (wide) formatting.

Appendix B – Network Adapter Information: Cisco UCS M200 B3 blade servers

```
PS C:\Users\Administrator> get-NetAdapter

Name                      InterfaceDescription                    ifIndex Status       MacAddress             LinkSpeed
----                      --------------------                    ------- ------       ----------             ---------
Ethernet 2                Cisco VIC Ethernet Interface #2              13 Up           00-25-B5-00-00-1F       40 Gbps
Ethernet                  Cisco VIC Ethernet Interface                 12 Up           00-25-B5-00-00-0F       40 Gbps

PS C:\Users\Administrator> get-NetAdapterAdvancedProperty

Name                      DisplayName                   DisplayValue               RegistryKeyword RegistryValue
----                      -----------                   ------------               --------------- -------------
Ethernet 2                Encapsulated Task Offload     Enabled                    *Encapsulate... {1}
Ethernet 2                Interrupt Moderation          Enabled                    *InterruptMo... {1}
Ethernet 2                Receive Side Scaling          Enabled                    *RSS            {1}
Ethernet 2                SR-IOV                        Disabled                   *Sriov          {0}
Ethernet 2                Virtual Machine Queues        Disabled                   *VMQ            {0}
Ethernet                  Encapsulated Task Offload     Enabled                    *Encapsulate... {1}
Ethernet                  Interrupt Moderation          Enabled                    *InterruptMo... {1}
Ethernet                  Receive Side Scaling          Enabled                    *RSS            {1}
Ethernet                  SR-IOV                        Disabled                   *Sriov          {0}
Ethernet                  Virtual Machine Queues        Disabled                   *VMQ            {0}

PS C:\Users\Administrator> get-NetAdapterBinding

Name                           DisplayName                                             ComponentID            Enabled
----                           -----------                                             -----------            -------
Ethernet 2                     Link-Layer Topology Discovery Responder                 ms_rspndr              True
Ethernet 2                     Link-Layer Topology Discovery Mapper I/O Driver         ms_lltdio              True
Ethernet 2                     Microsoft Network Adapter Multiplexor Protocol          ms_implat              False
Ethernet 2                     Client for Microsoft Networks                           ms_msclient            True
Ethernet 2                     QoS Packet Scheduler                                    ms_pacer               True
Ethernet 2                     File and Printer Sharing for Microsoft Networks         ms_server              True
Ethernet 2                     Internet Protocol Version 6 (TCP/IPv6)                  ms_tcpip6              True
Ethernet 2                     Internet Protocol Version 4 (TCP/IPv4)                  ms_tcpip               True
Ethernet                       Link-Layer Topology Discovery Responder                 ms_rspndr              True
Ethernet                       Link-Layer Topology Discovery Mapper I/O Driver         ms_lltdio              True
Ethernet                       Microsoft Network Adapter Multiplexor Protocol          ms_implat              False
Ethernet                       Client for Microsoft Networks                           ms_msclient            True
Ethernet                       QoS Packet Scheduler                                    ms_pacer               True
Ethernet                       File and Printer Sharing for Microsoft Networks         ms_server              True
Ethernet                       Internet Protocol Version 6 (TCP/IPv6)                  ms_tcpip6              True
Ethernet                       Internet Protocol Version 4 (TCP/IPv4)                  ms_tcpip               True

PS C:\Users\Administrator> get-NetAdapterChecksumOffload
PS C:\Users\Administrator> get-NetAdapterEncapsulatedPacketTaskOffload

Name                           Enabled
```

```
----                            -------
Ethernet 2                      True
Ethernet                        True

PS C:\Users\Administrator> get-NetAdapterHardwareInfo

Name                            Segment Bus Device Function Slot NumaNode PcieLinkSpeed PcieLinkWidth Version
----                            ------- --- ------ -------- ---- -------- ------------- ------------- -------
Ethernet 2                            0   6      0        0    1        0      5.0 GT/s            16 1.1
Ethernet                              0   7      0        0    1        0      5.0 GT/s            16 1.1

PS C:\Users\Administrator> get-NetAdapterIpsecOffload
PS C:\Users\Administrator> get-NetAdapterLso
PS C:\Users\Administrator> get-NetAdapterPowerManagement

InterfaceDescription    : Cisco VIC Ethernet Interface #2
Name                    : Ethernet 2
ArpOffload              : Unsupported
NSOffload               : Unsupported
RsnRekeyOffload         : Unsupported
D0PacketCoalescing      : Unsupported
