

Case Study

2nd Gen Intel® Xeon® Scalable Processor
Intel® Optane™ Persistent Memory
Intel® Optane™ SSD
All-flash Storage Solution
Bare Metal + Hosted Private Cloud



Intel® Optane™ Technology Delivers High Performance with Low TCO for CDS

Intel® Optane™ Technology Helps CDS Build a Bare-metal + Hosted Private Cloud All-flash Storage Solution Optimized for Compute and Storage



“To help customers develop efficient, stable, and secure comprehensive cloud services designed for agile deployment, we introduced advanced products such as the 2nd Gen Intel® Xeon® Scalable processor, Intel® Optane™ Persistent Memory, and Intel® Optane™ SSD. These technologies were used to build the CDS bare metal + hosted private cloud all-flash storage solution. The integration of compute, storage, and network virtualization led to a major boost in system compute and storage performance. More than 100 enterprises have adopted the online service and the feedback we have received has been generally positive.”

Niu Jibin
CPO

Capitalonline Data Service (CDS)

The increasing importance of cloud services in the core operations of many businesses has led to an increasingly fierce competition in the cloud computing market. In a market where the lion's share is split among cloud service giants, small and medium “players” must accelerate their technological innovation to boost platform performance and lower operating costs. They must also aggressively incorporate the advantages of different cloud solutions to deliver better services and satisfy the growing demand for diversification and customization. This has become their optimal strategy for development.

Capitalonline Data Service Co., Ltd. (CDS) is an international cloud service provider that provides cloud network integrated products and services for elastic compute, global networks, Internet Data Center (IDC) services, data processing and security. CDS also draws upon its industry-leading capabilities in gaming, multimedia, e-commerce, and education as well as multiple global locations to provide customers with premium services that balance cost and performance. The company is now focusing its efforts on building a full-stack hybrid cloud platform that encompasses IDC, public clouds, and private clouds to provide customers with highly flexible and diversified deployment options. The bare metal + hosted private cloud architecture based on an all-flash storage solution is a key solution that is gaining popularity among enterprise users due to its powerful throughput, low latency, and low total cost of ownership (TCO).

The software layer of this new architecture is based on the virtualized compute and storage solution optimized by CDS and its partners. Dedicated online services built upon bare metal are used to deploy the customer's private cloud to the IDC of CDS. These online services also provide the customer with a more independent, responsive,

Advantages of the bare metal + hosted private cloud all-flash storage solution based on Intel® Optane™ technology:

▪ Keeping up with technology and supporting business innovation

Every upgrade to the compute and storage solution deployed for the project included mutual ecological accreditation with Intel's latest technologies including Intel Optane technology. Customers that use the bare metal based CDS virtualized hosted private cloud solution can therefore keep up with the latest Intel technologies and combine them with their own applications to accelerate the pace of service innovation.

▪ Higher Performance and Lower Costs — Intel Optane technology Boosts Cloud Service Performance by More than 50% and Cuts Costs by More than Half

The Intel Optane persistent memory was combined with the CDS cloud platform system management platform along with Intel Optane SSD and Intel SSD to build the CDS “compute + cache + storage” bare metal + hosted private cloud all-flash solution. Agile and elastic dispatching by the system helps customers obtain the compute power and storage they require. System **throughput in terms of IOPS per second increased by more than 50%¹, latency decreased 40 to 50%², and cost per IOPS dropped 50 to 60%³.**

and secure hosted private cloud space via the CDS network. The CDS-hosted private cloud equipped with the 2nd Gen Intel Xeon Scalable processors for compute power support, along with Intel Optane persistent memory and Intel Optane SSD for cache. Intel Solid State Drives based on NVMe are also integrated for private high-capacity storage. The new solution combines compute, storage, and network virtualization all in one place to provide high-performance compute and storage output. The solution has also received positive feedback from enterprise customers in numerous industries that have implemented it.

