Achieve Optimal Network Throughput on the Cisco UCS S3260 Storage Server

Executive Summary
This document describes the network I/O performance characteristics of the Cisco UCS® S3260 Storage Server using the onboard 40-Gbps system I/O controller (SIOC) based on the Cisco UCS Virtual Interface Card (VIC) 1300 platform. The document discusses how to achieve optimal throughput on the S3260 M4 Server Node in a variety of scenarios. The goal of this document is to demonstrate to customers that, with this Cisco Unified Computing System™ (Cisco UCS) server platform, they are investing in a best-in-class dense server platform, and that they can achieve their desired level of throughput by implementing the configuration presented here.

All performance data presented in this document was obtained using the iperf testing tool, with analysis based on the aggregate throughput of all the streams used to saturate the 40-Gbps links. The primary focus of this document is on how to achieve optimal throughput regardless of the environment.

Main Findings
The main findings of the tests discussed in this document are listed here:

- The Cisco UCS S3260 SIOC built on the Cisco UCS VIC 1300 platform can fully saturate a 40-Gbps Ethernet port.
- Performance is similar with 1500-byte maximum-transmission-unit (MTU) frames and with 9000-byte MTU frames.
- Obtaining maximum performance with a 1500-byte MTU value requires an additional adapter profile configuration.

Introduction
The storage environment in the data center continues to evolve to meet customers’ changing requirements. Systems that used to be contained in a single traditional enterprise storage array are now being replaced by all-flash arrays and software-defined storage that scales without boundaries. Cisco continues to innovate by providing our customers with a dense family of servers that can provide up to 560 terabytes (TB) of storage in a 4-rack-unit (4RU) space. We also know that data doesn’t exist in isolation. For every hard drive sold, a best-in-class network infrastructure is mandatory to service every single request to read and write data.

In fact, there are as many different network environments as there are customers, and no single solution can address them all. This document addresses two of the most common environments and the points at which bottlenecks may exist. The Cisco UCS S3260 Storage Server SIOC is based on the most recent generation of the Cisco UCS VIC 1300 platform, which supports 40-Gbps throughput. This high level of throughput raises a new set of challenges in a variety of situations. This document discusses how to meet these challenges and achieve optimal throughput.
Audience

This document assumes that readers have some familiarity with data center trends, server and storage technology, and the Cisco UCS product line. Readers should also have a working knowledge of Cisco UCS Manager, because this guide does not offer the start-to-finish configuration details usually found in a more in-depth guide.

Network I/O Challenges

Prior to 40-Gbps networking, achieving maximum throughput was a relatively trivial task. But as server network I/O exceeds 10 Gbps, a new set of challenges has arisen. To achieve the maximum desired throughput with higher bandwidth, you must address two factors in particular:

- **Multiple application threads**: As network I/O increases, higher CPU frequencies are needed to accommodate the I/O load. If a higher frequency is not possible, you will need more CPU cores to process all the requests. To address this requirement, you need an application that can take advantage of today's multithreaded environments.

- **Reduced request load**: With network throughput of 40 Gbps, a tremendous amount of processing is required to service all the requests. You can reduce the load of those requests in two ways. The typical MTU value for most networks for many years has been 1500. However, by increasing the frame size so that the system uses an oversized or jumbo frame, you can reduce the processing load on the network adapter application-specific integrated circuit (ASIC) or the CPU in the system. Alternatively, you can increase the number queues, to achieve a more distributed method of receiving packets than with only a single queue.

Scope of This Document

All network performance testing was conducted between multiple Cisco UCS S3260 Storage Servers on properly configured SIOCs. Correct configurations were specified both for servers managed by Cisco UCS Manager and for standalone servers. Default and optimal performance configuration and performance results were captured for both MTU 1500 and 9000 settings. In addition, results were captured using a multithreaded network performance test: in this case, iperf. Note that the same settings as those used to achieve optimal throughput on the S3260 may be applicable to other Cisco UCS servers, but those results were not captured in these tests.

Infrastructure Components

Figure 1 shows the Cisco UCS components used in the tests described in this document.

