

# THE CISCO® UNIFIED COMPUTING SYSTEM™



SCALE 80 BLADES UP TO

**80 GBPS BANDWIDTH  
FOR 72% LESS**

THAN THE HP BLADESYSTEM C7000 AT 60 GBPS

80 Gbps

20 Gbps

Today's bandwidth needs are greater than ever, and modern blade servers need to rise to the occasion. In the past, a 1Gbps connection might have supported network traffic with ease, but now even a 10Gbps link can become sluggish when using technologies such as converged networks and bandwidth-heavy virtualization operations such as vMotion and Live Migration.

Adequate bandwidth is crucial to the day-to-day operations of many businesses. Companies need to accommodate their current level of activity and be able to scale up as demand increases.

In this report, we examine the bandwidth scale-up costs of two 80-node solutions: the Cisco Unified Computing System (UCS®) and the HP BladeSystem c7000. While the baseline Cisco UCS configuration, with 20 Gbps of bandwidth, is slightly less expensive than the baseline HP solution, the true savings come with scaling. Due to differences in the architecture of the two solutions, scaling to an 80 Gbps configuration with the Cisco UCS is 44 percent less expensive than reaching only the 40 Gbps tier on the HP c7000 solution and is 72 percent less expensive than scaling to the 60 Gbps top tier of bandwidth available to the half-height HP solution we tested.

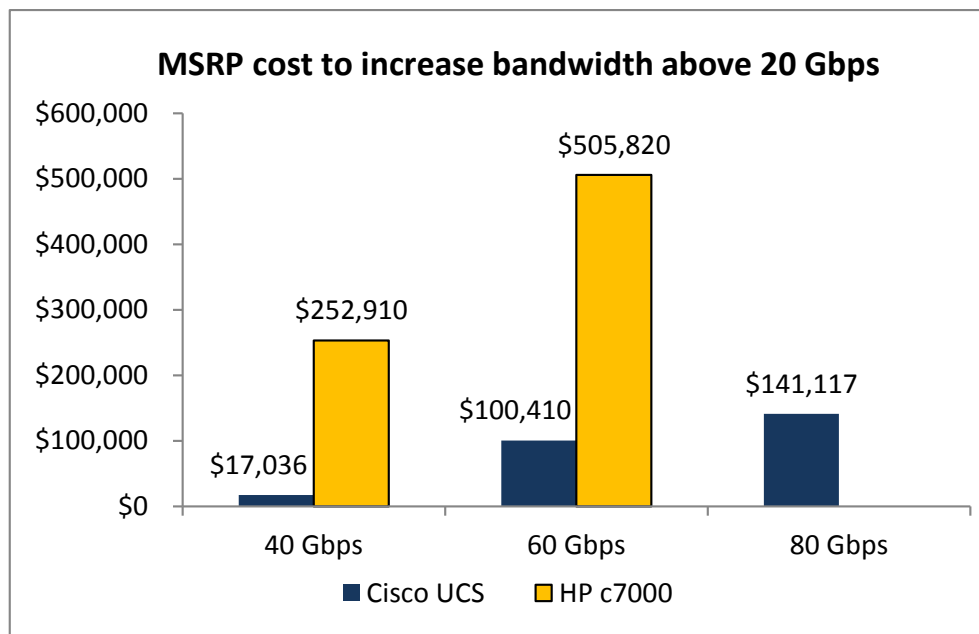


## MORE BANDWIDTH FOR BETTER PERFORMANCE

Several bandwidth-intensive new technologies, including vMotion and Live Migration, are increasing the need for network bandwidth. Virtual desktops now allow high-end graphics processing units (GPUs) to send high-resolution, lossless videos and graphics from a server in a data center to multiple client devices over the LAN, but these applications and videos maintain their high quality only with sufficient bandwidth. Bandwidth bottlenecks contribute to degraded quality during the data transfer process, resulting in deteriorated user experience. Newer and faster storage arrays now incorporate solid-state drives (SSDs); this means that the server has greater access to disk I/O via network-attached storage (NAS), but can only benefit from the NAS if the network link supports the transfer of data. Companies must be able to maintain high levels of service, even as bandwidth needs increase over time. To achieve this in a cost-effective way, they need to plan their purchases with an eye to future growth and to understand the costs associated with scaling up.

To understand the advantages of the pay-as-you-go approach to increasing bandwidth, we considered a hypothetical business environment requiring 80 compute nodes. The company wants to start with a baseline configuration that provides 20 Gbps of upstream bandwidth to any single node, and intends to increase bandwidth in later configurations. We considered two industry-leading solutions – the Cisco UCS and the HP BladeSystem c7000. We specified an 80-node compute environment with similarly configured blades. Both vendor environments can accommodate 80 nodes while utilizing fully populated chassis. To avoid having to replace parts as we scaled up, we selected hardware we could use in all of the configurations under consideration. This means our initial hardware may support higher bandwidth than we require during that phase, but we will avoid the cost of replacing that hardware with higher-performing components as we scale up.

