# Compatible, Reliable, and Performance-Leading

Huawei FusionSphere Cloud OS

**CompuWay**

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# Challenges for Enterprise Cloud Computing IT Infrastructure

Information technology is changing the way people live, bringing new and unprecedented conveniences to work and life. However, enterprises' use of IT applications is far behind that of individuals'. Therefore, CIOs need to implement new technologies in order to achieve better IT agility and bring more value to their businesses.

Across all industries, cloud computing has become the leading trend in IT transformation. However, CIOs now face various challenges in the deployment of cloud computing and these challenges includes the followings:

- A typical cloud infrastructure contains physical and virtual resources, and hardware and software from different manufacturers and systems, meaning that during the implementation of infrastructure virtualization, CIOs need to consider how to avoid potential adverse impacts on existing services while bringing the most value to new services.

- Due to heavy pressure on service growth and tight budgets, CIOs must also consider how to obtain industry-leading performance for the lowest cost and meet requirements of service growth.

- The open platform compatibility with third-party products and services is the basis of cloud computing, and should guide the future while taking the past into account in order to protect the existing IT investments.

Enterprises will encounter complex problems while building up their cloud computing platforms, but the optimal cloud computing infrastructure would be the one that meets their needs and is suitable to their service features. A mature cloud computing platform should be open and heterogeneous while supporting various service features.
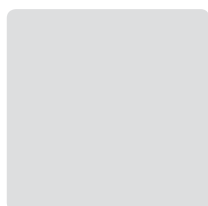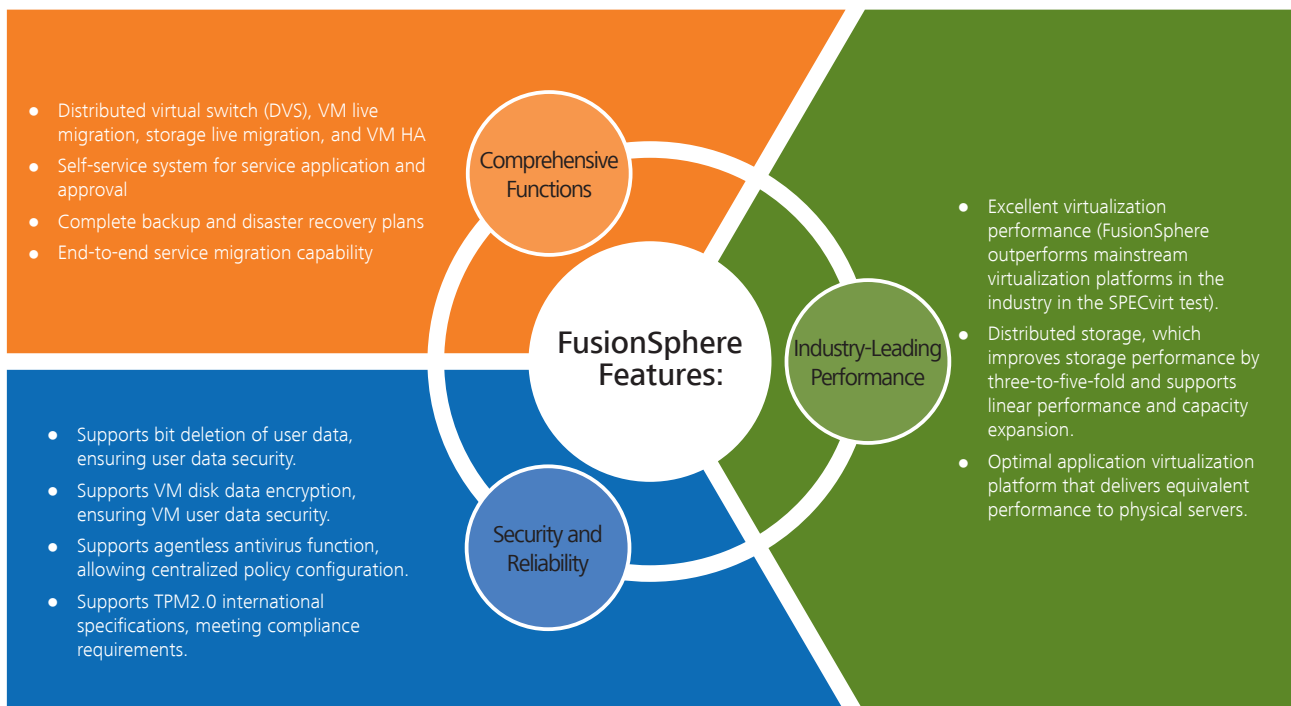
# Competitive FusionSphere Cloud OS

Developed by Huawei, FusionSphere is a cloud operating system that meets the needs of customers from a wide range of industries. FusionSphere offers powerful virtualization and resource pool management functions, comprehensive cloud infrastructure components and tools, and open application programming interfaces (APIs).