**Figure 1.** Cisco UCS Components: Two Cisco UCS 6332 Fabric Interconnects and One Dual-Node Cisco UCS S3260 Storage Server
Hardware Components

The Cisco UCS S3260 Storage Server is a modular, high-density, high-availability, dual-node storage-optimized server. It is well suited for service providers, enterprises, and industry-specific environments. It provides dense, cost-effective storage to address an organization's ever-growing data needs. Designed for a new class of data-intensive workloads, it is simple to deploy and excellent for applications for big data, data protection, software-defined storage, scale-out unstructured data repositories, media streaming, and content distribution.

The S3260 provides:

- Dual 2-socket server nodes based on Intel® Xeon® processor E5-2600 v2 or v4 CPUs with up to 36 cores per server node
- Up to 512 GB of DDR3 or DDR4 memory per server node (1 TB total)
- Support for high-performance Non-Volatile Memory Express (NVMe) and flash memory
- Massive 600 TB data storage capacity that easily scales to petabytes (PB) with Cisco UCS Manager
- Policy-based storage management framework for zero-touch capacity on demand
- Dual-port 40-Gbps SIOCs with a Cisco UCS VIC 1300 platform embedded chip
- Unified I/O for Ethernet or Fibre Channel to existing network-attached storage (NAS) or SAN storage environments
- Support for Cisco bidirectional (BiDi) transceivers, with 40-Gbps connectivity over existing 10-Gbps cabling infrastructure

The S3260 can be deployed as a standalone device or as part of a managed Cisco UCS environment. Cisco UCS unifies computing, networking, management, virtualization, and storage access into a single integrated architecture that can enable end-to-end server visibility, management, and control in both bare-metal and virtualized environments.

With a Cisco UCS managed deployment, the S3260 takes advantage of our standards-based unified computing innovations to significantly reduce customers' total cost of ownership (TCO) and increase business agility.

The server specifications include:

- Server: Cisco UCS S3260 Storage Server
- CPU: 2 x 2.20-GHz Intel Xeon processor E5-2650 v4 CPUs
- Memory: 16 x 16-GB (256-GB) DDR4
- SIOC: One SIOC per node; each includes an integrated VIC 1300 platform virtual interface

Table 1 summarizes the server specifications.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chassis</td>
<td>4RU server</td>
</tr>
<tr>
<td>Server nodes</td>
<td>Up to 2 nodes; Cisco UCS S3260 chassis fits in 2 types of server nodes:</td>
</tr>
<tr>
<td></td>
<td>• M4 server nodes based on Intel Xeon processor E5-2600 v4 CPUs</td>
</tr>
<tr>
<td></td>
<td>• M3 server nodes based on Intel Xeon processor E5-2600 v2 CPUs</td>
</tr>
<tr>
<td>Processors</td>
<td>• Dual Intel Xeon processor E5-2600 v2 or v4 product family CPUs per server node</td>
</tr>
<tr>
<td></td>
<td>• M4 server node processors: Intel Xeon processor E5-2620 v4, E5-2650 v4, E5-2680 v4, and E5-2695 v4</td>
</tr>
<tr>
<td></td>
<td>• M3 server node processors: Intel Xeon processor E5-2620 v2, E5-2660 v2, and E5-2695 v2</td>
</tr>
</tbody>
</table>
### Item Description