Figure 1: Increasing to 80 Gbps on the Cisco solution cost less than increasing to 40 Gbps on the HP solution.



As seen in Figure 1, the cost to increase bandwidth with the Cisco UCS environment was significantly lower than with the HP BladeSystem c7000. (Note: At the time of this writing, the HP environment does not offer an 80 Gbps Ethernet solution as an option for their half-height blades.)

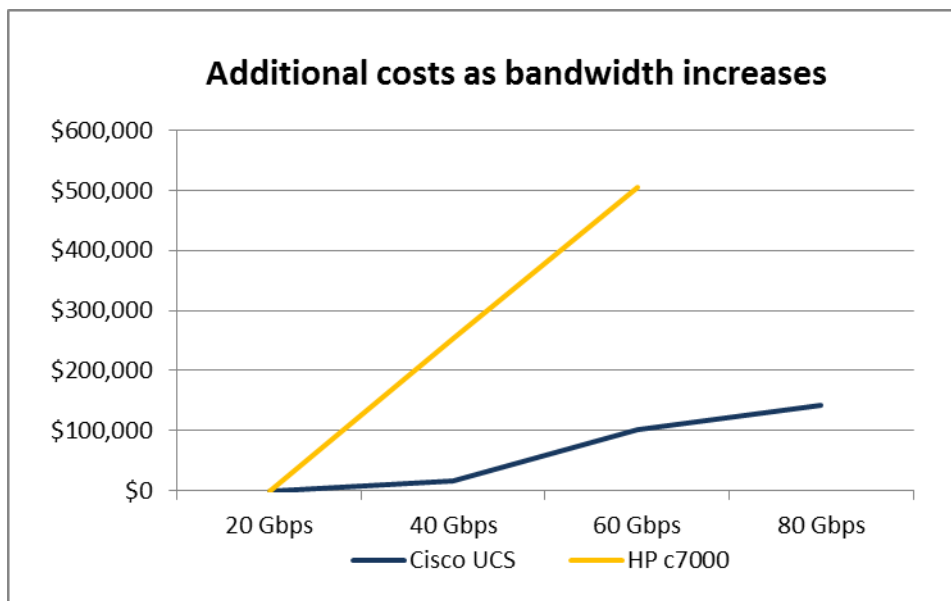
As seen in Figure 2, in our scenario the Cisco UCS environment has a lower list price than the HP BladeSystem c7000 environment for all configuration tiers. We noted that the list price for the Cisco UCS configuration at 80 Gbps is lower than the HP c7000 environment at 40 and 60 Gbps.

|         | Cisco UCS   | HP c7000    |
|---------|-------------|-------------|
| 20 Gbps | \$1,051,136 | \$1,094,128 |
| 40 Gbps | \$1,068,172 | \$1,347,038 |
| 60 Gbps | \$1,151,546 | \$1,599,948 |
| 80 Gbps | \$1,192,253 |             |

Figure 2: List prices of Cisco UCS and HP BladeSystem c7000 environments.

As seen in Figure 3, the HP BladeSystem c7000 costs rise in a straight line, due to the additional hardware required to increase bandwidth above the baseline configuration. Each subsequent increase in bandwidth requires the purchase of the full additional hardware to accommodate the need. Compare this with the shape of the cost line associated with the Cisco environment. The Cisco environment requires minimal additional hardware, aside from cabling, and utilizes a licensing model to increase bandwidth on a pay-as-you-go basis.

Figure 3: The Cisco UCS model scales up with little additional hardware, creating a gentle cost slope.



## SCALING UP THE ENVIRONMENT

### Cisco UCS

The Cisco UCS 6248UP Fabric Interconnects deliver up to 160 Gbps to a single chassis. The chassis contains eight half-height bays, and when populated with B200 M3 half-height server blades, can provide up to 80 Gbps of total bandwidth to any node within the chassis. It does this by licensing additional Fabric Interconnect ports, each of which provides 10 Gbps of bandwidth to a server. The chassis require no integrated switches, as switching is handled upstream by the Cisco UCS 6248UP Fabric Interconnect modules. The baseline configuration has 20 Gbps, with 10 Gbps to each of the two virtual adapter ports. This 80-blade scenario required 10 fully populated chassis. List pricing for this configuration as of February 4, 2014 was \$1,051,136.

You can double the bandwidth, with each of the two virtual NICs providing up to 20 Gbps, simply by increasing the number of uplinks between the chassis FEX (Fabric Extenders) and the Fabric Interconnect and adding port licenses. Implementing this change does not require additional hardware and provides up to 40 Gbps to each blade, increasing the list price by only 1.6 percent over the initial investment for a total of \$1,068,172.