SelectiveSuspend        : Unsupported
DeviceSleepOnDisconnect : Unsupported
WakeOnMagicPacket       : Unsupported
WakeOnPattern           : Unsupported

InterfaceDescription    : Cisco VIC Ethernet Interface
Name                    : Ethernet
ArpOffload              : Unsupported
NSOffload               : Unsupported
RsnRekeyOffload         : Unsupported
D0PacketCoalescing      : Unsupported
SelectiveSuspend        : Unsupported
DeviceSleepOnDisconnect : Unsupported
WakeOnMagicPacket       : Unsupported
WakeOnPattern           : Unsupported

PS C:\Users\Administrator> get-NetAdapterQoS
PS C:\Users\Administrator> get-NetAdapterRdma
PS C:\Users\Administrator> get-NetAdapterRsc
PS C:\Users\Administrator> get-NetAdapterRSS

Name                                        : Ethernet 2
InterfaceDescription                        : Cisco VIC Ethernet Interface #2
Enabled                                     : True
NumberOfReceiveQueues                       : 8
Profile                                     : NUMAStatic
BaseProcessor: [Group:Number]               : 0:0
MaxProcessor: [Group:Number]                : 0:15
MaxProcessors                               : 16
```

```
RssProcessorArray: [Group:Number/NUMA Distance] : 0:0/0  0:1/0  0:2/0  0:3/0  0:4/0  0:5/0  0:6/0  0:7/0
                                                  0:8/32767  0:9/32767  0:10/32767  0:11/32767  0:12/32767  0:13/32767
                                                   0:14/32767  0:15/32767
IndirectionTable: [Group:Number]                : 0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                                  0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                                  0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                                  0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                                  0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                                  0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                                  0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                                  0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                                  0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                                  0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                                  0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                                  0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                                  0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                                  0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                                  0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                                  0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11

Name                                            : Ethernet
InterfaceDescription                            : Cisco VIC Ethernet Interface
Enabled                                         : True
NumberOfReceiveQueues                           : 8
Profile                                         : NUMAStatic
BaseProcessor: [Group:Number]                   : 0:0
MaxProcessor: [Group:Number]                    : 0:15
MaxProcessors                                   : 16
RssProcessorArray: [Group:Number/NUMA Distance] : 0:0/0  0:1/0  0:2/0  0:3/0  0:4/0  0:5/0  0:6/0  0:7/0
                                                  0:8/32767  0:9/32767  0:10/32767  0:11/32767  0:12/32767  0:13/32767
                                                   0:14/32767  0:15/32767
IndirectionTable: [Group:Number]                : 0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15
                                                  0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15
                                                  0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15
                                                  0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15
                                                  0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15
                                                  0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15
                                                  0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15
                                                  0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15
                                                  0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15
                                                  0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15
                                                  0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15
                                                  0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15
                                                  0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15
                                                  0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15
                                                  0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15