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor cores</td>
<td>Up to 36 per server node</td>
</tr>
<tr>
<td>Memory</td>
<td>8 dual in-line memory module (DIMM) slots per processor with support for 128, 256, or 512 GB of capacity with DDR3 with M2 server node or DDR4 registered DIMMs (RDIMMs) or load-reduced DIMMs (LRDIMMs)</td>
</tr>
<tr>
<td>NVMe</td>
<td>One 2.5-inch NVMe 800-GB or 1.6-TB drive per M4 server node</td>
</tr>
<tr>
<td>System I/O controllers</td>
<td>Up to 2 SIOCs with onboard Cisco UCS VIC 1300 platform and 2 x 40-Gbps Quad Small-Form-Factor Pluggable (QSFP) ports (160 Gbps of throughput)</td>
</tr>
<tr>
<td>I/O expansion modules</td>
<td>• Dual x8 PCIe half-height, half-width slots for third-party add-in cards</td>
</tr>
<tr>
<td></td>
<td>• Unified I/O for storage</td>
</tr>
<tr>
<td></td>
<td>• 1 and 10 Gigabit Ethernet or 8- and 16-Gbps Fibre Channel</td>
</tr>
<tr>
<td></td>
<td>• Application acceleration with support for PCIe-based flash memory of 1000, 3200, or 6400 GB</td>
</tr>
<tr>
<td>RAID controllers</td>
<td>• M3 server node: Cisco 12-Gbps RAID, SAS host bus adapter (HBA), and LSI 3108 RAID-on-a-chip (ROC) controller</td>
</tr>
<tr>
<td></td>
<td>• M4 server node: LSI 3316 ROC controller with 4-GB RAID cache</td>
</tr>
<tr>
<td></td>
<td>• Controller support for RAID 0, 1, 5, 10, 50, and 60 and JBOD mode, providing enterprise-class data protection for all drives installed in the system</td>
</tr>
<tr>
<td>Drives</td>
<td>• Up to 56 top-accessible, hot-swappable 3.5-inch 4-inch, 6-inch, 8-inch, or 10-TB 7200-rpm NL-SAS hard-disk drives (HDDs)</td>
</tr>
<tr>
<td></td>
<td>• Up to 28 top-accessible, hot-swappable 400-GB, 800-GB, 1.6-TB, or 3.2-TB SAS solid-state disk (SSD) drives</td>
</tr>
<tr>
<td></td>
<td>• Up to 2 rear-accessible, hot-swappable, 2.5-inch, 120-inch, 480-GB SATA, or 1.6-TB SSD drives per server node</td>
</tr>
<tr>
<td></td>
<td>Note: These boot drives support a software RAID connected to an Intel Platform Controller Hub (PCH) with M3 server nodes and hardware RAID with the M4 server node connected to the RAID controller on the M4 server node.</td>
</tr>
<tr>
<td></td>
<td>• All drives are hot pluggable.</td>
</tr>
<tr>
<td>Disk expansion modules</td>
<td>You can expand data storage capacity with up to 4 rear-accessible, hot-swappable 3.5-inch, 4-inch, 6-inch, 8-inch, or 10-TB 7200-rpm NL-SAS HDDs.</td>
</tr>
<tr>
<td></td>
<td>Note: These drives are installed in server bay 2.</td>
</tr>
<tr>
<td>Power supplies</td>
<td>• 4 hot-pluggable, N+N redundant 1050-watt (W) 80 PLUS Platinum efficiency power supplies</td>
</tr>
<tr>
<td>Cisco® Integrated Management Controller (IMC)</td>
<td>Integrated baseboard management controller (BMC):</td>
</tr>
<tr>
<td></td>
<td>• IPMI 2.0 compliant for management and control</td>
</tr>
<tr>
<td></td>
<td>• One 10/100/1000 Gigabit Ethernet out-of-band management interface</td>
</tr>
<tr>
<td></td>
<td>• Command-line interface (CLI) and web GUI management tool for automated, lights-out management</td>
</tr>
<tr>
<td></td>
<td>• Keyboard, video, and mouse (KVM)</td>
</tr>
<tr>
<td></td>
<td>• HTML5 interface</td>
</tr>
<tr>
<td>Protocols</td>
<td>Fibre Channel, Fibre Channel over Ethernet (FCoE), Network File System (NFS), Server Message Block (SMB), SMB Direct, and Small Computer System Interface over IP (iSCSI)</td>
</tr>
<tr>
<td>Physical unit</td>
<td>• 4RU height x 32-inch depth</td>
</tr>
<tr>
<td>Operating systems</td>
<td>• Microsoft Windows Server 2012, Red Hat Enterprise Linux, SUSE Linux, or VMware vSphere</td>
</tr>
</tbody>
</table>

### Network Components

The Cisco UCS 6332 Fabric Interconnect is the management and communication backbone for Cisco UCS B-Series Blade Servers and C-Series Rack Servers and the Cisco UCS 5100 Series Blade Server Chassis. All servers attached to 6332 Fabric Interconnects become part of one highly available management domain.