It helps enterprises to horizontally consolidate physical and virtual resources in data centers and vertically optimize service platforms, facilitating the construction and use of cloud computing platforms. In July 2014, the outstanding performance of Huawei's FusionSphere led to Huawei becoming the only company added to Gartner's Magic Quadrant for x86 Server Virtualization Infrastructure during that year. FusionSphere was also recognized as an up-and-coming product in emerging markets.

FusionSphere integrates OpenStack architecture to build up a software-defined data center capability (including SDS and SDN) and optimal automated management capabilities, and supports commercial use of cloud-based telecom services (NFV and network function virtualization).

In addition, FusionSphere is an open, agile, and reliable cloud OS that aims to help enterprises and carriers deploy server virtualization, as well as private, public, and hybrid cloud services. Therefore, enterprises can use standard OpenStack architecture and APIs to choose freely from OpenStack-based third-party products and services, making cloud computing easier.

## FusionSphere Features:

### Comprehensive Functions
- Distributed virtual switch (DVS), VM live migration, storage live migration, and VM HA
- Self-service system for service application and approval
- Complete backup and disaster recovery plans
- End-to-end service migration capability

### Industry-Leading Performance
- Excellent virtualization performance (FusionSphere outperforms mainstream virtualization platforms in the industry in the SPECvirt test).
- Distributed storage, which improves storage performance by three-to-five-fold and supports linear performance and capacity expansion.
- Optimal application virtualization platform that delivers equivalent performance to physical servers.

### Security and Reliability
- Supports bit deletion of user data, ensuring user data security.
- Supports VM disk data encryption, ensuring VM user data security.
- Supports agentless antivirus function, allowing centralized policy configuration.
- Supports TPM2.0 international specifications, meeting compliance requirements.

# Customer Benefits

Huawei FusionSphere is already being used in more than 40 countries and regions throughout the globe and in a wide variety of fields including government, public utilities, telecommunication, energy, finance, transportation, health care, education, media, manufacturing and other industries. FusionSphere helps customers integrate and optimize their data centers and service platforms, improving system reliability and IT operational efficiency.

## Industry-Leading Performance

FusionSphere, with a bare-metal virtualization engine, consumes less than 5% of physical CPU resources, improves server utilization by up to 80%, and reduces IT infrastructure deployment costs by over 30%. In the SPECvirt test, FusionSphere has proven its superior virtualization performance among industry-leaders.

In carrier services, base station controller requires the virtualization latency to be less than 20 $\mu$s, which is much lower than the mainstream latency level. However, Huawei FusionSphere can meet this requirement. The distributed storage virtualization software provides the industry-leading performance. The reconstruction time per TB data is less than 30 minutes and multiple-disk concurrency can improve IOPS by ten times.

## Reliable Services

IT services deployed on the FusionSphere virtualization platform make use of the high availability, fault tolerance (FT), and active-active data center capabilities of FusionSphere to implement disaster recovery (DR) and backup functions, thereby reducing DR costs for enterprises. The live migration feature of FusionSphere implements in-service system upgrades and routine maintenance.

The health check tool and system running recorder allow the system to issue early warnings and facilitate fault locating. The trusted computing and data disk encryption features ensure service data security and prevent illegitimate data interceptions. FusionSphere is the only cloud platform of 99.999% in the industry.