Satisfying Customers’ Needs for Personalization through Rich Cloud Services

Cloud services have gradually become the de facto standard in all industries for the implementation of their next-generation information construction. Businesses looking to select a cloud platform are now increasingly thinking about how cloud services can be fused with their core operational capabilities to obtain greater benefits. Performance, security, stability, and cost considerations mean that different customers have distinct requirements when it comes to cloud services. For example, core production or data analysis and modeling require high performance and low latency of the system; for the storage of important information, there are strict standards for data security and system reliability; for online services and other modules, however, the flexibility and scalability of the system are more important.

Although public cloud platforms have the advantages of flexibility, ease of deployment, resilient scalability, and excellent price/performance ratio, they often suffer from problems such as insufficient performance and poor security isolation when carrying services that require high performance, low latency, and high security. Conventional private clouds may excel in terms of performance and security, but lack scalability.

For this reason, many businesses choosing a cloud solution for their core operations prefer a hybrid solution that incorporates the advantages offered by conventional IDC, public clouds, private clouds, and elastic bare metal. However, it is not easy to integrate the advantages of different cloud solutions without mutual interference. A cloud service provider must possess the following capabilities:

- Possess the ability to build a more competitive cloud platform architecture based on high-quality compute, storage, networking equipment, and excellent technology solutions.
- Possess extensive industry experience in terms of deployment of cloud services in different industries and be able to provide users with targeted solution recommendations.
- Possess a flexible and agile service model that can provide customized cloud service solutions that offer high performance and low TCO according to user demands.

As a cloud computing service provider that embraces the dual core philosophy of “IDC + Cloud Computing,” CDS’s years of experience with hybrid clouds have made its products and solutions become increasingly popular among enterprise users. The in-depth technical cooperation with Intel helps

CDS to build a full-stack hybrid cloud platform that integrates IDC, public clouds, and private clouds based on Intel’s advanced products and technologies. It helps industry users to customize their dedicated cloud computing solutions by extensive array of deployment options.

The all-new architecture for a full-stack hybrid cloud platform is as shown in Figure 1. The bottom layer is based on CDS global infrastructure. One side is connected to the CDS public cloud product to provide efficient, flexible, and scalable compute power that can be deployed in an agile and elastic manner. The other side is linked to the customer’s own data center and private cloud services to provide the customer with a secure, reliable, and easy-to-configure cloud environment. Based on this platform, enterprise users can leverage the platform to easily implement elastic deployment with the following attributes:

- **Convenient O&M** — Independent privatized spaces;
- **7/24 O&M Services** — Uninterrupted SLA service protocol;
- **Software Customization** — Control over deployment mode in dedicated spaces with elastic compute and storage.

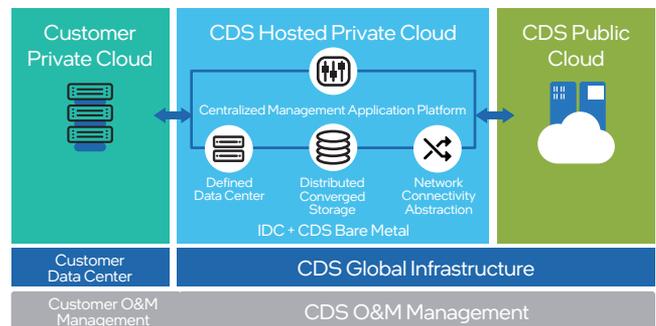


Figure 1. CDS Full-Stack Hybrid Cloud Platform Architecture

Bare Metal + Hosted Private Cloud Solution Injects New Cloud Power into Businesses

Due to the advantages it offers in terms of performance, security, resilient scalability, and TCO, numerous implementations of the CDS full-stack hybrid cloud solution have been developed based on the real-world requirements of business users. For example, existing IDC and network infrastructure were combined with elastic bare metal servers and an ultra-high performance storage solution to craft a software-defined hosted private cloud architecture. Hosting refers to the provision of stand-alone private cloud spaces to the user, even though all the private cloud spaces are hosted within the IDC of CDS.

In the bare metal + hosted private cloud solution, the data processed by the platform is buffered in the cache area before it is written to higher-capacity solid state drives using high-performance distributed storage hot data write back technology. Elastic compute is then applied to optimize the deployments of memory, cache, and storage space required by the customer to achieve elastic storage. The solution can therefore not only effectively protect the customer’s core data, but it can also increase the stability of highly parallel operations and their real-time responsiveness.