Increasing the bandwidth to 60 Gbps requires the addition of another virtual interface card (VIC) for each blade, increasing the number of uplinks between the Chassis FEX and the Fabric Interconnects and adding port licenses. These changes increase the cost of the system only 7.8 percent above the list cost of the 40 Gbps option. The list cost for this option is \$1,151,546 – a 9.6 percent total increase compared to the base configuration.

To upgrade from 60 Gbps to the maximum 80 Gbps of bandwidth per server only requires increasing the number of uplinks between the Chassis FEX and the Fabric Interconnects and adding port licenses as necessary. Making this change requires no additional hardware and increases the solution cost by only 3.5 percent over the list price of the 60 Gbps configuration, for a total of \$1,192,253. This is a 13.4 percent total increase in list price from the base configuration.

For details about the specific configurations and components used for the Cisco UCS environment, see [Appendix A](#).

## HP BladeSystem c7000

The HP BladeSystem c7000 enclosure contains 16 half-height bays and, when populated with HP ProLiant BL460c Gen8 blades, and may provide up to 60 Gbps of total bandwidth to any node within the chassis. In the base configuration, this bandwidth is provided by leveraging an HP FlexFabric 10Gb 2-port 554FLB adapter, which provides 10 Gbps per port, up to 20 Gbps total, when used in conjunction with HP Virtual Connect FlexFabric 10Gb/24-port modules housed within the chassis. Each Virtual Connect FlexFabric module connects to an upstream switch and provides connectivity for the servers in a single chassis. For the baseline configuration, two Virtual Connect FlexFabric modules per chassis are required in order to provide 20Gbps to the resident blades. Our 80-blade scenario required five fully populated chassis. List price for the baseline configuration as of February 4, 2014 was \$1,094,128.

Doubling the bandwidth to the blades requires the addition of a mezzanine card in each blade and two additional Virtual Connect FlexFabric modules per chassis. This configuration provides four 10Gbps paths to each blade for a total of 40 Gbps per blade. These additions increase the list price by 23.1 percent over the base configuration, for a total of \$1,347,038.

Increasing the bandwidth again, to 60 Gbps, requires the addition of another mezzanine card in each blade and the insertion of two more Virtual Connect FlexFabric modules, six total, in each chassis. These additional components add 18.8 percent to the cost of the solution over the previous tier. The list cost for this option is \$1,599,948 – a 46.2 percent increase over the list price of the base configuration.

As of February 4, 2014, the maximum available bandwidth available to the HP ProLiant BL460c Gen8 blade servers using 10 Gbps Ethernet technology was 60 Gbps. For details about the specific configurations and components used for the HP BladeSystem c7000 environment, see [Appendix B](#).

# PRODUCT ARCHITECTURES

## Cisco UCS

### Cisco UCS 6248UP Fabric Interconnect

The Cisco UCS 6248UP 48-port Fabric Interconnect provides converged access to both data and storage networks. Fabric Interconnects are typically configured in redundant pairs.

### Cisco UCS 2208XP Fabric Extenders

The Cisco UCS 2200 Series Fabric Extenders extend the I/O fabric, enabling Fibre Channel over Ethernet (FCoE) fabric to connect all blades and chassis together. Managed as an extension of the Fabric Interconnects, Fabric Extenders eliminate the need for redundant switches in each chassis.

Each Cisco UCS 2208XP Fabric Extender contains eight 10Gb Ethernet, FCoE-capable, Small Form-Factor Pluggable (SFP+) ports for connecting the blade chassis to the Fabric Interconnect, and thirty-two 10Gb Ethernet ports for connecting half-width bays through the mid-plane.

Fabric Extenders, typically configured in pairs for redundancy, can each provide up to 80 Gbps per fabric, for a total of 160 Gbps of I/O to the chassis.

### Cisco UCS B200 M3 Server

The Cisco UCS B200 M3 is a half-width blade providing up to two multi-core Intel® Xeon® E5-2600 v2 processors and 24 DIMM slots supporting up to 768 GB of DDR3 RAM. Up to eight B200 M3 servers can reside in a single Cisco UCS 5108 Blade Server Chassis. The B200 M3 can house two hot-pluggable SAS or SATA hard disk drives (HDDs) or solid-state drives.

### Cisco UCSB-MLOM Virtual Interface Cards

- **USB-MLOM-40G-01.** The Cisco UCSB-MLOM-40G-01 is a four port 10Gb Ethernet, Fibre Channel over Ethernet (FCoE)-capable modular LAN on motherboard (mLOM) card designed for Cisco UCS B-Series Blade Servers. It is capable of providing up to 40 Gbps of bandwidth to a half-height B200 M3 server.
- **UCSB-MLOM-PT-01.** The UCSB-MLOM-PT-01 is a port expander for use with the UCSB-MLOM-40G-01, which doubles the number of available ports, effectively doubling the total bandwidth available to a single node.