## Efficient Operation

The efficiency of a cloud operating system depends on how the system is operated. Huawei FusionSphere provides visual templates which allow customers to create virtual data centers within 10 minutes and implement one-click application deployment and highly effective operation and maintenance (O&M), simplifying cloud computing operations for enterprises.
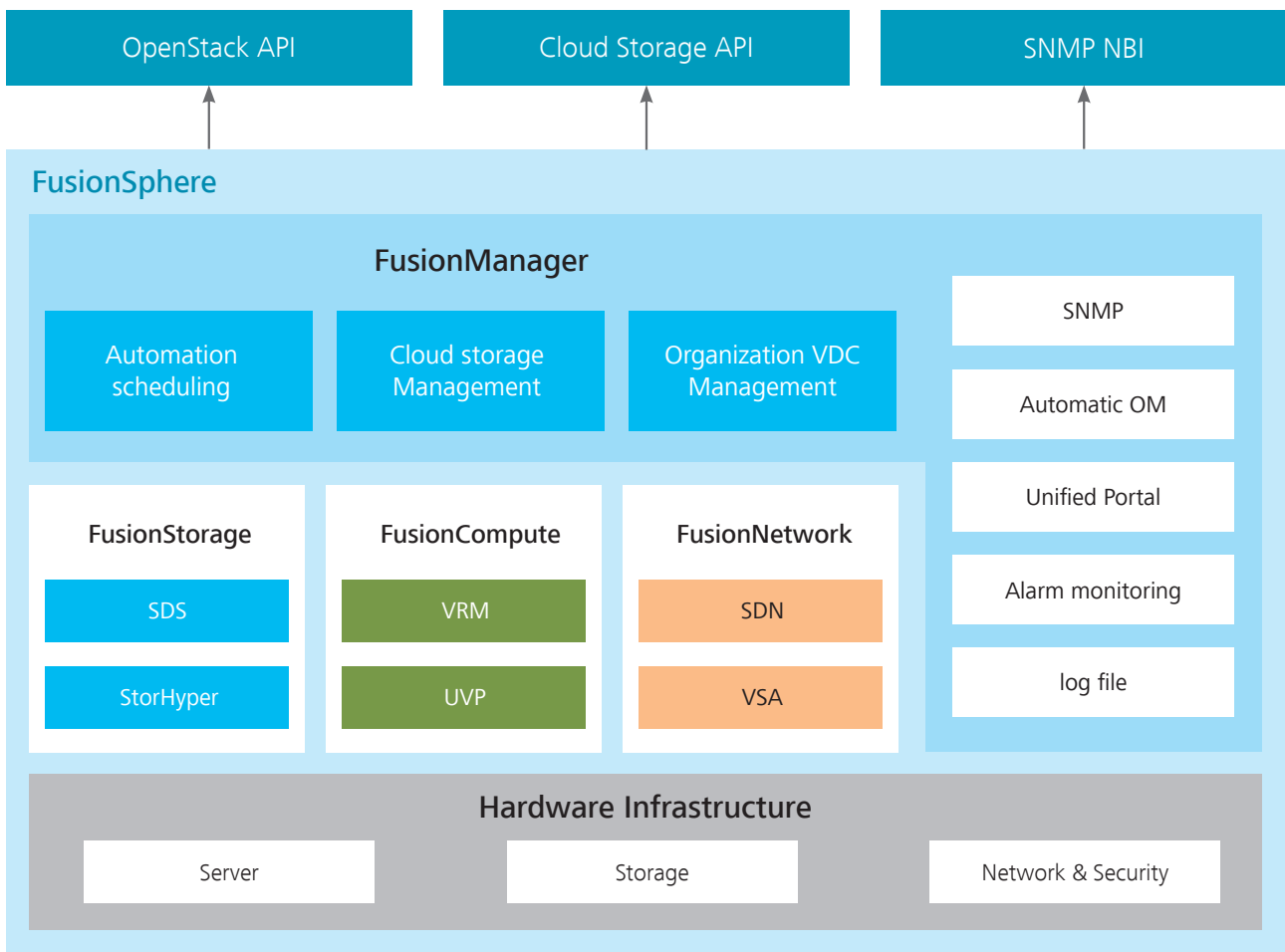
# FusionSphere Hierarchical Architecture

Huawei FusionSphere cloud OS supports resource reuse and automated resource management by achieving virtualization and its management. The centralized management and services provide dynamic data center adjustment and allocation, meeting requirements for high (resource) performance, high reliability, high security, and high adaptability of key enterprises applications for cloud migration.

In addition, FusionSphere increases the infrastructure's automated management capability, ensuring the rapid adaptability that services require and as a result reducing IT investment.

## FusionSphere adopts a hierarchical structure which includes the following components:

- FusionCompute, the engine that virtualizes hardware resources and realizes resource sharing and reuse.

- FusionManager, the cloud management software that manages virtualized resources, hardware resources, and provides service management functions.

- FusionStorage, the software-defined storage (SDS) provides high performance, expandable storage resource pool, and block storage capabilities.