As shown in Figure 2, the CDS bare metal + hosted private cloud all-flash storage solution is based on a cluster of general-purpose x86 servers. A centralized management application platform provides unified management of upstream/downstream virtual and physical machines. A data center is first defined by the management platform to remove the operating system and underlying hardware constraints. Distributed converged storage is then used to implement software-defined storage by assigning storage capacity, storage format, performance services, and fault domains for the virtual machine. Finally, network connectivity abstraction with SDN realizes dispatch management of the virtualized network. Such architecture offers the following advantages:

- **Shortest access path:** Storage access by the virtual machine is through the shortest path as there is no need to go through a dedicated storage network and controller.
- **Business continuity in case of a disaster:** Having multiple points of connection between the servers and storage resources means that the failure of any node can be rapidly restored by other backup nodes to ensure business continuity.

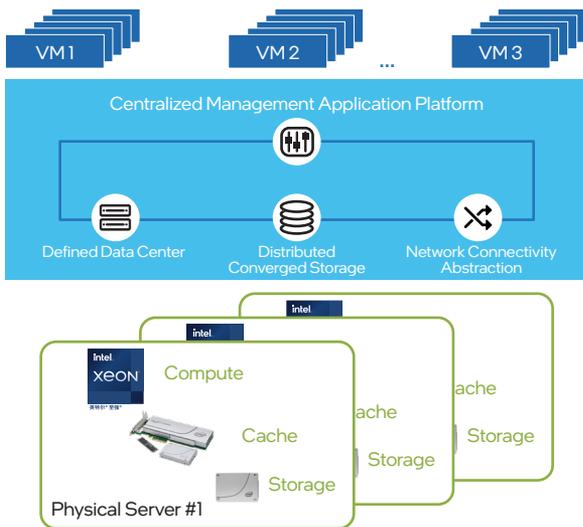


Figure 2. Architecture of the CDS Bare Metal + Hosted Private Cloud All-flash Storage Solution

The CDS bare metal + hosted private cloud architecture has been fully validated in real-world deployments. For example, the real-world deployment for a certain online education platform migrated the core data and core transcoding functions to the CDS bare metal + hosted private cloud to provide its users with improved security and stability. At the same time, in order to handle concurrent access requests from massive numbers of customers, operations with a higher order of magnitude that also needed to be scalable were deployed on the CDS public cloud to ensure cost-effectiveness and guarantee scalability on demand.

Thanks to the introduction of bare metal + hosted private cloud architecture, the online education platform withstood the massive user traffic during the COVID-19 pandemic and won their customers' recognition. As shown in Figure 3, platform traffic grew from one billion visitors a day to 10 billion visitors per day. Thanks to the new solution the core online streaming service's accessibility and performance always remained consistent and provided students with stable online education services.



Figure 3. Performance of the Online Education Platform Remained Unaffected Despite the Massive Traffic

Intel's Advanced Products and Technologies Provided the Platform with Efficient and Stable Performance

As previously stated, CDS used a combination of high-quality compute, storage, and network equipment, as well as outstanding technical solutions, to build a full-stack bare metal hybrid cloud platform architecture that boosts core competitiveness. A number of advanced products and technologies were also introduced for solutions such as the hosted private cloud architecture based on the needs of users across different scenarios.

For the software layer, CDS used virtualized compute and high-performance storage solutions that were optimized with partners. Every generation of the high-performance storage software was also under compatibility testing with the latest Intel storage technologies. Extensive fine-tuning was carried out on stability, performance, and application of the latest technologies. To keep up with the latest Intel technologies, CDS introduced the full range of Intel architecture products including the 2nd Gen Intel Xeon Scalable processor, Intel Optane persistent memory, Intel Optane SSD, and Intel® 3D NAND SSDs. Using these products to respectively handle the platform's compute, caching, and storage functions boosted overall system performance, and created a robust solid hardware infrastructure for the new architecture's "compute + cache + storage" all-flash storage solution. CDS also partnered with Intel to make software optimizations tailored to the platform functions. Cooperation between the two parties included:

- **Development of a powerful computing engine**

In terms of compute power construction, the new solution chose the 2nd Gen Intel Xeon Scalable processor as its mainstay. Intel® Xeon® Gold 6248 and Intel® Xeon® Gold 6240 processors provided ultra-fast memory speed, ultra-high memory capacity, and four-socket scalability to handle the workload from mainstream data centers, multi-cloud compute, networks, and storage.