### Cisco UCS Manager

Cisco UCS Manager provides centralized management of the software and hardware components in the Cisco UCS. The UCS Manager controls multiple chassis,

providing hardware profile management for rapid deployment and management of servers within the UCS environment.

### Required components for bandwidth increase

To increase bandwidth in the Cisco UCS environment, four components come into play. The VIC 1240 port expanders enable the VIC 1240 mLOM to access additional lanes, which is necessary in configurations above 40 Gbps. The UCS 6248UP 16-port expanders add additional ports to the 6248UP Fabric Interconnects, which enables additional lanes for the connected chassis. These expanders come with eight port licenses, which decreases the total number of individual port licenses to be bought separately. The UCS 6200 Series 1PORT license is required for each utilized port on the Fabric Interconnects, either for connection to the chassis or for upstream connections. The additional UCS SFP+ Copper Twinax cables make the connections between the chassis and the Fabric Interconnects. We do not include the prices for uplink connections or upstream port costs.

In Figure 4, we show the additional components required for the Cisco UCS environment in order to achieve increased bandwidth. See [Appendix A](#) for the list prices of each component.

| Cisco UCS components required     | 20 Gbps | 40 Gbps | 60 Gbps | 80 Gbps |
|-----------------------------------|---------|---------|---------|---------|
| VIC 1240 port expander            | 0       | 0       | 80      | 80      |
| UCS 6248UP 16-port expander + 8pL | 0       | 0       | 2       | 2       |
| UCS 6200 Series 1PORT license     | 0       | 8       | 32      | 56      |
| UCS SFP+ Copper Twinax cable      | 20      | 40      | 60      | 80      |

Figure 4: Cisco UCS components required to achieve each tier of bandwidth.

## HP BladeSystem c7000

### HP Virtual Connect FlexFabric 10Gb/24-port Module

HP Virtual Connect FlexFabric 10Gb/24-port modules provide converged networking capabilities to the HP c7000 chassis. Each module provides configurable connections for either data or storage to each of the connected 10Gb server ports. Two HP Virtual Connect FlexFabric 10Gb/24-port modules are required to provide 20 Gbps to each blade server.

### HP ProLiant BL460c Gen8 Server

The HP ProLiant BL460c Gen8 server is a half-height blade providing up to two multi-core Intel Xeon E5-2600 v2 processors and 16 DIMM slots supporting up to 512 GB of DDR3 RAM. Up to sixteen BL460c Gen8 servers can reside in a single HP BladeSystem c7000 enclosure. The BL460c Gen8 can house two hot-pluggable SAS or SATA hard disk drives (HDDs) or solid-state drives.



## HP FlexFabric Adapters

- **HP FlexFabric 10Gb 2-port 554FLB.** The HP FlexFabric 10Gb 2-port 554FLB adapter is a two port flexible LOM adapter capable of providing 10Gb Ethernet, Fibre Channel over Ethernet, iSCSI, or FlexFabric connectivity. Each port of the FlexFabric adapter maps to an interconnect module located on the rear of the HP BladeSystem c7000 chassis. Two FlexFabric modules are required in order to provide 20 Gbps to the HP FlexFabric 10G 2-port 554FLB adapter.
- **HP FlexFabric 10Gb 2-port 554M.** The HP FlexFabric 10Gb 2-port 554M adapter is a two port mezzanine adapter capable of providing 10Gb Ethernet, Fibre Channel over Ethernet, iSCSI, or FlexFabric connectivity. Each port of the FlexFabric adapter maps to one interconnect module located on the rear of the HP BladeSystem c7000 chassis. Two additional FlexFabric modules are required in order to provide 20 Gbps to the HP FlexFabric 10Gb 2-port 554M adapter.

## HP OneView

HP OneView is a software platform with an integrated workspace for converged infrastructure management. Tasks and collaboration are automated and streamlined, simplifying the management of both physical and virtual environments. HP OneView offers centralized management for up to 640 servers, allowing you to update and configure the compute nodes in your datacenter.

## Components required for bandwidth increase

The HP BladeSystem c7000 requires only two components in order to increase bandwidth. For each tier of bandwidth, you must install Virtual Connect FlexFabric 10Gb/24-port modules in pairs within each chassis. Additionally, for each tier of bandwidth, you must install an additional mezzanine adapter in each server. This means for each upgrade, you must purchase and install another set of redundant hardware components. Each FlexFabric module connects to an upstream core network; however, we do not include the cost of uplink connections or upstream port costs.