- FusionNetwork provides a solution that transforms traditional virtual switches to forward-thinking software-defined networking.

- UlterVR DR software and eBackup software provide all virtual applications with an end-to-end backup and DR solutions.

- FusionSphere system operation insight (SOI) monitors and analyzes the system's performance and provides administrators with performance management suggestions.

| OpenStack API | Cloud Storage API | SNMP NBI |
|---|---|---|

**FusionSphere**

**FusionManager**

| Automation scheduling | Cloud storage Management | Organization VDC Management |
|---|---|---|

- SNMP
- Automatic OM
- Unified Portal
- Alarm monitoring
- log file

**FusionStorage**
- SDS
- StorHyper

**FusionCompute**
- VRM
- UVP

**FusionNetwork**
- SDN
- VSA

**Hardware Infrastructure**

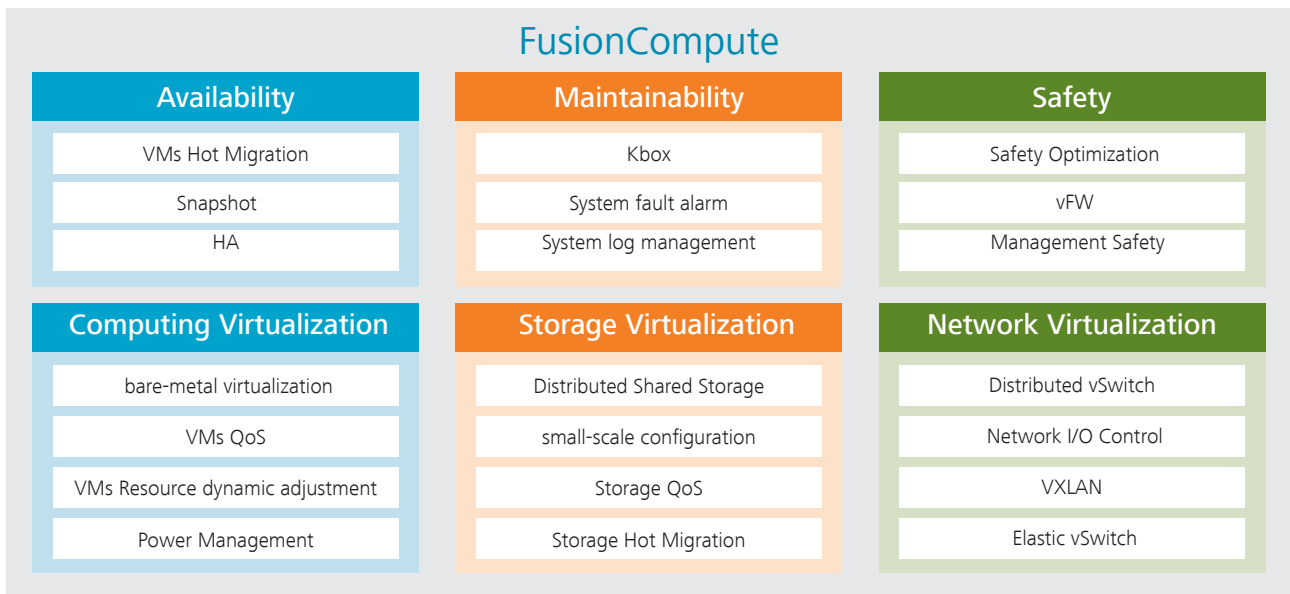| Server | Storage | Network & Security |
|---|---|---|

# FusionCompute Features and Capabilities

At the core of the cloud computing platform, Huawei FusionCompute hypervisor uses a bare-metal architecture to virtualize server resources, such as CPUs, memory, I/O resources, which are converted into logical resources that can be centrally managed, scheduled, and allocated.

Using logical resources, FusionCompute enables a physical server to simultaneously run multiple isolated VM execution environments, improving resource utilization, meeting flexible and dynamic resource allocation requirements for applications.

In addition, FusionCompute provides live migration and hot backup functions to ensure high VM availability, as well as a VXLAN large layer-2 network with raw device mapping (RDM) functions to provide low operating expenditures (OPEX).