                                                  0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15

PS C:\Users\Administrator> get-NetAdapterSRIOV
```

```
Name                  : Ethernet 2
InterfaceDescription : Cisco VIC Ethernet Interface #2
Enabled               : False
SriovSupport          : NoIoMmuSupport
SwitchName            : Default Switch Name
NumVFs                : 128

Name                  : Ethernet
InterfaceDescription : Cisco VIC Ethernet Interface
Enabled               : False
SriovSupport          : NoIoMmuSupport
SwitchName            : Default Switch Name
NumVFs                : 128

PS C:\Users\Administrator> get-NetAdapterSriovVf
PS C:\Users\Administrator> get-NetAdapterStatistics

Name                            ReceivedBytes ReceivedUnicastPackets       SentBytes SentUnicastPackets
----                            ------------- ----------------------       --------- ------------------
Ethernet 2                              19215                       6           10525                  6
Ethernet                                20618                      19           13310                 32

PS C:\Users\Administrator> get-NetAdapterVMq

Name                          InterfaceDescription             Enabled BaseVmqProcessor MaxProcessors NumberOfReceive
                                                                                                      Queues
----                          --------------------             ------- --------------- ------------- ---------------
Ethernet 2                    Cisco VIC Ethernet Interface #2  False   0:0                           0
Ethernet                      Cisco VIC Ethernet Interface     False   0:0                           0

PS C:\Users\Administrator> Get-NetAdapterVmqQueue
PS C:\Users\Administrator> Get-NetAdapterVPort
```

Appendix B – Network Adapter Information: HP BL460c blade servers

```
PS C:\Users\Administrator> get-NetAdapter

Name                      InterfaceDescription                    ifIndex Status       MacAddress             LinkSpeed
----                      --------------------                    ------- ------       ----------             ---------
Ethernet 2                HP FlexFabric 20Gb 2-port 630FLB ...#76      16 Up           40-A8-F0-2A-F8-90        20 Gbps
Ethernet                  HP FlexFabric 20Gb 2-port 630FLB ...#77      15 Up           40-A8-F0-2A-F8-98        20 Gbps

PS C:\Users\Administrator> get-NetAdapterAdvancedProperty

Name                      DisplayName                   DisplayValue                RegistryKeyword RegistryValue
----                      -----------                   ------------                --------------- -------------
Ethernet 2                Encapsulated Task Offload     Enabled                     *Encapsulate... {1}
Ethernet 2                Flow Control                  Disabled                    *FlowControl    {0}
Ethernet 2                Interrupt Moderation          Enabled                     *InterruptMo... {1}
Ethernet 2                Jumbo Packet                  9014                        *JumboPacket    {9014}
Ethernet 2                Large Send Offload V2 (IPv4)  Enabled                     *LSOv2IPv4      {1}
Ethernet 2                Large Send Offload V2 (IPv6)  Enabled                     *LSOv2IPv6      {1}
Ethernet 2                Maximum Number of RSS Queues  16                          *NumRSSQueues   {16}
Ethernet 2                Priority & VLAN               Priority & VLAN enabled     *PriorityVLA... {3}
Ethernet 2                Quality of Service            Disabled                    *QOS            {0}
Ethernet 2                Receive Buffers (0=Auto)      35000                       *ReceiveBuffers {35000}
Ethernet 2                Recv Segment Coalescing (IPv4) Enabled                    *RscIPv4        {1}
Ethernet 2                Recv Segment Coalescing (IPv6) Enabled                    *RscIPv6        {1}
Ethernet 2                Receive Side Scaling          Enabled                     *RSS            {1}
Ethernet 2                Starting RSS CPU              0                           *RssBaseProc... {0}
Ethernet 2                Speed & Duplex                20 Gbps Full Duplex         *SpeedDuplex    {8}
Ethernet 2                SR-IOV                        Disabled                    *Sriov          {0}
Ethernet 2                TCP Connection Offload (IPv4) Enabled                     *TCPConnecti... {1}
Ethernet 2                TCP Connection Offload (IPv6) Enabled                     *TCPConnecti... {1}
Ethernet 2                TCP/UDP Checksum Offload (I... Rx & Tx Enabled            *TCPUDPCheck... {3}
Ethernet 2                TCP/UDP Checksum Offload (I... Rx & Tx Enabled            *TCPUDPCheck... {3}
Ethernet 2                Transmit Buffers (0=Auto)     0                           *TransmitBuf... {0}
Ethernet 2                Virtual Machine Queues        Disabled                    *VMQ            {0}
Ethernet 2                Wake On Magic Packet          Disabled                    *WakeOnMagic... {0}
Ethernet 2                Wake On Pattern Match         Disabled                    *WakeOnPattern  {0}