In Figure 5, we show the additional components required for the HP BladeSystem c7000 environment in order to achieve increased bandwidth. See [Appendix B](#) for list prices of each component.

| HP BladeSystem components required              | 20 Gbps | 40 Gbps | 60 Gbps |
|---|---------|---------|---------|
| Virtual Connect FlexFabric 10Gb/24-port Modules | 10      | 20      | 30      |
| HP FlexFabric 10Gb 2-port 554M Adapters         | 0       | 80      | 160     |

**Figure 5: HP BladeSystem components required to achieve each tier of bandwidth.**



## CONCLUSION

Entry costs are an important factor in choosing a converged infrastructure environment for your business. Because bandwidth needs are always on the rise, it is also important to choose a solution with easy upgrade paths that will allow you to meet these increasing needs. As our analysis demonstrates, the future costs associated with those upgrades are just as important to consider as the maximum available bandwidth a solution can provide.

The Cisco UCS represents a good investment for companies expecting growth in bandwidth over time. Its 20 Gbps baseline configuration is less expensive than the equivalent configuration of the HP BladeSystem c7000. Even better, the cost to scale to its maximum of 80 Gbps is 72 percent lower than the cost of scaling to the HP BladeSystem c7000 maximum configuration of 60 Gbps. This means that the Cisco UCS can deliver more bandwidth at a lower cost than the HP BladeSystem c7000.

## APPENDIX A: CONFIGURATION DETAILS FOR THE CISCO UCS ENVIRONMENT

The following tables provide detailed configuration details and cost data for the components in the Cisco UCS solution. We first present the 20Gbps solution, followed by the 40Gbps, 60Gbps, and 80Gbps solutions. All prices are valid as of February 4, 2014 and obtained from [buildprice.cisco.com](http://buildprice.cisco.com).

### Cisco UCS Baseline Configuration (20 Gbps)

| Part  | Part number       | Quantity | List        | Total List            |
|---|-------------------|----------|-------------|-----------------------|
| B200 M3 blade server                            | UCSB-B200-M3-U    | 80       | \$1,682.13  | \$134,570.40          |
| Intel E5-2660 v2 processors                     | UCS-CPU-E5-2660B  | 160      | \$2,106.13  | \$336,980.80          |
| 16GB 1866MHz DDR3 RAM                           | UCS-MR-1X162RZ-A  | 640      | \$388.80    | \$248,832.00          |
| 146GB 6Gb SAS 15K RPM SFF HDD                   | A03-D146GC2       | 160      | \$369.07    | \$59,051.20           |
| VIC 1240 modular LOM                            | UCSB-MLOM-40G-01  | 80       | \$799.47    | \$63,957.60           |
| VIC 1240 port expander                          | UCSB-MLOM-PT-01   | 0        | \$320.00    | \$0.00                |
| UCS 5108 blade chassis                          | N20-C6508-UPG     | 10       | \$3,199.47  | \$31,994.70           |
| 2500W Platinum PSU for UCS 5108                 | UCSB-PSU-2500ACPL | 40       | \$499.20    | \$19,968.00           |
| Fan module for UCS 5108 (included with chassis) | N/A               | 0        | N/A         | \$0.00                |
| 2208XP FEX fabric extender modules              | UCS-IOM-2208XP    | 20       | \$5,333.33  | \$106,666.60          |
| Cisco R Series rack                             | R42610            | 2        | \$1,264.07  | \$2,528.14            |
| UCS 6248UP Fabric Interconnect + 12pL           | UCS-FI-6248UP     | 2        | \$18,560.01 | \$37,120.02           |
| UCS 6248UP chassis accessory kit                | UCS-ACC-6248UP    | 2        | N/A         | \$0.00                |
| UCS 6248UP 16-port expander + 8pL               | UCS-FI-E16UP      | 0        | \$8,533.33  | \$0.00                |
| UCS 6200 Series 1PORT license                   | UCS-LIC-10GE      | 0        | \$1,479.47  | \$0.00                |
| UCS SFP+ Copper Twinax cable                    | SFP-H10GB-CU5M    | 20       | \$260.00    | \$5,200.00            |
| UCS 6248UP power supply                         | UCS-PSU-6248UP-AC | 4        | \$1,066.67  | \$4,266.68            |
| UCS 6248UP fan module (included)                | N/A               | 0        | N/A         | \$0.00                |
| <b>Total cost</b>                               |                   |          |             | <b>\$1,051,136.14</b> |