## FusionCompute

| Availability | Maintainability | Safety |
|---|---|---|
| VMs Hot Migration | Kbox | Safety Optimization |
| Snapshot | System fault alarm | vFW |
| HA | System log management | Management Safety |

| Computing Virtualization | Storage Virtualization | Network Virtualization |
|---|---|---|
| bare-metal virtualization | Distributed Shared Storage | Distributed vSwitch |
| VMs QoS | small-scale configuration | Network I/O Control |
| VMs Resource dynamic adjustment | Storage QoS | VXLAN |
| Power Management | Storage Hot Migration | Elastic vSwitch |

# FusionNetwork Features and Capabilities

FusionNetwork provides a solution that transforms traditional virtual switches to forward-thinking software-defined networking. With the support of Layer 2 Tunneling Protocol (L2TP) of VXLAN, FusionNetwork works with the Huawei SDN Controller to automatically deploy and configure the SDN, service level agreement (SLA) controlling, as well as multi-tenant isolation and division.

FusionNetwork integrates the Virtual Service Appliance Management (VSAM) and Virtual Service Appliance (VSA) nodes to provide basic network services, such as load balancing, DHCP, routing, and firewall services.
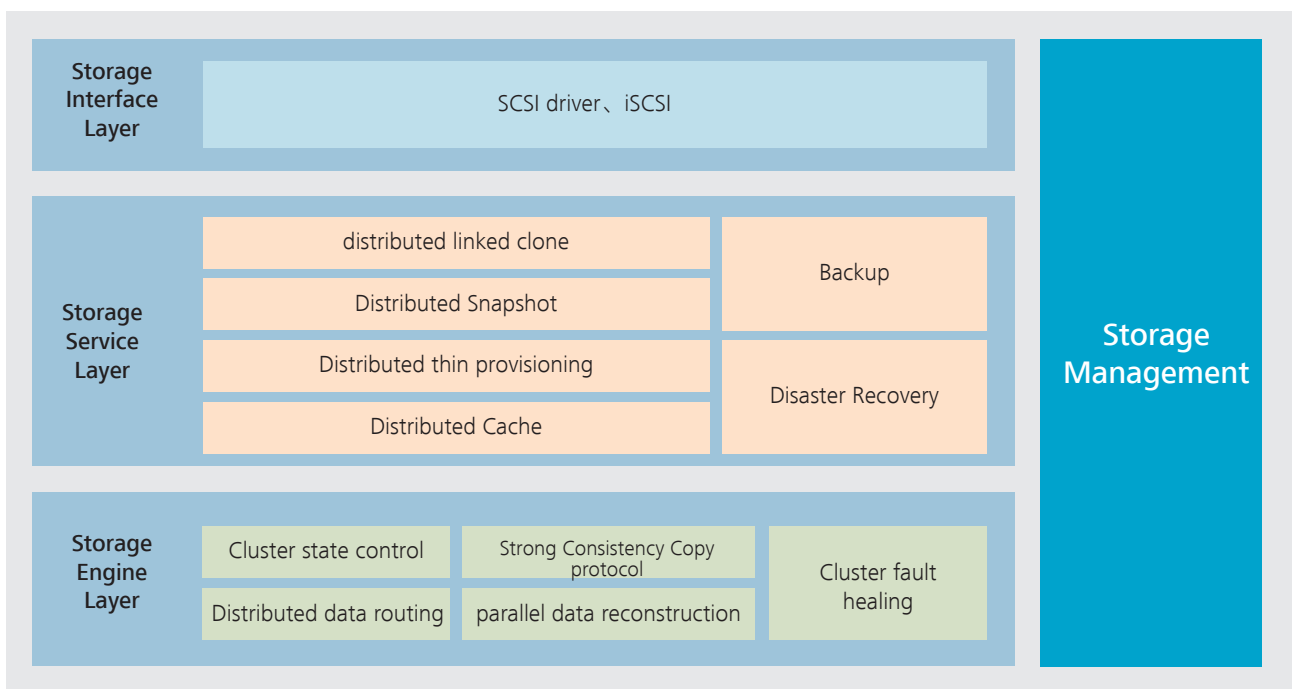
In this case, customers can lower networking costs, increase networking flexibility. FusionNetwork creates a fully automatic, intelligent, and dynamically programmable network, which provides multi-layer security protection for data center applications.
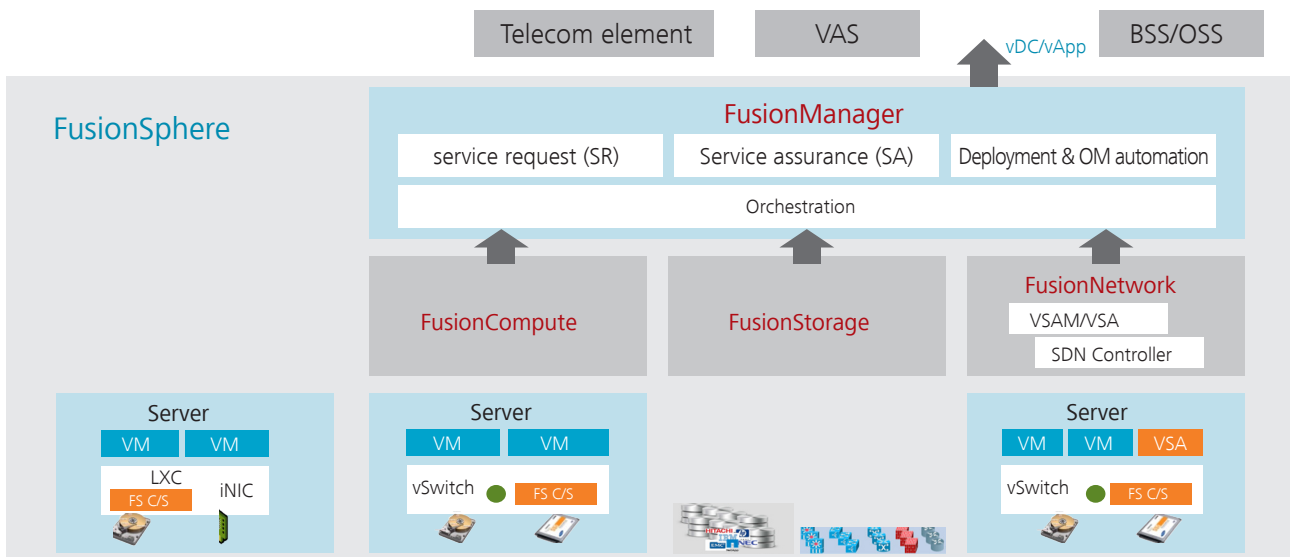
# FusionStorage Features and Capabilities