- **Two-level cache to increase compute performance and storage IOPS throughput**

As shown in Figure 4, under the conventional "compute-storage" architecture, the read/write speed during data processing in Dynamic Random Access Memory (DRAM) memory is quite

different with that in traditional solid state drives or HDD drives, creating a natural “divide” during the compute and storage process. In this architecture, compute power is ultimately limited by storage performance. To overcome this problem, Intel Optane persistent memory and Intel Optane Solid State Drives were introduced by CDS with the help of Intel to provide high-capacity memory scaling and high-performance storage caching. The resulting two-level cache mechanism improved the performance and flow during data processing.

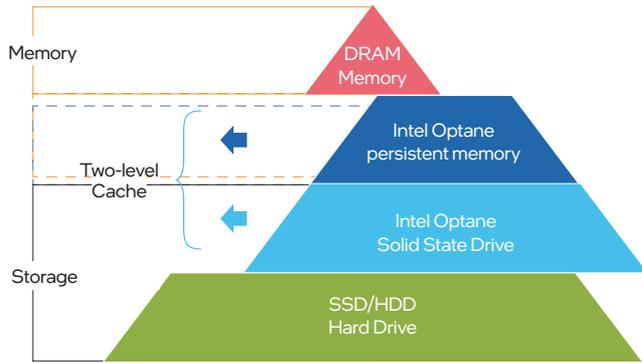


Figure 4. Building a Two-level Cache Mechanism with Optane Products

Both products are based on Intel Optane technology using 3D XPoint™ memory media. A series of advanced system memory controllers, interface hardware and software technologies were also incorporated to provide a number of technical advantages.

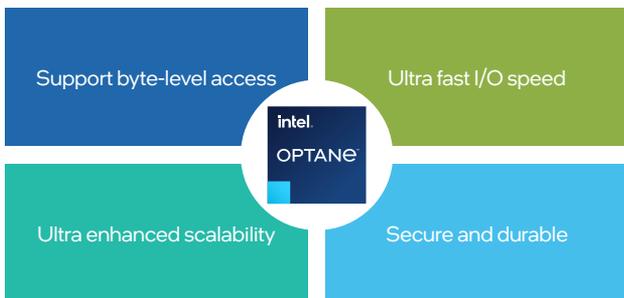


Figure 5. Advantages of Intel Optane Technology

 <p>Intel Optane persistent memory</p>	<p>Intel Optane persistent memory offers a high capacity and low volatility scaling option for DRAM memory. In addition to improving the overall efficiency of customer solutions by allowing them to deploy more VMs or other workloads, more process data can be deployed to the memory rather than storage devices for a substantial boost to compute performance.</p>
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 <p>Intel Optane SSD</p>	<p>Intel Optane Solid State Drive is a high-performance storage cache that can be used in concert with other Intel SSD products to not only satisfy customers’ needs for massive data storage, but also to improve the performance and hit rate of data caches. The benefits it brings to the solution’s storage system include higher IOPS, more efficient read/write access, and enhanced synchronization latency. It also effectively increases processing efficiency of key data and greatly lowers cost per IOPS.</p>
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Table 1. Storage Products Based on Intel Optane Technology

▪ **Creating an Elastic Compute Advantage**

The introduction of Intel Optane products provide robust support for elastic compute of CDS’ solution. The introduction of elastic compute improves the price-performance ratio of customers’ systems as compute power and storage space can be tapped on demand in response to workloads. Take some memory-based workloads as an example. For e-commerce recommendation systems based on Redis* services, the resources required by the system will constantly fluctuate according to the sales cycle, so the system must be able to integrate more compute and memory resources and deploy them to applications as necessary. In this situation, high-capacity Intel Optane persistent memory and the CDS cloud system management software can work together to provide the customer with agile and elastic dispatching capabilities that traditional DRAM memory would not be able to achieve quickly.