Ethernet 2                Locally Administered Address  --                          networkaddress  {--}
Ethernet 2                Receive CPU Affinity          --                          rx_cpu          {--}
Ethernet 2                Transmit CPU Affinity         --                          tx_cpu          {--}
Ethernet 2                VLAN ID                       0                           VlanID          {0}
Ethernet                  Encapsulated Task Offload     Enabled                     *Encapsulate... {1}
Ethernet                  Flow Control                  Disabled                    *FlowControl    {0}
Ethernet                  Interrupt Moderation          Enabled                     *InterruptMo... {1}
Ethernet                  Jumbo Packet                  9014                        *JumboPacket    {9014}
Ethernet                  Large Send Offload V2 (IPv4)  Enabled                     *LSOv2IPv4      {1}
Ethernet                  Large Send Offload V2 (IPv6)  Enabled                     *LSOv2IPv6      {1}
Ethernet                  Maximum Number of RSS Queues  16                          *NumRSSQueues   {16}
Ethernet                  Priority & VLAN               Priority & VLAN enabled     *PriorityVLA... {3}
```

```
Ethernet                  Quality of Service             Disabled                       *QOS             {0}
Ethernet                  Receive Buffers (0=Auto)       35000                          *ReceiveBuffers  {35000}
Ethernet                  Recv Segment Coalescing (IPv4) Enabled                        *RscIPv4         {1}
Ethernet                  Recv Segment Coalescing (IPv6) Enabled                        *RscIPv6         {1}
Ethernet                  Receive Side Scaling           Enabled                        *RSS             {1}
Ethernet                  Starting RSS CPU               0                              *RssBaseProc...  {0}
Ethernet                  Speed & Duplex                 20 Gbps Full Duplex            *SpeedDuplex     {8}
Ethernet                  SR-IOV                         Disabled                       *Sriov           {0}
Ethernet                  TCP Connection Offload (IPv4)  Enabled                        *TCPConnecti...  {1}
Ethernet                  TCP Connection Offload (IPv6)  Enabled                        *TCPConnecti...  {1}
Ethernet                  TCP/UDP Checksum Offload (I... Rx & Tx Enabled                *TCPUDPCheck...  {3}
Ethernet                  TCP/UDP Checksum Offload (I... Rx & Tx Enabled                *TCPUDPCheck...  {3}
Ethernet                  Transmit Buffers (0=Auto)      0                              *TransmitBuf...  {0}
Ethernet                  Virtual Machine Queues         Disabled                       *VMQ             {0}
Ethernet                  Wake On Magic Packet           Disabled                       *WakeOnMagic...  {0}
Ethernet                  Wake On Pattern Match          Disabled                       *WakeOnPattern   {0}
Ethernet                  Locally Administered Address   --                             networkaddress   {--}
Ethernet                  Receive CPU Affinity           --                             rx_cpu           {--}
Ethernet                  Transmit CPU Affinity          --                             tx_cpu           {--}
Ethernet                  VLAN ID                        0                              VlanID           {0}

PS C:\Users\Administrator> get-NetAdapterBinding

Name                      DisplayName                                        ComponentID          Enabled
----                      -----------                                        -----------          -------
Ethernet 2                Link-Layer Topology Discovery Responder            ms_rspndr            True
Ethernet 2                Link-Layer Topology Discovery Mapper I/O Driver    ms_lltdio            True
Ethernet 2                Microsoft Network Adapter Multiplexor Protocol     ms_implat            False
Ethernet 2                Client for Microsoft Networks                      ms_msclient          True
Ethernet 2                QoS Packet Scheduler                               ms_pacer             True
Ethernet 2                File and Printer Sharing for Microsoft Networks    ms_server            True
Ethernet 2                Internet Protocol Version 6 (TCP/IPv6)             ms_tcpip6            True
Ethernet 2                Internet Protocol Version 4 (TCP/IPv4)             ms_tcpip             True
Ethernet                  Link-Layer Topology Discovery Responder            ms_rspndr            True
Ethernet                  Link-Layer Topology Discovery Mapper I/O Driver    ms_lltdio            True
Ethernet                  Microsoft Network Adapter Multiplexor Protocol     ms_implat            False
Ethernet                  Client for Microsoft Networks                      ms_msclient          True
Ethernet                  QoS Packet Scheduler                               ms_pacer             True
Ethernet                  File and Printer Sharing for Microsoft Networks    ms_server            True
Ethernet                  Internet Protocol Version 6 (TCP/IPv6)             ms_tcpip6            True