Huawei FusionStorage is a distributed storage software that can be deployed on generic x86 servers to consolidate all local disks into a virtual storage resource pool, providing block storage functions. Huawei FusionStorage has the following features:

## Industry-leading Distributed Architecture

FusionStorage uses a distributed architecture, which includes the distributed management clusters, distributed hash-based routing algorithm, distributed stateless engine, and distributed intelligent cache. This architecture effectively prevents single points of failures (SPOFs) in the entire system.

## High Scalability

The distributed stateless engines in the FusionStorage system support horizontal expansion, smooth and parallel capacity expansion of storage and computing resources, and non-chimney ultra-large capacity expansion. A maximum of 4096 nodes are supported in the FusionStorage system.

## Cost-effectiveness

FusionStorage is installed on generic x86 servers instead of dedicated servers. In the distributed storage system, fiber channel (FC) network interface cards (NICs) and host bus adapters (HBAs) are depreciated for reduced energy consumption and reduced system storage space required.

In addition, FusionStorage uses solid state disks (SSDs), PCIe acceleration cards, and InfiniBand NICs. In this case, millions of IOPS, high throughput, and low latency are provided with the help of a distributed hash-based routing algorithm, I/O parallel processing, and distributed storage technologies.

## High Reliability and Quick Restoring of Faulty Data

FusionStorage supports several data copies and each copy is allocated on different servers or disks. Therefore, failures on a single hardware device do not interrupt services. In addition, the strong-consistency replication technology used by FusionStorage ensures data consistency among data copies.

The data is fragmented and distributed in the resource pool. If a disk is faulty, these data fragments can be automatically reconstructed by simultaneously restoring data copies in the resource pool. It takes less than 30 minutes for FusionStorage to rebuild 1 TB data.

## Openness and compatibility

FusionStorage is compatible with OpenStack and mainstream hypervisors. It supports most mainstream operating systems (OSs) and database applications, and can be installed on almost any kind of server, offering customers flexible choices.

| Storage Interface Layer | SCSI driver、iSCSI | | |
|---|---|---|---|
| **Storage Service Layer** | distributed linked clone | Backup | **Storage Management** |
| | Distributed Snapshot | | |
| | Distributed thin provisioning | Disaster Recovery | |
| | Distributed Cache | | |
| **Storage Engine Layer** | Cluster state control | Strong Consistency Copy protocol | Cluster fault healing |
| | Distributed data routing | parallel data reconstruction | |

# FusionManager Features and Capabilities

FusionManager is a cloud platform for unified resource management. It provides a unified management portal with the following functions:

- Automatic detection of physical devices within its management domain, including subracks, servers, blades, storage devices, and switches, as well as networking between these devices.