## Cisco UCS 40 Gbps

| Part  | Part number       | Quantity | List        | Total List            |
|---|-------------------|----------|-------------|-----------------------|
| B200 M3 blade server                            | UCSB-B200-M3-U    | 80       | \$1,682.13  | \$134,570.40          |
| Intel E5-2660 v2 processors                     | UCS-CPU-E5-2660B  | 160      | \$2,106.13  | \$336,980.80          |
| 16GB 1866MHz DDR3 RAM                           | UCS-MR-1X162RZ-A  | 640      | \$388.80    | \$248,832.00          |
| 146GB 6Gb SAS 15K RPM SFF HDD                   | A03-D146GC2       | 160      | \$369.07    | \$59,051.20           |
| VIC 1240 modular LOM                            | UCSB-MLOM-40G-01  | 80       | \$799.47    | \$63,957.60           |
| VIC 1240 port expander                          | UCSB-MLOM-PT-01   | 0        | \$320.00    | \$0.00                |
| UCS 5108 blade chassis                          | N20-C6508-UPG     | 10       | \$3,199.47  | \$31,994.70           |
| 2500W Platinum PSU for UCS 5108                 | UCSB-PSU-2500ACPL | 40       | \$499.20    | \$19,968.00           |
| Fan module for UCS 5108 (included with chassis) | N/A               | 0        | N/A         | \$0.00                |
| 2208XP FEX fabric extender modules              | UCS-IOM-2208XP    | 20       | \$5,333.33  | \$106,666.60          |
| Cisco R Series rack                             | R42610            | 2        | \$1,264.07  | \$2,528.14            |
| UCS 6248UP Fabric Interconnect + 12pL           | UCS-FI-6248UP     | 2        | \$18,560.01 | \$37,120.02           |
| UCS 6248UP chassis accessory kit                | UCS-ACC-6248UP    | 2        | N/A         | \$0.00                |
| UCS 6248UP 16-port expander + 8pL               | UCS-FI-E16UP      | 0        | \$8,533.33  | \$0.00                |
| UCS 6200 Series 1PORT license                   | UCS-LIC-10GE      | 8        | \$1,479.47  | \$11,835.76           |
| UCS SFP+ Copper Twinax cable                    | SFP-H10GB-CU5M    | 40       | \$260.00    | \$10,400.00           |
| UCS 6248UP power supply                         | UCS-PSU-6248UP-AC | 4        | \$1,066.67  | \$4,266.68            |
| UCS 6248UP fan module (included)                | N/A               | 0        | N/A         | \$0.00                |
| <b>Total cost</b>                               |                   |          |             | <b>\$1,068,171.90</b> |

## Cisco UCS 60 Gbps

| Part  | Part number       | Quantity | List        | Total List            |
|---|-------------------|----------|-------------|-----------------------|
| B200 M3 blade server                            | UCSB-B200-M3-U    | 80       | \$1,682.13  | \$134,570.40          |
| Intel E5-2660 v2 processors                     | UCS-CPU-E5-2660B  | 160      | \$2,106.13  | \$336,980.80          |
| 16GB 1866MHz DDR3 RAM                           | UCS-MR-1X162RZ-A  | 640      | \$388.80    | \$248,832.00          |
| 146GB 6Gb SAS 15K RPM SFF HDD                   | A03-D146GC2       | 160      | \$369.07    | \$59,051.20           |
| VIC 1240 modular LOM                            | UCSB-MLOM-40G-01  | 80       | \$799.47    | \$63,957.60           |
| VIC 1240 port expander                          | UCSB-MLOM-PT-01   | 80       | \$320.00    | \$25,600.00           |
| UCS 5108 blade chassis                          | N20-C6508-UPG     | 10       | \$3,199.47  | \$31,994.70           |
| 2500W Platinum PSU for UCS 5108                 | UCSB-PSU-2500ACPL | 40       | \$499.20    | \$19,968.00           |
| Fan module for UCS 5108 (included with chassis) | N/A               | 0        | N/A         | \$0.00                |
| 2208XP FEX fabric extender modules              | UCS-IOM-2208XP    | 20       | \$5,333.33  | \$106,666.60          |
| Cisco R Series rack                             | R42610            | 2        | \$1,264.07  | \$2,528.14            |
| UCS 6248UP Fabric Interconnect + 12pL           | UCS-FI-6248UP     | 2        | \$18,560.01 | \$37,120.02           |
| UCS 6248UP chassis accessory kit                | UCS-ACC-6248UP    | 2        | N/A         | \$0.00                |
| UCS 6248UP 16-port expander + 8pL               | UCS-FI-E16UP      | 2        | \$8,533.33  | \$17,066.66           |
| UCS 6200 Series 1PORT license                   | UCS-LIC-10GE      | 32       | \$1,479.47  | \$47,343.04           |
| UCS SFP+ Copper Twinax cable                    | SFP-H10GB-CU5M    | 60       | \$260.00    | \$15,600.00           |
| UCS 6248UP power supply                         | UCS-PSU-6248UP-AC | 4        | \$1,066.67  | \$4,266.68            |
| UCS 6248UP fan module (included)                | N/A               | 0        | N/A         | \$0.00                |
| <b>Total cost</b>                               |                   |          |             | <b>\$1,151,545.84</b> |