Because they support unified fabric, Cisco UCS 6300 Series Fabric Interconnects provide both LAN and SAN connectivity for all servers within their domains.
Features and capabilities include:

- Bandwidth of up to 2.56 Tbps
- 32 x 40-Gbps ports in 1RU
- Support for 4 x 10-Gbps breakout cables
- Ports capable of line-rate, low-latency, lossless 40 Gigabit Ethernet and FCoE
- Centralized unified management with Cisco UCS Manager
- Efficient cooling and serviceability

Table 2 summarizes the fabric interconnect specifications.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form factor</td>
<td>1RU</td>
</tr>
<tr>
<td>Number of fixed 10 and 40 Gigabit Ethernet and FCoE Enhanced Small Form-Factor Pluggable (SFP+) ports</td>
<td>32 fixed ports</td>
</tr>
<tr>
<td>Throughput</td>
<td>2.56 Tbps</td>
</tr>
<tr>
<td>Fan modules</td>
<td>2+2</td>
</tr>
<tr>
<td>VLANs supported</td>
<td>2000</td>
</tr>
<tr>
<td>MAC address table entries</td>
<td>32,000</td>
</tr>
<tr>
<td>Power supplies</td>
<td>1+1 power redundancy, AC or DC</td>
</tr>
</tbody>
</table>

Infrastructure Configuration

Each Cisco UCS S3260 Storage Server was connected to a pair of Cisco UCS 6332 Fabric Interconnects. Port 0 from each SIOC was connected to Fabric Interconnect A, and port 1 was connected to Fabric Interconnect B. Both S3260 Storage Servers were managed by Cisco UCS Manager housed on the 6332 Fabric Interconnects.

Four infrastructure configuration states were captured in the results:

- **State 1**: The first configuration state is as close to a default configuration as possible. The Cisco UCS fabric is configured with a standard 1500-MTU frame size. The adapter profiles on each S3260 are configured with the default adapter profile.
- **State 2**: The second configuration state applies jumbo frames to the Cisco UCS fabric.
- **State 3**: The third configuration applies only the adapter profile to the network adapter on the SIOCs but keeps the Cisco UCS fabric at the default frame size of 1500 MTU.
- **State 4**: The final configuration state applies jumbo frames to the Cisco UCS fabric and applies an optimal adapter profile to the network adapter on the SIOCs.
**State 1: Default Configuration**

A service profile must be applied to the S3260 server nodes in a Cisco UCS managed environment. Use the default adapter profile, shown here.

<table>
<thead>
<tr>
<th>Resources</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmit Queues</td>
<td>1 [1-1000]</td>
<td></td>
</tr>
<tr>
<td>Ring Size</td>
<td>256 [64-4096]</td>
<td></td>
</tr>
<tr>
<td>Receive Queues</td>
<td>1 [1-1000]</td>
<td></td>
</tr>
<tr>
<td>Ring Size</td>
<td>512 [64-4096]</td>
<td></td>
</tr>
<tr>
<td>Completion Queues</td>
<td>2 [1-2000]</td>
<td></td>
</tr>
<tr>
<td>Interrupts</td>
<td>4 [1-1024]</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Options</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmit Checksum Offload</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receive Checksum Offload</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TCP Segmentation Offload</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TCP Large Receive Offload</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receive Side Scaling (RSS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accelerated Receive Flow Steering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Network Virtualization using Generic Routing Encapsulation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Virtual Extensible LAN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fallback Timeout (Seconds)</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Interrupt Mode</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interrupt Coalescing Type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interrupt Timer (us)</td>
<td>125</td>
<td></td>
</tr>
<tr>
<td>RoCE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advance Filter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interrupt Scaling</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
State 2: Jumbo Frames Enabled

Configure jumbo frames in the Cisco UCS fabric, following these steps:

1. In Cisco UCS Manager, navigate to the LAN tab. At the left, select QoS System Class located under LAN > LAN Cloud.
2. If it is not already enabled, enable the Platinum system class by selecting the Enabled check box.
3. In the MTU column, in the row for the Platinum systems class enabled in step 2, set the frame size to 9216, as shown here. Then click Save Changes.

5. At the right, click the Add button.
6. Give the policy a name, such as Jumbo, and in the Priority drop-down menu choose Platinum. Then click the OK button.