- Physical and virtual resource management, such as centralized topology, alarm reporting, monitoring, capacity management, metering, performance reports, correlation analysis, and lifecycle management

- Organization VDC management, self-service portals, service catalogs, rights management, capacity management, IT resource management (including heterogeneous resources), performance management, configuration change management, and task management.

Developed based on industry standards, FusionManager is compatible with third-party hypervisors and diversified hardware devices. FusionManager comes with the following features:

| Centralized management | Automatic management | Fault diagnosis |
|---|---|---|
| • Centrally manages hardware devices, virtualization platforms, and applications.<br>• Centrally manages virtualization platforms and hardware devices from different vendors.<br>• Manages organization VDCs.<br>• Provides rights- and domain-based management, and role-based access control. | • Automatically detects and deploys hardware.<br>• Automatically deploys applications using templates.<br>• Schedules resources based on demand.<br>• Manages service catalogs. | • Centrally manages hardware and software systems.<br>• Provides complete resource, topology, alarm, and log monitoring mechanisms.<br>• Generates performance reports. |

# Performance Specifications

FusionSphere supports the largest system capacity in the industry, provides industry-leading performance, and can be applied to various service deployment scenarios for carriers and enterprises, such as server virtualization, private/hybrid clouds, and consolidation of multiple data centers.

| Management Performance Indicator | Specifications |
|---|---|
| Maximum number of hosts supported by a VRM node | 1024 |
| Maximum VRM sites that can be cascaded | 16 |
| Maximum number of clusters supported by a VRM node | 32 |
| Maximum number of VMs supported by a VRM node | 10,000 running VMs or 30,000 registered VMs |
| Maximum number of built-in vSwitches supported by a VRM node | 128 |
| Maximum number of hosts supported by a logical cluster | 128 (LUNs storage) |
| 64 (virtual storage) | 10,000 |
| Maximum number of VMs supported by a logical cluster | 3000 |
| Maximum physical servers in a system | 4096 |
| Maximum number of VMs in a system | 80,000 |
| Host Indicator | Value |
| Maximum number of logical CPU cores supported by a host | 512 |
| Maximum memory size supported by a host | 16 TB |
| Maximum number of VMs that can be created on a host | 1024 |
| Maximum number of LUNs that can be attached to a host | 512 |
| Maximum number of volumes supported by a host | 2048 |
| Maximum number of non-uniform memory access (NUMA) nodes supported by a host | 16 |
| Maximum number of concurrently live migrated VMs supported by a host | 8 |
| Maximum number of concurrently live migrated VMs supported by a host | 8 |

| VM Indicator | Value |
| --- | --- |
| Maximum number of vCPUs supported by a VM | 128 |
| Maximum number of NICs supported by a VM | 12 |
| Maximum number of virtual disks supported by a VM | 60 |
| Maximum memory size supported by a VM | 4TB |
| Maximum virtual disk capacity supported by a VM | 64 TB |
| Maximum number of snapshots supported by a VM | 32 |
| Storage Capacity Indicator | Value |
| Maximum number of volumes supported by a VRM node | 20,000 |
| Maximum number of hard disks supported by distributed storage | 2000 |
| Maximum number of snapshots supported by the system | 48,000 |
| Network Capacity Indicator | Value |
| Maximum number of DVSs supported by the system | 128 |
| Maximum number of hosts managed by a DVS | 1024 |
| Maximum number of port groups supported by a DVS | 4096 |

A Virtualization Resource Management (VRM) node is a management node in the FusionSphere system and can manage resources in physical clusters and logical clusters.

# Success Stories

## Huawei Cloud Computing Helping Sichuan Telecom Develop ICT Services

With the boom of smart phones, tablets and other like devices, a multitude of technologies have converged and diversified people's ability to communicate. Telecommunication services too, must diversify from not just voice and data services but also to cloud computing, intelligent pipes, and mobile Internet. Telecommunication companies have begun to focus on integrated information and communication technology (ICT) services for enterprises, not just on consumers.