▪ **Comprehensive Software Optimization**

In addition to advanced hardware products, CDS integrated its private cloud software stack with Intel’s latest hardware platform technology to optimize the performance of the platform’s distributed storage and other modules. Every generation of the storage software undergoes mutual ecological accreditation with Intel technology, automatically introducing the latest Intel technologies. At the same time, the CDS team worked with Intel experts to optimize the compatibility of their proprietary storage technology and provide customers with more efficient and stable private cloud services.

The strong support provided by Intel Optane products meant that the CDS bare metal + hosted private cloud all-flash storage solution offered significant performance improvements compared to solutions that employ standard SSDs. To verify the effect of Intel Optane products on project performance, comparative testing was carried out by CDS between the all-flash configuration with Intel Optane persistent memory + Intel Optane SSD + Intel SSD and the Intel Optane persistent memory + Intel SSD configuration.

Testing found that the all-flash configuration based on Optane products improved system IOPS by more than 50%⁴, reduced latency by 40 to 50%⁵, and lowered cost per IOPS by 50 to 60%⁶.

“The two Optane SSD features that really left a strong impression on me were its ultra-low latency and ultra-high IOPS. It offers faster read speeds, lower write latencies, more reliable support for storage spaces, and even lower storage failure rates. The biggest benefit that Optane technology can provide customers with is flexibility in capacity planning and scaling.”

Niu Jibin
CPO
Capitalonline Data Service (CDS)

Thanks to the introduction of Intel Optane products and strong support from Intel, CDS created a bare metal full-stack hybrid cloud capability characterized by elastic performance and agile services that has since been translated into rapid business development. Up to 20 regional centers have now been built around the world with more than 30 data centers deployed overseas and 60 data centers deployed within China. The CDS solution has helped many Chinese companies successfully expand overseas, winning their unanimous praise in the process.

Looking Ahead

The proliferation of cloud services means applications are diversifying and evolving at an even faster rate. Custom cloud services will soon become commonplace, as well making differentiation for a competitive advantage inevitable. Cloud service providers will in turn be driven to continue refining their services in terms of platform architecture as well as software/hardware technologies. In the future, CDS will continue to expand and strengthen its collaboration with Intel to keep up with every new generation of compute and storage technologies from Intel. This will in turn help CDS satisfy the diverse needs of end customers. At the same time, CDS hopes to apply other Intel products and technologies such as the OpenVINO™ toolkit and other AI frameworks to the CDS cloud platform. Other innovations such as hardware acceleration technology, heterogeneous computing, and AI computing can also be incorporated to provide customers with personalized services that offer higher performance at a lower cost.



^{1,2,3,4,5,6} Test platform configuration: The benchmark group used the Dell R740 server; Processor: Two-socket Intel Xeon Gold 6240 processors with a clock frequency of 2.6 GHz. Each processor has 18 cores/36 threads with Hyper-threading and Turbo Boost enabled. DRAM Memory: 12 x DDR4 2666 MHz 32GB; Intel Optane persistent memory: 8 x 128GB; Hard Drive: 2 x 600GB SAS hard drives; 6 x 1.92TB Intel SSDs (D3-S4510); 1 x 375GB Intel Optane SSD (P4800X); Operating System: ESXi 6.7; vSAN Ver.: 6.7U2. The control group used the Dell R740 server; Processor: Two-socket Intel Xeon Gold 6240 processors with a clock frequency of 2.6 GHz. Each processor has 18 cores/36 threads with Hyper-threading and Turbo Boost enabled. DRAM Memory: 12 x DDR4 2666MHz 32GB; Intel Optane persistent memory: 8 x 128GB; Hard Drive: 2 x 600GB SAS hard drives; 6 x 1.92TB Intel SSDs (D3-S4510); Operating System: ESXi 6.7; vSAN Ver.: 6.7U2.

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