7. Navigate to the service profile applied to the server, expand the profile tree, expand the virtual network interface card (vNIC) tree, and select vNIC eth0 (or whatever name was given to the first Ethernet port).
8. In the Policies section for the selected vNIC, change the selection in the drop-down menu for QoS Policy to the name you created for the QoS policy in step 6. In addition, in the Properties section change the MTU setting to 9000. Save your changes and update your profile.
State 3: Adapter Profile Applied

Apply an adapter profile, following these steps:

1. In Cisco UCS Manager, navigate to the Servers tab and locate the Adapter Policies section under Servers > Policies > root > Adapter Policies at the left.

2. Click the Add button at the right.

3. Provide a name for the Ethernet adapter policy. Change the following fields and click Save Changes when you are finished:

   - Resources
     - Transmit Queues: 8
     - Ring Size: 4096
     - Receive Queues: 8
     - Ring Size: 4096
     - Completion Queues: 16
     - Interrupts: 32

   - Options
     - Receive Side Scaling (RSS): Enabled
4. Navigate to the service profile applied to the server, expand the profile tree, expand the vNIC tree, and select vNIC eth0 (or whatever name was given to the first Ethernet port).

5. In the Policies section for the selected vNIC, change the name in the drop-down menu for Adapter Policy to the name you created for the Ethernet adapter policy in step 3. Save your changes and update your profile.
State 4: Adapter Profile Applied, Jumbo Frames Enabled
Follow all steps for State 2 and State 3 and verify that they are applied correctly to the service profile.

Workload Characterization
The tools most commonly used to test network performance are iperf and iperf3. The classic tool is iperf. It has been in use for many years. The more recent version, iperf3, is fundamentally different from the original iperf. It benefits from a more compact code base and a more modern implementation. However, although iperf3 supports multiple streams, all streams used by its process are single-threaded and must be run in such a way that they manually distribute the load across multiple CPU cores. Otherwise, the total throughput will be restricted by the CPU frequency of the system under test.

Both iperf and iperf3 are synthetic benchmarks that conduct memory-to-memory copy testing across the network. Results can vary dramatically under a real-world load. The classic iperf tool is generally considered to be reliable enough, despite its age, and it is still in wide use because of the single-threaded limitations of iperf3. The tests described in this document were conducted using the original version of iperf.

Test Configuration
The results presented here represent all four states detailed in the preceding "Infrastructure Configuration" section. Performance was measured using iperf to examine 40-Gbps throughput under a variety of conditions.

State 1 Performance Results
State 1 results are based on a default configuration from the SIOC on the S3260. The default adapter profile was applied, and the fabric was configured with 1500 MTU. Expected performance was between 15 and 25 Gbps, depending on the operating system.

Interface Configuration

```
[root@rhei ~]# ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN qlen 1
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: enp7s0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP qlen 1000
    link/ether 00:25:b5:00:00:2e brd ff:ff:ff:ff:ff:ff
    inet 192.168.1.11/24 brd 192.168.1.255 scope global enp7s0
       valid_lft forever preferred_lft forever
    inet6 fe80::225:b5ff:fe00:2e64 scope link
       valid_lft forever preferred_lft forever
```
Results

```
[root@rhel11 ~]# iperf -c 192.168.1.12 -m -t 60 -P 4

Client connecting to 192.168.1.12, TCP port 5001
TCP window size: 85.0 KByte (default)

[ 4] local 192.168.1.11 port 55250 connected with 192.168.1.12 port 5001
[ 6] local 192.168.1.11 port 55254 connected with 192.168.1.12 port 5001
[ 3] local 192.168.1.11 port 55252 connected with 192.168.1.12 port 5001
[ 5] local 192.168.1.11 port 55256 connected with 192.168.1.12 port 5001
[ ID] Interval Transfer Bandwidth
[ 4] 0.0-60.0 sec 47.7 GBytes 6.83 Gbits/sec
[ 4] MSS size 1448 bytes (MTU 1500 bytes, ethernet)
[ 6] 0.0-60.0 sec 42.4 GBytes 6.07 Gbits/sec
[ 6] MSS size 1448 bytes (MTU 1500 bytes, ethernet)
[ 3] 0.0-60.0 sec 48.3 GBytes 6.92 Gbits/sec
[ 3] MSS size 1448 bytes (MTU 1500 bytes, ethernet)
[ 5] 0.0-60.0 sec 48.4 GBytes 6.92 Gbits/sec
[ 5] MSS size 1448 bytes (MTU 1500 bytes, ethernet)
[SUM] 0.0-60.0 sec 187 GBytes 26.7 Gbits/sec
```