In 2011, China Telecom, Sichuan branch launched the Cloud Sea project to develop its ICT services. This project uses the Huawei virtualization and cloud management platform to establish a cloud computing data center. All existing infrastructure is integrated into one cloud computing resource pool, which enables China Telecom, Sichuan Branch to provide cloud desktops to employees, integrate the service platform, and provides Virtual Private Server (VPS) services to customers.

This project has helped Sichuan Telecom increase its server utilization efficiency from 15% to 85%, and shorten the service rollout duration by 80%. All resources are centrally shared and managed to reduce power consumption.

## Huawei Cloud Computing Facilitating the Administration for Industry and Commerce Informatization Efforts in Fujian

The Administration for Industry and Commerce in Fujian is the provincial agency responsible for market supervision and management. The administration has 511 branches throughout the province. Huawei helped the administration build a cloud data center that includes internal and external network service platforms, two local disaster recovery centers in Fuzhou, and an inter-city backup center in Sanming.

The data center helped the administration implement resource virtualization and unified resource scheduling. Huawei also deployed virtual desktops to improve work efficiency. This project reduced construction costs for the Fujian Administration for Industry and Commerce by 30%.

## Huawei Helping SGCC Excavate IT Infrastructure Potentials

State Grid Corporation of China (SGCC) is the world's largest state-owned electrical utilities company, whose core businesses include power grid service construction and operation. The electrical grid covers 88% of China and serves over 1.1 billion people. In 2013, Huawei FusionSphere ranked first among all competitors and won the bid to virtualize the servers in SGCC's IT systems.

By using Huawei FusionSphere, multiple SGCC provincial branches now have virtualized servers and cloud management technologies. These improvements have improved server utilization and reduced yearly procurement requisition by over 30%.

In addition, power consumption costs have been reduced by tens of millions of RMB, operation and maintenance efficiency has improved by 10 times, and the service provisioning rate has accelerated by 50%.

# Other success stories

| Government | Huawei cloud computing solution helped the Beijing municipal government build its e-government cloud. Huawei FusionSphere helped Jilin Social Security Bureau transform its information platform. |
|---|---|
| Public security | Huawei cloud platform helped Guangxi Public Security Department construct safety mechanisms to improve safety in Guangxi. Huawei cloud computing helped the Shaoxing Municipal Public Security Bureau establish a secure and efficient public security platform. |
| Finance | Huawei helped Infocast build an efficient cloud platform to trade securities. Huawei cloud computing helped the Shenzhen Stock Exchange safeguard financial information. |
| Education | Huawei helped the Guangzhou Bureau of Education construct the research cloud platform. Huawei cloud computing helped Xi'an Jiaotong University build an efficient education cloud. |
| Carriers | Huawei helped Guangdong Unicom enter the cloud computing era. Huawei FusionSphere solution helped Singapore StarHub launch public cloud services. |
| Other industries | For cases about other industries, see Huawei Cloud Computing Case Set or visit http://e.huawei.com/en/products/ cloud-computing-dc/cloud-computing/fusionsphere/fusionsphere |

# How to Purchase

Huawei FusionSphere services use a license authorization mode that only depends on the number of CPUs on a server, counting no other in-use physical resources. Huawei provides FusionSphere Foundation, a free-trial edition, which provides customers with a convenient and excellent experience before purchasing other FusionSphere editions. You can download the free-trial edition from Huawei's official website or the Chinese software develop net (CSDN) Huawei cloud computing forum. This free-trial edition allows users to use FusionSphere in a system with less than or equal to six CPUs free of charge permanently, without any function restrictions. If more virtualization CPUs are required, purchase a license for an upgrade edition.

FusionSphere provides various commercial licenses: FusionSphere Standard Edition, FusionSphere Advanced Edition, and FusionSphere Platinum Edition. These editions differ from each other in functions and prices.

| Category | Function and Feature | Product | FusionSphere Editions | | | |
|---|---|---|---|---|---|---|
| | | | Foundation Edition | Standard Edition | Advanced Edition | Platinum Edition/ Operation Edition |
| Virtualization | Computing virtualization | FusionCompute | ★ | ★ | ★ | ★ |
| | Virtual storage | | ★ | ★ | ★ | ★ |
| | Virtual network | | ★ | ★ | ★ | ★ |
| | VM reliability | | ★ | ★ | ★ | ★ |
| | Security management | | ★ | ★ | ★ | ★ |
| | Antivirus virtualization | | ★ | | ★ | ★ |

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