Ethernet                  Internet Protocol Version 4 (TCP/IPv4)             ms_tcpip             True

PS C:\Users\Administrator> get-NetAdapterChecksumOffload

Name                      IpIPv4Enabled   TcpIPv4Enabled  TcpIPv6Enabled  UdpIPv4Enabled  UdpIPv6Enabled
----                      -------------   --------------  --------------  --------------  --------------
Ethernet 2                Disabled        RxTxEnabled     RxTxEnabled     RxTxEnabled     RxTxEnabled
Ethernet                  Disabled        RxTxEnabled     RxTxEnabled     RxTxEnabled     RxTxEnabled

PS C:\Users\Administrator> get-NetAdapterEncapsulatedPacketTaskOffload
```

```
Name                            Enabled
----                            -------
Ethernet 2                      True
Ethernet                        True

PS C:\Users\Administrator> get-NetAdapterHardwareInfo

Name                            Segment Bus Device Function Slot NumaNode PcieLinkSpeed PcieLinkWidth Version
----                            ------- --- ------ -------- ---- -------- ------------- ------------- -------
Ethernet 2                            0   4      0        0              0       Unknown             8 1.1
Ethernet                              0   4      0        1              0       Unknown             8 1.1

PS C:\Users\Administrator> get-NetAdapterIpsecOffload
PS C:\Users\Administrator> get-NetAdapterLso

Name                            Version         V1IPv4Enabled  IPv4Enabled  IPv6Enabled
----                            -------         -------------  -----------  -----------
Ethernet 2                      LSO Version 2   False          True         True
Ethernet                        LSO Version 2   False          True         True

PS C:\Users\Administrator> get-NetAdapterPowerManagement

InterfaceDescription    : HP FlexFabric 20Gb 2-port 630FLB Adapter #76
Name                    : Ethernet 2
ArpOffload              : Unsupported
NSOffload               : Unsupported
RsnRekeyOffload         : Unsupported
D0PacketCoalescing      : Unsupported
SelectiveSuspend        : Unsupported
DeviceSleepOnDisconnect : Inactive
WakeOnMagicPacket       : Disabled
WakeOnPattern           : Disabled

InterfaceDescription    : HP FlexFabric 20Gb 2-port 630FLB Adapter #77
Name                    : Ethernet
ArpOffload              : Unsupported
NSOffload               : Unsupported
RsnRekeyOffload         : Unsupported
D0PacketCoalescing      : Unsupported
SelectiveSuspend        : Unsupported
DeviceSleepOnDisconnect : Inactive
WakeOnMagicPacket       : Disabled
WakeOnPattern           : Disabled

PS C:\Users\Administrator> get-NetAdapterQos

Name         : Ethernet 2
Enabled      : False
Capabilities :                      Hardware     Current
```

```
                                         --------      -------
                MacSecBypass        : NotSupported NotSupported
                DcbxSupport         : CEE          None
                NumTCs(Max/ETS/PFC) : 3/3/3        0/0/0

Name         : Ethernet
Enabled      : False
Capabilities :                        Hardware     Current
                                      --------     -------
                MacSecBypass        : NotSupported NotSupported
                DcbxSupport         : CEE          None
                NumTCs(Max/ETS/PFC) : 3/3/3        0/0/0

PS C:\Users\Administrator> get-NetAdapterRdma
PS C:\Users\Administrator> get-NetAdapterRsc

Name                           IPv4Enabled  IPv6Enabled  IPv4Operational IPv6Operational IPv4FailureReason  IPv6FailureR
                                                         State           State                              eason
----                           -----------  -----------  --------------- --------------- -----------------  ------------
Ethernet 2                     True         True         False           False           Capability         Capability
Ethernet                       True         True         False           False           Capability         Capability

PS C:\Users\Administrator> get-NetAdapterRss

Name                                            : Ethernet 2
InterfaceDescription                            : HP FlexFabric 20Gb 2-port 630FLB Adapter #76
Enabled                                         : True
NumberOfReceiveQueues                           : 16
Profile                                         : NUMAStatic
BaseProcessor: [Group:Number]                   : 0:0
MaxProcessor: [Group:Number]                    : 0:15
MaxProcessors                                   : 16
RssProcessorArray: [Group:Number/NUMA Distance] : 0:0/0  0:1/0  0:2/0  0:3/0  0:4/0  0:5/0  0:6/0  0:7/0
                                                  0:8/32767  0:9/32767  0:10/32767  0:11/32767  0:12/32767  0:13/32767
                                                   0:14/32767  0:15/32767
IndirectionTable: [Group:Number]                : 0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                                  0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15
                                                  0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                                  0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15