State 2 Performance Results

State 2 results are based on a configuration with 9000 MTU configured on the fabric and a default adapter profile applied. By using a more efficient transmission unit, the adapter can achieve from 39 to 40 Gbps without the need to increase the number of queues and interrupts. If you can modify the existing network to support jumbo frames, or if jumbo frames are already set, this change is relatively simple to make. However, many customers cannot or do not want to accommodate an MTU of 9000 in their data center environments.

Interface Configuration

```
[root@rhel11 ~]# ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN qlen 1
   link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
   inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
   inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: enp7s0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 9000 qdisc mq state UP qlen 1000
   link/ether 00:25:b5:00:00:2e brd ff:ff:ff:ff:ff:ff
   inet 192.168.1.11/24 brd 192.168.1.255 scope global enp7s0
       valid_lft forever preferred_lft forever
   inet6 fe80::225:b5ff:fe00:2e64 scope link
       valid_lft forever preferred_lft forever
```
Results

```
[root@rhel11 ~]# iperf -c 192.168.1.12 -m -t 60 -P 4
---------------
Client connecting to 192.168.1.12, TCP port 5001
TCP window size:  325 KByte (default)
[ 6] local 192.168.1.11 port 51974 connected with 192.168.1.12 port 5001
[ 5] local 192.168.1.11 port 51972 connected with 192.168.1.12 port 5001
[ 3] local 192.168.1.11 port 51970 connected with 192.168.1.12 port 5001
[ 4] local 192.168.1.11 port 51968 connected with 192.168.1.12 port 5001
[ ID] Interval Transfer Bandwidth
[ 6] 0.0-60.0 sec 69.0 GBytes 9.87 Gbits/sec
[ 6] MSS size 8948 bytes (MTU 8988 bytes, unknown interface)
[ 5] 0.0-60.0 sec 69.0 GBytes 9.87 Gbits/sec
[ 5] MSS size 8948 bytes (MTU 8988 bytes, unknown interface)
[ 3] 0.0-60.0 sec 69.2 GBytes 9.90 Gbits/sec
[ 3] MSS size 8948 bytes (MTU 8988 bytes, unknown interface)
[ 4] 0.0-60.0 sec 69.2 GBytes 9.90 Gbits/sec
[ 4] MSS size 8948 bytes (MTU 8988 bytes, unknown interface)
[SUM] 0.0-60.0 sec 276 GBytes 39.6 Gbits/sec
```

State 3 Performance Results

State 3 results are based on a configuration with 1500 MTU configured on the fabric and an optimized adapter profile applied. This state is well suited for environments in which the use of jumbo frames is not acceptable. Although State 3 is much more efficient than the default (State 1) configuration, it is still less efficient than configuring the environment with MTU 9000. The expected results are from 37 to 40 Gbps.

Interface Configuration

```
[root@rhel11 ~]# ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN qlen 1
   link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
   inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
   inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: enp7s0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP qlen 1000
   link/ether 00:25:b5:00:00:2e brd ff:ff:ff:ff:ff:ff
   inet 192.168.1.24/24 brd 192.168.1.255 scope global enp7s0
       valid_lft forever preferred_lft forever
   inet6 fe80::225:b5ff:fe00:2e64 scope link
       valid_lft forever preferred_lft forever
```
State 4 Performance Results
State 4 results are based on a configuration with 9000 MTU configured on the fabric and an optimized adapter profile applied. By applying both settings, maximum throughput should be observed in almost all circumstances. Expected results are from 39 to 40 Gbps.