## Cisco UCS 80 Gbps

| Part  | Part number       | Quantity | List        | Total List            |
|---|-------------------|----------|-------------|-----------------------|
| B200 M3 blade server                            | UCSB-B200-M3-U    | 80       | \$1,682.13  | \$134,570.40          |
| Intel E5-2660 v2 processors                     | UCS-CPU-E5-2660B  | 160      | \$2,106.13  | \$336,980.80          |
| 16GB 1866MHz DDR3 RAM                           | UCS-MR-1X162RZ-A  | 640      | \$388.80    | \$248,832.00          |
| 146GB 6Gb SAS 15K RPM SFF HDD                   | A03-D146GC2       | 160      | \$369.07    | \$59,051.20           |
| VIC 1240 modular LOM                            | UCSB-MLOM-40G-01  | 80       | \$799.47    | \$63,957.60           |
| VIC 1240 port expander                          | UCSB-MLOM-PT-01   | 80       | \$320.00    | \$25,600.00           |
| UCS 5108 blade chassis                          | N20-C6508-UPG     | 10       | \$3,199.47  | \$31,994.70           |
| 2500W Platinum PSU for UCS 5108                 | UCSB-PSU-2500ACPL | 40       | \$499.20    | \$19,968.00           |
| Fan module for UCS 5108 (included with chassis) | N/A               | 0        | N/A         | \$0.00                |
| 2208XP FEX fabric extender modules              | UCS-IOM-2208XP    | 20       | \$5,333.33  | \$106,666.60          |
| Cisco R Series rack                             | R42610            | 2        | \$1,264.07  | \$2,528.14            |
| UCS 6248UP Fabric Interconnect + 12pL           | UCS-FI-6248UP     | 2        | \$18,560.01 | \$37,120.02           |
| UCS 6248UP chassis accessory kit                | UCS-ACC-6248UP    | 2        | N/A         | \$0.00                |
| UCS 6248UP 16-port expander + 8pL               | UCS-FI-E16UP      | 2        | \$8,533.33  | \$17,066.66           |
| UCS 6200 Series 1PORT license                   | UCS-LIC-10GE      | 56       | \$1,479.47  | \$82,850.32           |
| UCS SFP+ Copper Twinax cable                    | SFP-H10GB-CU5M    | 80       | \$260.00    | \$20,800.00           |
| UCS 6248UP power supply                         | UCS-PSU-6248UP-AC | 4        | \$1,066.67  | \$4,266.68            |
| UCS 6248UP fan module (included)                | N/A               | 0        | N/A         | \$0.00                |
| <b>Total cost</b>                               |                   |          |             | <b>\$1,192,253.12</b> |

## APPENDIX B: CONFIGURATION DETAILS FOR THE HP BLADESYSTEM C7000 ENVIRONMENT

The following tables provide detailed configuration details and cost data for the components in the HP BladeSystem c7000 solution. We first present the 20Gbps solution, followed by the 40Gbps and 60Gbps solutions. All list prices are current as of February 4, 2014 and obtained using the HP Product Bulletin.

### HP BladeSystem c7000 Baseline Configuration (20 Gbps)

| Part   | Part number | Quantity | List        | Total List            |
|--|-------------|----------|-------------|-----------------------|
| HP BL460c Gen8 configurable blade                  | 735151-B21  | 80       | \$1,986.00  | \$158,880.00          |
| Intel Xeon processors E5-2660                      | 718058-L21  | 160      | \$1,859.00  | \$297,440.00          |
| 16GB 1600MHz DDR3 RAM                              | 708641-B21  | 640      | \$369.00    | \$236,160.00          |
| 146GB 6Gb SAS 15K RPM SFF HDD                      | 652605-B21  | 160      | \$355.00    | \$56,800.00           |
| HP FlexFabric 10Gb 2-port 554FLB adapter           | 647586-B21  | 80       | \$599.00    | \$47,920.00           |
| HP iLO Advanced Blade 1 server license 3yr 24x7*   | BD502A      | 80       | \$365.00    | \$29,200.00           |
| HP OneView 3 year 24x7                             | F6Q91A      | 80       | \$400.00    | \$32,000.00           |
| HP C7000 blade chassis w/one OBA; 2 x PS; 4 x fans | 681840-B21  | 5        | \$5,999.00  | \$29,995.00           |
| HP 2400 watt Platinum hot plug power supplies      | 588603-B21  | 20       | \$399.00    | \$7,980.00            |
| HP BladeSystem c7000 fans                          | 412140-B21  | 30       | \$149.00    | \$4,470.00            |
| HP Onboard Admin w/KVM (redundant)                 | 456204-B21  | 5        | \$899.00    | \$4,495.00            |
| HP Virtual Connect FlexFabric 10Gb/24-port module  | 00D5823     | 10       | \$18,499.00 | \$184,990.00          |
| HP 642 1075mm Shock Intelligent Series rack        | BW904A      | 2        | \$1,899.00  | \$3,798.00            |
| HP FlexFabric 10Gb 2-port 554M adapter             | 647590-B21  | 0        | \$849.00    | \$0.00                |
| <b>Total cost</b>                                  |             |          |             | <b>\$1,094,128.00</b> |

