

Huawei Storage: R&D Innovation is the Core Strength

Cloud and storage are the most demanding areas in the ICT industry. Users demand that their core business processes and data are always stable and secure. Huawei invests more funds and personnel in storage R&D than any peer company. We began researching storage technologies in 2002 and now have R&D offices around the world. Our Silicon Valley office is the bridgehead of storage technologies, and the storage algorithm research center in Russia and delivery competence centers in Shenzhen, Chengdu, and Beijing all contribute to technology innovation and core competitiveness. Huawei has already invested more than US\$2 billion and 3200 R&D engineers in this field, obtaining more than 800 storage patents.

In addition to the continuous accumulation of "hardware" strengths, Huawei is also an industry leader in data applications. In the future, the core competitiveness in the storage industry lies in the organic combination of software and hardware capabilities, integrating chips and solid-state drives (SSDs) with algorithms, compute, and software capabilities. Huawei is the only vendor with a proprietary storage operating system (OceanStor OS), controllers, and SSDs (Huawei's SSDs/HSSDs). We implement end-to-end, in-depth, flash-oriented optimization on OceanStor OS and HSSDs to maximize the advantages of all-flash storage. The dedicated flash-optimized OceanStor OS, unique flash-optimized algorithms, and dedicated performance-acceleration HSSDs enable Huawei's all-flash storage to deliver the industry's highest performance and reliability.

As the core for Huawei's all-flash storage software and hardware, OceanStor OS and HSSDs are of strategic significance for us.

The core of a storage system is its operating system. An optimal operating system ensures smooth storage experience of end users. Currently, the configuration, service logics, and hardware deployment of Huawei's storage rely on OceanStor OS, the soul of Huawei's storage products, fully developed by Huawei's employees.

Powered by OceanStor OS, Huawei's storage products enjoy continual innovation in storage management. Traditional storage vendors such as Dell EMC and HPE usually obtain the latest popular technologies through M&As. Over the past few years, HPE has acquired storage start-ups, such as 3PAR in 2010 and Nimble Storage in 2017, helping them offer new products.

However, M&A brings unique problems. Users find that storage products of multiple sub-brands in a data center fail to collaborate properly with each other. It is difficult to migrate services from an old storage device to a new one because sub-brand products adopt different storage operating systems at the underlying layer, making flexible data replication and migration impossible.

As for hardware, Huawei launches chips supporting comprehensive capabilities pertaining to computing, storage, network, and management, to improve overall storage performance and reliability. Take a flash controller chip as an example. It is an essential component of an SSD. In the industry, only Huawei, Intel, and Samsung are capable of developing SSDs and SSD controller chips.

Through in-depth understanding of the underlying layer in a data center, we have designed proprietary high-performance, highly reliable SSDs. Competitors like Dell EMC and NetApp use SSDs from Toshiba, SanDisk, Micron, and Memblaze, which are powered by third-party controller chips. Huawei's HSSD controller chips adopt hard logics to implement dynamic RAID, data inspection, and LDPC algorithms, providing higher efficiency and better performance than SSD controller chips of other vendors using built-in CPU algorithms.

Moore's law, named after Gordon Moore, the co-founder of Fairchild Semiconductor and Intel, proposed the, is the observation that the number of transistors in a dense integrated circuit approximately doubles about every two years. It describes Intel's success in crossing the industrial development gap and has accurately described the development of the IT industry for decades. Moore's law not only describes technological development, but also represents a physical or natural law. Each successful product has its own "Moore's law" describing its exponential growth trend. We must have an open mind and insist on learning and self-iteration to adapt to the changing times.

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