Interface Configuration
Standalone Cisco Integrated Management Controller Configuration

You can also configure a Cisco UCS S3260 in a standalone configuration with the adapter profile noted earlier for State 3. Because Cisco UCS Manager is not present in a standalone configuration, the procedure for configuring systems with MTU 9000 depends largely on the network environment in place and is beyond the scope of this document. However, you can modify the adapter profile in a standalone Cisco IMC configuration by following these steps:

1. From the S3260 home screen, select the top-right button that looks like this:

   ![Adapter profile button]

2. In the menu that appears, expand the Networking section and select the SIOC that represents the S3260 server node that you want to modify.

3. Select the vNICs tab.

4. In the left tree beneath the vNICs section, select the Ethernet adapter to be modified: most likely eth0 or eth1, or both.

5. After selecting the appropriate Ethernet device, expand the following sections and make the following changes:
   - Ethernet Interrupt
     - Interrupt Count: 32
   - Ethernet Receive Queue
     - Receive Queue Count: 8
     - Receive Queue Ring Size: 4096

Results

```
[root@rhel11 ~]# iperf -c 192.168.1.12 -m -t 60 -P 4
TCP window size: 325 KByte (default)

--- 192.168.1.12 5001 ---
  local 192.168.1.11 port 43620 connected with 192.168.1.12 port 5001
  local 192.168.1.11 port 43614 connected with 192.168.1.12 port 5001
  local 192.168.1.11 port 43616 connected with 192.168.1.12 port 5001
  local 192.168.1.11 port 43618 connected with 192.168.1.12 port 5001

ID  Interval Transfer Bandwidth
[ 6] 0.0-60.0 sec 69.1 GBytes 9.89 Gbits/sec
[ 6] MSS size 8948 bytes (MTU 8988 bytes, unknown interface)
[ 3] 0.0-60.0 sec 69.1 GBytes 9.89 Gbits/sec
[ 3] MSS size 8948 bytes (MTU 8988 bytes, unknown interface)
[ 3] 0.0-60.0 sec 69.1 GBytes 9.89 Gbits/sec
[ 3] MSS size 8948 bytes (MTU 8988 bytes, unknown interface)
[ 4] 0.0-60.0 sec 276 GBytes 39.6 Gbits/sec
[ 4] MSS size 8948 bytes (MTU 8988 bytes, unknown interface)
```

---
- Ethernet Transmit Queue
  - Transmit Queue Count: 8
  - Receive Queue Ring Size: 4096
- Completion Queue
  - Completion Queue Count: 16
- Receive Side Scaling
  - Enable TCP Receive Side Scaling: Selected

6. Make sure that your settings match the settings shown here. Then save the changes and reboot the server.

- vNIC Properties
  - General
  - Ethernet Interrupt
    - Interrupt Count: 32 (1 - 514)
    - Interrupt Mode: MSix
  - Ethernet Receive Queue
    - Receive Queue Count: 8 (1 - 256)
    - Receive Queue Ring Size: 4096 (64 - 4096)
  - Ethernet Transmit Queue
    - Transmit Queue Count: 8 (1 - 256)
    - Transmit Queue Ring Size: 4096 (64 - 4096)
  - Completion Queue
    - Completion Queue Count: 16 (1 - 512)
    - Completion Queue Ring Size: 1

- RoCE Properties

- TCP Offload

- Receive Side Scaling
  - Enable TCP Receive Side Scaling: ✓
  - Enable TCP-IPv6 RSS: ✓
  - Enable IPv4 RSS: ✓
  - Enable TCP-IPv4 RSS: ✓
  - Enable IPv6 RSS: ✓
Configurations That Do Not Use the Cisco UCS S3260 VIC

The default adapter profile on other Cisco UCS servers can suffer from the same problems as the S3260 with the VIC, without configuration for maximum throughput. If the environment does not allow jumbo frames, you should be able to configure the adapter profile with the same settings as discussed previously for either Cisco UCS managed servers or standalone Cisco UCS servers using the IMC.

Consider the following results without jumbo frames and a default adapter profile on a Cisco UCS C220 M4 Rack Server with a Cisco UCS VIC 1387 modular LAN on motherboard (mLOM).