### HP BladeSystem c7000 40 Gbps

| Part   | Part number | Quantity | List        | Total List            |
|--|-------------|----------|-------------|-----------------------|
| HP BL460c Gen8 configurable blade                  | 735151-B21  | 80       | \$1,986.00  | \$158,880.00          |
| Intel Xeon processors E5-2660                      | 718058-L21  | 160      | \$1,859.00  | \$297,440.00          |
| 16GB 1600MHz DDR3 RAM                              | 708641-B21  | 640      | \$369.00    | \$236,160.00          |
| 146GB 6Gb SAS 15K RPM SFF HDD                      | 652605-B21  | 160      | \$355.00    | \$56,800.00           |
| HP FlexFabric 10Gb 2-port 554FLB adapter           | 647586-B21  | 80       | \$599.00    | \$47,920.00           |
| HP iLO Advanced Blade 1 server license 3yr 24x7*   | BD502A      | 80       | \$365.00    | \$29,200.00           |
| HP OneView 3 year 24x7                             | F6Q91A      | 80       | \$400.00    | \$32,000.00           |
| HP C7000 blade chassis w/one OBA; 2 x PS; 4 x fans | 681840-B21  | 5        | \$5,999.00  | \$29,995.00           |
| HP 2400 watt Platinum hot plug power supplies      | 588603-B21  | 20       | \$399.00    | \$7,980.00            |
| HP BladeSystem c7000 fans                          | 412140-B21  | 30       | \$149.00    | \$4,470.00            |
| HP Onboard Admin w/KVM (redundant)                 | 456204-B21  | 5        | \$899.00    | \$4,495.00            |
| HP Virtual Connect FlexFabric 10Gb/24-port module  | 00D5823     | 20       | \$18,499.00 | \$369,980.00          |
| HP 642 1075mm Shock Intelligent Series rack        | BW904A      | 2        | \$1,899.00  | \$3,798.00            |
| HP FlexFabric 10Gb 2-port 554M adapter             | 647590-B21  | 80       | \$849.00    | \$67,920.00           |
| <b>Total cost</b>                                  |             |          |             | <b>\$1,347,038.00</b> |

## HP BladeSystem c7000 60 Gbps

| Part   | Part number | Quantity | List        | Total List            |
|--|-------------|----------|-------------|-----------------------|
| HP BL460c Gen8 configurable blade                  | 735151-B21  | 80       | \$1,986.00  | \$158,880.00          |
| Intel Xeon processors E5-2660                      | 718058-L21  | 160      | \$1,859.00  | \$297,440.00          |
| 16GB 1600MHz DDR3 RAM                              | 708641-B21  | 640      | \$369.00    | \$236,160.00          |
| 146GB 6Gb SAS 15K RPM SFF HDD                      | 652605-B21  | 160      | \$355.00    | \$56,800.00           |
| HP FlexFabric 10Gb 2-port 554FLB adapter           | 647586-B21  | 80       | \$599.00    | \$47,920.00           |
| HP iLO Advanced Blade 1 server license 3yr 24x7*   | BD502A      | 80       | \$365.00    | \$29,200.00           |
| HP OneView 3 year 24x7                             | F6Q91A      | 80       | \$400.00    | \$32,000.00           |
| HP C7000 blade chassis w/one OBA; 2 x PS; 4 x fans | 681840-B21  | 5        | \$5,999.00  | \$29,995.00           |
| HP 2400 watt Platinum hot plug power supplies      | 588603-B21  | 20       | \$399.00    | \$7,980.00            |
| HP BladeSystem c7000 fans                          | 412140-B21  | 30       | \$149.00    | \$4,470.00            |
| HP Onboard Admin w/KVM (redundant)                 | 456204-B21  | 5        | \$899.00    | \$4,495.00            |
| HP Virtual Connect FlexFabric 10Gb/24-port module  | 00D5823     | 30       | \$18,499.00 | \$554,970.00          |
| HP 642 1075mm Shock Intelligent Series rack        | BW904A      | 2        | \$1,899.00  | \$3,798.00            |
| HP FlexFabric 10Gb 2-port 554M adapter             | 647590-B21  | 160      | \$849.00    | \$135,840.00          |
| <b>Total cost</b>                                  |             |          |             | <b>\$1,599,948.00</b> |

## ABOUT PRINCIPLED TECHNOLOGIES



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