                                                  0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                                  0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15
                                                  0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                                  0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15
                                                  0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                                  0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15
                                                  0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                                  0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15
                                                  0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                                  0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15
                                                  0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
```

```
                                            0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15

Name                                      : Ethernet
InterfaceDescription                      : HP FlexFabric 20Gb 2-port 630FLB Adapter #77
Enabled                                   : True
NumberOfReceiveQueues                     : 16
Profile                                   : NUMAStatic
BaseProcessor: [Group:Number]             : 0:0
MaxProcessor: [Group:Number]              : 0:15
MaxProcessors                             : 16
RssProcessorArray: [Group:Number/NUMA Distance] : 0:0/0  0:1/0  0:2/0  0:3/0  0:4/0  0:5/0  0:6/0  0:7/0
                                            0:8/32767  0:9/32767  0:10/32767  0:11/32767  0:12/32767  0:13/32767
                                             0:14/32767  0:15/32767
IndirectionTable: [Group:Number]          : 0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                            0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15
                                            0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                            0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15
                                            0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                            0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15
                                            0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                            0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15
                                            0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                            0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15
                                            0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                            0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15
                                            0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                            0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15
                                            0:0    0:8    0:1    0:9    0:2    0:10    0:3    0:11
                                            0:4    0:12    0:5    0:13    0:6    0:14    0:7    0:15

PS C:\Users\Administrator> get-NetAdapterSriov

Name                 : Ethernet 2
InterfaceDescription : HP FlexFabric 20Gb 2-port 630FLB Adapter #76
Enabled              : False
SriovSupport         : NoIoMmuSupport
SwitchName           : Default Switch
NumVFs               : 64

Name                 : Ethernet
InterfaceDescription : HP FlexFabric 20Gb 2-port 630FLB Adapter #77
Enabled              : False
SriovSupport         : NoIoMmuSupport
SwitchName           : Default Switch
NumVFs               : 64

PS C:\Users\Administrator> get-NetAdapterSriovVf
PS C:\Users\Administrator> get-NetAdapterStatistics

Name                                ReceivedBytes ReceivedUnicastPackets       SentBytes SentUnicastPackets
```

```
----                           ------------- ----------------------       --------- ------------------
Ethernet 2                             10048                     0          40977                  0
Ethernet                                7380                     0          35774                  0

PS C:\Users\Administrator> get-NetAdapterVmq

Name                           InterfaceDescription             Enabled BaseVmqProcessor MaxProcessors NumberOfReceive
                                                                                                       Queues
----                           --------------------             ------- ---------------- ------------- ---------------
Ethernet 2                     HP FlexFabric 20Gb 2-port 6...#76 False   0:0              16             0
Ethernet                       HP FlexFabric 20Gb 2-port 6...#77 False   0:0              16             0

PS C:\Users\Administrator> get-NetAdapterVmqQueue
PS C:\Users\Administrator> get-NetAdapterVPort
PS C:\Users\Administrator>
```

The original version of this document is available at:
http://www.demartek.com/Demartek_HP_20GbE_Adapter_Evaluation_2015-01.html on the Demartek website.