Interface Configuration

```
[root@rhe103 ~]# ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN qlen 1
   link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
   inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
   inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: enp7s0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP qlen 1000
   link/ether 00:25:b5:00:00:ce brd ff:ff:ff:ff:ff:ff
   inet 192.168.1.103/24 brd 192.168.1.255 scope global enp7s0
       valid_lft forever preferred_lft forever
   inet6 fe80::225:b5ff:fe00:ce64 scope link
       valid_lft forever preferred_lft forever
```

Results

```
[root@rhe103 ~]# iperf -c 192.168.1.104 -m -P 4
---------------------------------------------
Client connecting to 192.168.1.104, TCP port 5001
TCP window size: 85.0 KByte (default)
---------------------------------------------
[ 6] local 192.168.1.103 port 44886 connected with 192.168.1.104 port 5001
[ 3] local 192.168.1.103 port 44882 connected with 192.168.1.104 port 5001
[ 4] local 192.168.1.103 port 44880 connected with 192.168.1.104 port 5001
[ 5] local 192.168.1.103 port 44884 connected with 192.168.1.104 port 5001

[ ID] Interval Transfer Bandwidth
[ 6] 0.0-10.0 sec 8.26 GBytes 7.10 Gbits/sec
[ 6] MSS size 1448 bytes (MTU 1500 bytes, ethernet)
[ 3] 0.0-10.0 sec 7.79 GBytes 6.69 Gbits/sec
[ 3] MSS size 1448 bytes (MTU 1500 bytes, ethernet)
[ 4] 0.0-10.0 sec 7.97 GBytes 6.84 Gbits/sec
[ 4] MSS size 1448 bytes (MTU 1500 bytes, ethernet)
[ 5] 0.0-10.0 sec 8.01 GBytes 6.88 Gbits/sec
[ 5] MSS size 1448 bytes (MTU 1500 bytes, ethernet)
[SUM] 0.0-10.0 sec 32.0 GBytes 27.5 Gbits/sec
```

The same server was used to generate the following results. The hardware remains a Cisco UCS C220 M4 with a Cisco UCS VIC 1387 mLOM. The network is still configured with the default setting of 1500 MTU. The only difference between the previous C220 M4 results and the following results is that the adapter profile has been configured in the same way as the S3260 SIOC adapter in State 3, detailed earlier.
Interface Configuration

[root@rhel103 ~]# ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN qlen 1
   link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
   inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
   inet6 :1/128 scope host
       valid_lft forever preferred_lft forever
2: enp7s0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP qlen 1000
   link/ether 00:25:b5:00:00:ce brd ff:ff:ff:ff:ff:ff
   inet 192.168.1.103/24 brd 192.168.1.255 scope global enp7s0
       valid_lft forever preferred_lft forever
   inet6 fe80::225:b5ff:fe00:ce64 scope link
       valid_lft forever preferred_lft forever

Results

[root@rhel103 ~]# iperf -c 192.168.1.104 -m -t 60 -P 4
---------------------------------------------------------
Client connecting to 192.168.1.104, TCP port 5001
TCP window size: 85.0 KByte (default)
---------------------------------------------------------
[  5]  local 192.168.1.103 port 35190 connected with 192.168.1.104 port 5001
[  6]  local 192.168.1.103 port 35194 connected with 192.168.1.104 port 5001
[  3]  local 192.168.1.103 port 35188 connected with 192.168.1.104 port 5001
[  4]  local 192.168.1.103 port 35192 connected with 192.168.1.104 port 5001
[ ID]    Interval   Transfer    Bandwidth
[  5]    0.0-60.0 sec  87.1 GBytes  12.5 Gbits/sec
[  5]     MSS size  1448 bytes (MTU 1500 bytes, ethernet)
[  6]    0.0-60.0 sec  43.6 GBytes  6.24 Gbits/sec
[  6]     MSS size  1448 bytes (MTU 1500 bytes, ethernet)
[  3]    0.0-60.0 sec  87.1 GBytes  12.5 Gbits/sec
[  3]     MSS size  1448 bytes (MTU 1500 bytes, ethernet)
[  4]    0.0-60.0 sec  43.6 GBytes  6.24 Gbits/sec
[  4]     MSS size  1448 bytes (MTU 1500 bytes, ethernet)
[SUM]    0.0-60.0 sec  261 GBytes  37.4 Gbits/sec

For More Information
