Improving Object Storage Performance

10 Gigabit Intel® Ethernet Converged Network Adapter and Intel® Solid-State Drives boost throughput capacity of TEAMSUN's object storage solution

With the rapid development of the Internet and cloud computing, the amount of unstructured data—such as text, images, audio and video—has exploded at an exponential rate. This has the marketplace turning to highly scalable object storage solutions to meet growing data demands. Realizing the need for improvement, Beijing TEAMSUN Co., Ltd. (TEAMSUN), China's leading IT integrated services provider, worked with Intel to carry out testing and performance optimization of its Openstack® Swift® object storage solution running on Intel® architecture.

CHALLENGES

• Enhance core competitiveness. Provide clients with a highly scalable storage solution to improve TEAMSUN's competitiveness in the marketplace.

• Improve utilization rate of storage resources. Improve the load balancing and data throughput capacity of proxy servers so the object storage solution can fully use its storage node's maximum data input/output capacity.

• Optimize performance. Improve write performance of the metadata information in the Openstack Swift object storage solution.

SOLUTIONS

• Utilize 10 Gigabit Intel® Ethernet Converged Network Adapter. Replace the Intel® Ethernet Server Adapter I350 with 10 Gigabit Intel Ethernet Converged Network Adapter X520-DA2 to improve the performance of TEAMSUN's storage system.

• Utilize Intel® Solid-State Drives (Intel® SSDs). Use Intel Solid-State Drive to store the accounts and container data information of the Openstack Swift object storage solution.

IMPACT

• Improved the utilization rate of storage resources. 10 Gigabit Intel Ethernet Converged Network Adapter X520-DA2 helped TEAMSUN's Openstack Swift object storage solution increase its data throughput capacity by more than five times and the concurrent connection by more than four times. The storage nodes’ maximum data read/write capacity and the storage resources can both now be fully utilized.1

• Improved overall performance. Compared with the mechanical drive, the Intel SSD, used as media for the metadata information storage, helped TEAMSUN improve its Openstack Swift object storage solution's overall performance by more than 20 percent.1

Improving data storage scalability

TEAMSUN's businesses have covered almost all the fields of IT services, including cloud computing, mobile Internet, Internet of Things, and information security. Through these services, TEAMSUN aims to provide its customers with appropriate data storage solutions.

"In the past years, services such as micro-blogging, online games, online video, and enterprise private cloud have grown at an explosive rate. All these applications have generated vast amounts of unstructured data, like text, images, audio, video, and virtual machine mirror images. These static files need to be stored for a long time. They are mainly retrieved for read requests, and are unlikely to be updated or deleted very frequently. This poses increasingly severe challenges in terms of capacity expansion and data service performance for the traditional vertical storage solution," shared Zheng Chi, product manager for TEAMSUN.

Intel helped TEAMSUN testing performance of Openstack Swift-based object storage services running on Intel® architecture using Cloud Object Storage Benchmark (COSBench).
10 Gigabit Intel® Ethernet Converged Network Adapter and Intel® SSDs have improved the overall performance of the TEAMSUN object storage solution

Figure 1. Initial test environment at TEAMSUN
The test solution consisted of one load-balancing server, two proxy servers, and eight storage nodes. Another server was used to collect the test data. Five more servers were used as the stress test clients. Each of these servers included Intel® Xeon® processors E5 2680, 64GB of memory, and a SATA mechanical hard drive with 2TB capacity.

Ethernet data throughput capacity hinders storage resources utilization
In the first phase of testing, the Intel® Ethernet Server Adapter 1550, designed for Gigabit Ethernet, was used in all servers. The file size was between 50KB and 200KB; the distribution of data write, read, and deletion were 5 percent, 90 percent, and 5 percent, respectively; and five pressure test client ends were allowed to operate continuously for 30 minutes.

Where there is 100 concurrent connections from the test clients, the load balancing server already attained a network throughput of 817Mbps, close to the theoretical maximum network throughput. The service throughput of the test system was at 827 operations per second (OPS). When the concurrent connections were increased to 2,000, the service throughput was only increased slightly to 830 OPS. However, the average service response time had grown significantly from 500ms to over 2 seconds. At this time, the utilization rate of the processors, memory and network in all storage node servers remained very low. The data throughput capacity of the load balancing server adapter caused a bottleneck in the storage node utilization.

Boosting data throughput capacity
TEAMSUN then replaced the Intel Ethernet Server Adapter 1550 in the load balancing server and proxy server with 10 Gigabit Intel Ethernet Converged Network Adapter X520-DA2, while the test method and procedures remained unchanged.

The test results showed that the increased bandwidth delivered significant performance improvements. With 300 concurrent connections, the five pressure test client ends attained a total bandwidth of 4.2Gbps, close to the maximum combined theoretical bandwidth. The Ethernet flow of the eight storage nodes stood at about 600Mbps, while the network utilization of the load balancing and proxy server was only about 25 percent. The service throughput of the test system was at 4100 OPS. When the concurrent connections were increased to 2000, the service throughput of the whole system increased to 4500 OPS. The average service response time remained below 500ms. The service response time significantly improved to an average time below 500ms.

“The two test results showed that when using 10 Gigabit Intel Ethernet Converged Network Adapter X520 in the load balancing server and proxy server, the service throughput can be increased by more than five times and the concurrent connections supported increased by four times,” explained Zheng. “In our actual solution, the performance can be improved more, because the processors, memory, and bandwidth of the load balancing and proxy server have not been fully utilized. With the same configuration, we continued to simulate other commonly seen application scenarios, such as online video, enterprise backup, virtual machine mirror image, files with a size of between 10MB and several gigabytes. All the test results showed that the 10 Gigabit Intel Ethernet Converged Network Adapter X520-DA2 has offered us satisfactory performance.”

Optimized metadata storage and improved overall performance
In the Openstack Swift-based object storage solution, new files are written into the data container when it already contained many object files. The performance of the whole system is affected, since more time is needed to update the metadata information.
To test the benefit of using SSD, TEAMSUN setup one proxy server and two stress test client ends, while the storage structure remained unchanged. The test procedure was:

- Write 100,000 object files in four containers in advance.
- Write a file of 64KB with 2048 concurrent connections.

The test results showed that, in the case of traditional mechanical hard drive, the system’s service throughput was about 3,500 operations per second, and the data average response time was about 580ms. TEAMSUN then switched to use Intel SSD 320 in each storage node for the metadata storage (i.e., account and container information). In this case, the service throughput grew to 4,200 operations per second, with the data average response time reduced to 480ms. The TEAMSUN Openstack Swift object storage solution has improved overall performance by 20 percent.

As a result of the tests, TEAMSUN is adopting both 10 Gigabit Intel Ethernet Converged Network Adapter X520 series and Intel SSDs into its Openstack Swift-based object storage solution. Now TEAMSUN is beginning testing and validation of Intel’s latest datacenter SSD product, the Intel SSD DC S3500, which offers more consistent performance and reliability features. TEAMSUN will continue to cooperate with Intel in developing industry solutions, particularly in the fields of storage, data center optimization, and transferring open source technology into products, to promote the development of the industry and the application of new technology.

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LESSONS LEARNED
• 10 Gigabit Ethernet Converged Network Adapter has more powerful data throughput capacity, helping the Openstack Swift object storage solution at TEAMSUN achieve the storage node’s maximum data read/write capability and increase concurrent connections.
• Intel® SSDs have excellent data write capacity, when used for the metadata information storage of the intensive data exchange in the laterally expanding storage solution, it can significantly improve the system’s overall performance.

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